

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

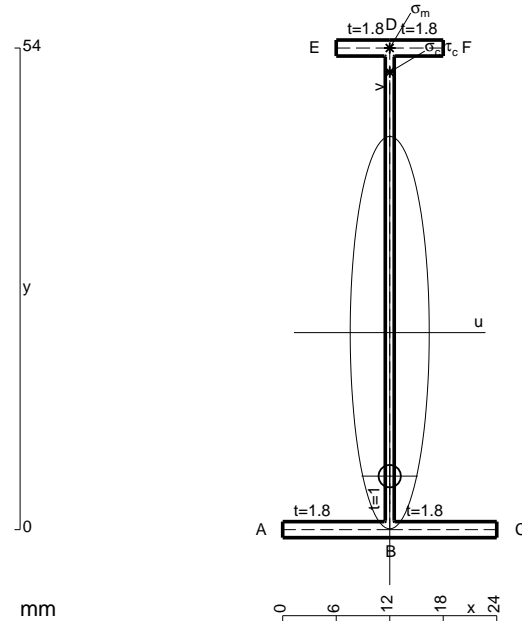
$$L_{HG}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

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

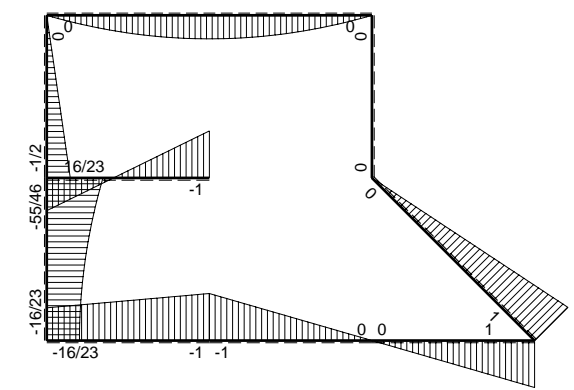
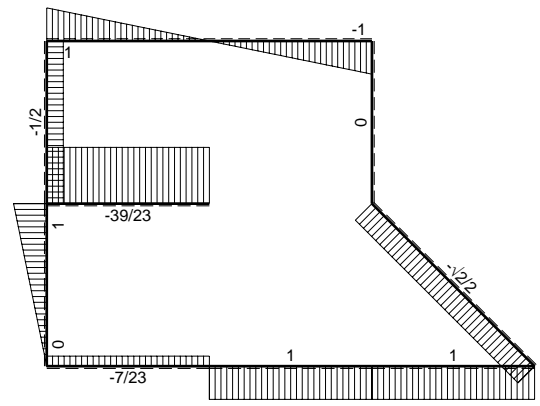
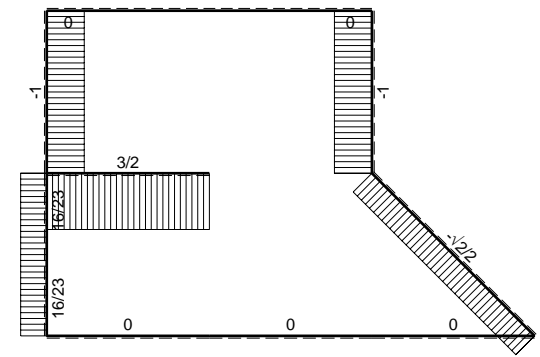
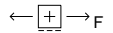
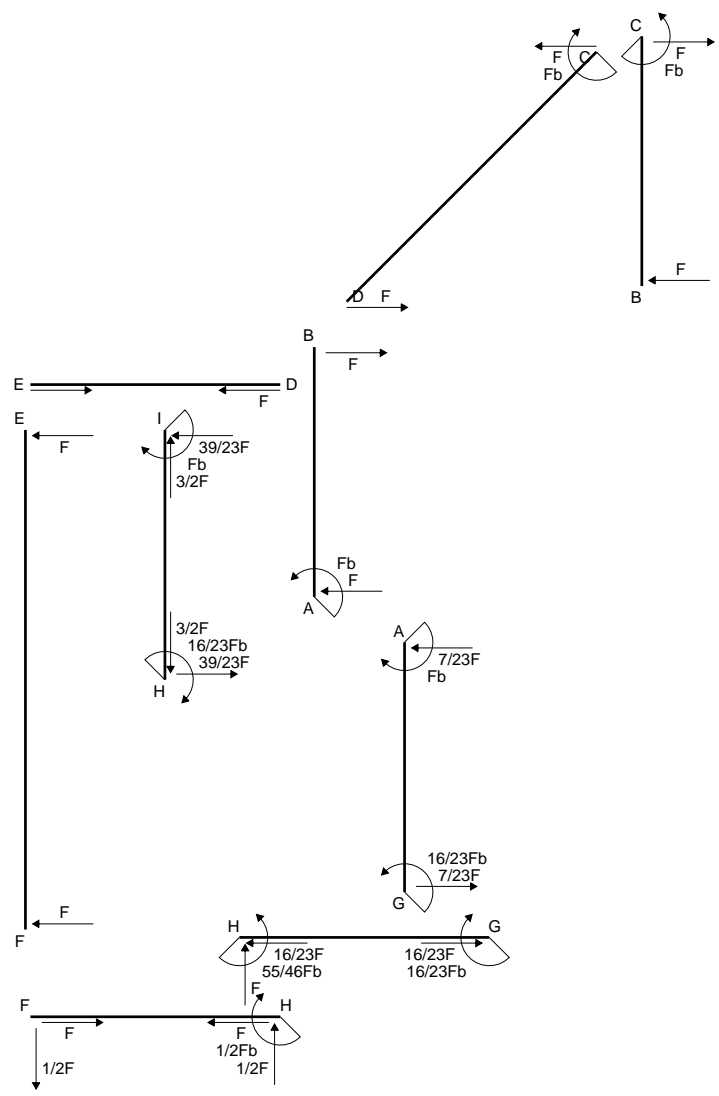
$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/6 Fb^2/EJ$$

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

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



- A = 118.8 mm²
- J_u = 57498. mm⁴
- J_v = 2333. mm⁴
- J_i = 87.98 mm⁴
- y_o = -16.09 mm
- y_g = 22.09 mm
- T_y = -1510. N
- M_x = -377500. Nmm
- x_m = 12. mm
- y_m = 54. mm
- v_m = 31.91 mm
- σ_m = -Mv/J_u = 209.5 N/mm²
- y_c = 2. mm
- u_c = -12. mm
- v_c = -20.09 mm
- σ_c = -Mv/J_u = 209.5 N/mm²
- τ_c = TS_i/tJ_u = 18.1 N/mm²
- τ_g = TS_i/tJ_u = 18.1 N/mm²
- t_c = 1510. mm
- σ_o = √σ²+3τ² = 211.8 N/mm²



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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

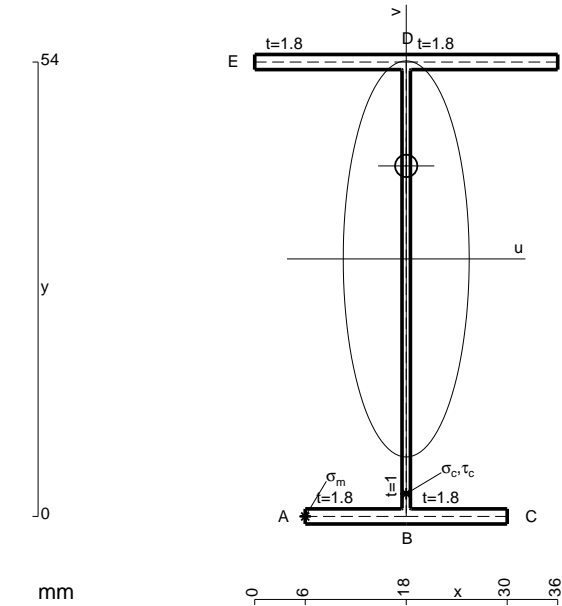
$$L_{HG}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

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

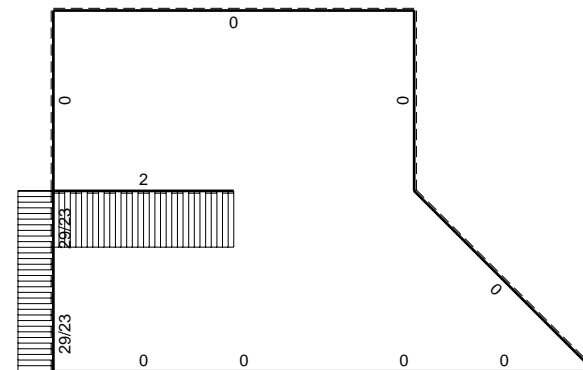
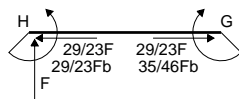
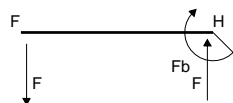
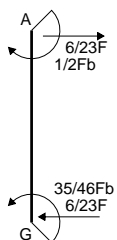
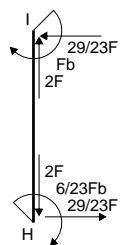
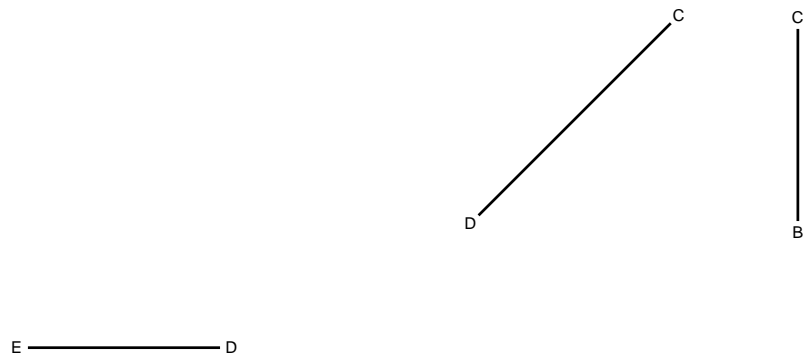
$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/6 Fb^2/EJ$$

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

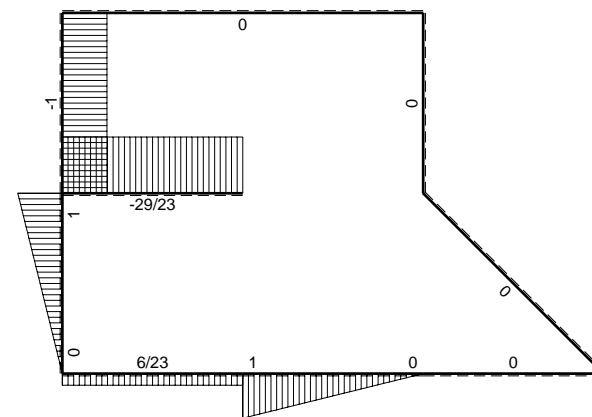
$$= (1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/6 Fb^2/EJ$$



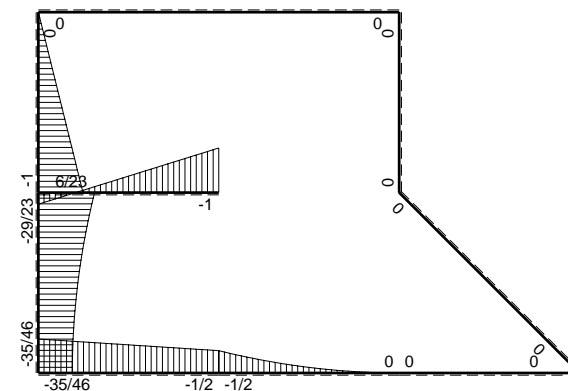
- A = 162. mm²
- J_u = 89755. mm⁴
- J_v = 9072. mm⁴
- J_i = 134.6 mm⁴
- y_o = 11.06 mm
- y_g = 30.6 mm
- T_y = 1170. N
- M_x = -643500. Nmm
- x_m = 6. mm
- u_m = -12. mm
- v_m = -30.6 mm
- σ_m = -Mv/J_u = -219.4 N/mm²
- x_c = 18. mm
- v_c = -30.6 mm
- σ_c = -Mv/J_u = -219.4 N/mm²
- τ_c = TS_i/tJ_u = 17.23 N/mm²
- τ_g = TS_i/tJ_u = 17.23 N/mm²
- t_c = 1170. mm
- σ_o = √σ²+3τ² = 221.4 N/mm²



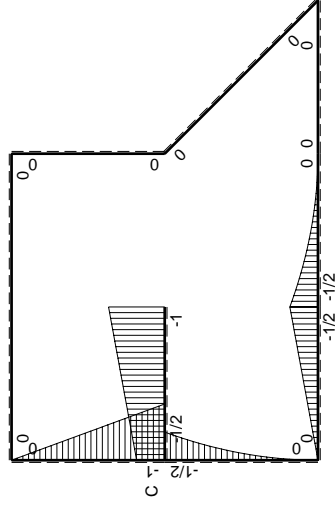
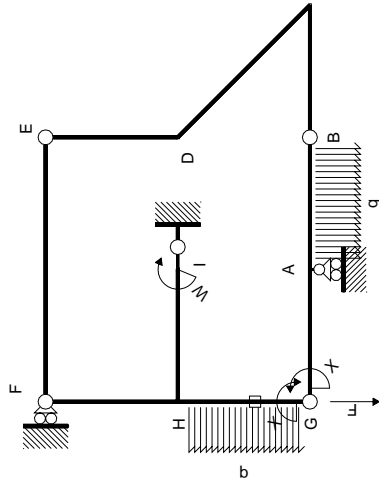
← ⊕ → F



↑ ⊕ ↓ F

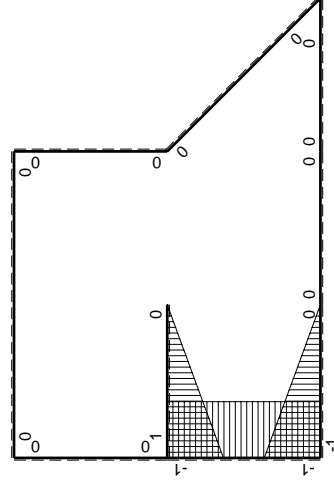


⊕ ⊕ Fb



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-1/2Fb + Fx - 1/2qx^2$	0	0	0	0
BA b	0	$1/2qx^2$	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	0	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$-1/2Fx$	$1/2Fx - 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$1/2Fb - 1/2Fx$	$1/2Fx - 1/2Fx^2/b$	x^2/b^2	$1/12Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$-Fx$	0	0	0	0
HF b	0	$Fb - Fx$	0	0	0	0
HI b	$1-x/b$	$-1/2Fb - 1/2Fx$	$-1/2Fb + 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$-1/3Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$Fb - 1/2Fx$	$-Fx + 1/2Fx^2/b$	x^2/b^2	$-1/3Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	$-1/2Fb + Fx - 1/2qx^2$	$1/2Fb - Fx + 1/2Fx^2/b$	1	$1/6Fb^2/EJ$	Xb/EJ
GH b	1	$1/2qx^2$	$1/2Fx^2/b$	1	$1/6Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG} = N_{HG} - HG$					
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$					
	totali					
	iperstatica X=W _{GA}					

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

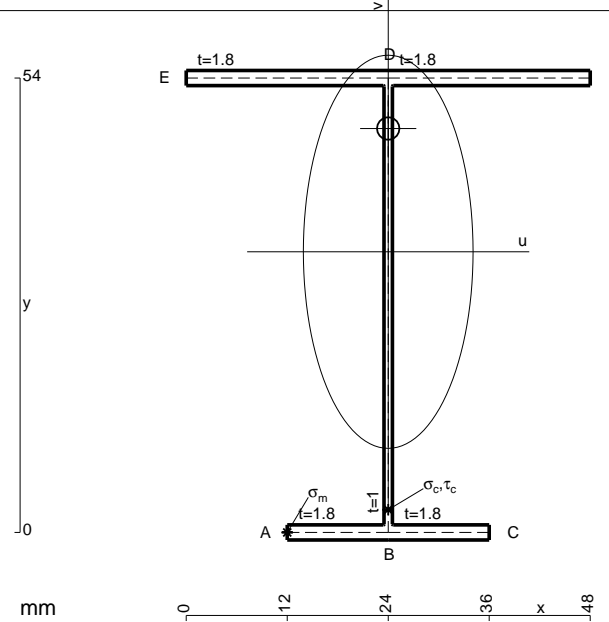
$$L_{HG}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

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

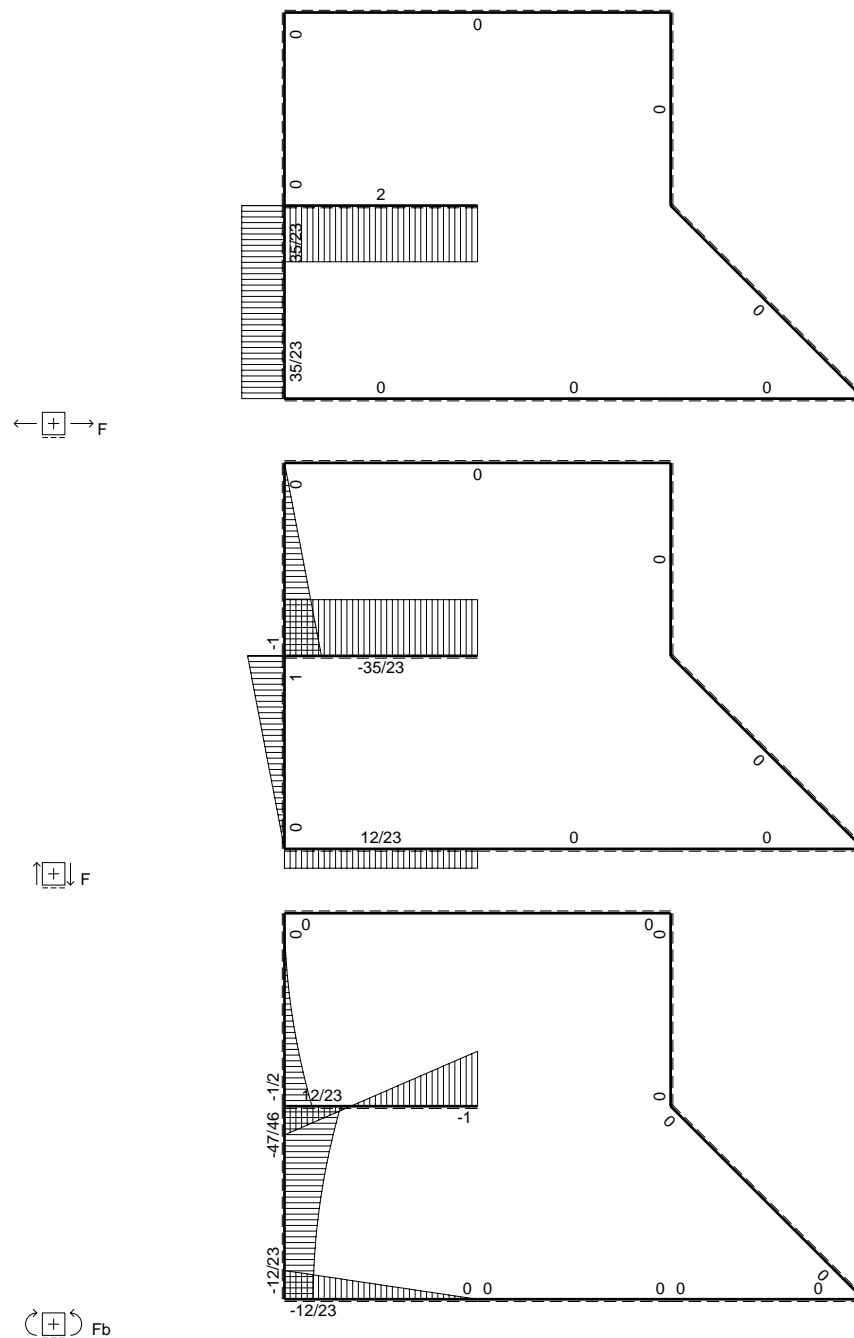
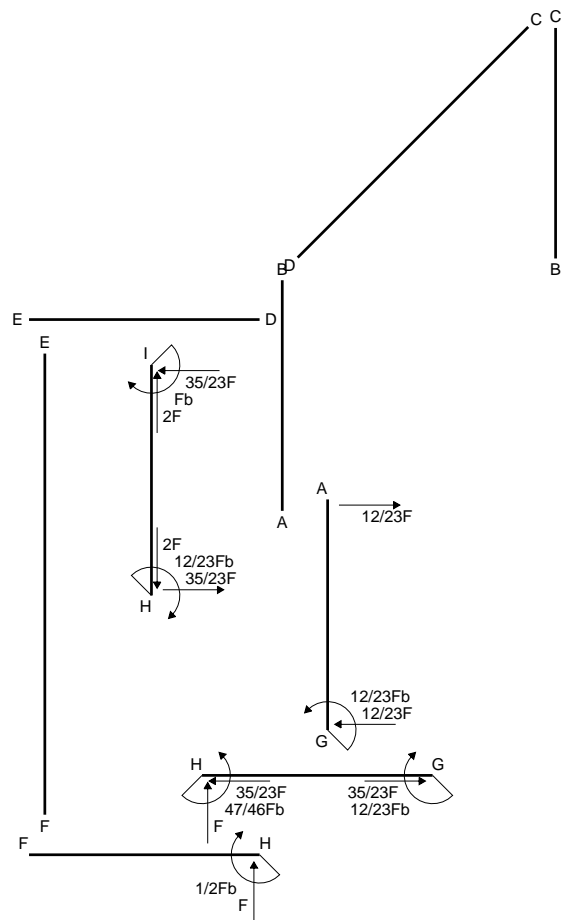
$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/6 Fb^2/EJ$$

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

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



- A = 183.6 mm²
- J_u = 100190. mm⁴
- J_v = 18662. mm⁴
- J_i = 158. mm⁴
- y_o = 14.65 mm
- y_g = 33.35 mm
- T_y = -1170. N
- M_x = -690300. Nmm
- x_m = 12. mm
- u_m = -12. mm
- v_m = -33.35 mm
- σ_m = -Mv/J_u = -229.8 N/mm²
- x_c = 24. mm
- v_c = -33.35 mm
- σ_c = -Mv/J_u = -229.8 N/mm²
- τ_c = TS_v/tJ_u = 16.83 N/mm²
- τ_g = TS_v/tJ_u = 16.83 N/mm²
- t_c = 1170. mm
- σ_o = √σ²+3τ² = 231.6 N/mm²



⊕ ↺ F_b

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

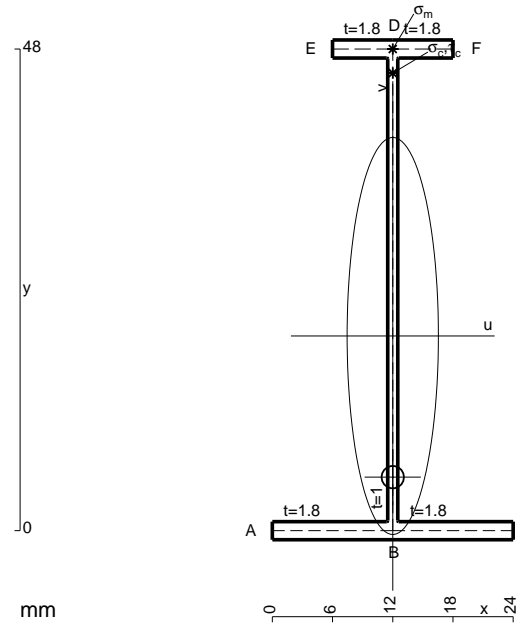
$$L_{HG}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

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

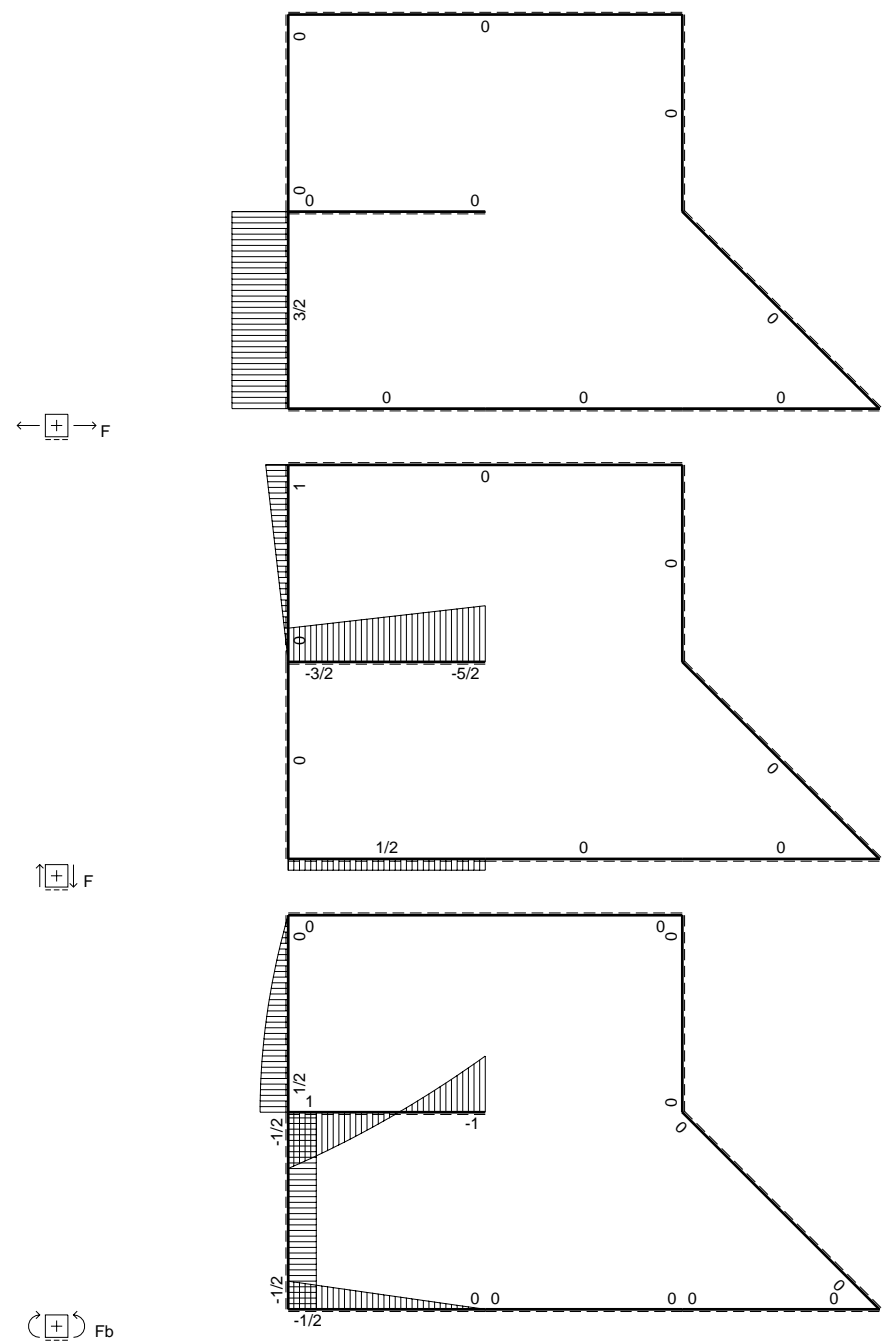
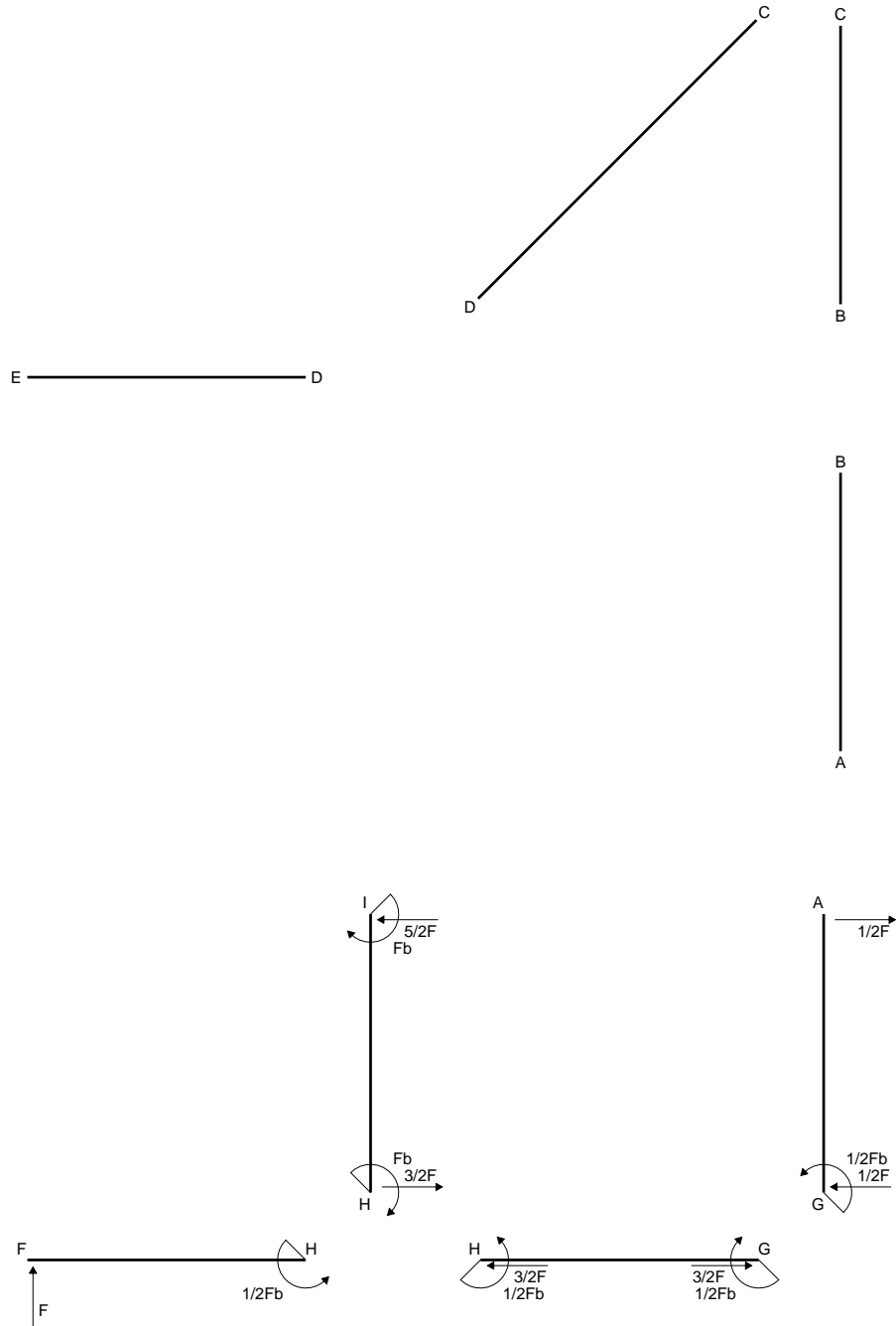
$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/6 Fb^2/EJ$$

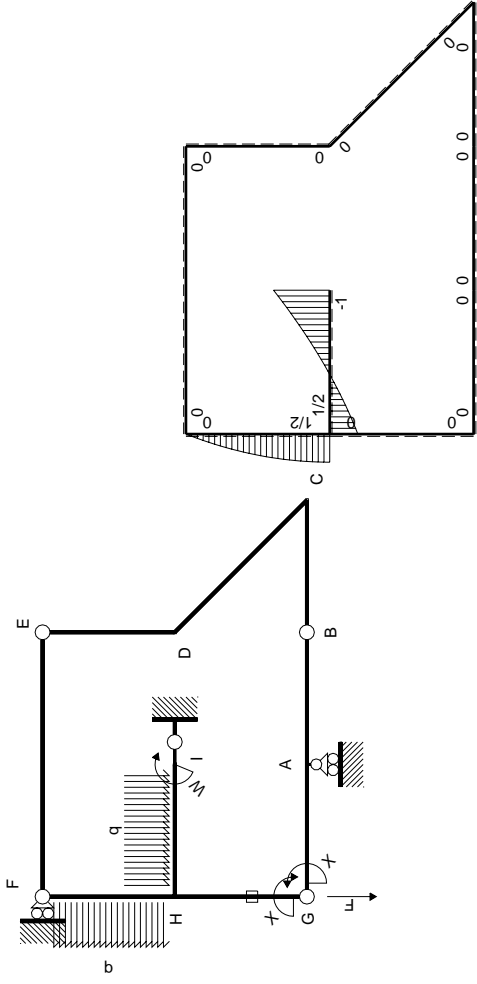
$$L_{GH}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

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



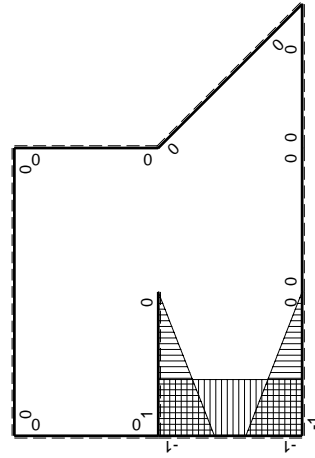
- A = 112.8 mm²
- J_u = 44158. mm⁴
- J_v = 2333. mm⁴
- J_t = 85.98 mm⁴
- y_o = -14.07 mm
- y_g = 19.4 mm
- T_y = -1300. N
- M_x = -370500. Nmm
- x_m = 12. mm
- y_m = 48. mm
- v_m = 28.6 mm
- σ_m = -Mv/J_u = 239.9 N/mm²
- y_c = 2. mm
- u_c = -12. mm
- v_c = -17.4 mm
- σ_c = -Mv/J_u = 239.9 N/mm²
- τ_c = TS'/tJ_u = 18.18 N/mm²
- τ_g = TS'/tJ_u = 18.18 N/mm²
- t_c = 1300. mm
- σ_o = √(σ²+3τ²) = 242. N/mm²





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_o(x)$	$M_x M_o$	$M_x M_x$	$\int M_x M_o / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	0	0	0	0	0
BA b	0	0	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	0	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
AG b	x/b	0	0	x^2/b^2	0	$1/3Xb/EJ$
FH b	0	$Fx-1/2qx^2$	0	0	0	0
HF b	0	$-1/2Fb+1/2qx^2$	0	0	0	0
HI b	$1-x/b$	$1/2Fb-Fx-1/2qx^2$	$1/2Fb-3/2Fx+1/2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$1/24Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$Fb-2Fx+1/2qx^2$	$-Fx+2Fx^2/b-1/2qx^3/b$	x^2/b^2	$1/24Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	0	0	1	0	Xb/EJ
GH b	1	0	0	1	0	Xb/EJ
HG	elongazione asta $N_{1HG} \epsilon_{HG} L_{HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{oA}+XV_{1A})/k_A$					$1/4Xb/EJ$
	totali				$-23/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$1/2Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

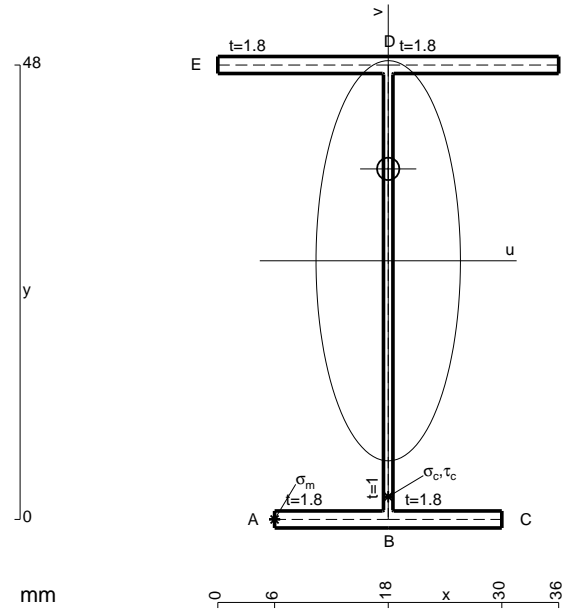
$$L_{HI}^{xo} = \int_0^b (1/2 - 3/2 x/b + 1/2 x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx$$

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

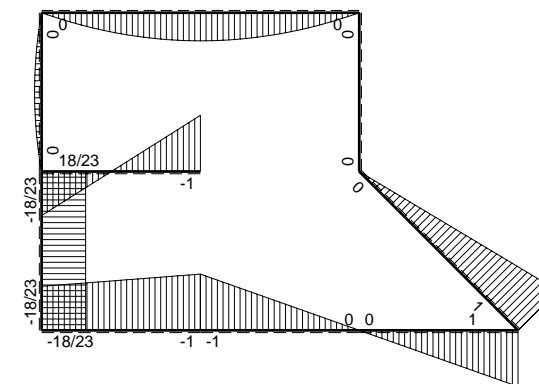
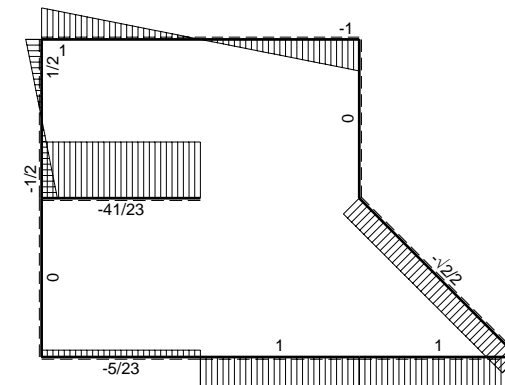
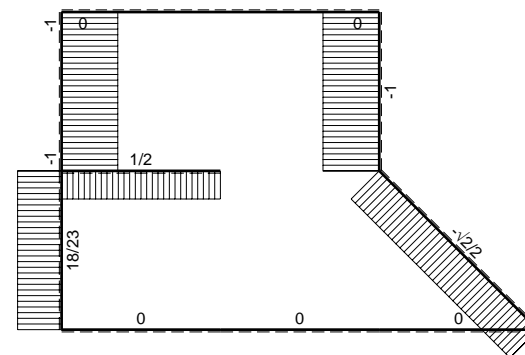
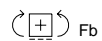
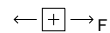
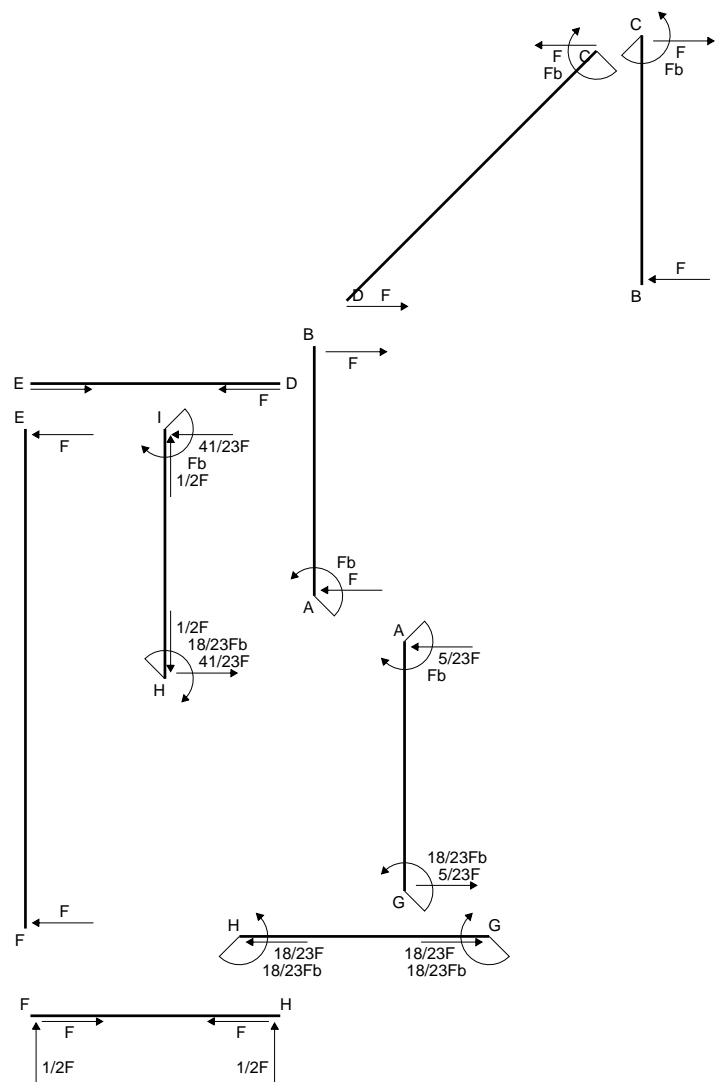
$$= (1/2 b - 3/4 b + 1/6 b + 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

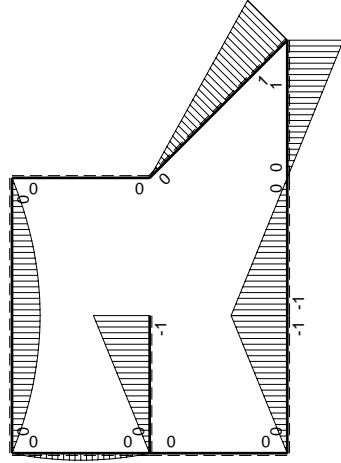
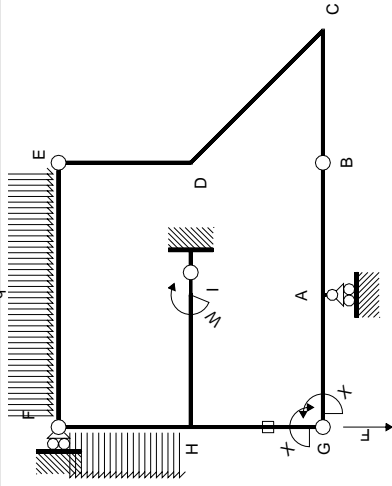
$$L_{IH}^{xo} = \int_0^b (-x/b + 2x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [-1/2 x^2/b + 2/3 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

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

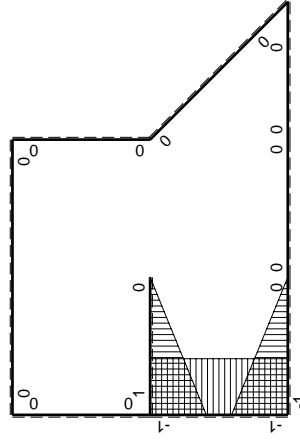


- A = 156. mm²
- J_u = 69701. mm⁴
- J_v = 9072. mm⁴
- J_i = 132.6 mm⁴
- y_o = 9.705 mm
- y_g = 27.32 mm
- T_y = 1115. N
- M_x = 510113. Nmm
- x_m = 6. mm
- u_m = -12. mm
- v_m = -27.32 mm
- σ_m = -Mv/J_u = 200. N/mm²
- x_c = 18. mm
- v_c = -27.32 mm
- σ_c = -Mv/J_u = 200. N/mm²
- τ_c = TS'/tJ_u = 18.88 N/mm²
- τ_g = TS'/tJ_u = 18.88 N/mm²
- t_c = 2230. mm
- σ_o = √σ²+3τ² = 202.6 N/mm²





(\oplus) M_0 flessione da carichi assegnati



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

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

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int M_x M_x / E J dx$
AB b	0	-Fb+Fx	0	0	0	0
BA b	0	Fx	0	0	0	0
BC b	0	Fx	0	0	0	0
CB b	0	-Fb+Fx	0	0	0	0
CD $\sqrt{2}b$	0	$Fb-\sqrt{2}/2Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	$-Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$Fx-1/2qx^2$	0	0	0	0
GA b	$-1+x/b$	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2		
FH b	0	$1/2Fx-1/2qx^2$	0	0	0	0
HF b	0	$-1/2Fx+1/2qx^2$	0	0	0	0
HI b	$1-x/b$	-Fx	$-Fx+Fx^2/b$	$1-2x/b+x^2/b^2$	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	Fb-Fx	$-Fx+Fx^2/b$	x^2/b^2		
HG b	-1	0	0	1	0	Xb/EJ
GH b	1	0	0	1	0	Xb/EJ
HG	elongazione asta $N_{1HG} \pm HG$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{0A}+XV_{1A})/k_A$				$-1/2Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-3/2Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$18/23Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

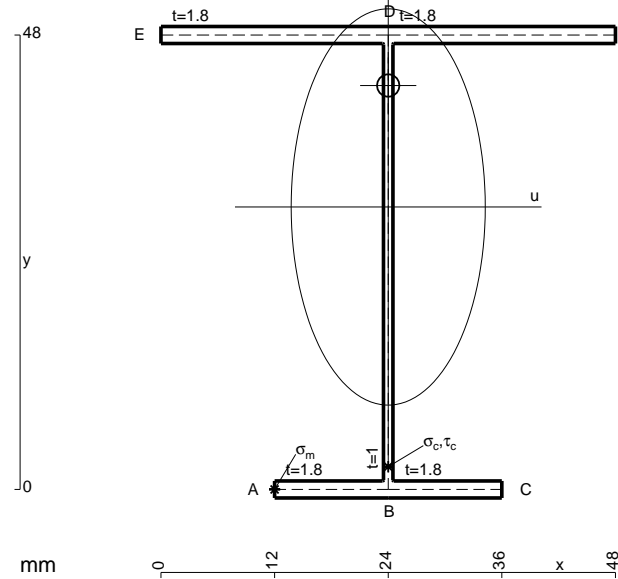
$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

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

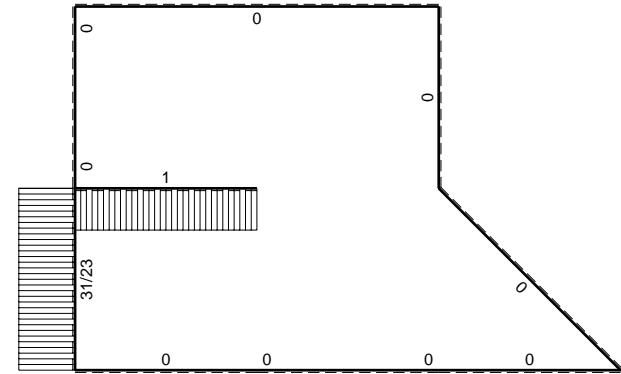
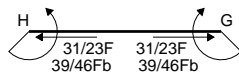
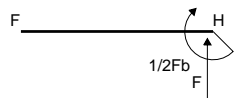
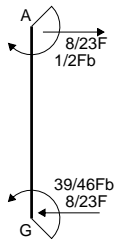
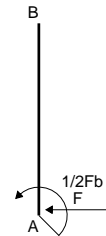
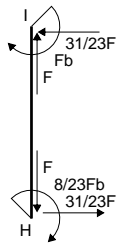
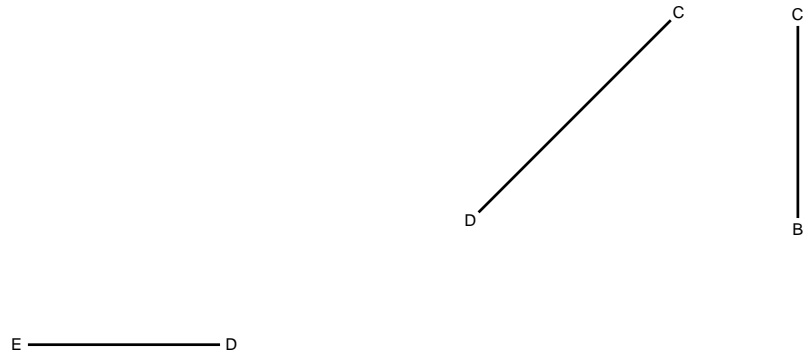
$$= (-1/2 b + 1/3 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

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

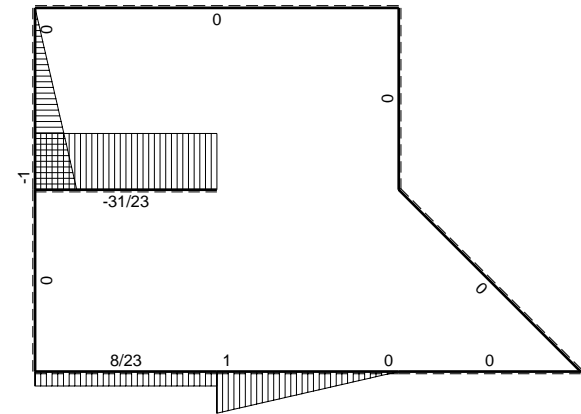
$$= (-1/2 b + 1/3 b) Fb 1/EJ = -1/6 Fb^2/EJ$$



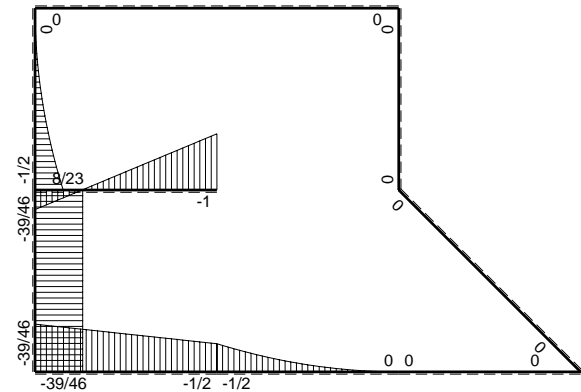
- A = 177.6 mm²
- J_u = 77813. mm⁴
- J_v = 18662. mm⁴
- J_i = 156. mm⁴
- y_o = 12.83 mm
- y_g = 29.84 mm
- T_y = 840. N
- M_x = -546000. Nmm
- x_m = 12. mm
- u_m = -12. mm
- v_m = -29.84 mm
- σ_m = -Mv/J_u = -209.4 N/mm²
- x_c = 24. mm
- v_c = -29.84 mm
- σ_c = -Mv/J_u = -209.4 N/mm²
- τ_c = TS_v/tJ_u = 13.91 N/mm²
- τ_g = TS_v/tJ_u = 13.91 N/mm²
- t_c = 840. mm
- σ_o = √σ²+3τ² = 210.8 N/mm²



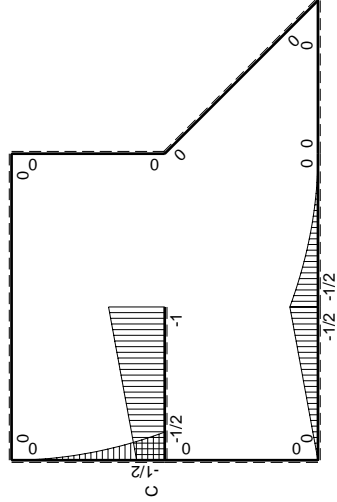
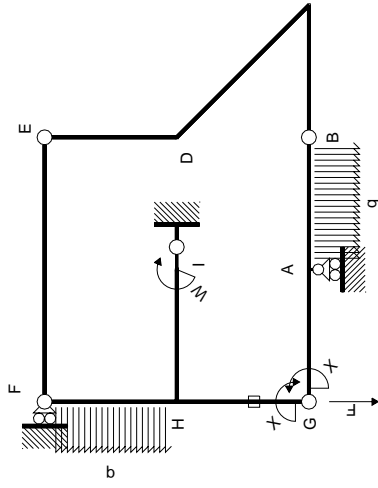
← ⊕ → F



↑ ⊕ ↓ F

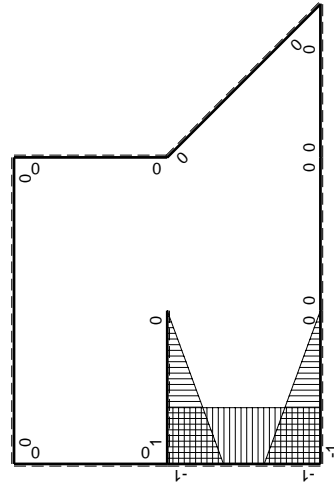


⊕ ⊖ Fb



Schema di calcolo iperstatico

(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-1/2Fb + Fx - 1/2qx^2$	0	0	0	0
BA b	0	$1/2qx^2$	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	0	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$-1/2Fx$	$1/2Fx - 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$1/2Fb - 1/2Fx$	$1/2Fx - 1/2Fx^2/b$	x^2/b^2	$1/12Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$-1/2qx^2$	0	0	0	0
HF b	0	$1/2Fb - Fx + 1/2qx^2$	0	0	0	0
HI b	$1-x/b$	$-1/2Fb - 1/2Fx$	$-1/2Fb + 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$-1/3Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$Fb - 1/2Fx$	$-Fx + 1/2Fx^2/b$	x^2/b^2	$-1/3Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	0	0	1	0	Xb/EJ
GH b	1	0	0	1	0	Xb/EJ
HG	elongazione asta $N_{1HG^{\pm}HG^{\pm}HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{0A} + XV_{1A})/k_A$				$-3/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-13/8Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica X=W _{GA}				$39/46Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

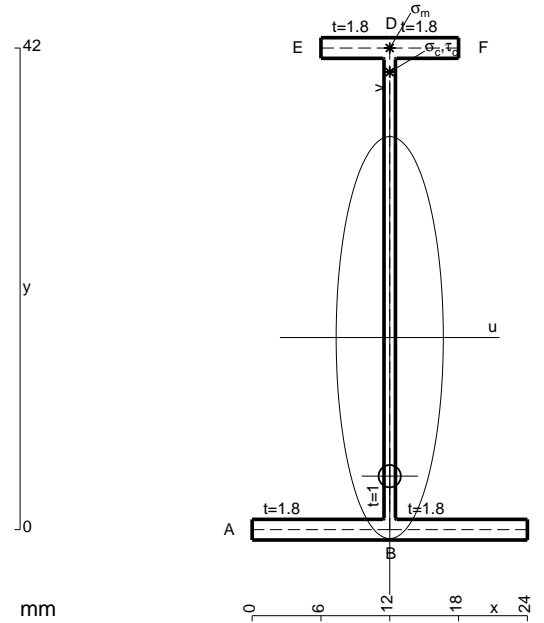
$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

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

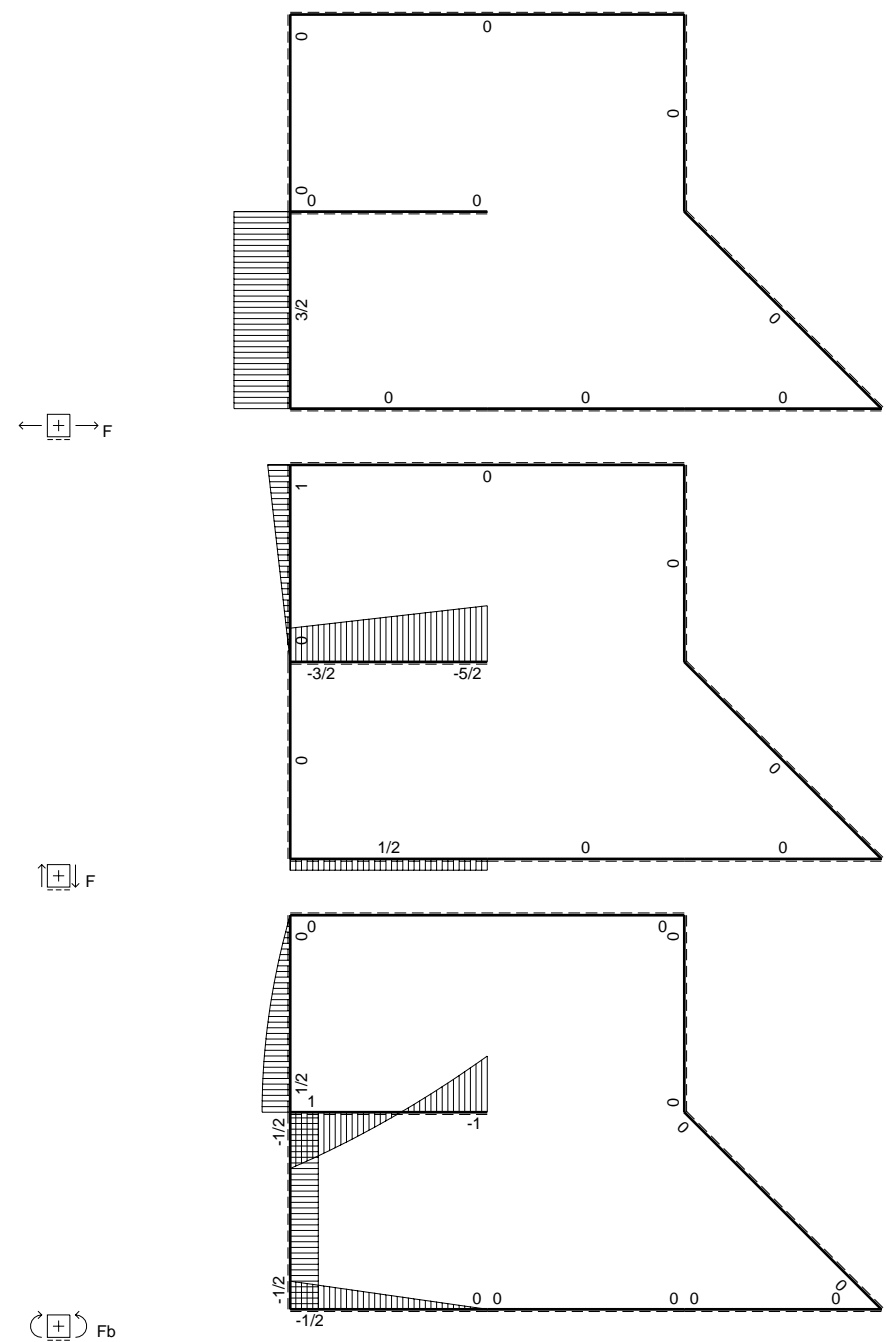
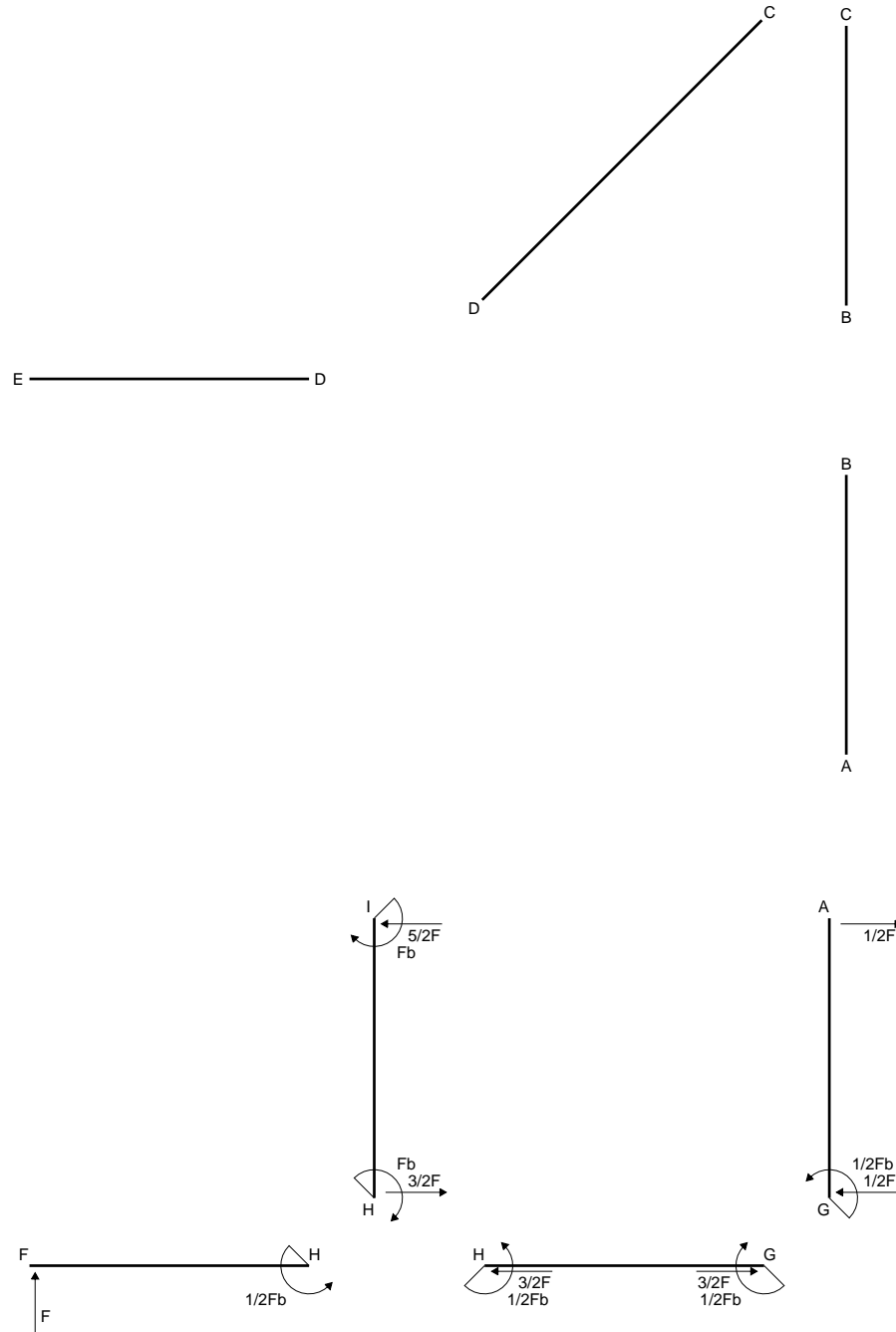
$$= (-1/2 b + 1/6 b) Fb 1/EJ = -1/3 Fb^2/EJ$$

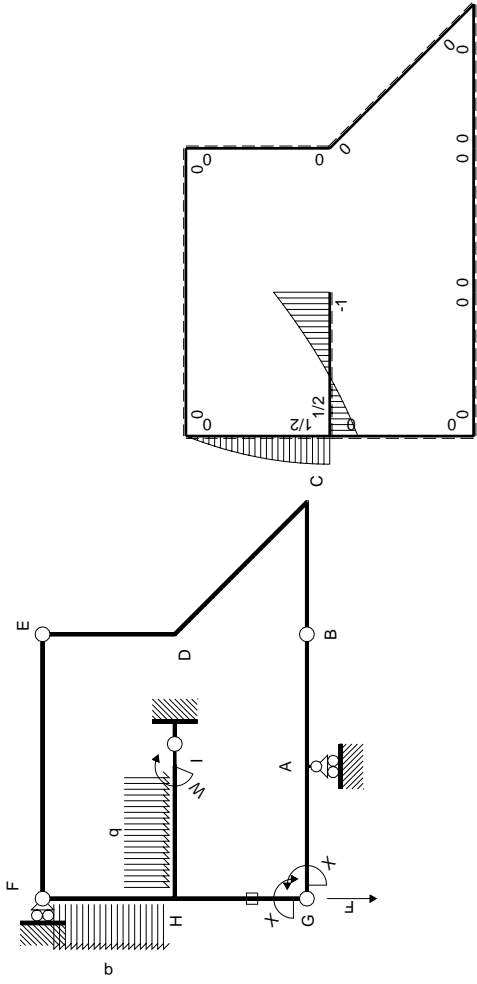
$$L_{IH}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

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



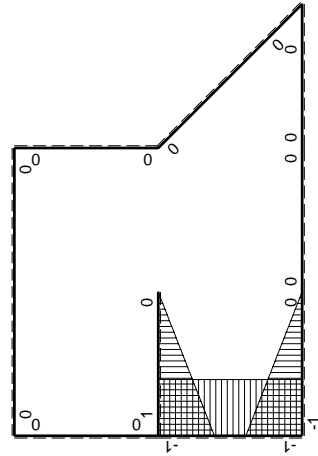
- A = 106.8 mm²
- J_u = 32824. mm⁴
- J_v = 2333. mm⁴
- J_i = 83.98 mm⁴
- y_o = -12.09 mm
- y_g = 16.75 mm
- T_y = 930. N
- M_x = -283650. Nmm
- x_m = 12. mm
- y_m = 42. mm
- v_m = 25.25 mm
- σ_m = -Mv/J_u = 218.2 N/mm²
- y_c = 2. mm
- u_c = -12. mm
- v_c = -14.75 mm
- σ_c = -Mv/J_u = 218.2 N/mm²
- τ_c = TS_y/tJ_u = 15.45 N/mm²
- τ_g = TS_y/tJ_u = 15.45 N/mm²
- t_c = 930. mm
- σ_o = √σ²+3τ² = 219.8 N/mm²





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	$M_x M_o$	$M_x M_x$	$\int M_x M_o / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	0	0	0	0	0
BA b	0	0	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	0	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
AG b	x/b	0	0	x^2/b^2	0	$1/3Xb/EJ$
FH b	0	$Fx-1/2qx^2$	0	0	0	0
HF b	0	$-1/2Fb+1/2qx^2$	0	0	0	0
HI b	$1-x/b$	$1/2Fb-Fx-1/2qx^2$	$1/2Fb-3/2Fx+1/2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$1/24Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$Fb-2Fx+1/2qx^2$	$-Fx+2Fx^2/b-1/2qx^3/b$	x^2/b^2	$1/24Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	0	0	1	0	Xb/EJ
GH b	1	0	0	1	0	Xb/EJ
HG	elongazione asta $N_{1HG} \epsilon_{HG} L_{HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{oA}+XV_{1A})/k_A$					$1/4Xb/EJ$
	totali				$-23/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$1/2Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

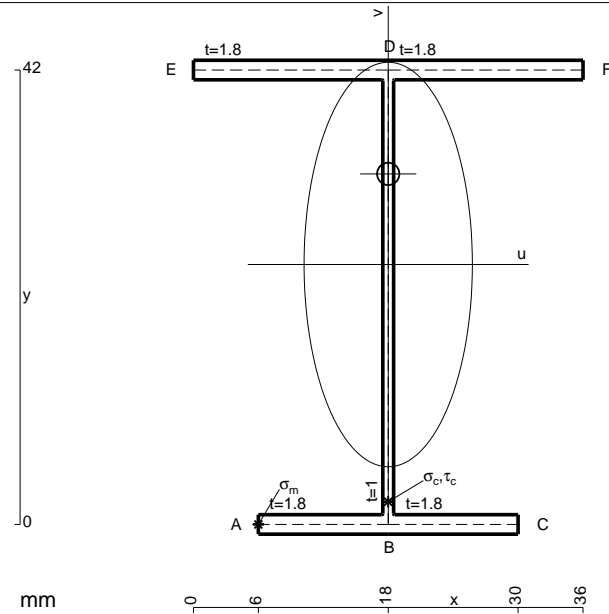
$$L_{HI}^{xo} = \int_0^b (1/2 - 3/2 x/b + 1/2 x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx$$

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

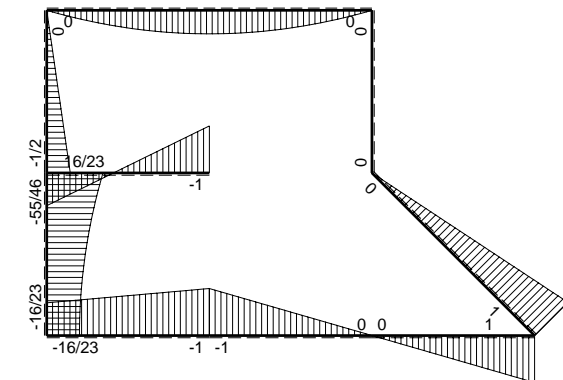
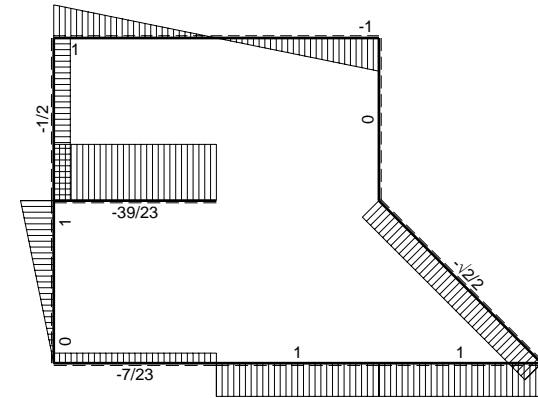
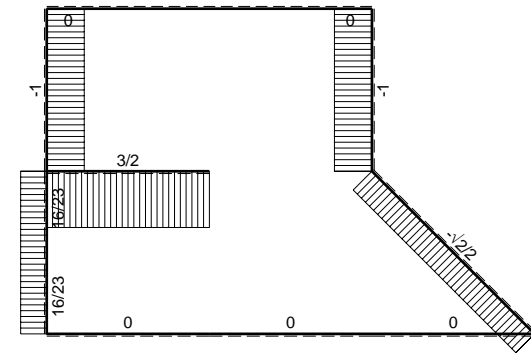
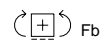
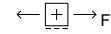
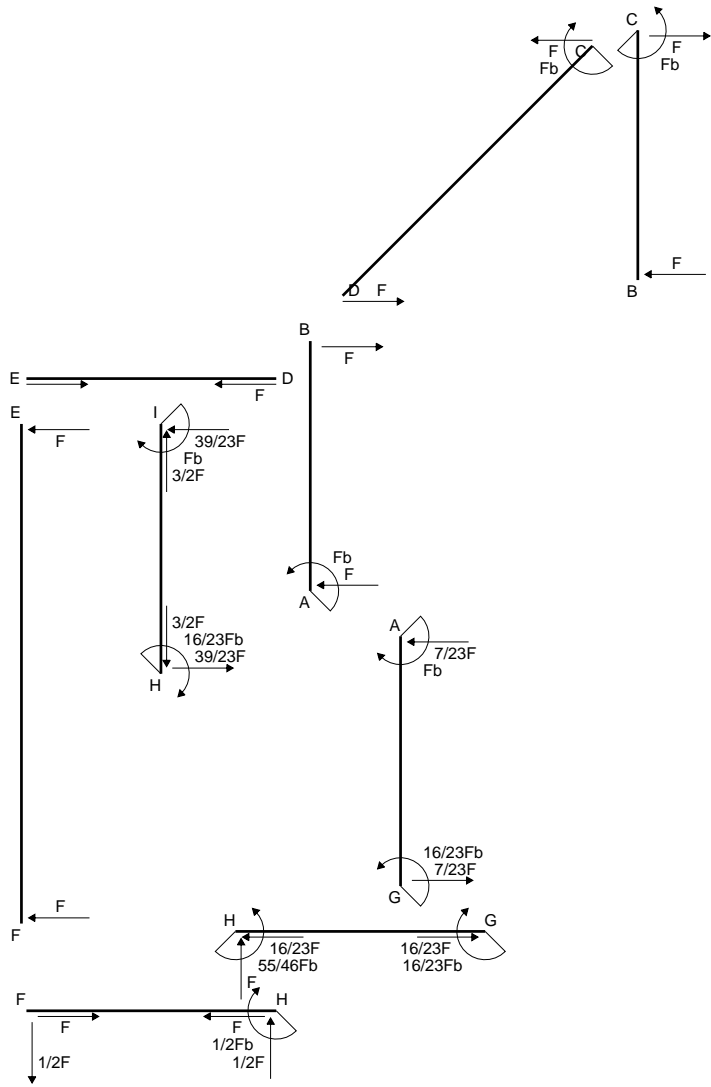
$$= (1/2 b - 3/4 b + 1/6 b + 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

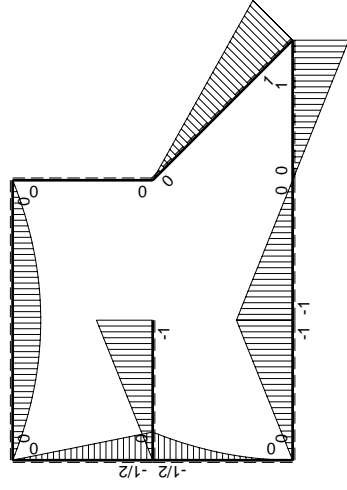
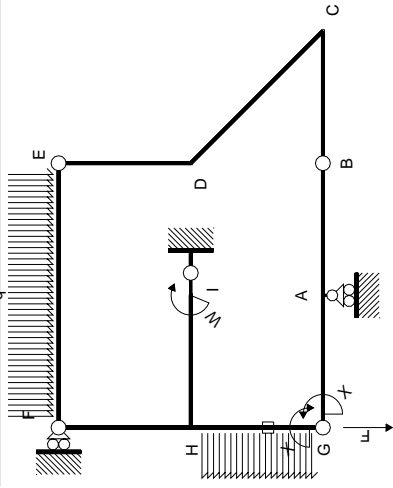
$$L_{IH}^{xo} = \int_0^b (-x/b + 2x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = \left[-1/2 x^2/b + 2/3 x^3/b^2 - 1/8 x^4/b^3 \right]_0^b Fb 1/EJ$$

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

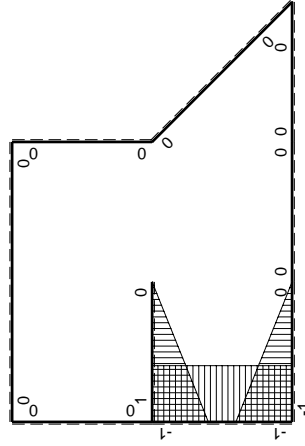


- A = 150. mm²
- J_u = 52430. mm⁴
- J_v = 9072. mm⁴
- J_i = 130.6 mm⁴
- y_o = 8.376 mm
- y_g = 24.02 mm
- T_y = 1045. N
- M_x = 501600. Nmm
- x_m = 6. mm
- u_m = -12. mm
- v_m = -24.02 mm
- σ_m = -Mv/J_u = 229.8 N/mm²
- x_c = 18. mm
- v_c = -24.02 mm
- σ_c = -Mv/J_u = 229.8 N/mm²
- τ_c = TS_y/tJ_u = 20.69 N/mm²
- τ_g = TS_y/tJ_u = 20.69 N/mm²
- t_c = 2090. mm
- σ_o = √σ²+3τ² = 232.6 N/mm²





M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-Fb+Fx	0	0	0	0
BA b	0	Fx	0	0	0	0
BC b	0	Fx	0	0	0	0
CB b	0	-Fb+Fx	0	0	0	0
CD $\sqrt{2}b$	0	Fb $\sqrt{2}/2Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	-Fx+1/2qx ²	0	0	0	0
FE 2b	0	Fx-1/2qx ²	0	0	0	0
GA b	-1+x/b	-Fx	Fx-Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
AG b	x/b	Fb-Fx	Fx-Fx ² /b	x ² /b ²	-1/6Fb ² /EJ	1/3Xb/EJ
FH b	0	-1/2Fx	0	0	0	0
HF b	0	1/2Fb-1/2Fx	0	0	0	0
HI b	1-x/b	-Fx	-Fx+Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
IH b	-x/b	Fb-Fx	-Fx+Fx ² /b	x ² /b ²	-1/6Fb ² /EJ	1/3Xb/EJ
HG b	-1	-1/2Fb+Fx-1/2qx ²	1/2Fb-Fx+1/2Fx ² /b	1	1/6Fb ² /EJ	Xb/EJ
GH b	1	1/2qx ²	1/2Fx ² /b	1	1/6Fb ² /EJ	Xb/EJ
HG	elongazione asta $N_{1HG^{\pm HG}} \pm HG$				-Fb ² /EJ	
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$				-1/2Fb ² /EJ	1/4Xb/EJ
	totali				-4/3Fb ² /EJ	23/12Xb/EJ
	iperstatica X=W _{GA}				16/23Fb	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

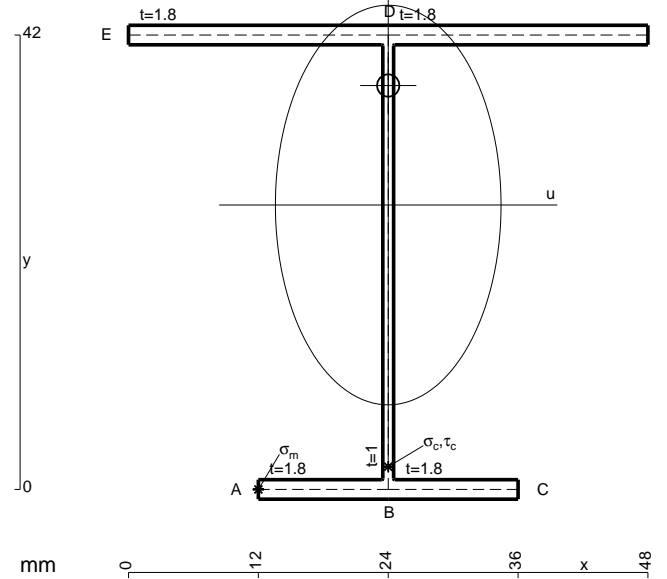
$$L_{HG}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

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

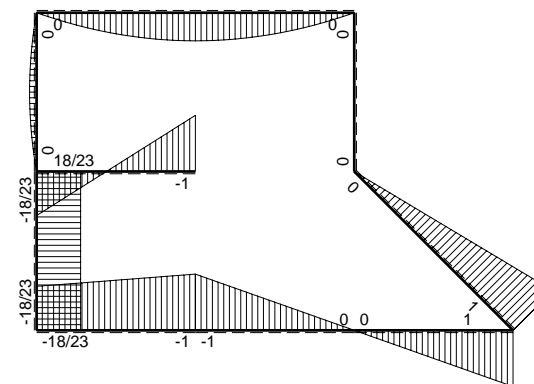
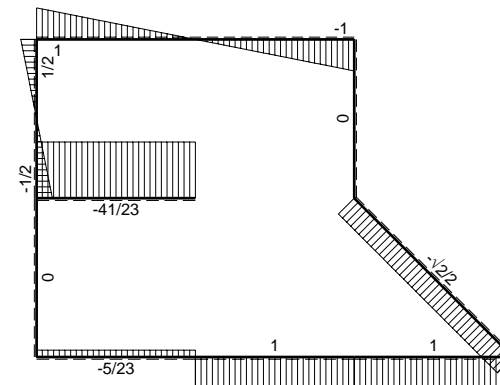
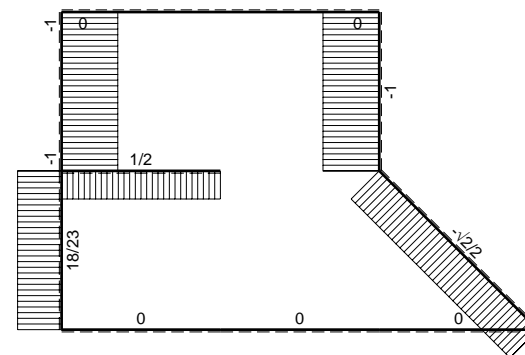
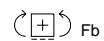
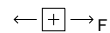
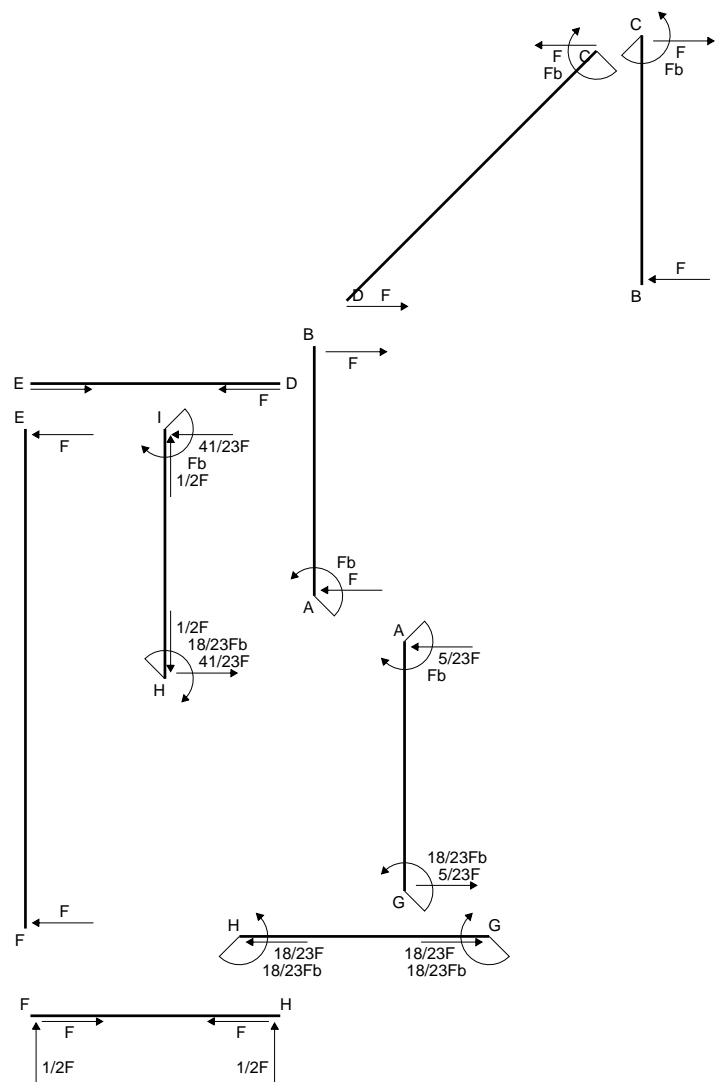
$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/6 Fb^2/EJ$$

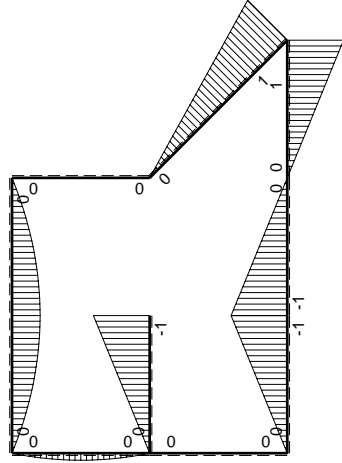
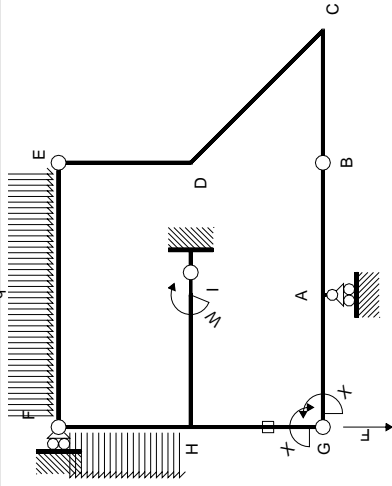
$$L_{GH}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

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

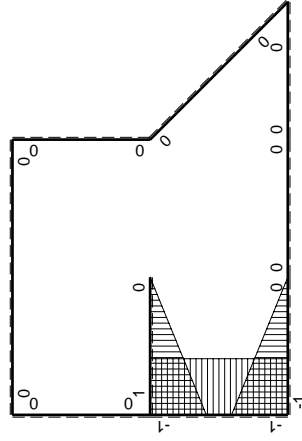


- A = 171.6 mm²
- J_u = 58532. mm⁴
- J_v = 18662. mm⁴
- J_i = 154. mm⁴
- y_o = 11.05 mm
- y_g = 26.29 mm
- T_y = 780. N
- M_x = -530400. Nmm
- x_m = 12. mm
- u_m = -12. mm
- v_m = -26.29 mm
- σ_m = -Mv/J_u = -238.2 N/mm²
- x_c = 24. mm
- v_c = -26.29 mm
- σ_c = -Mv/J_u = -238.2 N/mm²
- τ_c = TS'/tJ_u = 15.13 N/mm²
- τ_g = TS'/tJ_u = 15.13 N/mm²
- t_c = 780. mm
- σ_o = √σ²+3τ² = 239.6 N/mm²





M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int M_x M_x / E J dx$
AB b	0	-Fb+Fx	0	0	0	0
BA b	0	Fx	0	0	0	0
BC b	0	Fx	0	0	0	0
CB b	0	-Fb+Fx	0	0	0	0
CD $\sqrt{2}b$	0	$Fb-\sqrt{2}/2Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	$-Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$Fx-1/2qx^2$	0	0	0	0
GA b	$-1+x/b$	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2		
FH b	0	$1/2Fx-1/2qx^2$	0	0	0	0
HF b	0	$-1/2Fx+1/2qx^2$	0	0	0	0
HI b	$1-x/b$	-Fx	$-Fx+Fx^2/b$	$1-2x/b+x^2/b^2$	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	Fb-Fx	$-Fx+Fx^2/b$	x^2/b^2		
HG b	-1	0	0	1	0	Xb/EJ
GH b	1	0	0	1	0	Xb/EJ
HG	elongazione asta $N_{1HG} \pm HG$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{0A}+XV_{1A})/k_A$				$-1/2Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-3/2Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$18/23Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

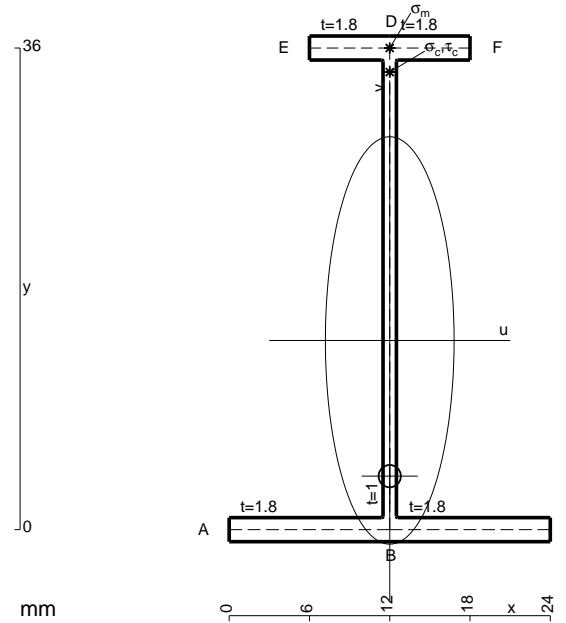
$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

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

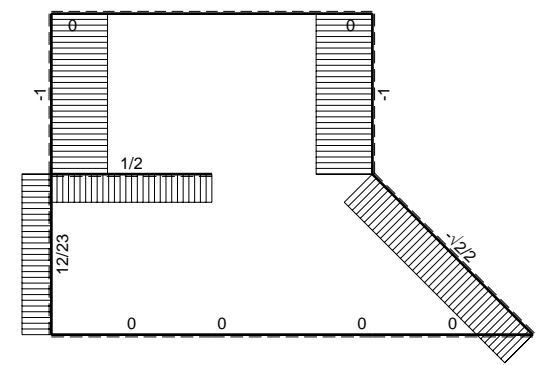
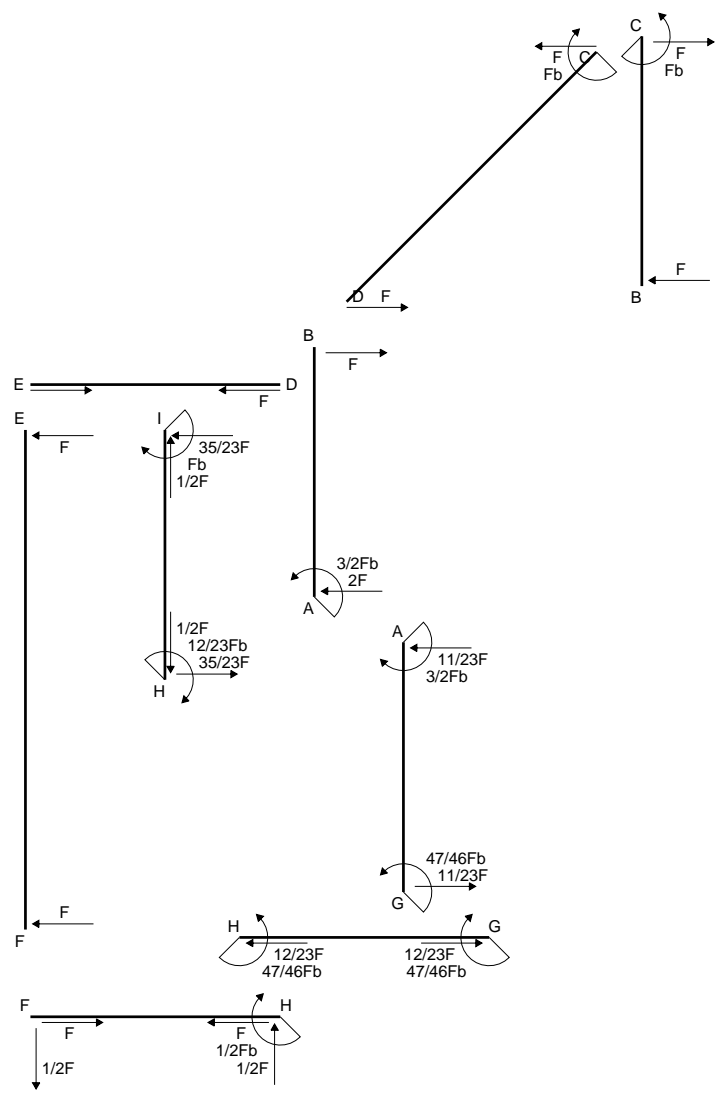
$$= (-1/2 b + 1/3 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

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

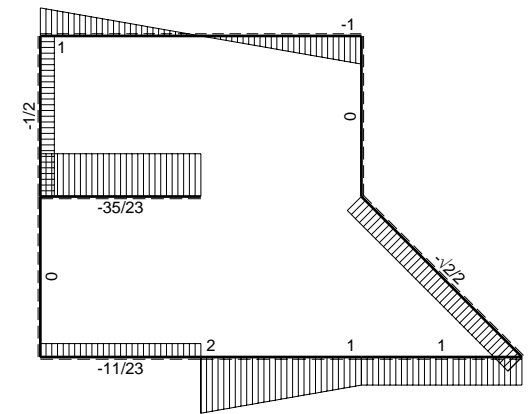
$$= (-1/2 b + 1/3 b) Fb 1/EJ = -1/6 Fb^2/EJ$$



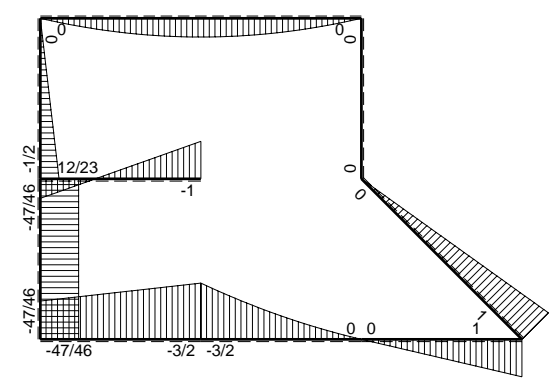
- A = 100.8 mm²
- J_u = 23384. mm⁴
- J_v = 2333. mm⁴
- J_i = 81.98 mm⁴
- y_o = -10.14 mm
- y_g = 14.14 mm
- T_y = 690. N
- M_x = -213900. Nmm
- x_m = 12. mm
- y_m = 36. mm
- v_m = 21.86 mm
- σ_m = -Mv/J_u = 199.9 N/mm²
- y_c = 2. mm
- u_c = -12. mm
- v_c = -12.14 mm
- σ_c = -Mv/J_u = 199.9 N/mm²
- τ_c = TS_i/tJ_u = 13.93 N/mm²
- τ_g = TS_i/tJ_u = 13.93 N/mm²
- t_c = 690. mm
- σ_o = √σ²+3τ² = 201.4 N/mm²



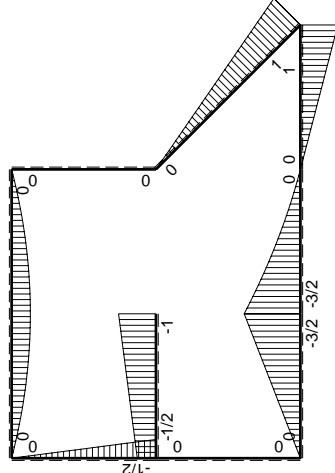
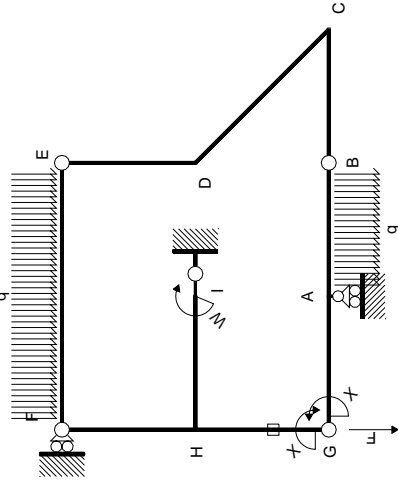
← ⊕ → F



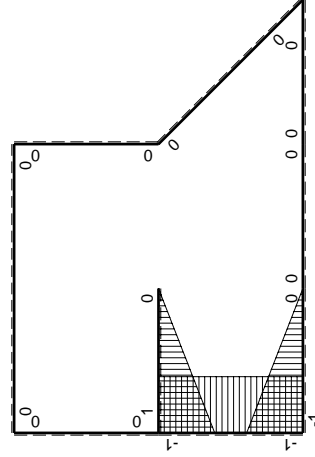
↑ ⊕ ↓ F



⊕ ⊖ Fb



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x^2 M_x$	$\int M_x M_0 / EJ dx$	$\int M_x^2 M_x / EJ dx$
AB b	0	$-3/2Fb+2Fx-1/2qx^2$	0	0	0	0
BA b	0	$Fx+1/2qx^2$	0	0	0	0
BC b	0	Fx	0	0	0	0
CB b	0	$-Fb+Fx$	0	0	0	0
CD $\sqrt{2}b$	0	$Fb-\sqrt{2}/2Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	$-Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$Fx-1/2qx^2$	0	0	0	0
GA b	$-1+x/b$	$-3/2Fx$	$3/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/4Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$3/2Fb-3/2Fx$	$3/2Fx-3/2Fx^2/b$	x^2/b^2	$1/4Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$-1/2Fx$	0	0	0	0
HF b	0	$1/2Fb-1/2Fx$	0	0	0	0
HI b	$1-x/b$	$-1/2Fb-1/2Fx$	$-1/2Fb+1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$-1/3Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$Fb-1/2Fx$	$-Fx+1/2Fx^2/b$	x^2/b^2	$-1/3Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	0	0	1	0	Xb/EJ
GH b	1	0	0	1	0	Xb/EJ
HG	elongazione asta $N_{1HG^{\pm}HG^{\pm}HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{GA}+XV_{1A})/k_A$				$-7/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-47/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				47/46Fb	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

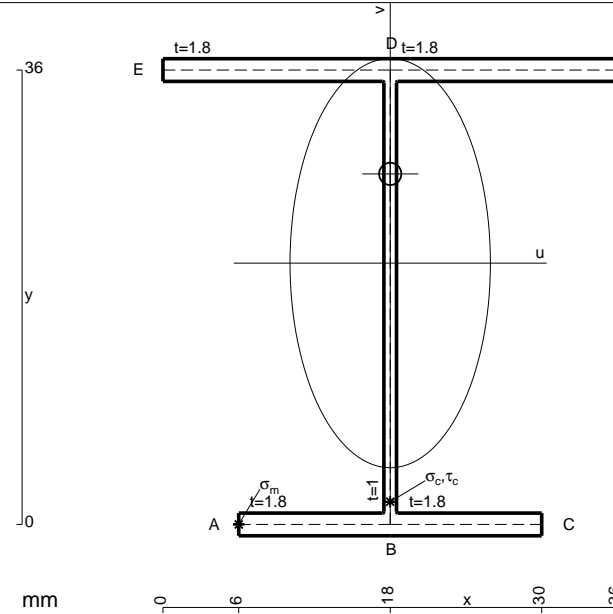
$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

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

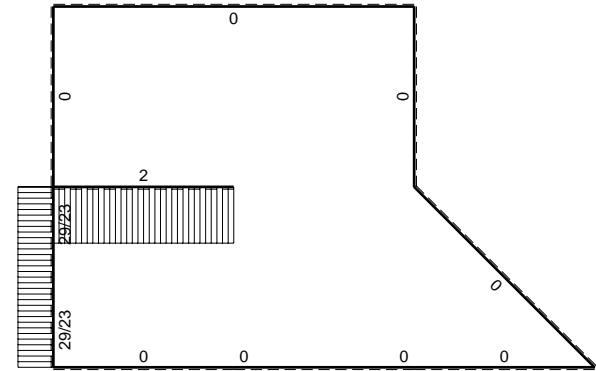
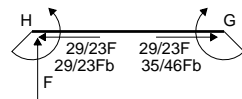
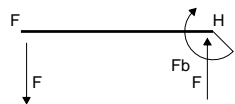
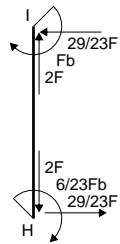
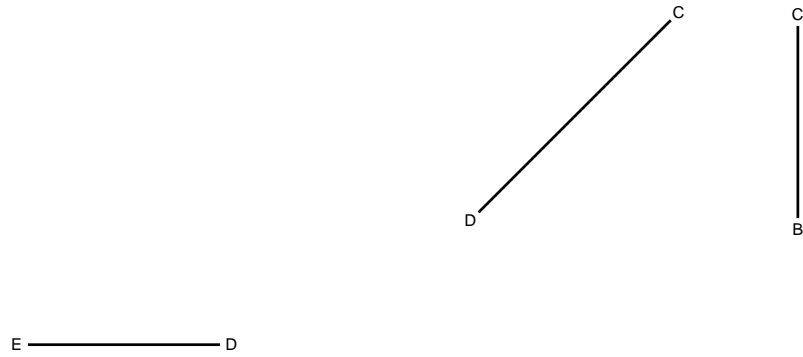
$$= (-1/2 b + 1/6 b) Fb 1/EJ = -1/3 Fb^2/EJ$$

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

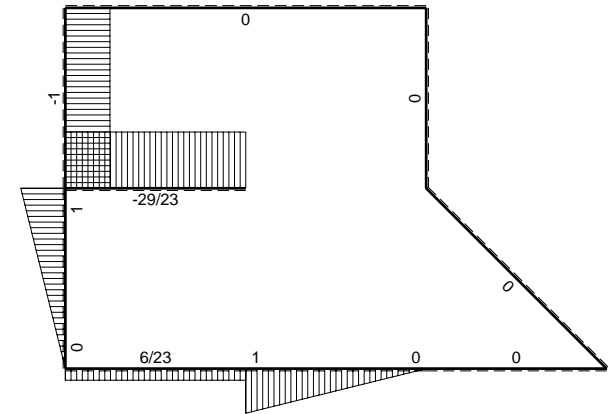
$$= (-1/2 b + 1/6 b) Fb 1/EJ = -1/3 Fb^2/EJ$$



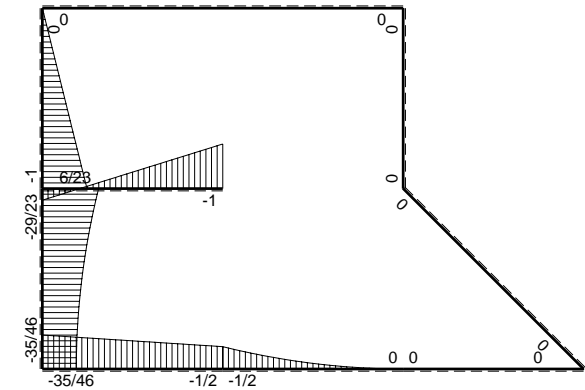
- A = 144. mm²
- J_u = 37830. mm⁴
- J_v = 9072. mm⁴
- J_i = 128.6 mm⁴
- y_o = 7.071 mm
- y_g = 20.7 mm
- T_y = 1500. N
- M_x = -382500. Nmm
- x_m = 6. mm
- u_m = -12. mm
- v_m = -20.7 mm
- σ_m = -Mv/J_u = -209.3 N/mm²
- x_c = 18. mm
- v_c = -20.7 mm
- σ_c = -Mv/J_u = -209.3 N/mm²
- τ_c = TS_i/tJ_u = 35.46 N/mm²
- τ_g = TS_i/tJ_u = 35.46 N/mm²
- t_c = 750. mm
- σ_o = √σ²+3τ² = 218.1 N/mm²



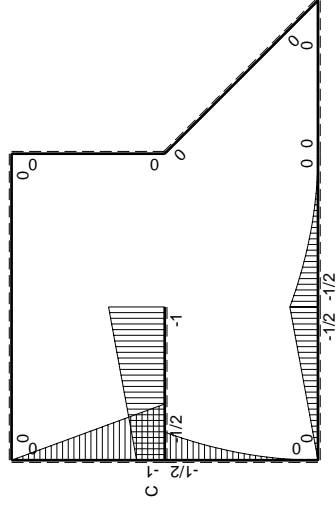
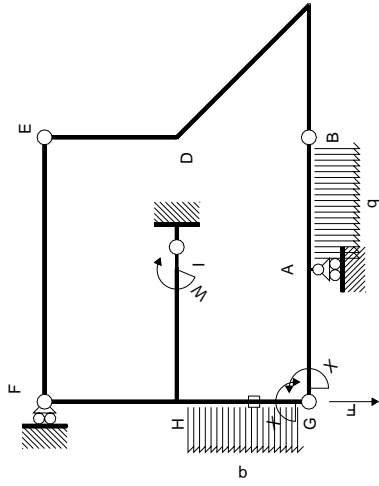
← ⊕ → F



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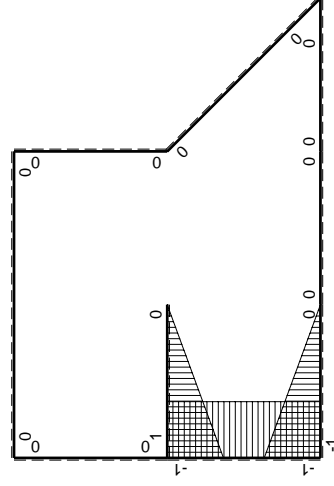


⊕ ⊖ Fb



Schema di calcolo iperstatico

(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica X=1

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

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-1/2Fb + Fx - 1/2qx^2$	0	0	0	0
BA b	0	$1/2qx^2$	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	0	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$-1/2Fx$	$1/2Fx - 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$1/2Fb - 1/2Fx$	$1/2Fx - 1/2Fx^2/b$	x^2/b^2	$1/12Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$-Fx$	0	0	0	0
HF b	0	$Fb - Fx$	0	0	0	0
HI b	$1-x/b$	$-1/2Fb - 1/2Fx$	$-1/2Fb + 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$-1/3Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$Fb - 1/2Fx$	$-Fx + 1/2Fx^2/b$	x^2/b^2	$-1/3Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	$-1/2Fb + Fx - 1/2qx^2$	$1/2Fb - Fx + 1/2Fx^2/b$	1	$1/6Fb^2/EJ$	Xb/EJ
GH b	1	$1/2qx^2$	$1/2Fx^2/b$	1	$1/6Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG} = N_{HG} + N_{HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$				$-3/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-35/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$35/46Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

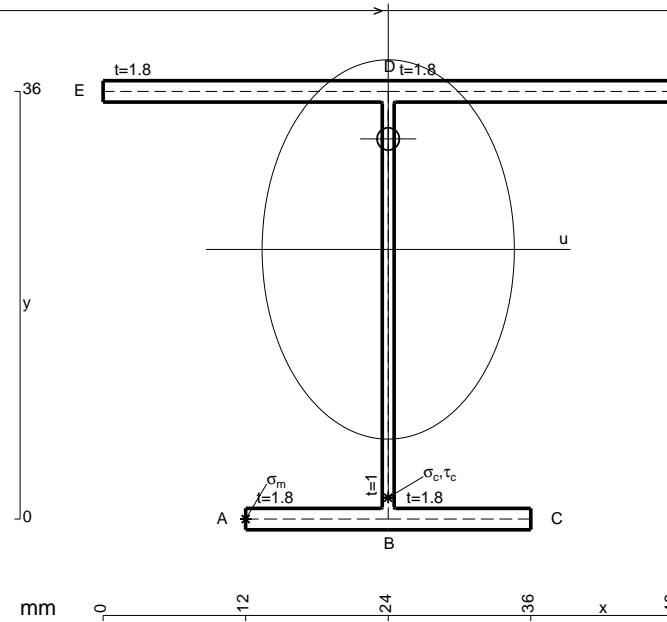
$$L_{HG}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

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

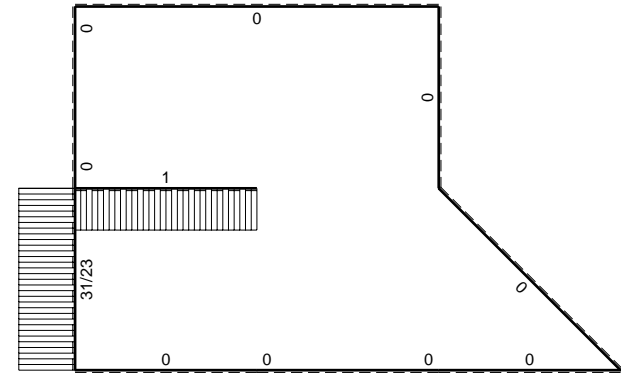
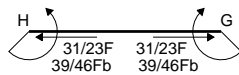
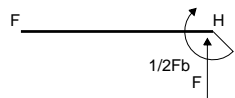
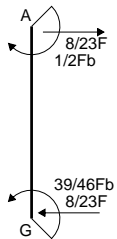
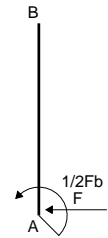
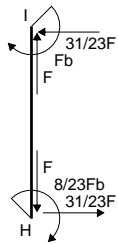
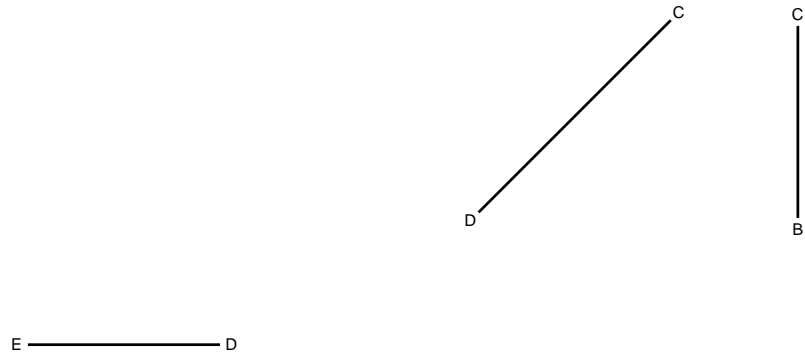
$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/6 Fb^2/EJ$$

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

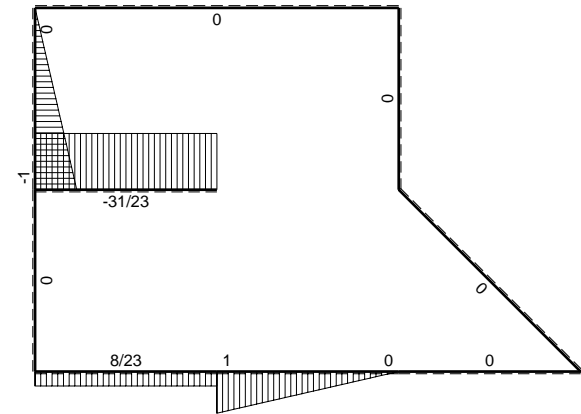
$$= (1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/6 Fb^2/EJ$$



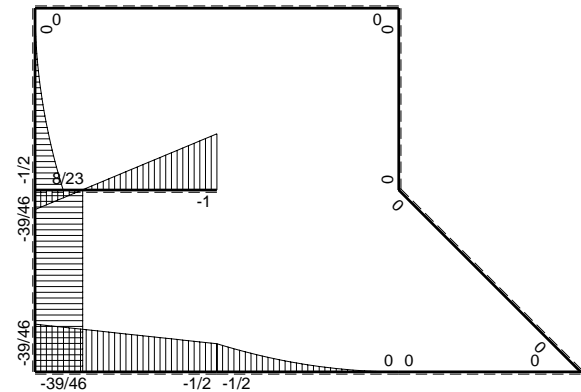
- A = 165.6 mm²
- J_u = 42227. mm⁴
- J_v = 18662. mm⁴
- J_i = 152. mm⁴
- y_o = 9.304 mm
- y_g = 22.7 mm
- T_y = -1100. N
- M_x = -407000. Nmm
- x_m = 12. mm
- u_m = -12. mm
- v_m = -22.7 mm
- σ_m = -Mv/J_u = -218.7 N/mm²
- x_c = 24. mm
- v_c = -22.7 mm
- σ_c = -Mv/J_u = -218.7 N/mm²
- τ_c = TS_i/t_u = 25.54 N/mm²
- τ_g = TS_i/t_u = 25.54 N/mm²
- t_c = 1100. mm
- σ_o = √σ²+3τ² = 223.2 N/mm²



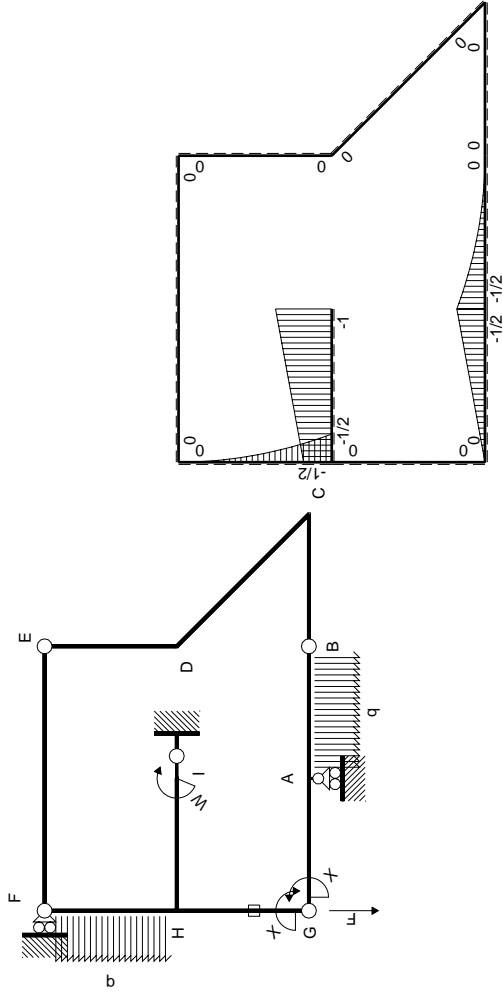
← ⊕ → F



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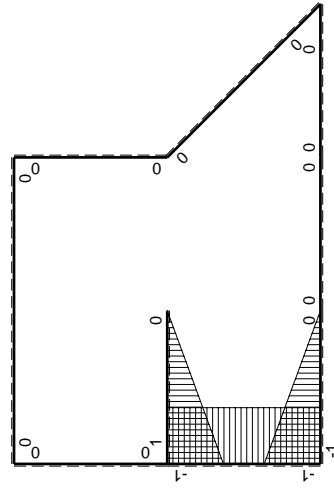


⊕ ⊖ Fb



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-1/2Fb + Fx - 1/2qx^2$	0	0	0	0
BA b	0	$1/2qx^2$	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	0	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$-1/2Fx$	$1/2Fx - 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$1/2Fb - 1/2Fx$	$1/2Fx - 1/2Fx^2/b$	x^2/b^2	$1/12Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$-1/2qx^2$	0	0	0	0
HF b	0	$1/2Fb - Fx + 1/2qx^2$	0	0	0	0
HI b	$1-x/b$	$-1/2Fb - 1/2Fx$	$-1/2Fb + 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$-1/3Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$Fb - 1/2Fx$	$-Fx + 1/2Fx^2/b$	x^2/b^2	$-1/3Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	0	0	1	0	Xb/EJ
GH b	1	0	0	1	0	Xb/EJ
HG	elongazione asta $N_{1HG} = N_{HG} + N_{HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$				$-3/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-13/8Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica X=W _{GA}				$39/46Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

$$L_{GA}^{x_0} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[1/4 x^2/b - 1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

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

$$L_{AG}^{x_0} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[1/4 x^2/b - 1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

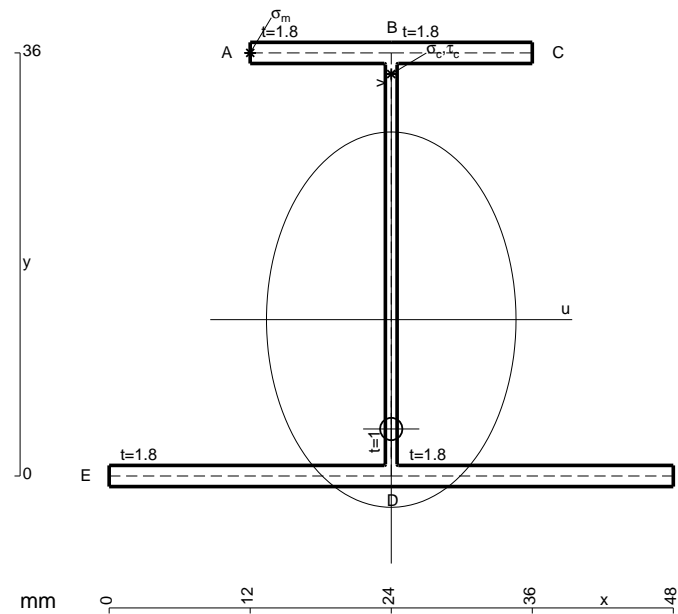
$$= (1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/12 \cdot Fb^2/EJ$$

$$L_{HI}^{x_0} = \int_0^b (-1/2 + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[-1/2 x + 1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

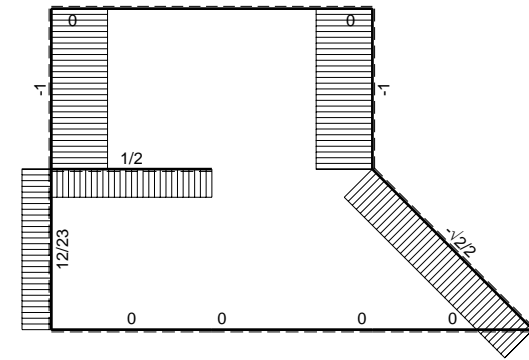
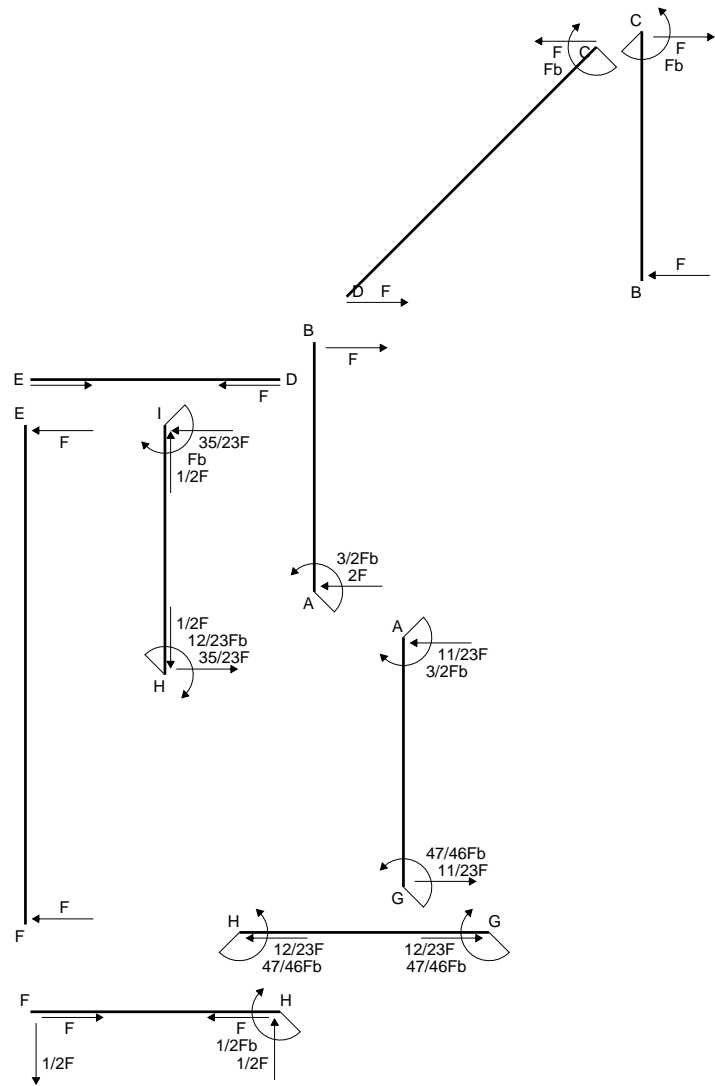
$$= (-1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = -1/3 \cdot Fb^2/EJ$$

$$L_{IH}^{x_0} = \int_0^b (-x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[-1/2 x^2/b + 1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

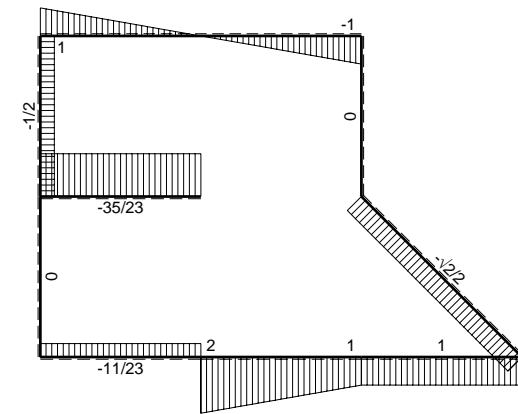
$$= (-1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = -1/3 \cdot Fb^2/EJ$$



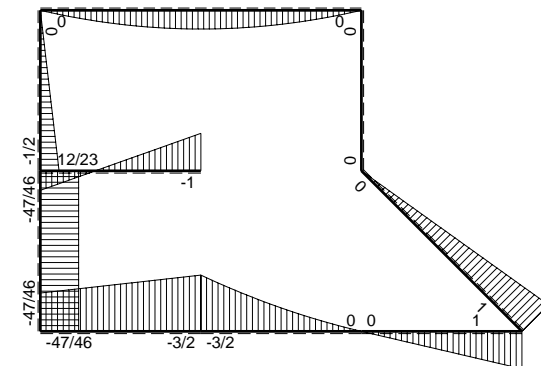
- A = 165.6 mm²
- J_u = 42227. mm⁴
- J_v = 18662. mm⁴
- J_y = 152. mm⁴
- y_o = -9.304 mm
- y_g = 13.3 mm
- T_y = 2130. N
- M_x = -426000. Nmm
- x_m = 12. mm
- y_m = 36. mm
- u_m = -12. mm
- v_m = 22.7 mm
- σ_m = -Mv/J_u = 229. N/mm²
- x_c = 24. mm
- y_c = 36. mm
- v_c = 22.7 mm
- σ_c = -Mv/J_u = 229. N/mm²
- τ_c = TS_y/tJ_u = 49.46 N/mm²
- τ_g = TS_y/tJ_u = 49.46 N/mm²
- t_c = 2130. mm
- σ_o = √(σ² + 3τ²) = 244.5 N/mm²



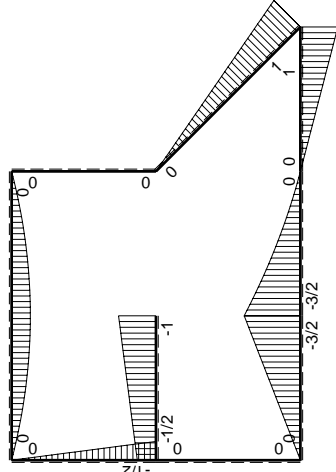
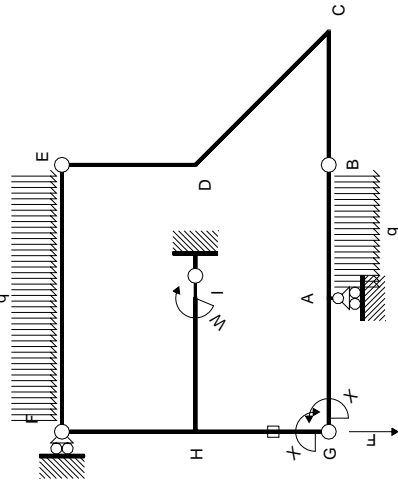
← ⊕ → F



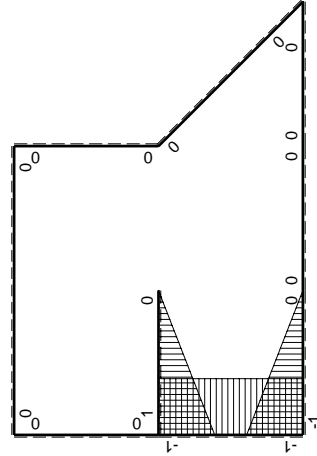
↑ ⊕ ↓ F



⊕ ⊖ F_b



(\oplus) M_0 flessione da carichi assegnati



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

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

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x^2 M_x$	$\int M_x M_0 / EJ dx$	$\int M_x^2 M_x / EJ dx$
AB b	0	$-3/2Fb+2Fx-1/2qx^2$	0	0	0	0
BA b	0	$Fx+1/2qx^2$	0	0	0	0
BC b	0	Fx	0	0	0	0
CB b	0	$-Fb+Fx$	0	0	0	0
CD $\sqrt{2}b$	0	$Fb-\sqrt{2}/2Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	$-Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$Fx-1/2qx^2$	0	0	0	0
GA b	$-1+x/b$	$-3/2Fx$	$3/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/4Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$3/2Fb-3/2Fx$	$3/2Fx-3/2Fx^2/b$	x^2/b^2	$1/4Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$-1/2Fx$	0	0	0	0
HF b	0	$1/2Fb-1/2Fx$	0	0	0	0
HI b	$1-x/b$	$-1/2Fb-1/2Fx$	$-1/2Fb+1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$-1/3Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$Fb-1/2Fx$	$-Fx+1/2Fx^2/b$	x^2/b^2	$-1/3Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	0	0	1	0	Xb/EJ
GH b	1	0	0	1	0	Xb/EJ
HG	elongazione asta $N_{1HG} \pm HG \pm HG$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$				$-7/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-47/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$47/46Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

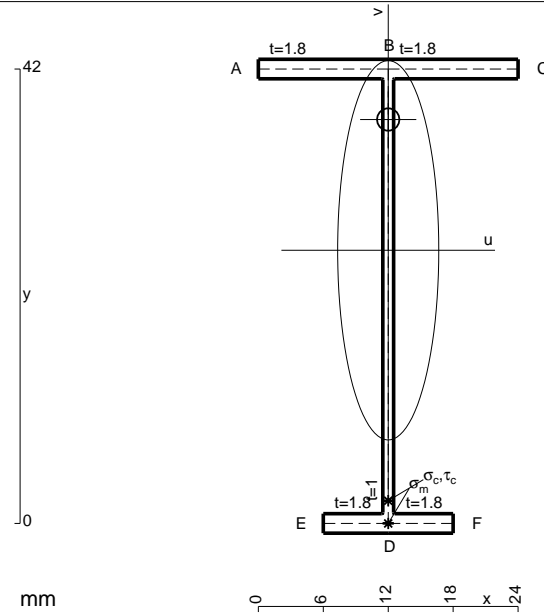
$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

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

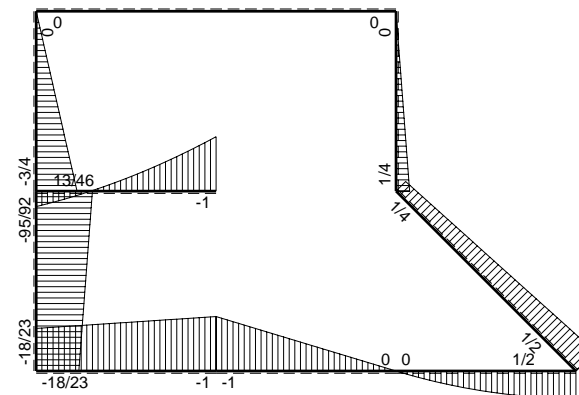
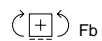
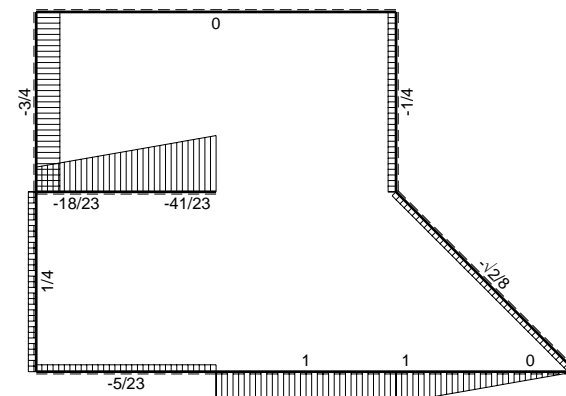
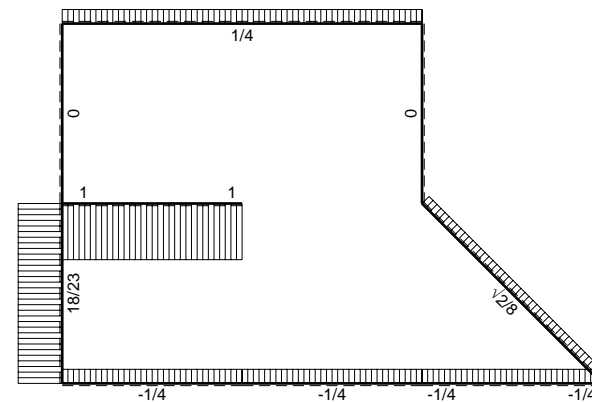
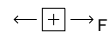
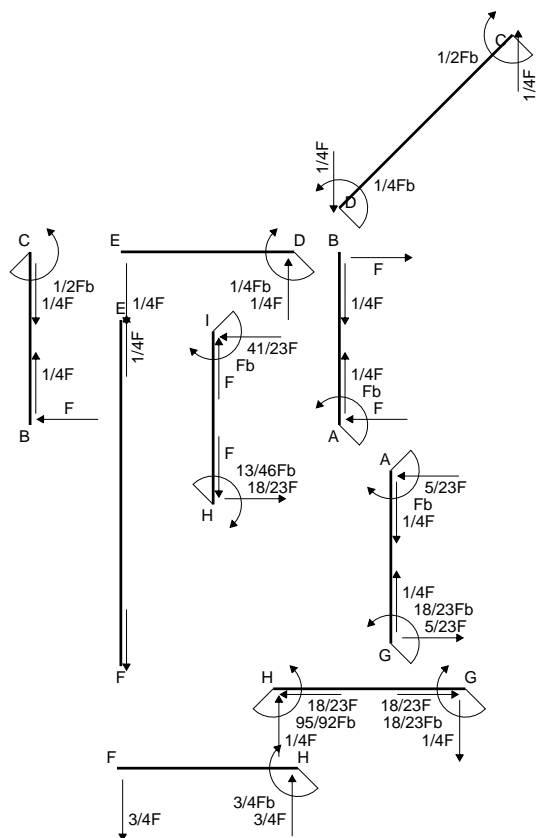
$$= (-1/2 b + 1/6 b) Fb 1/EJ = -1/3 Fb^2/EJ$$

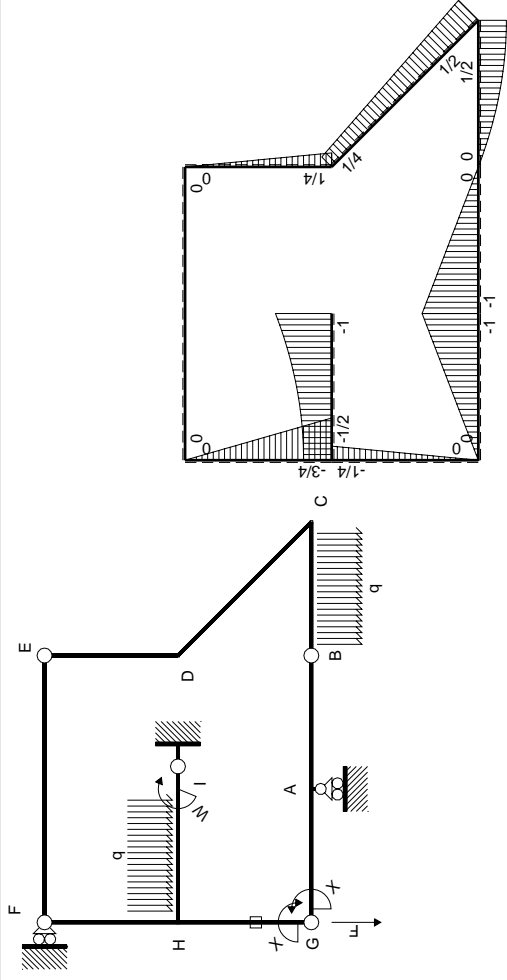
$$L_{IH}^{xo} = \int_0^b (-x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

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

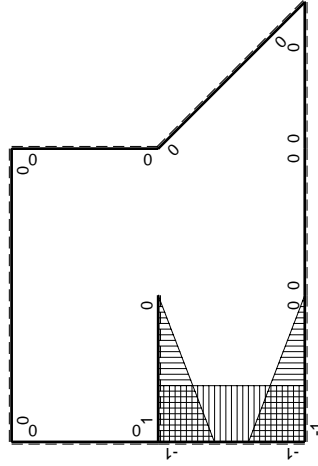


- A = 106.8 mm²
- J_u = 32824. mm⁴
- J_v = 2333. mm⁴
- J_i = 83.98 mm⁴
- y_o = 12.09 mm
- y_g = 25.25 mm
- T_y = 820. N
- M_x = -307500. Nmm
- x_m = 12. mm
- v_m = -25.25 mm
- σ_m = -Mv/J_u = -236.5 N/mm²
- y_c = 3. mm
- u_c = -12. mm
- v_c = -22.25 mm
- σ_c = -Mv/J_u = -236.5 N/mm²
- τ_c = TS_i/tJ_u = 13.62 N/mm²
- τ_g = TS_i/tJ_u = 13.62 N/mm²
- t_c = 410. mm
- σ_o = √σ²+3τ² = 237.7 N/mm²





M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	$M_x M_o$	$M_x M_x$	$\int M_x M_o / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-Fb+Fx	0	0	0	0
BA b	0	Fx	0	0	0	0
BC b	0	$Fx-1/2qx^2$	0	0	0	0
CB b	0	$-1/2Fb+1/2qx^2$	0	0	0	0
CD $\sqrt{2}b$	0	$1/2Fb-\sqrt{2}/8Fx$	0	0	0	0
DE b	0	$1/4Fb-1/4Fx$	0	0	0	0
ED b	0	$-1/4Fx$	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2		
FH b	0	$-3/4Fx$	0	0	0	0
HF b	0	$3/4Fb-3/4Fx$	0	0	0	0
HI b	$1-x/b$	$-1/2Fb-1/2qx^2$	$-1/2Fb+1/2Fx-1/2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$-7/24Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$Fb-Fx+1/2qx^2$	$-Fx+Fx^2/b-1/2qx^3/b$	x^2/b^2		
HG b	-1	$-1/4Fb+1/4Fx$	$1/4Fb-1/4Fx$	1	$1/8Fb^2/EJ$	Xb/EJ
GH b	1	$1/4Fx$	$1/4Fx$	1		
HG	elongazione asta $N_{1HG} \epsilon_{HG} L_{HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{oA}+XV_{1A})/k_A$				$-1/2Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-3/2Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$18/23Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

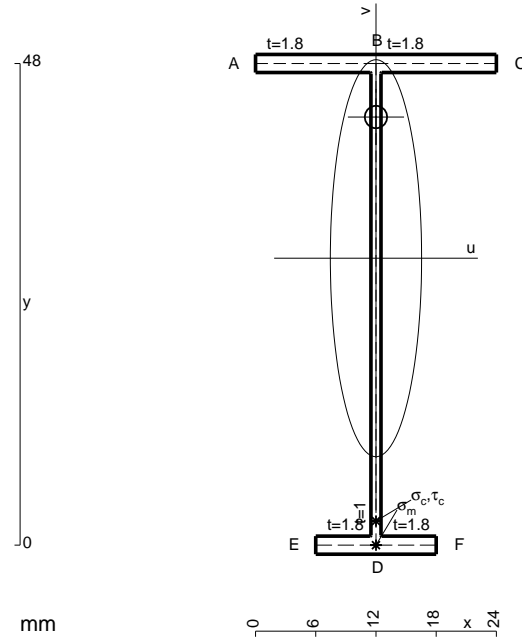
$$L_{HG}^{xo} = \int_0^b (1/4 - 1/4 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/4 x - 1/8 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

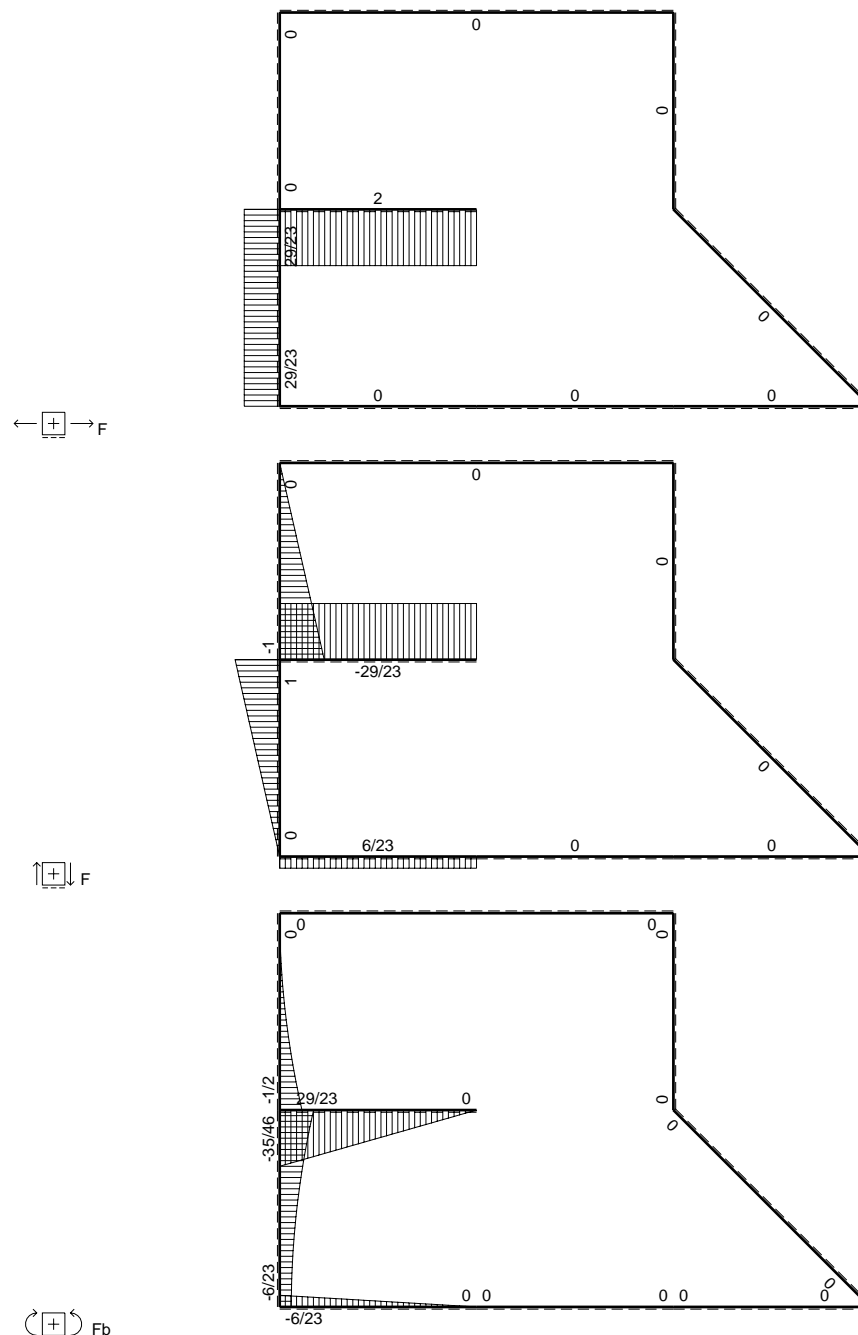
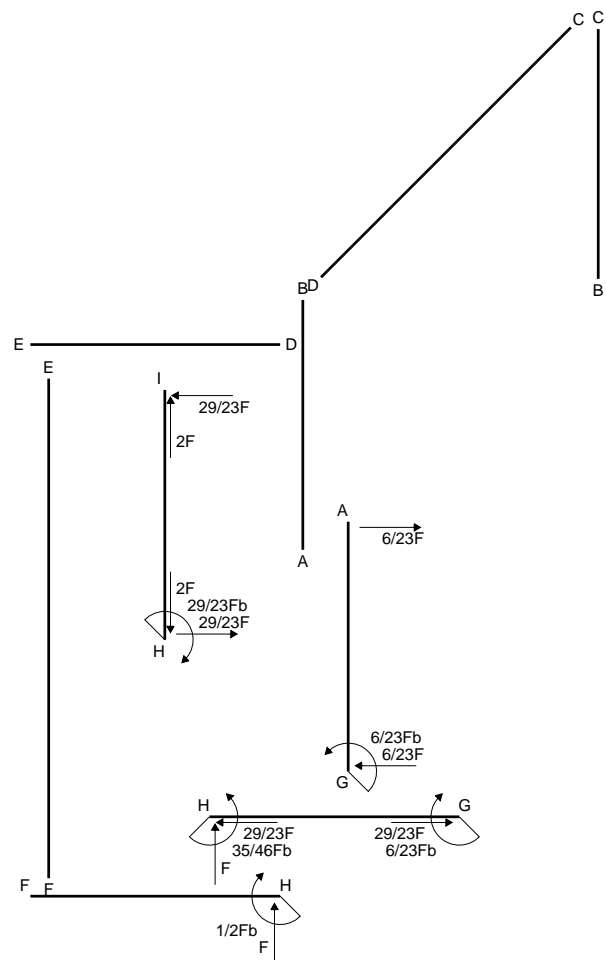
$$= (1/4 b - 1/8 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -7/8 Fb^2/EJ$$

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

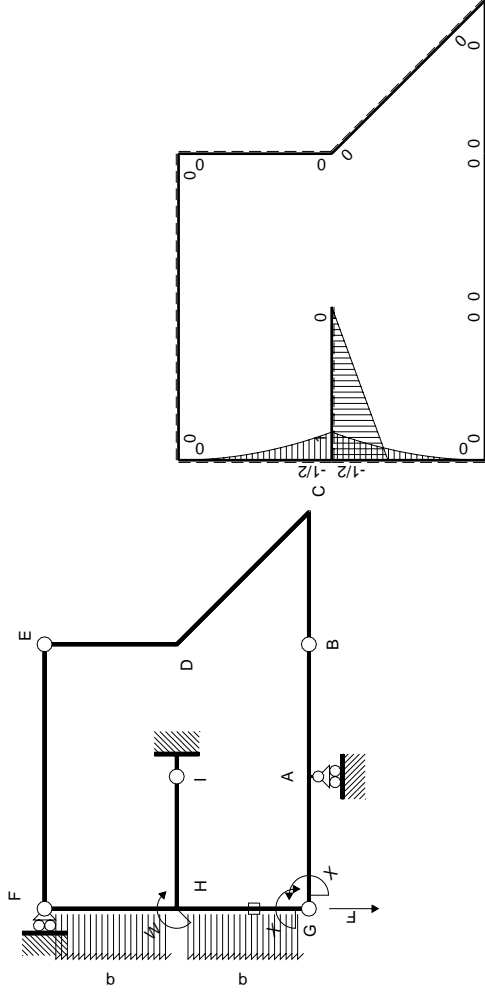
$$= (1/8 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -7/8 Fb^2/EJ$$



- A = 112.8 mm²
- J_u = 44158. mm⁴
- J_v = 2333. mm⁴
- J_t = 85.98 mm⁴
- y_o = 14.07 mm
- y_g = 28.6 mm
- N = -125. N
- T_y = 500. N
- M_x = -305000. Nmm
- x_m = 12. mm
- v_m = -28.6 mm
- σ_m = N/A - Mv/J_u = -198.6 N/mm²
- y_c = 3. mm
- u_c = -12. mm
- v_c = -25.6 mm
- σ_c = N/A - Mv/J_u = -198.6 N/mm²
- τ_c = TS/tJ_u = 6.994 N/mm²
- τ_g = TS/tJ_u = 6.994 N/mm²
- t_c = 500. mm
- σ_o = √σ² + 3τ² = 199. N/mm²

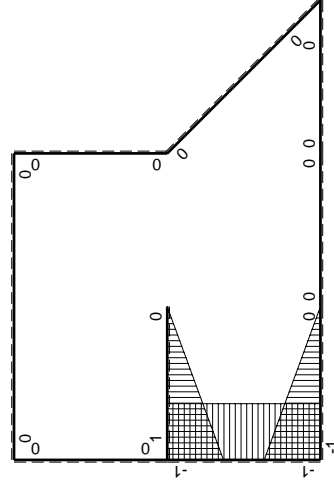


$\left[\begin{matrix} + \\ + \end{matrix} \right] F_b$



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	0	0	0	0	0
BA b	0	0	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	0	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
AG b	x/b	0	0	x^2/b^2	0	$1/3Xb/EJ$
FH b	0	$-1/2qx^2$	0	0	0	0
HF b	0	$1/2Fb-Fx+1/2qx^2$	0	0	0	0
HI b	$1-x/b$	$Fb-Fx$	$Fb-2Fx+Fx^2/b$	$1-2x/b+x^2/b^2$	$1/3Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$-Fx$	Fx^2/b	x^2/b^2	$1/6Fb^2/EJ$	Xb/EJ
HG b	-1	$-1/2Fb+Fx-1/2qx^2$	$1/2Fb-Fx+1/2Fx^2/b$	1	$1/6Fb^2/EJ$	Xb/EJ
GH b	1	$1/2qx^2$	$1/2Fx^2/b$	1	$1/6Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG^5HG^4HG}$					
A	molla nodo $-V_{1A}(V_{0A}+XV_{1A})/k_A$					
	totali					
	iperstatica $X=W_{GA}$					
					$-1/2Fb^2/EJ$	$23/12Xb/EJ$
					$6/23Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

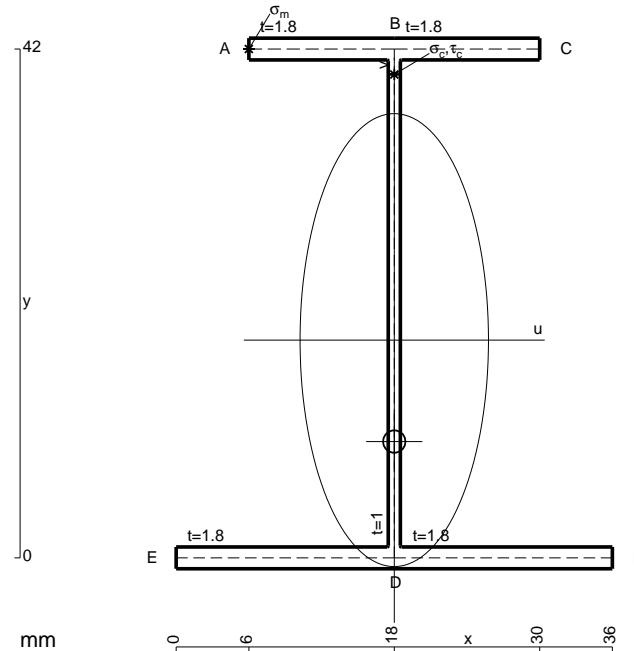
$$L_{HG}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

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

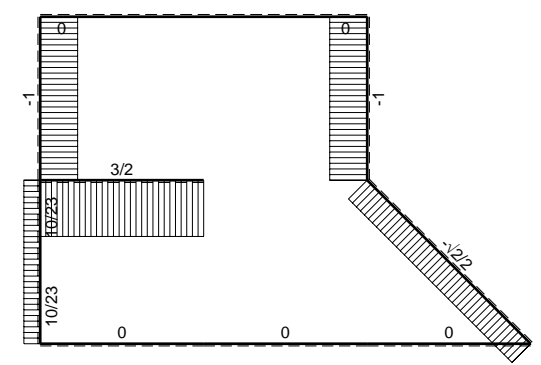
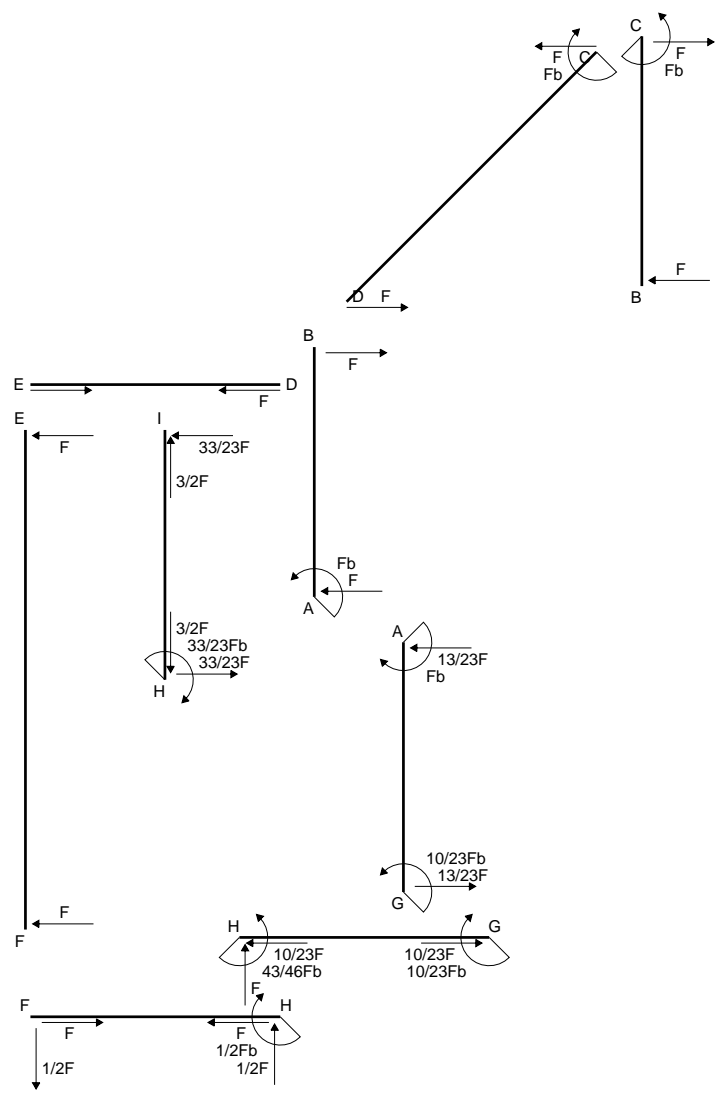
$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/6 Fb^2/EJ$$

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

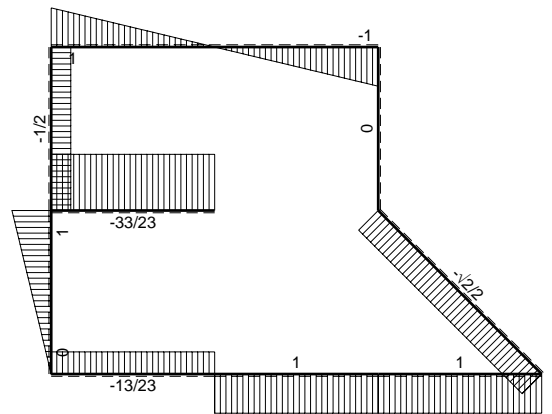
$$= (1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/6 Fb^2/EJ$$



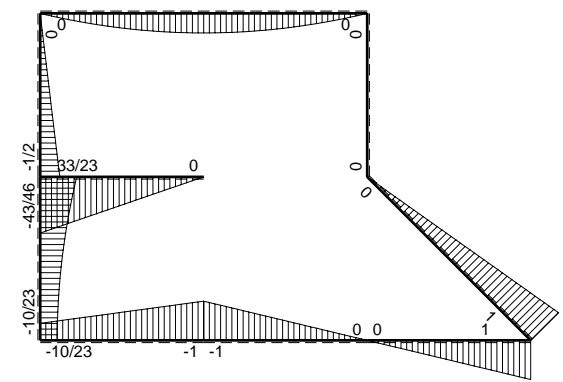
- A = 150. mm²
- J_u = 52430. mm⁴
- J_v = 9072. mm⁴
- J_t = 130.6 mm⁴
- y_o = -8.376 mm
- y_g = 17.98 mm
- T_y = -1600. N
- M_x = -456000. Nmm
- x_m = 6. mm
- y_m = 42. mm
- u_m = -12. mm
- v_m = 24.02 mm
- σ_m = -Mv/J_u = 208.9 N/mm²
- x_c = 18. mm
- y_c = 42. mm
- v_c = 24.02 mm
- σ_c = -Mv/J_u = 208.9 N/mm²
- τ_c = TS/tJ_u = 31.67 N/mm²
- τ_g = TS/tJ_u = 31.67 N/mm²
- t_c = 1600. mm
- σ_o = √σ²+3τ² = 216. N/mm²



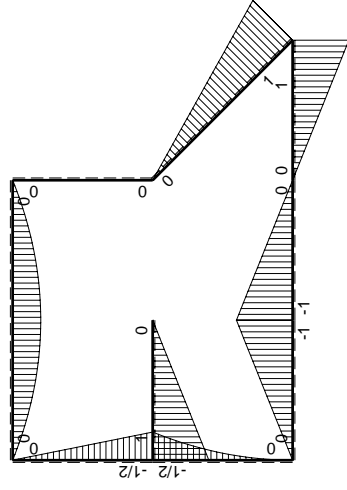
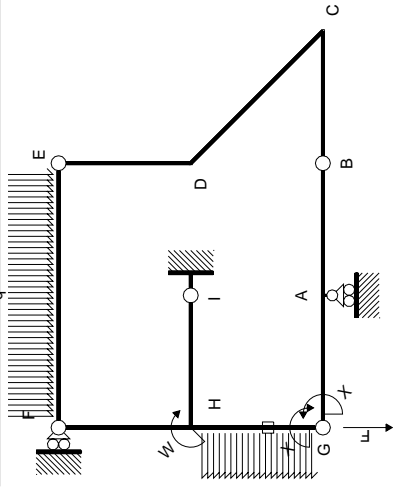
← ⊕ → F



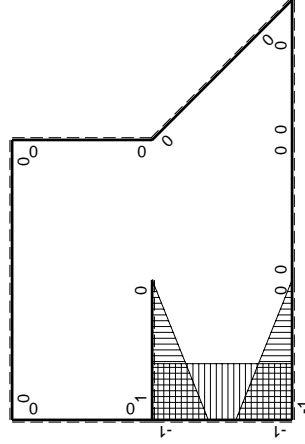
↑ ⊕ ↓ F



⊕ ⊖ Fb



(\oplus) M_0 flessione da carichi assegnati



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

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

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-Fb+Fx	0	0	0	0
BA b	0	Fx	0	0	0	0
BC b	0	Fx	0	0	0	0
CB b	0	-Fb+Fx	0	0	0	0
CD $\sqrt{2}b$	0	$Fb-\sqrt{2}2Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	$-Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$Fx-1/2qx^2$	0	0	0	0
GA b	$-1+x/b$	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$Fb-Fx$	$Fx-Fx^2/b$	x^2/b^2	$1/6Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$-1/2Fx$	0	0	0	0
HF b	0	$1/2Fb-1/2Fx$	0	0	0	0
HI b	$1-x/b$	$Fb-Fx$	$Fb-2Fx+Fx^2/b$	$1-2x/b+x^2/b^2$	$1/3Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	-Fx	Fx^2/b	x^2/b^2	$1/6Fb^2/EJ$	Xb/EJ
HG b	-1	$-1/2Fb+Fx-1/2qx^2$	$1/2Fb-Fx+1/2Fx^2/b$	1	$1/6Fb^2/EJ$	Xb/EJ
GH b	1	$1/2qx^2$	$1/2Fx^2/b$	1	$1/6Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG^{\pm HG}} \pm HG$					
A	molla nodo $-V_{1A}(V_{0A}+XV_{1A})/k_A$					
	totali					
	iperstatica $X=W_{GA}$					

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

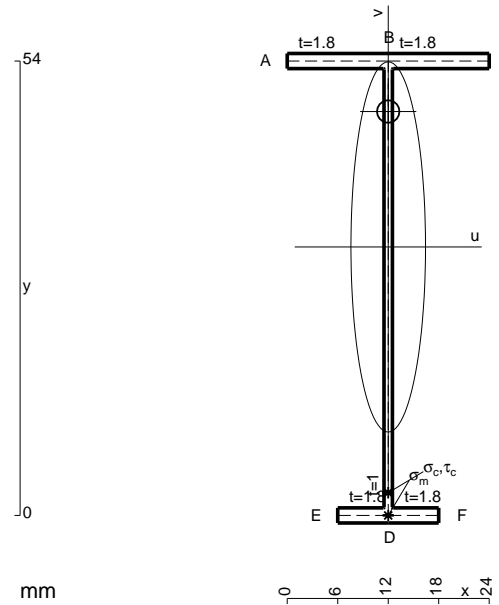
$$L_{HG}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 \cdot (-1) \cdot (-1) Fb^2/EJ$$

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

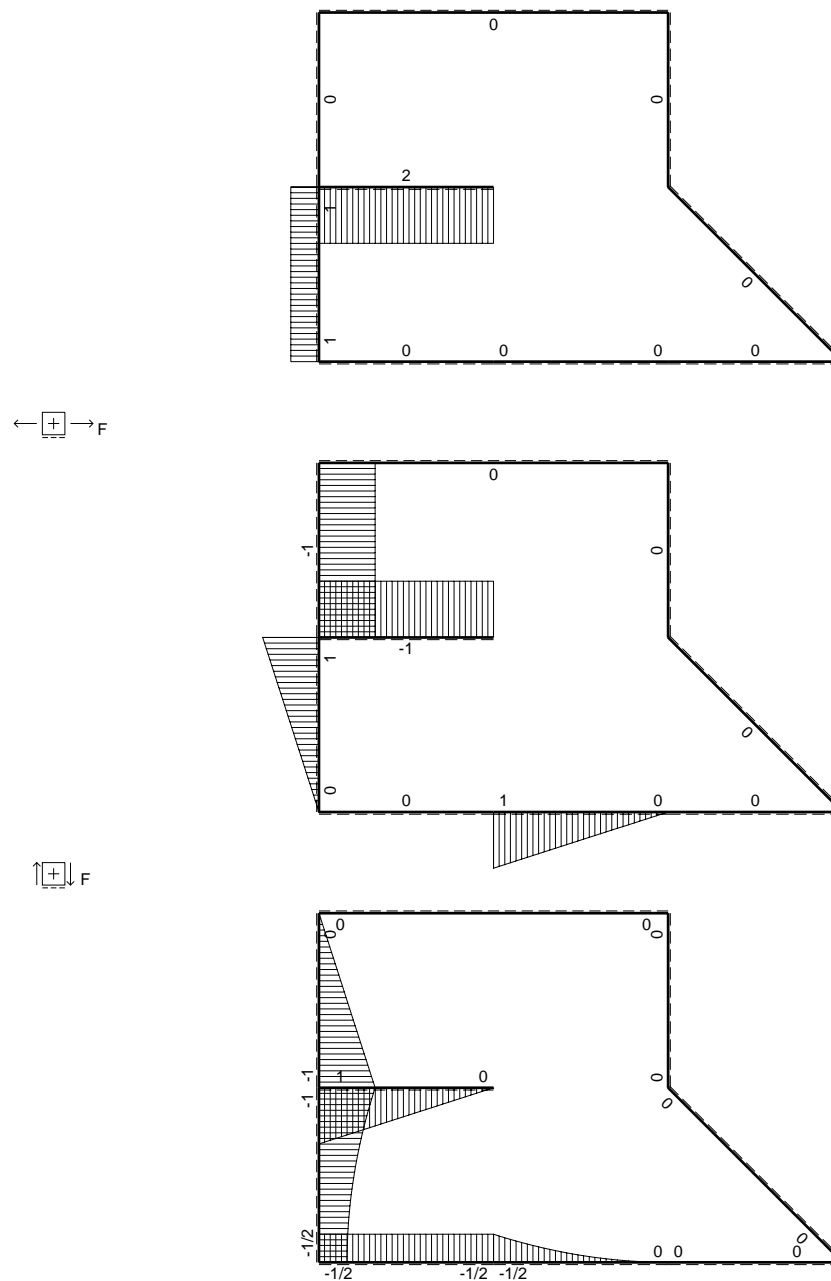
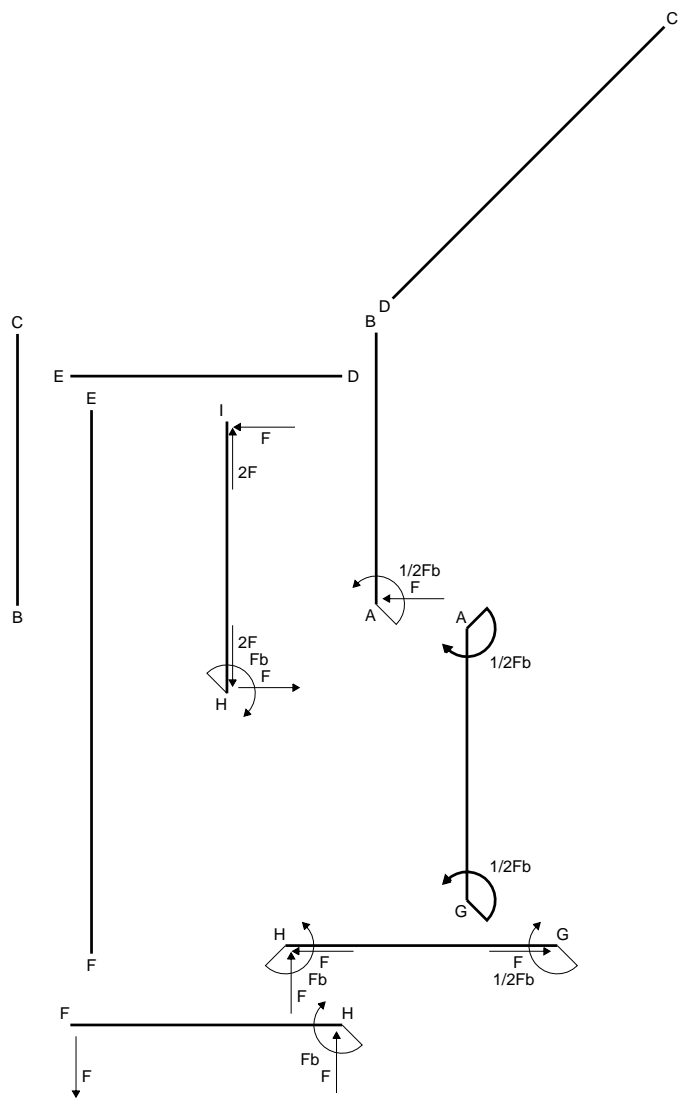
$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ - 1 \cdot (-1) \cdot (-1) Fb^2/EJ = -5/6 Fb^2/EJ$$

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

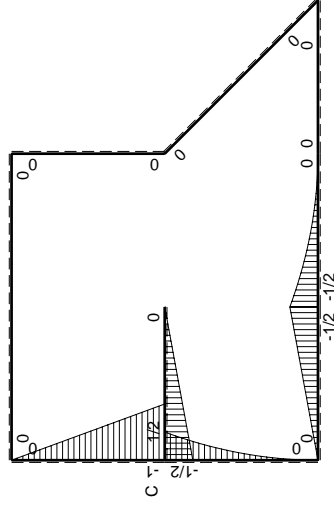
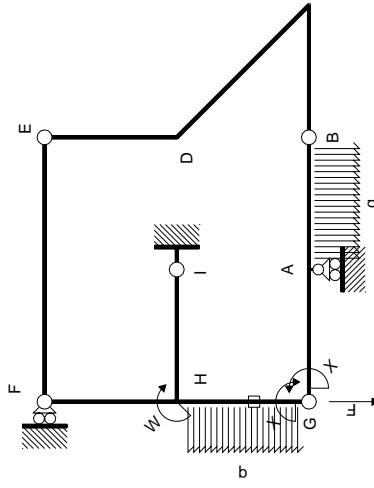
$$= (1/6 b) Fb 1/EJ - 1 \cdot (-1) \cdot (-1) Fb^2/EJ = -5/6 Fb^2/EJ$$



- A = 118.8 mm²
- J_u = 57498. mm⁴
- J_v = 2333. mm⁴
- J_i = 87.98 mm⁴
- y_o = 16.09 mm
- y_g = 31.91 mm
- T_y = 500. N
- M_x = -390000. Nmm
- x_m = 12. mm
- v_m = -31.91 mm
- σ_m = -Mv/J_u = -216.4 N/mm²
- y_c = 3. mm
- u_c = -12. mm
- v_c = -28.91 mm
- σ_c = -Mv/J_u = -216.4 N/mm²
- τ_c = TS_i/tJ_u = 5.994 N/mm²
- τ_g = TS_i/tJ_u = 5.994 N/mm²
- t_c = 500. mm
- σ_o = √σ²+3τ² = 216.7 N/mm²

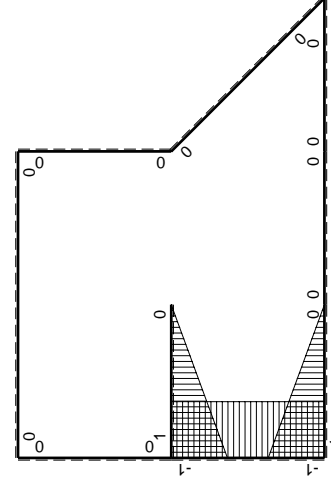


⊕ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-1/2Fb + Fx - 1/2qx^2$	0	0	0	0
BA b	0	$1/2qx^2$	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	0	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$-1/2Fx$	$1/2Fx - 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$1/2Fb - 1/2Fx$	$1/2Fx - 1/2Fx^2/b$	x^2/b^2	$1/12Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$-Fx$	0	0	0	0
HF b	0	$Fb - Fx$	0	0	0	0
HI b	$1-x/b$	$1/2Fb - 1/2Fx$	$1/2Fb - Fx + 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$-1/2Fx$	$1/2Fx^2/b$	x^2/b^2	$1/6Fb^2/EJ$	Xb/EJ
HG b	-1	$-1/2Fb + Fx - 1/2qx^2$	$1/2Fb - Fx + 1/2Fx^2/b$	1	$1/6Fb^2/EJ$	Xb/EJ
GH b	1	$1/2qx^2$	$1/2Fx^2/b$	1	$1/6Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG^{\pm}HG^{\mp}HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$				$-3/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-23/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica X=W _{GA}				$1/2Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

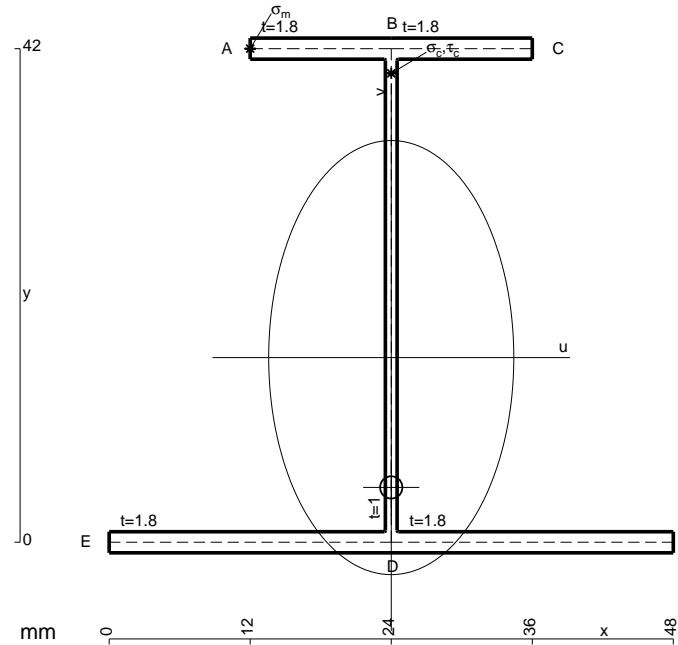
$$L_{HG}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

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

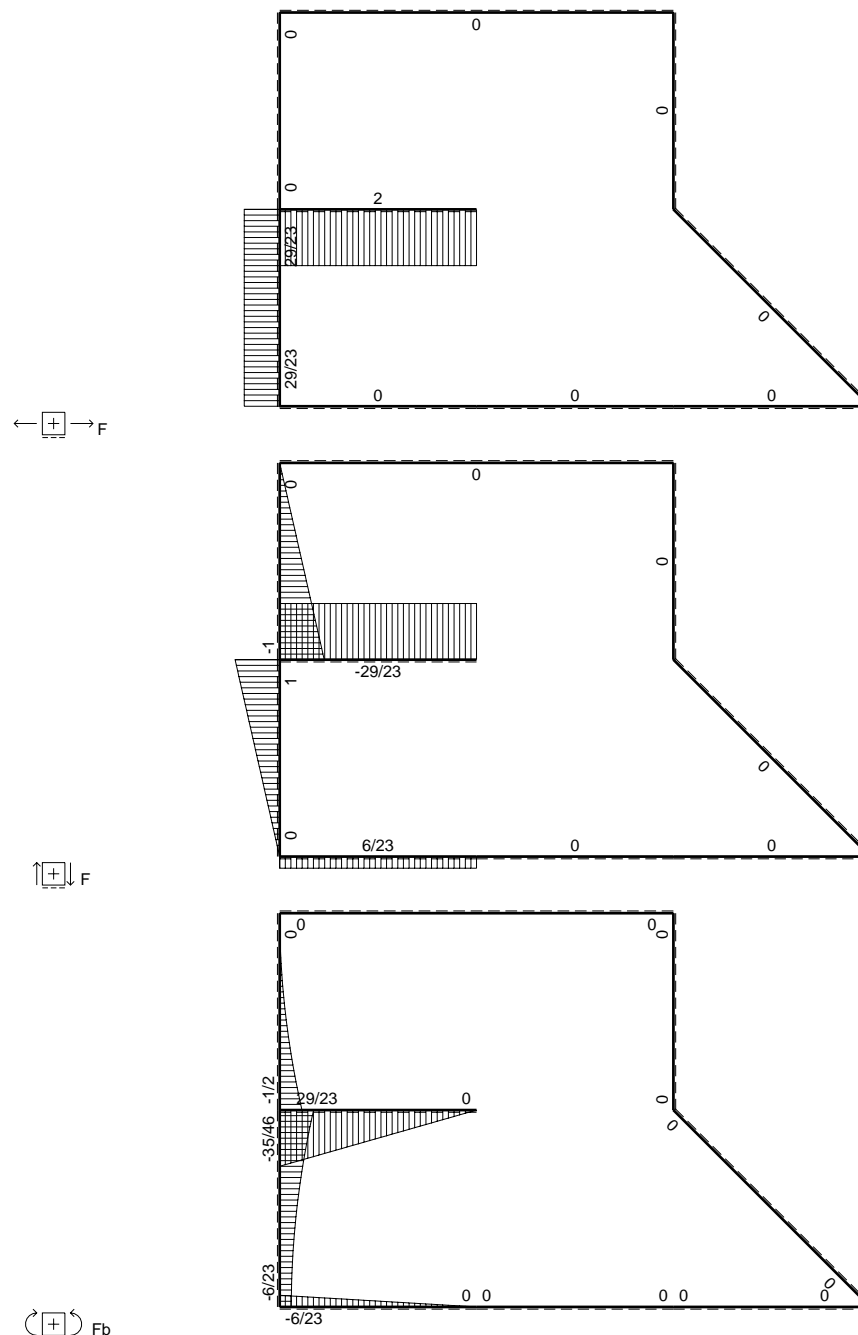
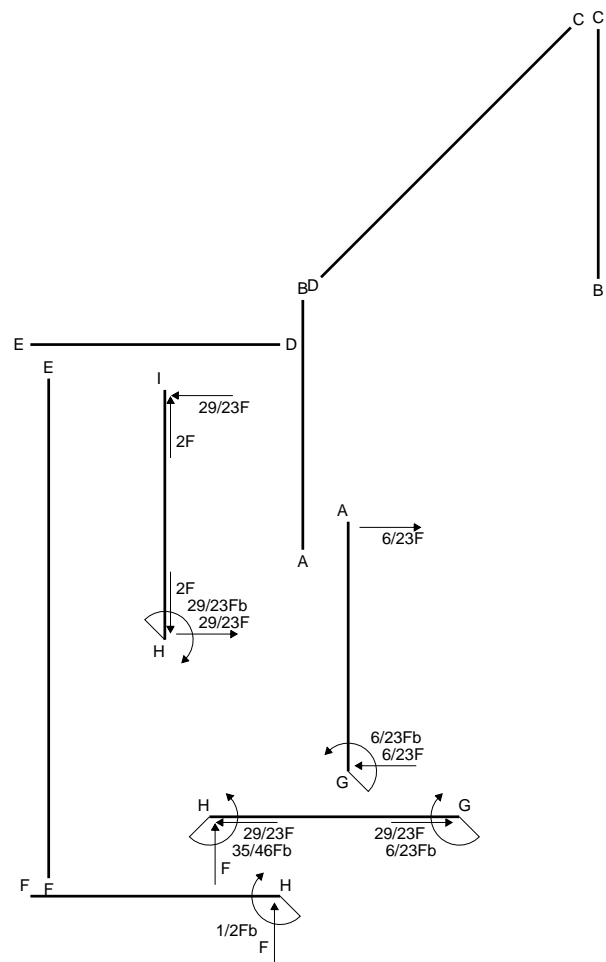
$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/6 Fb^2/EJ$$

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

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



- A = 171.6 mm²
- J_u = 58532. mm⁴
- J_v = 18662. mm⁴
- J_i = 154. mm⁴
- y_o = -11.05 mm
- y_g = 15.71 mm
- T_y = -800. N
- M_x = -512000. Nmm
- x_m = 12. mm
- y_m = 42. mm
- u_m = -12. mm
- v_m = 26.29 mm
- σ_m = -M_y/J_u = 229.9 N/mm²
- x_c = 24. mm
- y_c = 42. mm
- v_c = 26.29 mm
- σ_c = -M_y/J_u = 229.9 N/mm²
- τ_c = T_S/t_{J_u} = 15.52 N/mm²
- τ_g = T_S/t_{J_u} = 15.52 N/mm²
- t_c = 800. mm
- σ_o = √(σ²+3τ²) = 231.5 N/mm²



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

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

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

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

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

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

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

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

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

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

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

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

$$L_{HI}^{x_0} = \int_0^b (1 - 2x/b + x^2/b^2) Fb 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b Fb 1/EJ$$

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

$$L_{IH}^{x_0} = \int_0^b (x^2/b^2) Fb 1/EJ dx = [1/3 x^3/b^2]_0^b Fb 1/EJ$$

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

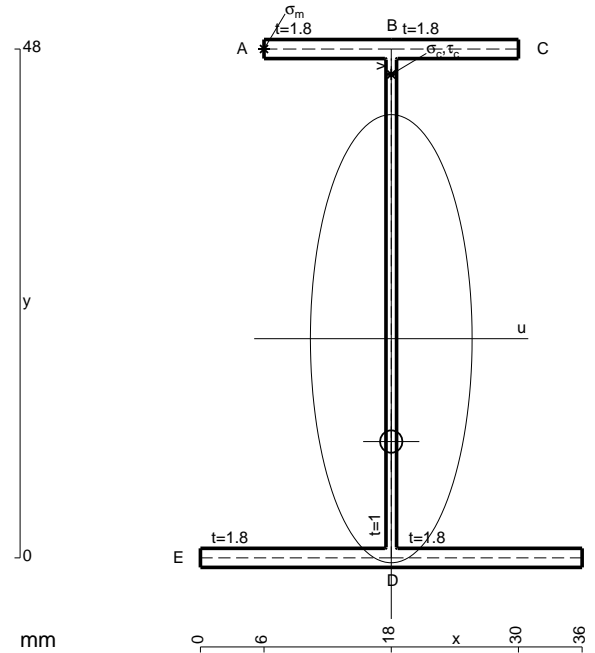
$$L_{HG}^{x_0} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

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

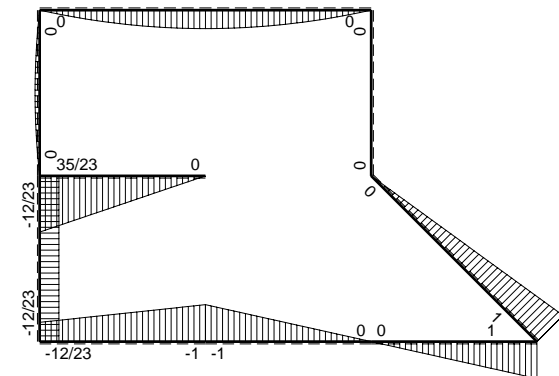
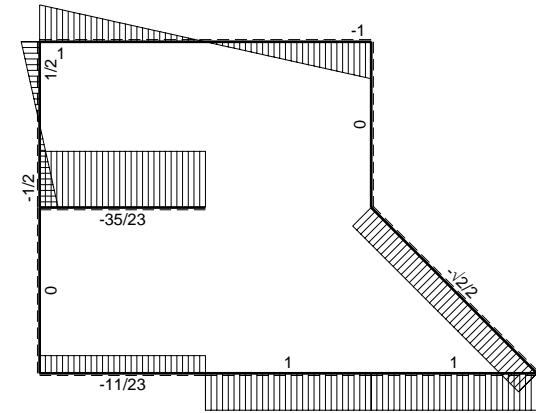
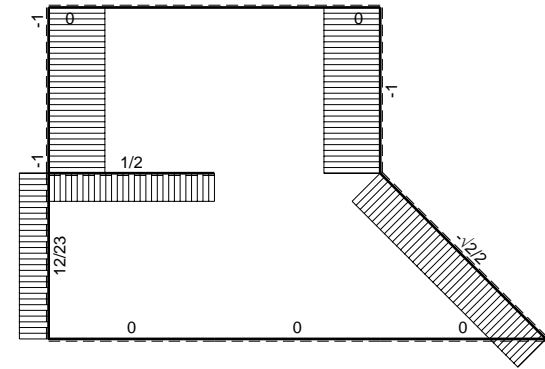
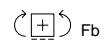
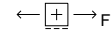
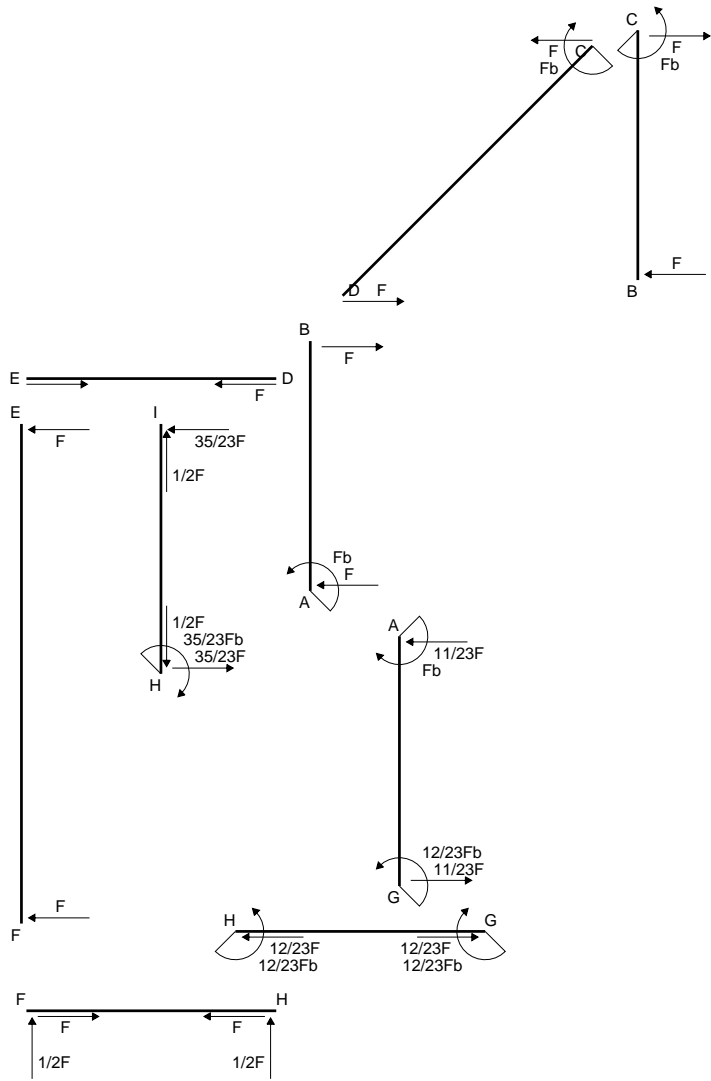
$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/6 Fb^2/EJ$$

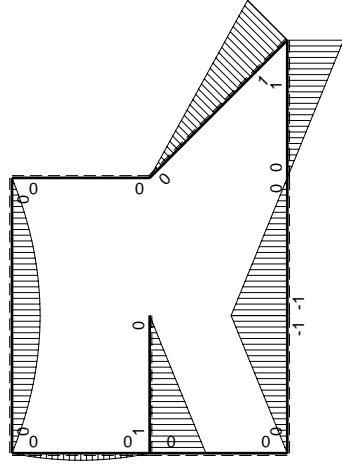
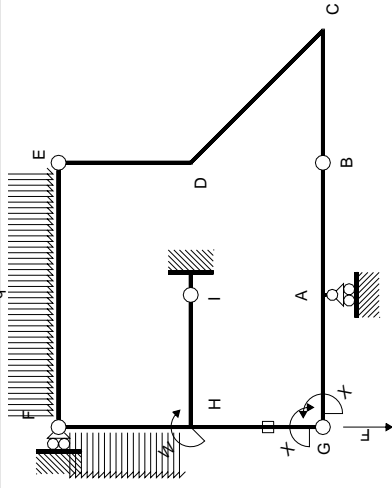
$$L_{GH}^{x_0} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

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

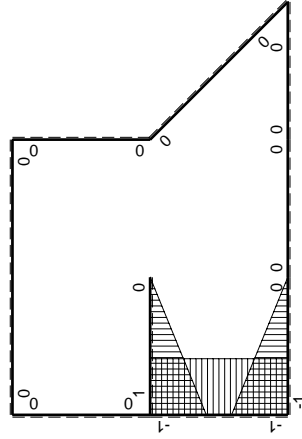


- A = 156. mm²
- J_u = 69701. mm⁴
- J_v = 9072. mm⁴
- J_i = 132.6 mm⁴
- y_o = -9.705 mm
- y_g = 20.68 mm
- T_y = -1590. N
- M_x = -612150. Nmm
- x_m = 6. mm
- y_m = 48. mm
- u_m = -12. mm
- v_m = 27.32 mm
- σ_m = -M_y/J_u = 240. N/mm²
- x_c = 18. mm
- y_c = 48. mm
- v_c = 27.32 mm
- σ_c = -M_y/J_u = 240. N/mm²
- τ_c = T_S/t_u = 26.93 N/mm²
- τ_g = T_S/t_u = 26.93 N/mm²
- t_c = 1590. mm
- σ_o = √σ²+3τ² = 244.5 N/mm²





(\oplus) M_0 flessione da carichi assegnati



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

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

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-Fb+Fx	0	0	0	0
BA b	0	Fx	0	0	0	0
BC b	0	Fx	0	0	0	0
CB b	0	-Fb+Fx	0	0	0	0
CD $\sqrt{2}b$	0	$Fb-\sqrt{2}/2Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	$-Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$Fx-1/2qx^2$	0	0	0	0
GA b	$-1+x/b$	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2	$1/6Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$1/2Fx-1/2qx^2$	0	0	0	0
HF b	0	$-1/2Fx+1/2qx^2$	0	0	0	0
HI b	$1-x/b$	Fb-Fx	$Fb-2Fx+Fx^2/b$	$1-2x/b+x^2/b^2$	$1/3Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	-Fx	Fx^2/b	x^2/b^2	$1/3Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	0	0	1	0	Xb/EJ
GH b	1	0	0	1	0	Xb/EJ
HG	elongazione asta $N_{1HG+HG-HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{GA}+XV_{1A})/k_A$				$-1/2Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$12/23Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

$$L_{GA}^{x_0} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[1/2 x^2/b - 1/3 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

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

$$L_{AG}^{x_0} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[1/2 x^2/b - 1/3 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

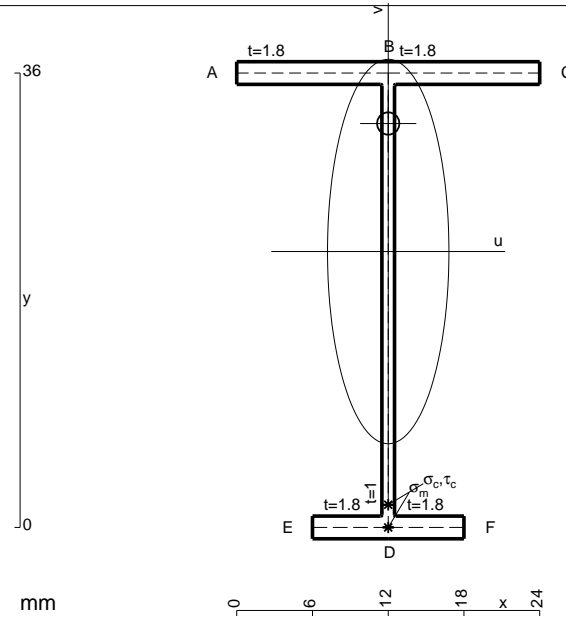
$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

$$L_{HI}^{x_0} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

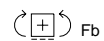
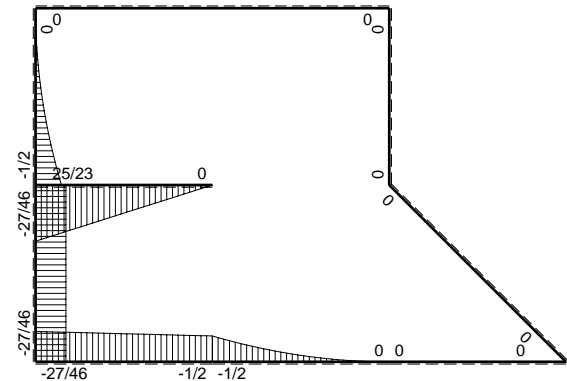
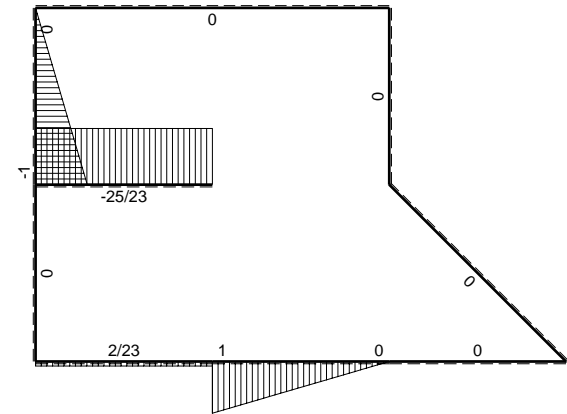
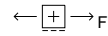
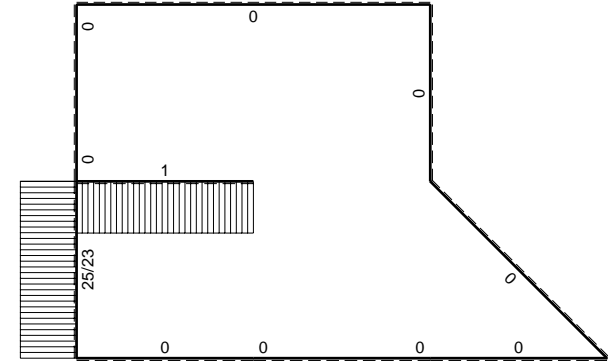
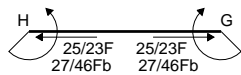
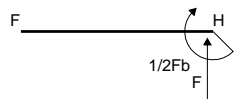
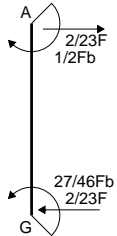
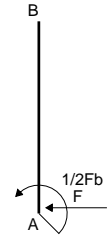
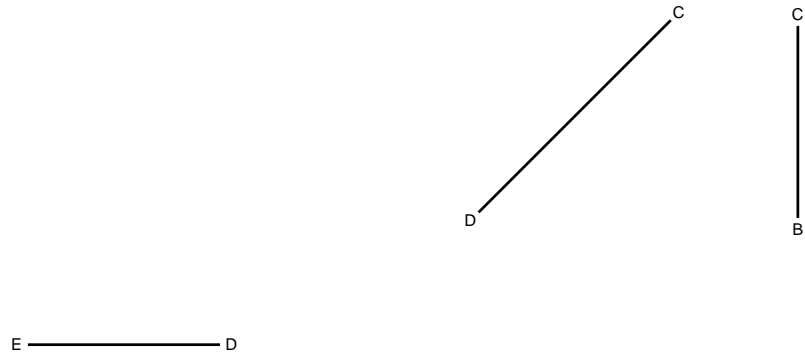
$$= (b - b + 1/3 b) \cdot Fb \cdot 1/EJ = 1/3 \cdot Fb^2/EJ$$

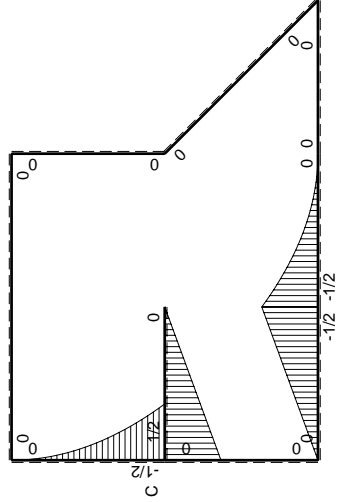
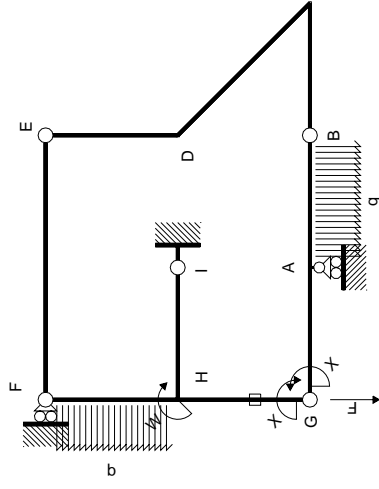
$$L_{IH}^{x_0} = \int_0^b (x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[1/3 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

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



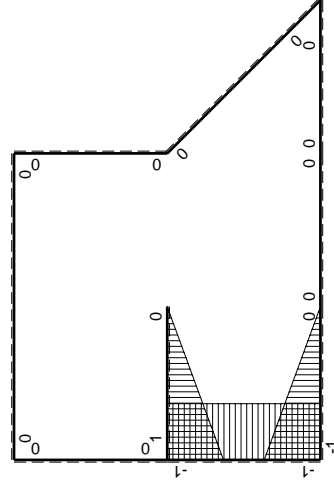
- A = 100.8 mm²
- J_u = 23384. mm⁴
- J_v = 2333. mm⁴
- J_i = 81.98 mm⁴
- y_o = 10.14 mm
- y_g = 21.86 mm
- T_y = 690. N
- M_x = -213900. Nmm
- x_m = 12. mm
- v_m = -21.86 mm
- σ_m = -Mv/J_u = -199.9 N/mm²
- y_c = 3. mm
- u_c = -12. mm
- v_c = -18.86 mm
- σ_c = -Mv/J_u = -199.9 N/mm²
- τ_c = TS_v/tJ_u = 13.93 N/mm²
- τ_g = TS_v/tJ_u = 13.93 N/mm²
- t_c = 690. mm
- σ_o = √(σ² + 3τ²) = 201.4 N/mm²





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-1/2Fb + Fx - 1/2qx^2$	0	0	0	0
BA b	0	$1/2qx^2$	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	0	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$-1/2Fx$	$1/2Fx - 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$1/2Fb - 1/2Fx$	$1/2Fx - 1/2Fx^2/b$	x^2/b^2		
FH b	0	$-1/2qx^2$	0	0	0	0
HF b	0	$1/2Fb - Fx + 1/2qx^2$	0	0	0	0
HI b	$1-x/b$	$1/2Fb - 1/2Fx$	$1/2Fb - Fx + 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$-1/2Fx$	$1/2Fx^2/b$	x^2/b^2		
HG b	-1	0	0	1	0	Xb/EJ
GH b	1	0	0	1	0	Xb/EJ
HG	elongazione asta $N_{1HG^{\pm}HG^{\pm}HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$				$-3/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-9/8Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica X=W _{GA}				$27/46Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

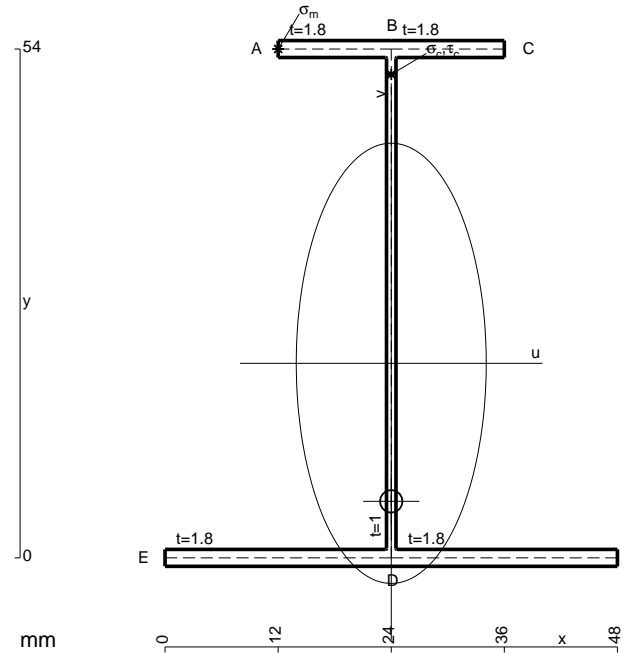
$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

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

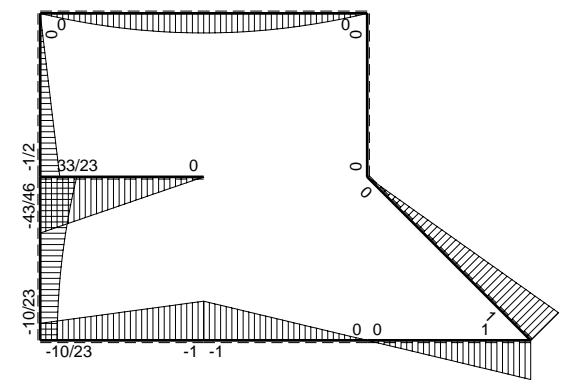
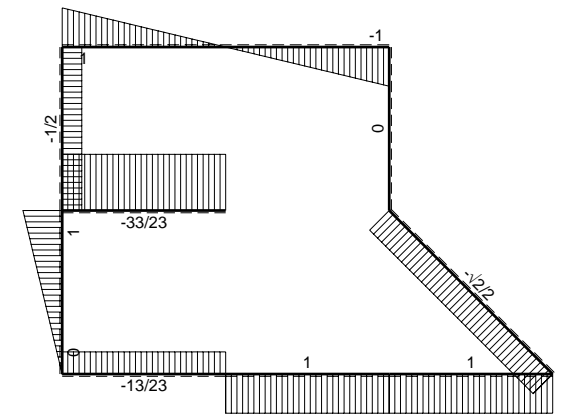
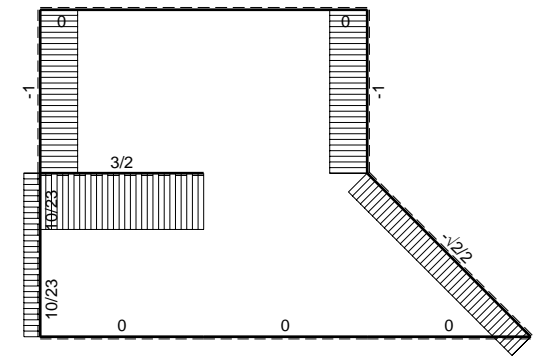
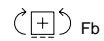
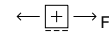
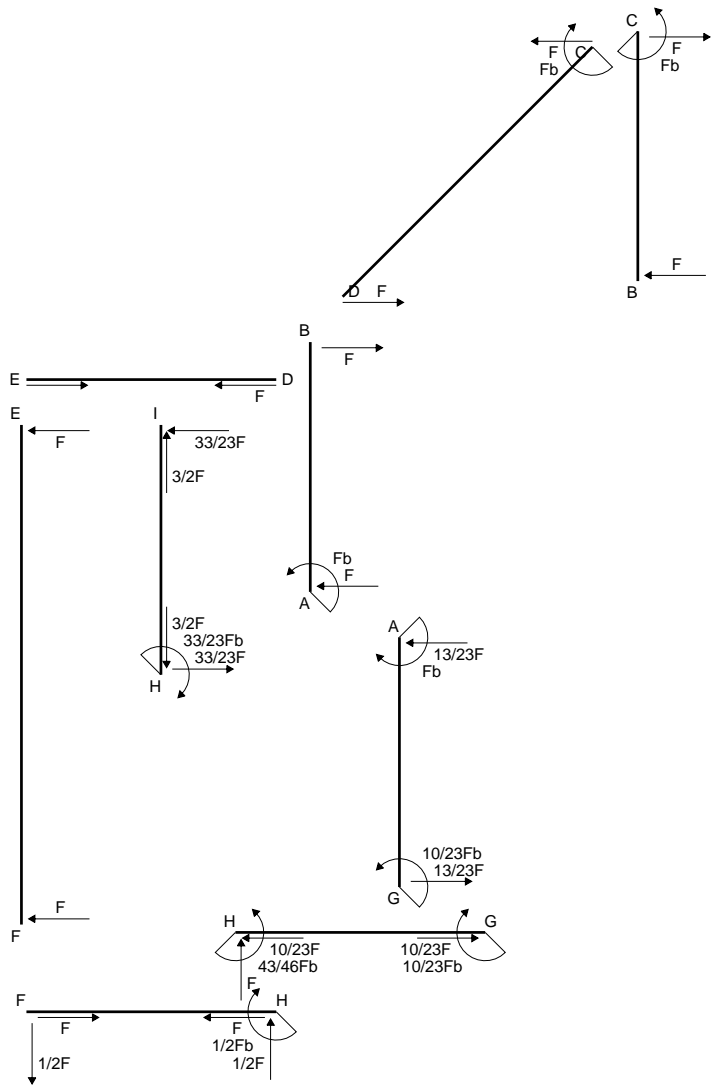
$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

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

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



- A = 183.6 mm²
- J_u = 100190. mm⁴
- J_v = 18662. mm⁴
- J_t = 158. mm⁴
- y_o = -14.65 mm
- y_g = 20.65 mm
- T_y = 2520. N
- M_x = -630000. Nmm
- x_m = 12. mm
- y_m = 54. mm
- u_m = -12. mm
- v_m = 33.35 mm
- σ_m = -Mv/J_u = 209.7 N/mm²
- x_c = 24. mm
- y_c = 54. mm
- v_c = 33.35 mm
- σ_c = -Mv/J_u = 209.7 N/mm²
- τ_c = TS_y/tJ_u = 36.24 N/mm²
- τ_g = TS_y/tJ_u = 36.24 N/mm²
- t_c = 2520. mm
- σ_o = √(σ²+3τ²) = 218.9 N/mm²



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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

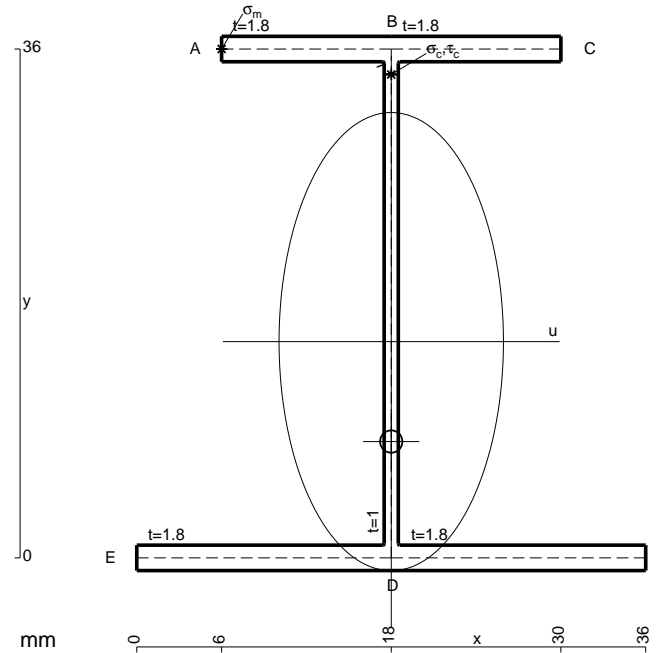
$$L_{HG}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

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

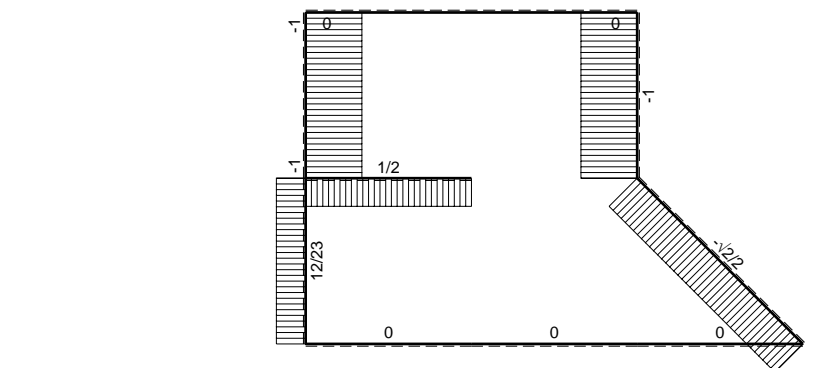
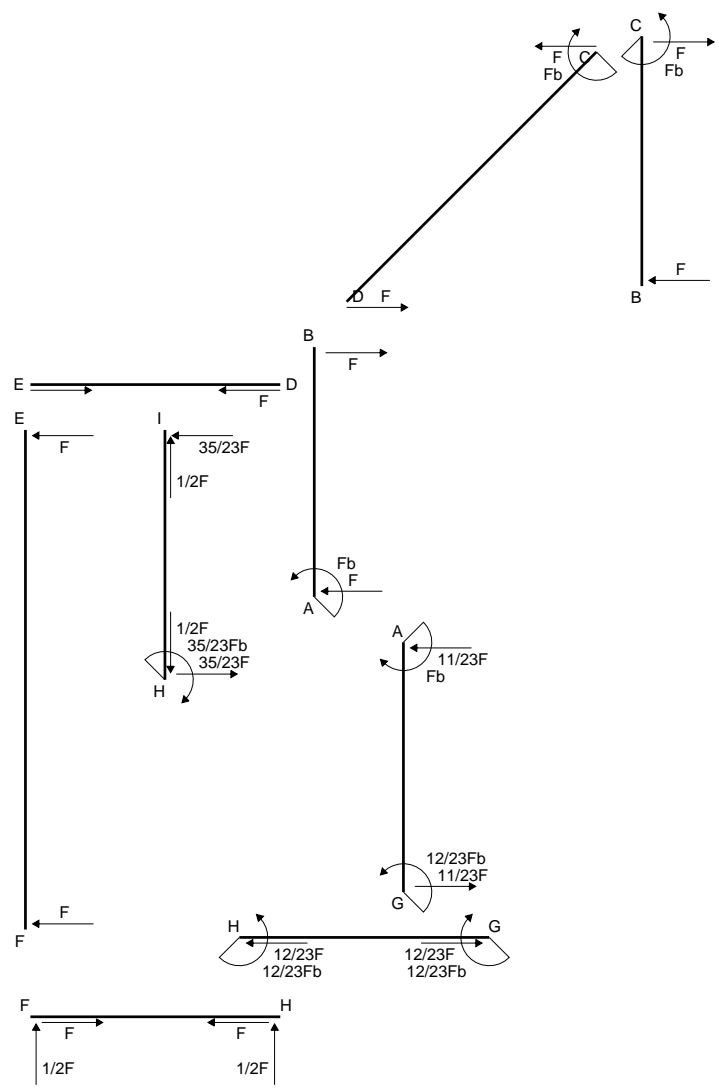
$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/6 Fb^2/EJ$$

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

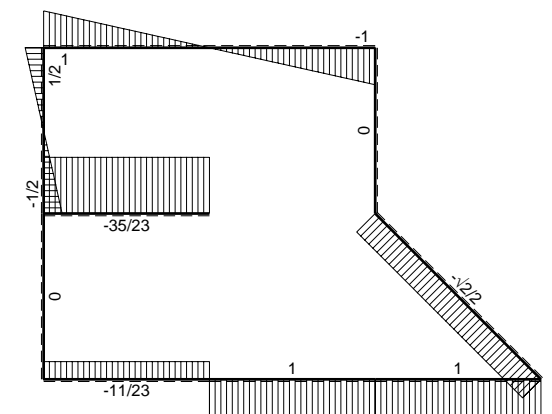
$$= (1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/6 Fb^2/EJ$$



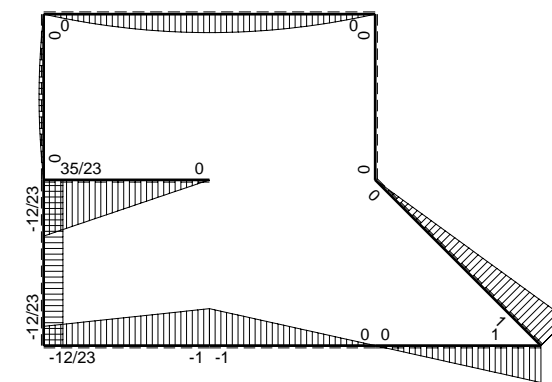
- A = 144. mm²
- J_u = 37830. mm⁴
- J_v = 9072. mm⁴
- J_i = 128.6 mm⁴
- y_o = -7.071 mm
- y_g = 15.3 mm
- T_y = 1080. N
- M_x = -399600. Nmm
- x_m = 6. mm
- y_m = 36. mm
- u_m = -12. mm
- v_m = 20.7 mm
- σ_m = -Mv/J_u = 218.7 N/mm²
- x_c = 18. mm
- y_c = 36. mm
- v_c = 20.7 mm
- σ_c = -Mv/J_u = 218.7 N/mm²
- τ_c = TS/tJ_u = 25.53 N/mm²
- τ_g = TS/tJ_u = 25.53 N/mm²
- t_c = 1080. mm
- σ_o = √σ²+3τ² = 223.1 N/mm²



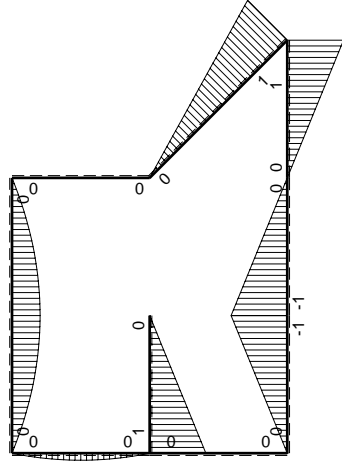
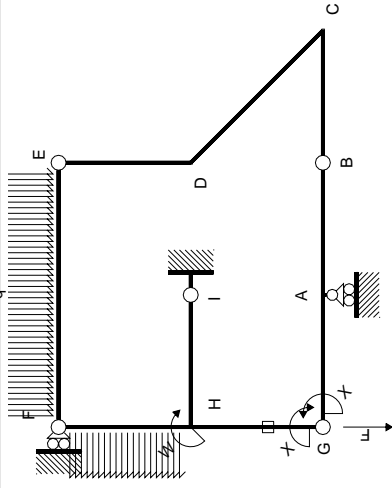
← ⊕ → F



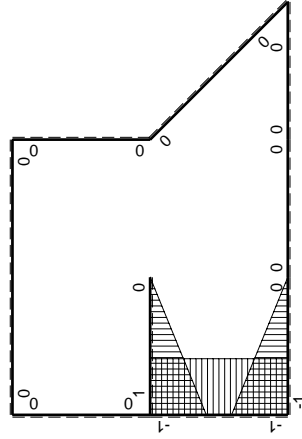
↑ ⊕ ↓ F



⊕ ⊖ F_b



M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-Fb+Fx	0	0	0	0
BA b	0	Fx	0	0	0	0
BC b	0	Fx	0	0	0	0
CB b	0	-Fb+Fx	0	0	0	0
CD $\sqrt{2}b$	0	$Fb-\sqrt{2}/2Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	$-Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$Fx-1/2qx^2$	0	0	0	0
GA b	$-1+x/b$	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2		
FH b	0	$1/2Fx-1/2qx^2$	0	0	0	0
HF b	0	$-1/2Fx+1/2qx^2$	0	0	0	0
HI b	$1-x/b$	Fb-Fx	$Fb-2Fx+Fx^2/b$	$1-2x/b+x^2/b^2$	$1/3Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	-Fx	Fx^2/b	x^2/b^2		
HG b	-1	0	0	1	0	Xb/EJ
GH b	1	0	0	1	0	Xb/EJ
HG	elongazione asta $N_{1HG+HG-HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{0A}+XV_{1A})/k_A$				$-1/2Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$12/23Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

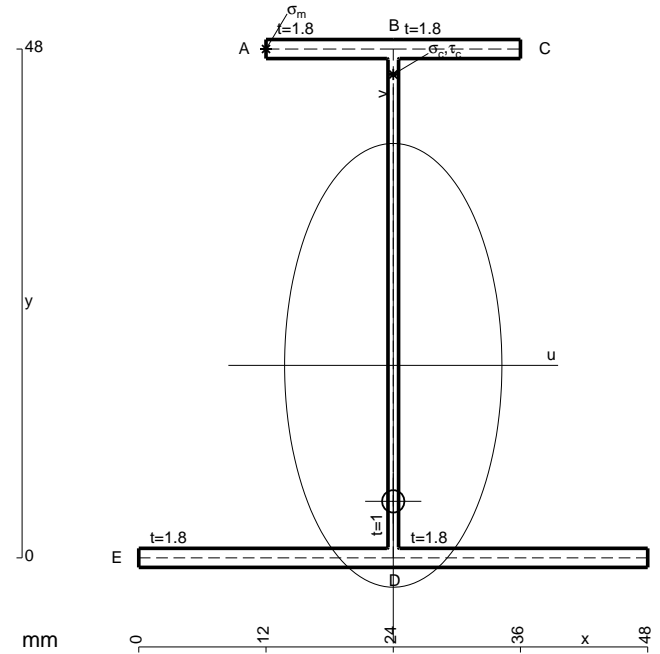
$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

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

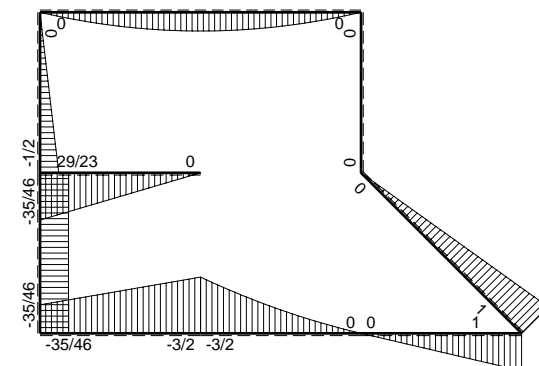
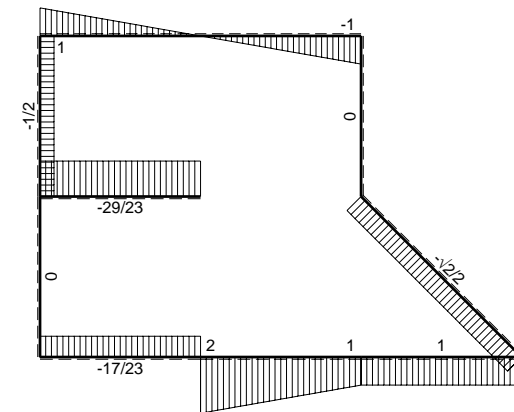
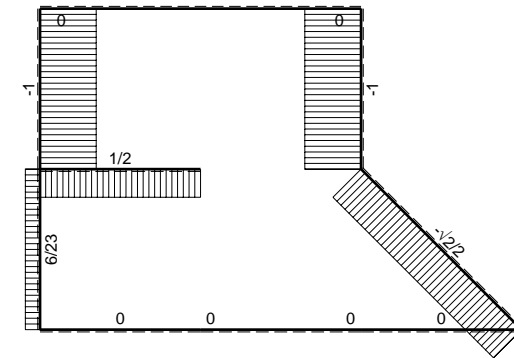
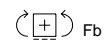
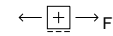
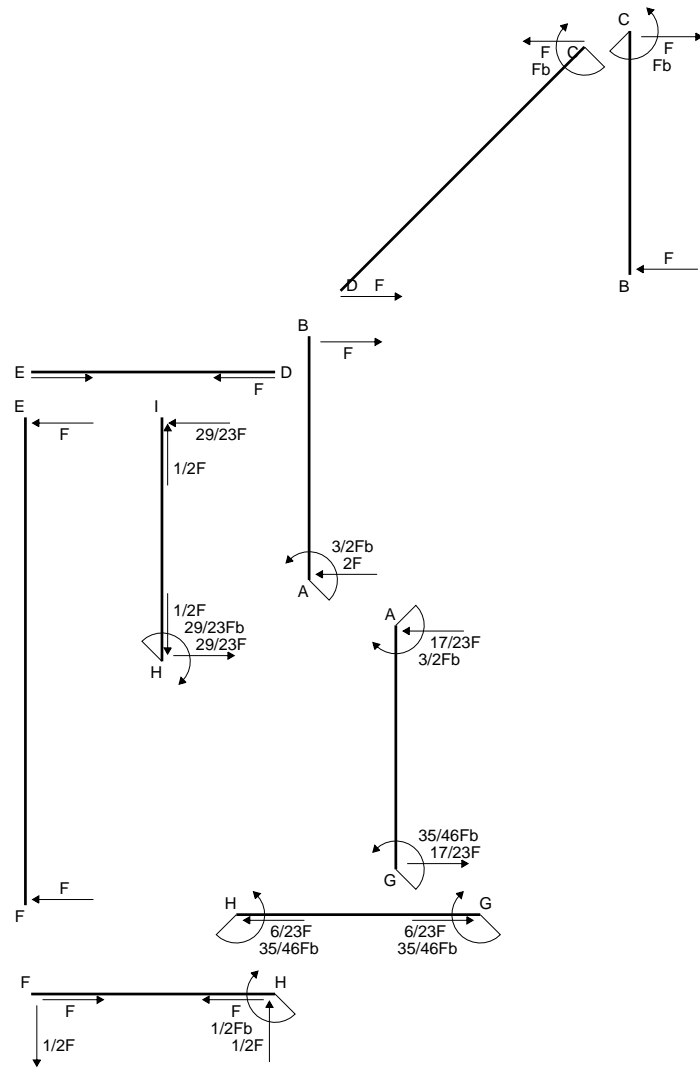
$$= (b - b + 1/3 b) \cdot Fb \cdot 1/EJ = 1/3 \cdot Fb^2/EJ$$

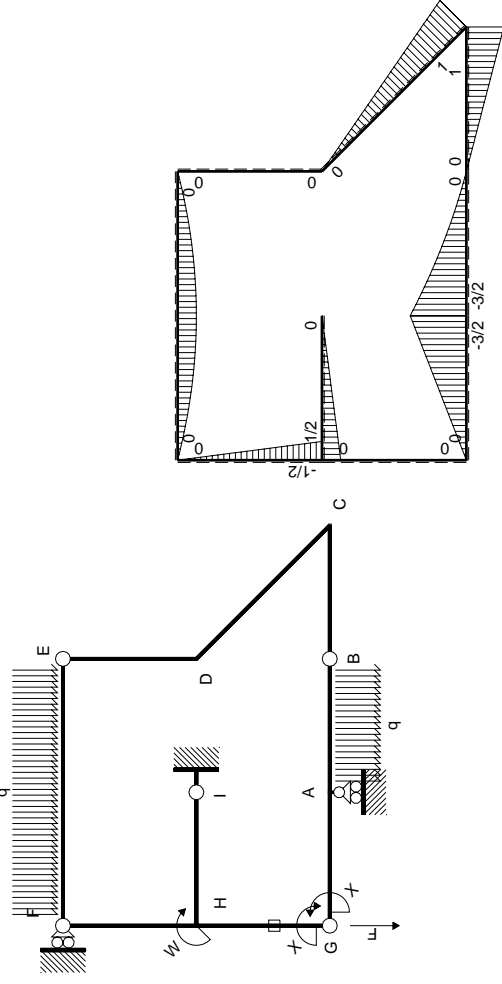
$$L_{IH}^{xo} = \int_0^b (x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[1/3 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

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

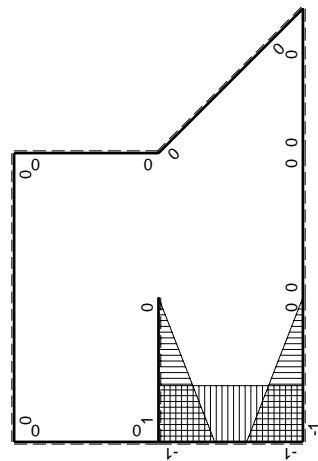


- A = 177.6 mm²
- J_u = 77813. mm⁴
- J_v = 18662. mm⁴
- J_t = 156. mm⁴
- y_o = -12.83 mm
- y_g = 18.16 mm
- T_y = 1130. N
- M_x = -598900. Nmm
- x_m = 12. mm
- y_m = 48. mm
- u_m = -12. mm
- v_m = 29.84 mm
- σ_m = -Mv/J_u = 229.7 N/mm²
- x_c = 24. mm
- y_c = 48. mm
- v_c = 29.84 mm
- σ_c = -Mv/J_u = 229.7 N/mm²
- τ_c = TS/tJ_u = 18.72 N/mm²
- τ_g = TS/tJ_u = 18.72 N/mm²
- t_c = 1130. mm
- σ_o = √σ²+3τ² = 231.9 N/mm²





M_0 flessione da carichi assegnati

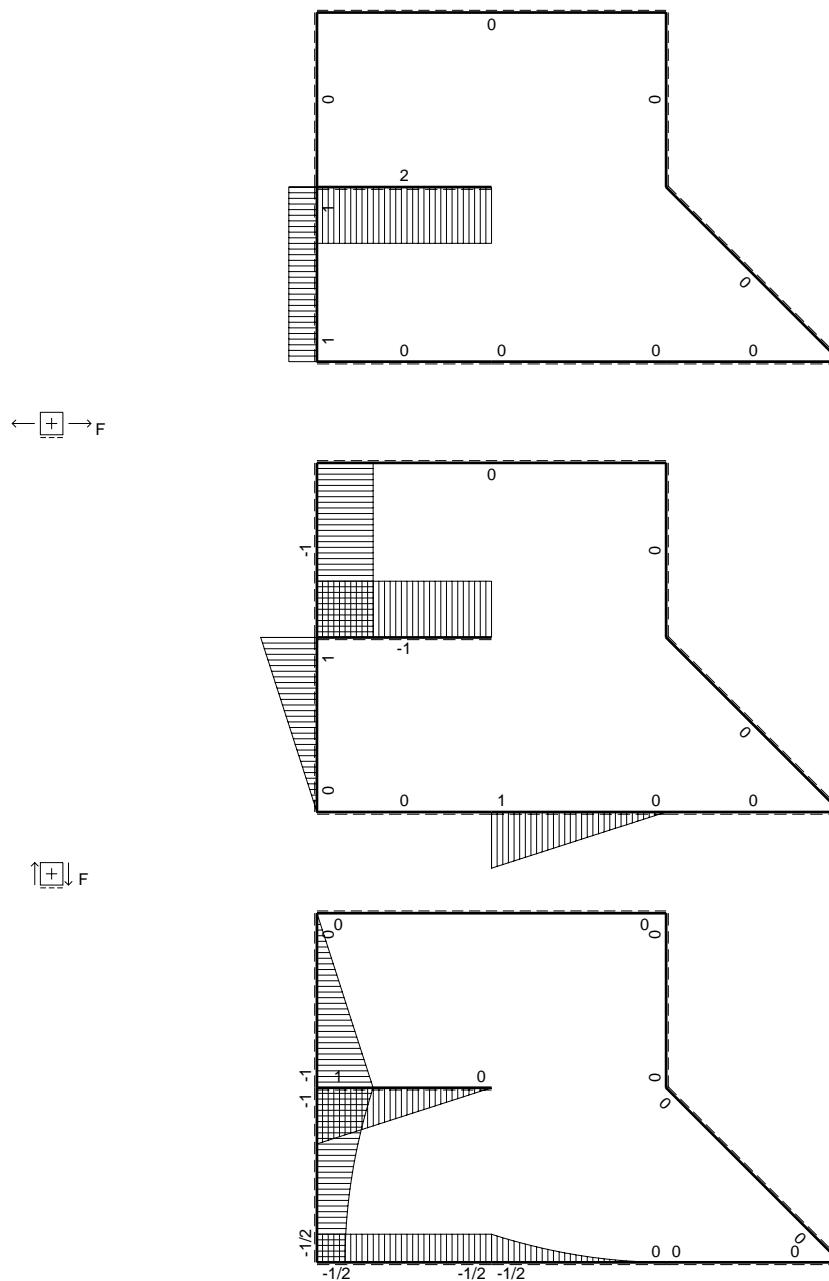
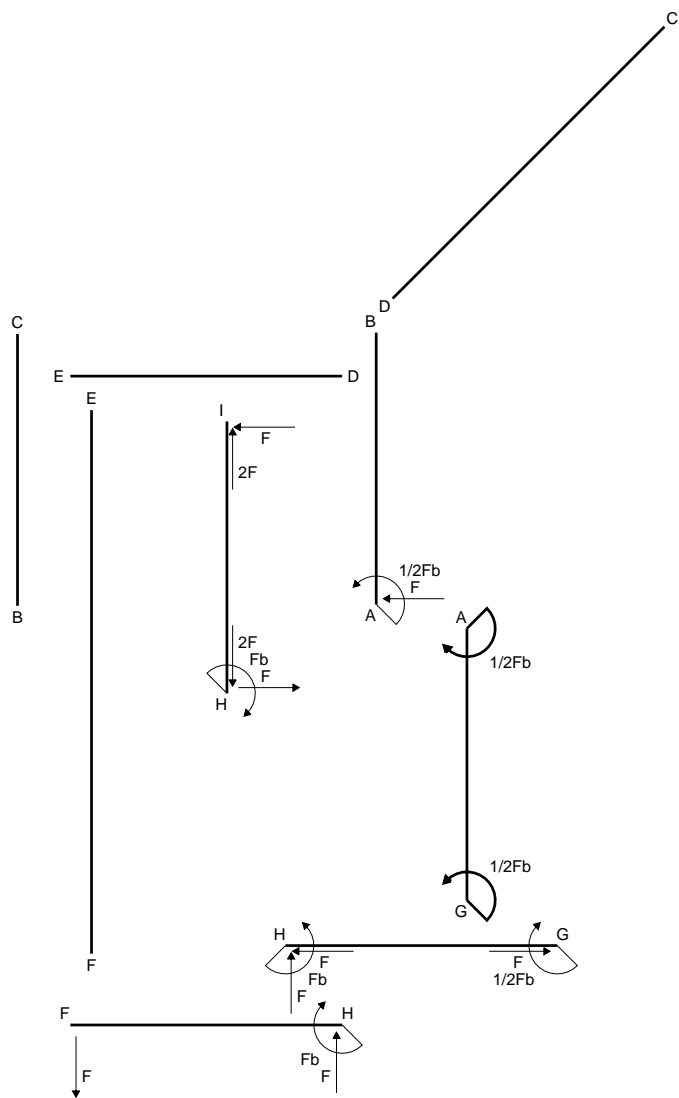


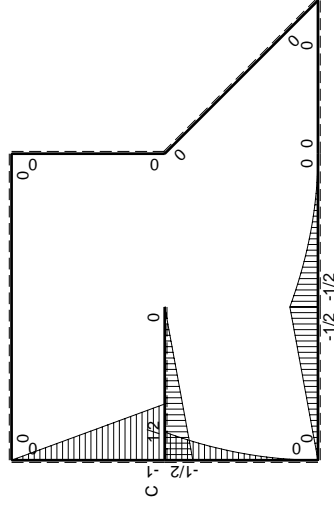
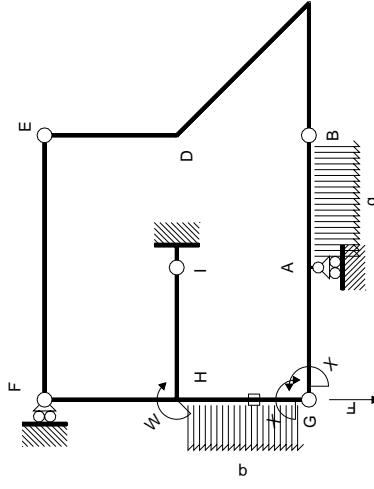
M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	M _x (x)	M ₀ (x)	M _x M ₀	M _x M ₀	M _x M _x	∫M _x M ₀ /EJdx	∫XM _x M ₀ /EJdx
AB b	0	-3/2Fb+2Fx-1/2qx ²	0	0	0	0	0
BA b	0	Fx+1/2qx ²	0	0	0	0	0
BC b	0	Fx	0	0	0	0	0
CB b	0	-Fb+Fx	0	0	0	0	0
CD √2b	0	Fb-√2/2Fx	0	0	0	0	0
DE b	0	0	0	0	0	0	0
ED b	0	0	0	0	0	0	0
EF 2b	0	-Fx+1/2qx ²	0	0	0	0	0
FE 2b	0	Fx-1/2qx ²	0	0	0	0	0
GA b	-1+x/b	-3/2Fx	3/2Fx-3/2Fx ² /b	1-2x/b+x ² /b ²	0	1/4Fb ² /EJ	1/3Xb/EJ
AG b	x/b	3/2Fb-3/2Fx	3/2Fx-3/2Fx ² /b	x ² /b ²	0	0	0
FH b	0	-1/2Fx	0	0	0	0	0
HF b	0	1/2Fb-1/2Fx	0	0	0	0	0
HI b	1-x/b	1/2Fb-1/2Fx	1/2Fb-Fx+1/2Fx ² /b	1-2x/b+x ² /b ²	0	1/6Fb ² /EJ	1/3Xb/EJ
IH b	-x/b	-1/2Fx	1/2Fx ² /b	x ² /b ²	0	0	0
HG b	-1	0	0	1	0	0	Xb/EJ
GH b	1	0	0	1	0	0	0
HG	elongazione asta N _{1HG} ^{±HG} ±HG					-Fb ² /EJ	
A	molla nodo -V _{1A} (V _{0A} +XV _{1A})/k _A					-7/8Fb ² /EJ	1/4Xb/EJ
	totali					-35/24Fb ² /EJ	23/12Xb/EJ
	iperstatica X=W _{GA}					35/46Fb	

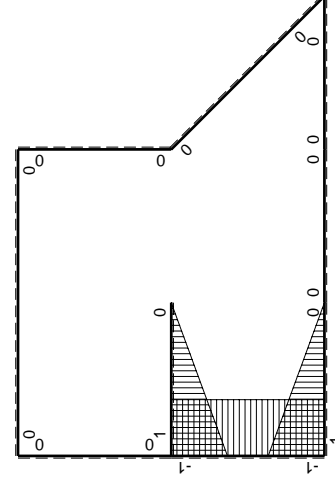
Sviluppi di calcolo iperstatica





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-1/2Fb + Fx - 1/2qx^2$	0	0	0	0
BA b	0	$1/2qx^2$	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	0	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$-1/2Fx$	$1/2Fx - 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$1/2Fb - 1/2Fx$	$1/2Fx - 1/2Fx^2/b$	x^2/b^2	$1/12Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$-Fx$	0	0	0	0
HF b	0	$Fb - Fx$	0	0	0	0
HI b	$1-x/b$	$1/2Fb - 1/2Fx$	$1/2Fb - Fx + 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$-1/2Fx$	$1/2Fx^2/b$	x^2/b^2	$1/6Fb^2/EJ$	Xb/EJ
HG b	-1	$-1/2Fb + Fx - 1/2qx^2$	$1/2Fb - Fx + 1/2Fx^2/b$	1	$-Fb^2/EJ$	$1/4Xb/EJ$
GH b	1	$1/2qx^2$	$1/2Fx^2/b$	1	$-3/8Fb^2/EJ$	$23/12Xb/EJ$
HG	elongazione asta $N_{1HG} = N_{HG} + HG$					
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$					
	totali				$-23/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica X=W _{GA}				$1/2Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

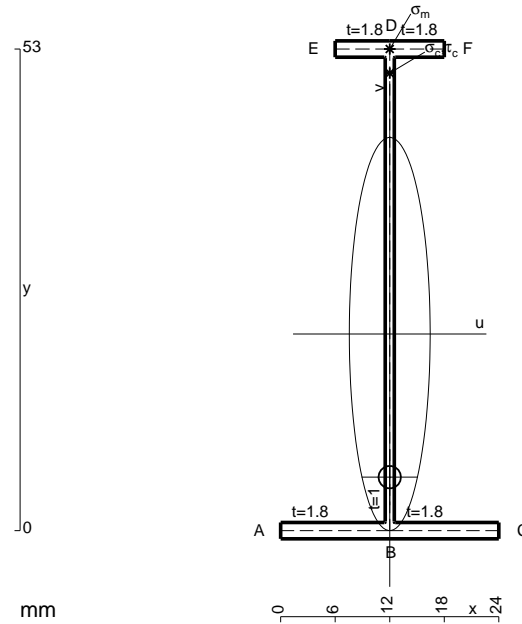
$$L_{HG}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

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

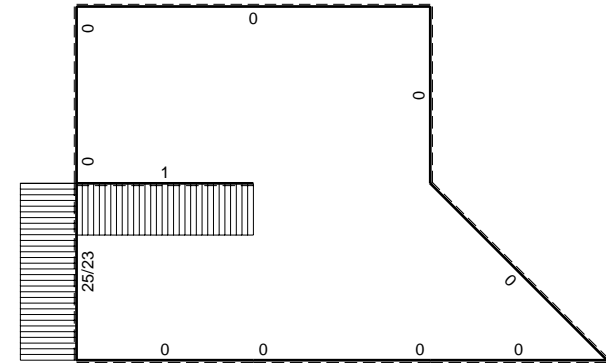
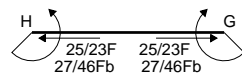
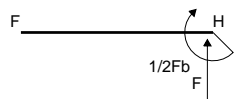
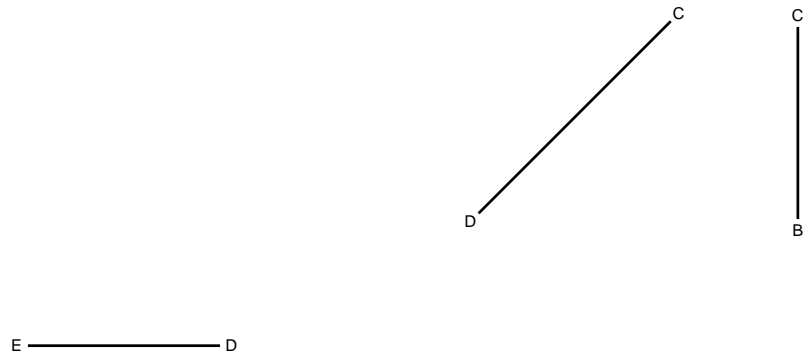
$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/6 Fb^2/EJ$$

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

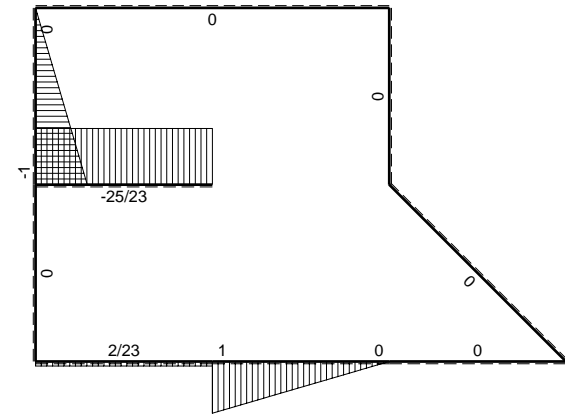
$$= (1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/6 Fb^2/EJ$$



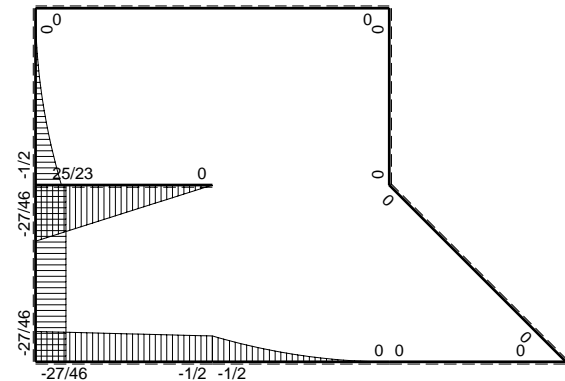
- A = 117.8 mm²
- J_u = 55131. mm⁴
- J_v = 2333. mm⁴
- J_i = 87.65 mm⁴
- y_o = -15.75 mm
- y_g = 21.64 mm
- T_y = -520. N
- M_x = -348400. Nmm
- x_m = 12. mm
- y_m = 53. mm
- v_m = 31.36 mm
- σ_m = -Mv/J_u = 198.2 N/mm²
- y_c = 2. mm
- u_c = -12. mm
- v_c = -19.64 mm
- σ_c = -Mv/J_u = 198.2 N/mm²
- τ_c = TS_y/tJ_u = 6.389 N/mm²
- τ_g = TS_y/tJ_u = 6.389 N/mm²
- t_c = 520. mm
- σ_o = √σ²+3τ² = 198.5 N/mm²



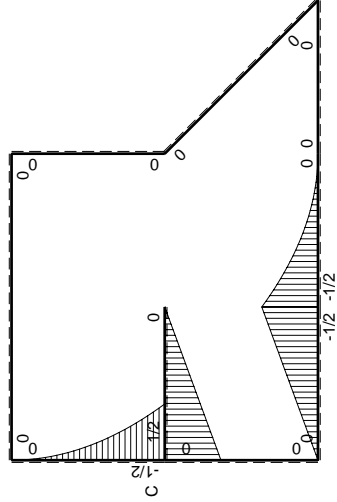
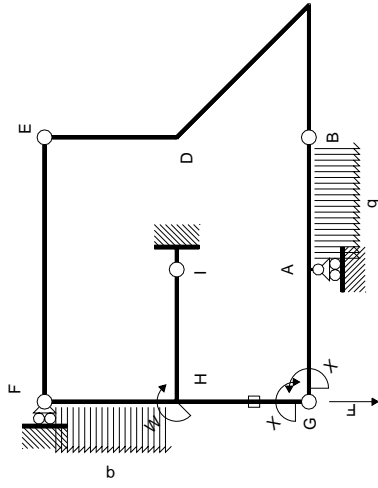
← ⊕ → F



↑ ⊕ ↓ F

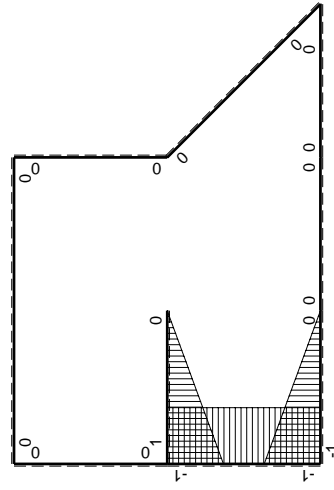


⊕ ⊖ Fb



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-1/2Fb + Fx - 1/2qx^2$	0	0	0	0
BA b	0	$1/2qx^2$	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	0	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$-1/2Fx$	$1/2Fx - 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$1/2Fb - 1/2Fx$	$1/2Fx - 1/2Fx^2/b$	x^2/b^2	$1/12Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$-1/2qx^2$	0	0	0	0
HF b	0	$1/2Fb - Fx + 1/2qx^2$	0	0	0	0
HI b	$1-x/b$	$1/2Fb - 1/2Fx$	$1/2Fb - Fx + 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$-1/2Fx$	$1/2Fx^2/b$	x^2/b^2	$1/6Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	0	0	1	0	Xb/EJ
GH b	1	0	0	1	0	Xb/EJ
HG	elongazione asta $N_{1HG^{\pm}HG^{\pm}HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$				$-3/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-9/8Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica X=W _{GA}				$27/46Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

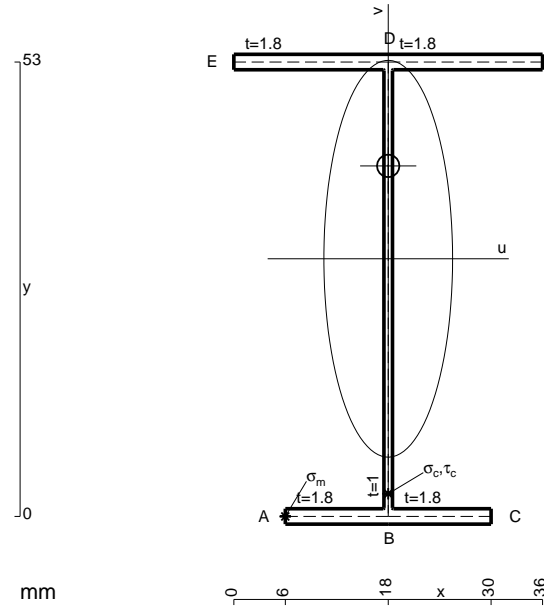
$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

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

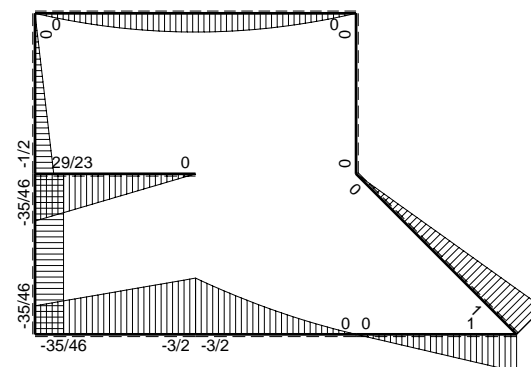
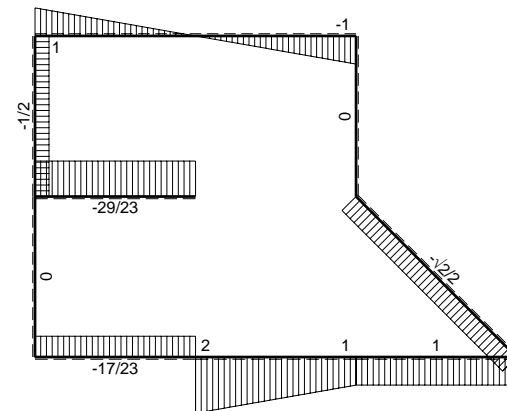
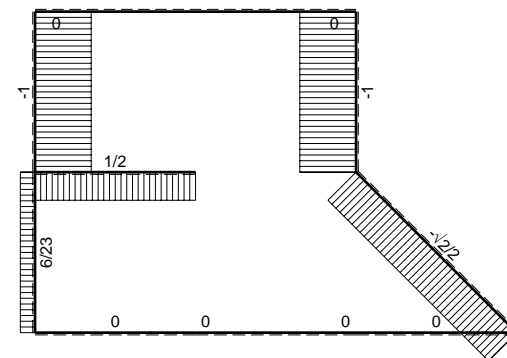
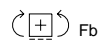
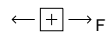
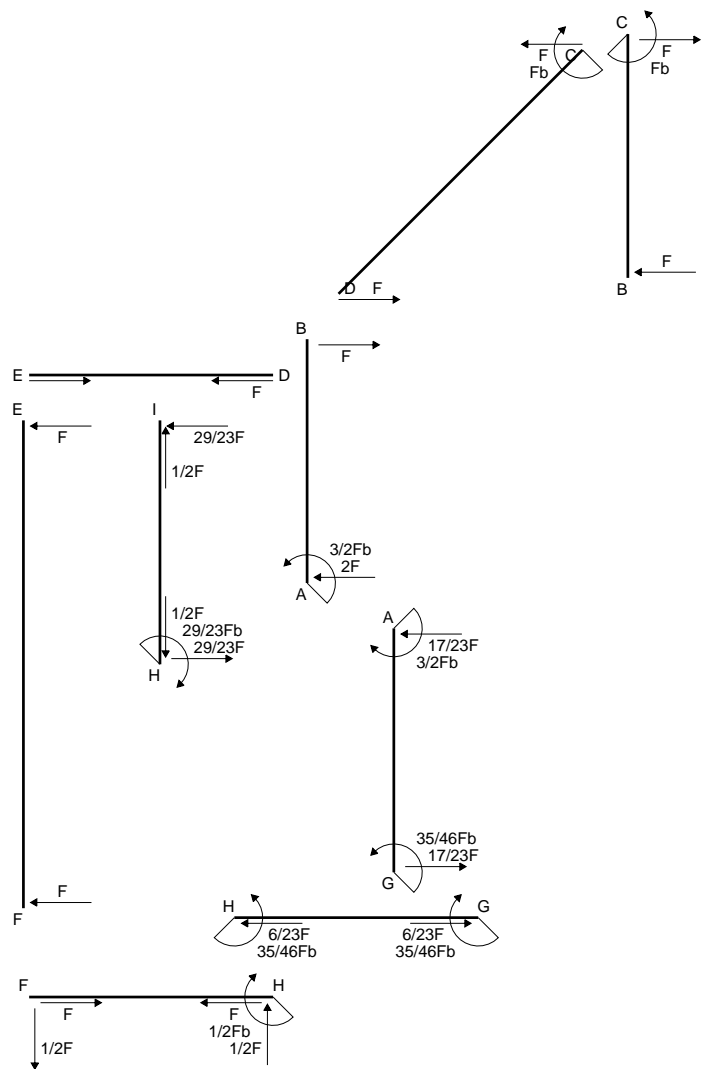
$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

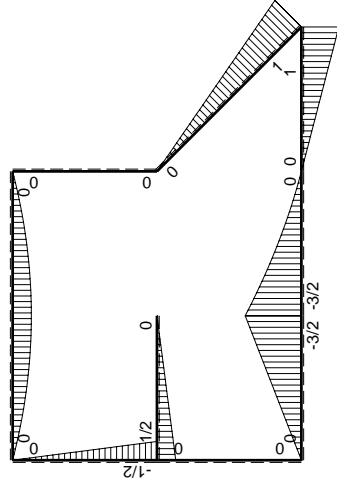
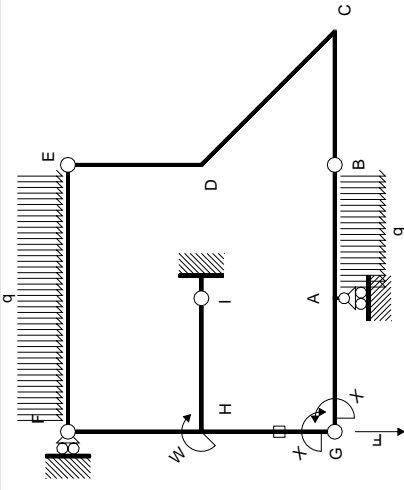
$$L_{IH}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

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

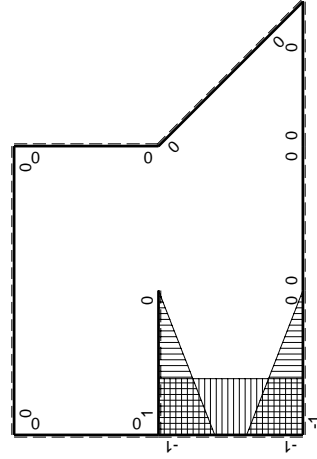


- A = 161. mm²
- J_u = 86214. mm⁴
- J_v = 9072. mm⁴
- J_i = 134.3 mm⁴
- y_o = 10.83 mm
- y_g = 30.06 mm
- T_y = 1670. N
- M_x = -601200. Nmm
- x_m = 6. mm
- u_m = -12. mm
- v_m = -30.06 mm
- σ_m = -Mv/J_u = -209.6 N/mm²
- x_c = 18. mm
- v_c = -30.06 mm
- σ_c = -Mv/J_u = -209.6 N/mm²
- τ_c = TS_v/tJ_u = 25.15 N/mm²
- τ_g = TS_v/tJ_u = 25.15 N/mm²
- t_c = 1670. mm
- σ_o = √σ²+3τ² = 214.1 N/mm²





M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int M_x M_x / E J dx$
AB b	0	$-3/2Fb+2Fx-1/2qx^2$	0	0	0	0
BA b	0	$Fx+1/2qx^2$	0	0	0	0
BC b	0	Fx	0	0	0	0
CB b	0	$-Fb+Fx$	0	0	0	0
CD $\sqrt{2}b$	0	$Fb-\sqrt{2}/2Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	$-Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$Fx-1/2qx^2$	0	0	0	0
GA b	$-1+x/b$	$-3/2Fx$	$3/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/4Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$3/2Fb-3/2Fx$	$3/2Fx-3/2Fx^2/b$	x^2/b^2	$1/4Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$-1/2Fx$	0	0	0	0
HF b	0	$1/2Fb-1/2Fx$	0	0	0	0
HI b	$1-x/b$	$1/2Fb-1/2Fx$	$1/2Fb-Fx+1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$-1/2Fx$	$1/2Fx^2/b$	x^2/b^2	$1/6Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	0	0	1	0	Xb/EJ
GH b	1	0	0	1	0	Xb/EJ
HG	elongazione asta $N_{1HG}^{\pm HG} \pm HG$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{GA}+XV_{1A})/k_A$				$-7/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-35/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$35/46Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

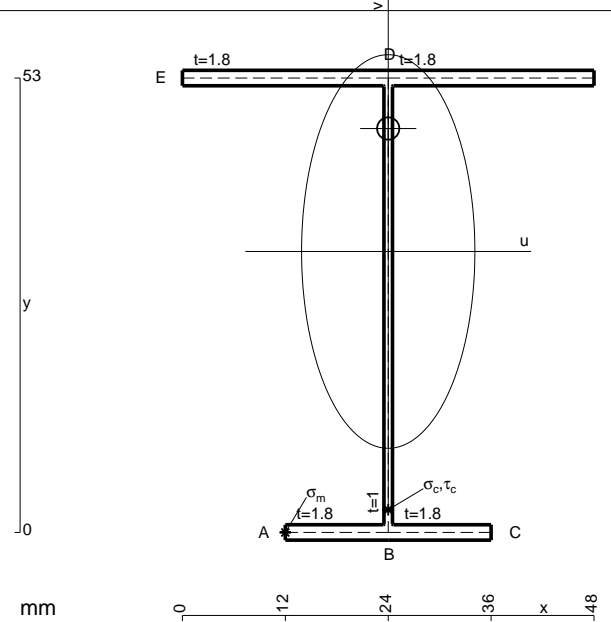
$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

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

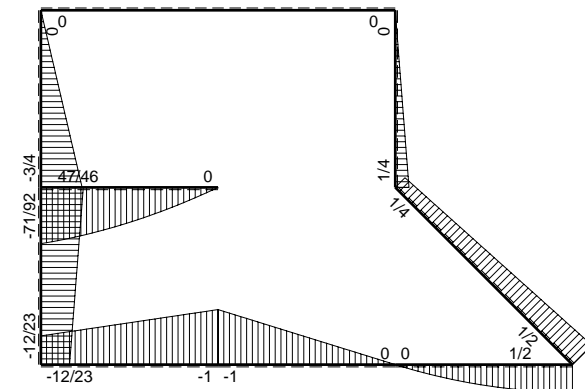
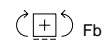
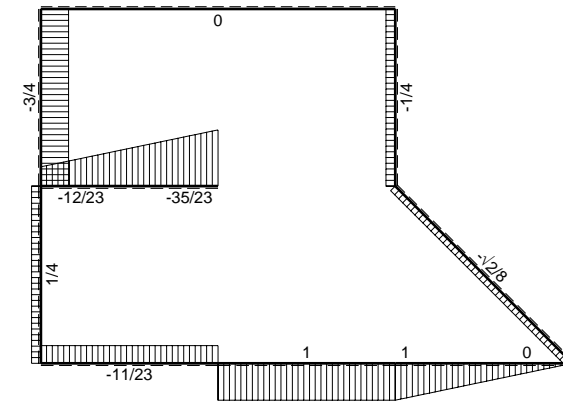
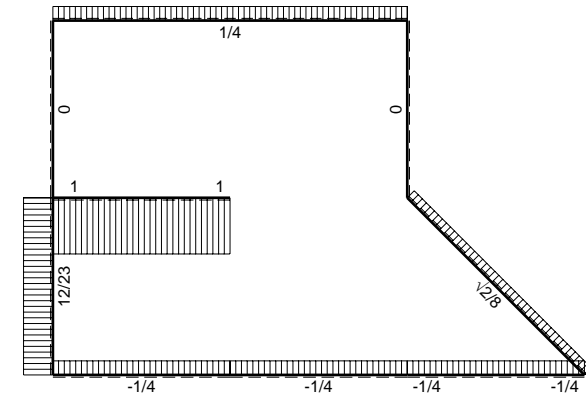
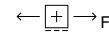
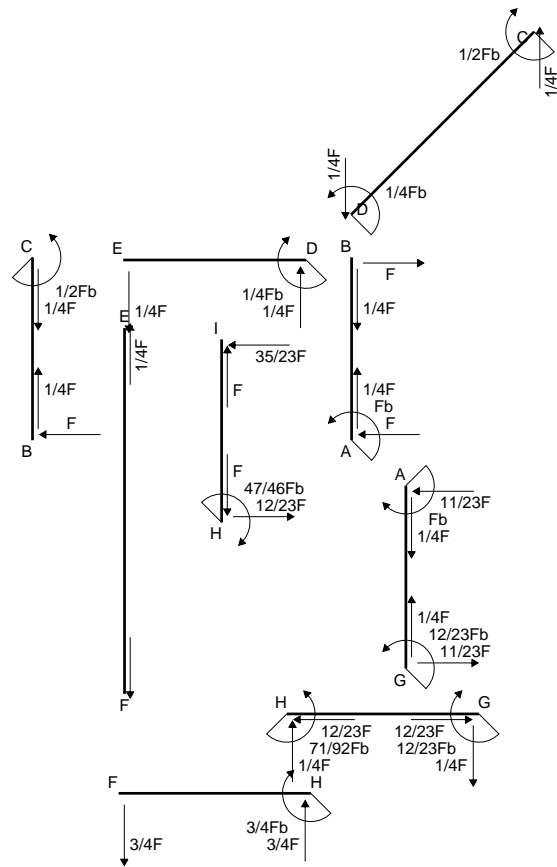
$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

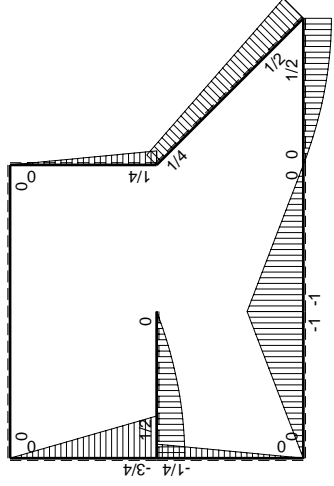
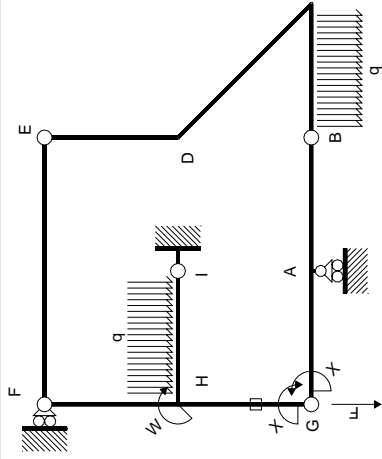
$$L_{IH}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

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

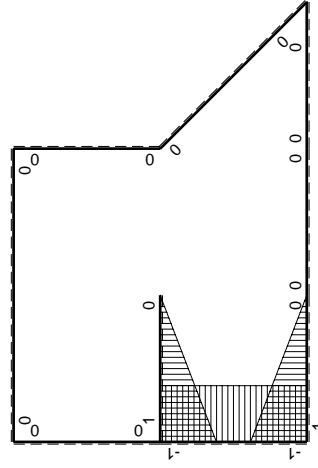


- A = 182.6 mm²
- J_u = 96241. mm⁴
- J_v = 18662. mm⁴
- J_i = 157.6 mm⁴
- y_o = 14.34 mm
- y_g = 32.77 mm
- T_y = 1120. N
- M_x = -638400. Nmm
- x_m = 12. mm
- u_m = -12. mm
- v_m = -32.77 mm
- σ_m = -Mv/J_u = -217.4 N/mm²
- x_c = 24. mm
- v_c = -32.77 mm
- σ_c = -Mv/J_u = -217.4 N/mm²
- τ_c = TS_i/tJ_u = 16.47 N/mm²
- τ_g = TS_i/tJ_u = 16.47 N/mm²
- t_c = 560. mm
- σ_o = √σ²+3τ² = 219.2 N/mm²





M_0 , flessione da carichi assegnati



M_x , flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-Fb+Fx	0	0	0	0
BA b	0	Fx	0	0	0	0
BC b	0	$Fx-1/2qx^2$	0	0	0	0
CB b	0	$-1/2Fb+1/2qx^2$	0	0	0	0
CD $\sqrt{2}b$	0	$1/2Fb-\sqrt{2}/8Fx$	0	0	0	0
DE b	0	$1/4Fb-1/4Fx$	0	0	0	0
ED b	0	$-1/4Fx$	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2		
FH b	0	$-3/4Fx$	0	0	0	0
HF b	0	$3/4Fb-3/4Fx$	0	0	0	0
HI b	$1-x/b$	$1/2Fb-1/2qx^2$	$1/2Fb-1/2Fx-1/2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$5/24Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$-Fx+1/2qx^2$	$Fx^2/b-1/2qx^3/b$	x^2/b^2		
HG b	-1	$-1/4Fb+1/4Fx$	$1/4Fb-1/4Fx$	1	$1/8Fb^2/EJ$	Xb/EJ
GH b	1	$1/4Fx$	$1/4Fx$	1		
HG	elongazione asta $N_{1HG} \epsilon_{HG} L_{HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{0A}+XV_{1A})/k_A$				$-1/2Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$12/23Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

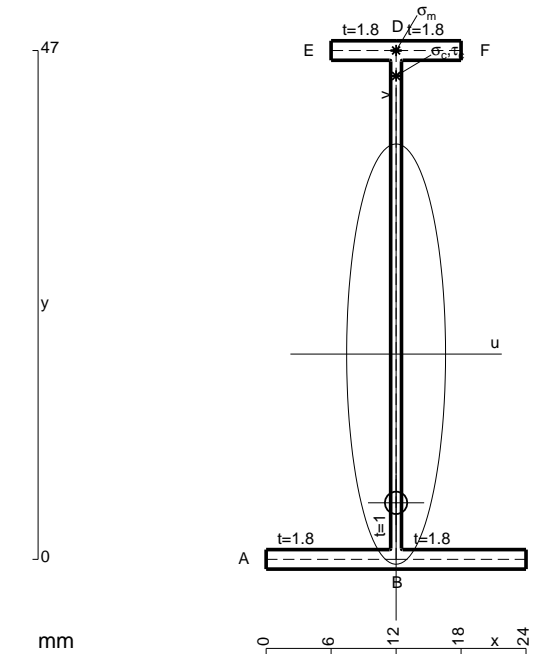
$$L_{HG}^{xo} = \int_0^b (1/4 - 1/4 x/b) \cdot Fb \cdot 1/EJ \, dx - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ$$

$$= \left[1/4 x - 1/8 x^2/b \right]_0^b \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ$$

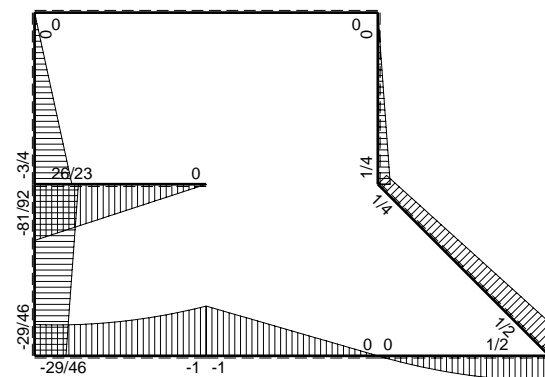
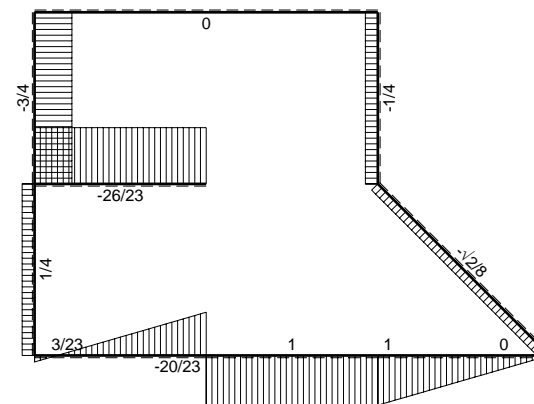
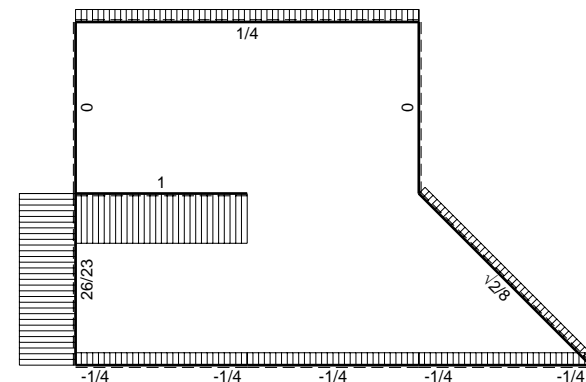
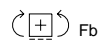
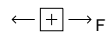
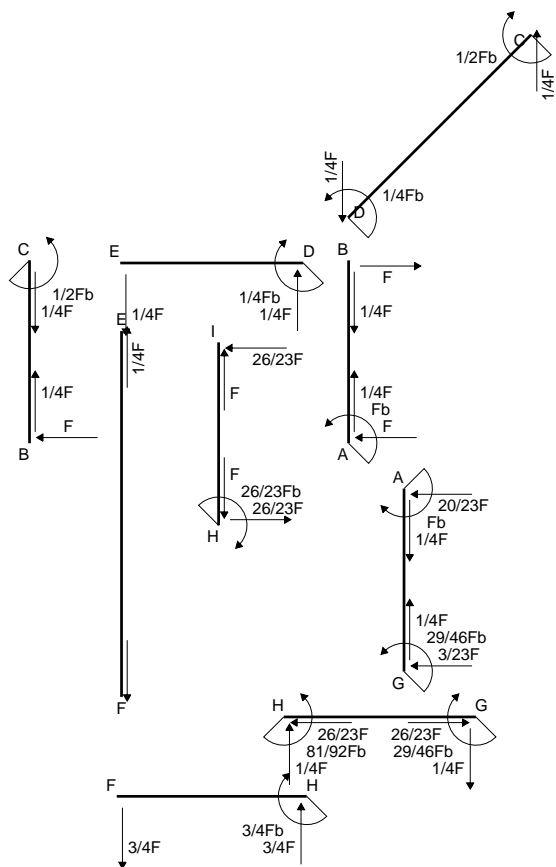
$$= (1/4 b - 1/8 b) \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ = -7/8 \cdot Fb^2/EJ$$

$$L_{GH}^{xo} = \int_0^b (1/4 x/b) \cdot Fb \cdot 1/EJ \, dx - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ = \left[1/8 x^2/b \right]_0^b \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ$$

$$= (1/8 b) \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ = -7/8 \cdot Fb^2/EJ$$



- A = 111.8 mm²
- J_u = 42133. mm⁴
- J_v = 2333. mm⁴
- J_t = 85.65 mm⁴
- y_o = -13.74 mm
- y_g = 18.96 mm
- N = -120. N
- T_y = 480. N
- M_x = -345600. Nmm
- x_m = 12. mm
- y_m = 47. mm
- v_m = 28.04 mm
- σ_m = N/A-Mv/J_u = 228.9 N/mm²
- y_c = 2. mm
- u_c = -12. mm
- v_c = -16.96 mm
- σ_c = N/A-Mv/J_u = 228.9 N/mm²
- τ_c = TS_y/tJ_u = 6.9 N/mm²
- τ_g = TS_y/tJ_u = 6.9 N/mm²
- t_c = 480. mm
- σ_o = √σ²+3τ² = 229.2 N/mm²



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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

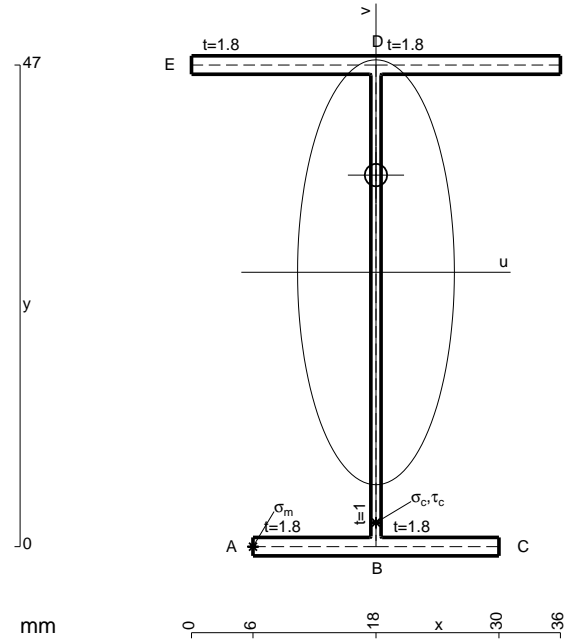
$$L_{HG}^{xo} = \int_0^b (1/4 - 1/4 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/4 x - 1/8 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

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

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

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



- A = 155. mm²
- J_u = 66633. mm⁴
- J_v = 9072. mm⁴
- J_I = 132.3 mm⁴
- y_o = 9.482 mm
- y_g = 26.77 mm
- N = -195. N
- T_y = 780. N
- M_x = -592800. Nmm
- x_m = 6. mm
- u_m = -12. mm
- v_m = -26.77 mm
- σ_m = N/A-Mv/J_u = -239.5 N/mm²
- x_c = 18. mm
- v_c = -26.77 mm
- σ_c = N/A-Mv/J_u = -239.5 N/mm²
- τ_c = TS'/tJ_u = 13.54 N/mm²
- τ_g = TS'/tJ_u = 13.54 N/mm²
- t_c = 780. mm
- σ_o = √σ²+3τ² = 240.6 N/mm²

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

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

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

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

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

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

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

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

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

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

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

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

$$L_{GA}^{x_0} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

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

$$L_{AG}^{x_0} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

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

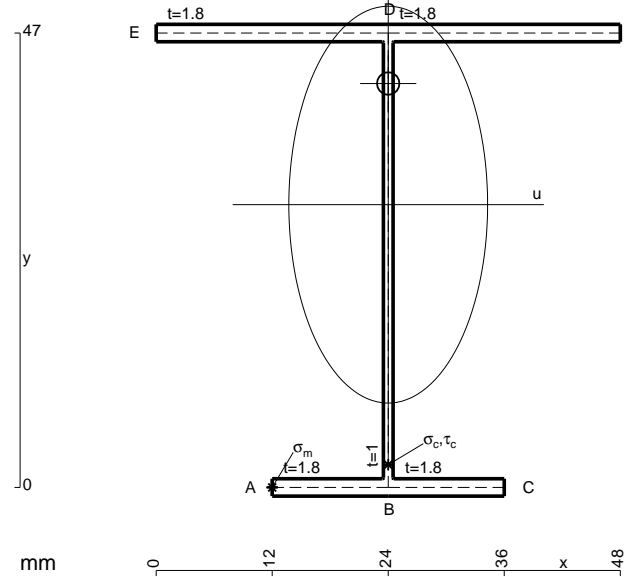
$$L_{HG}^{x_0} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

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

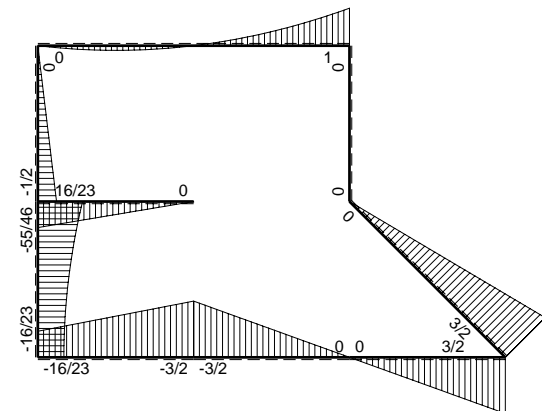
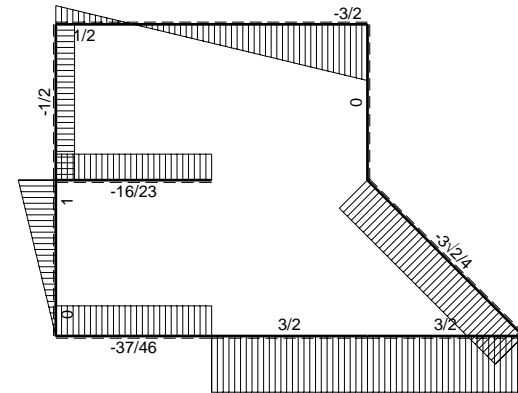
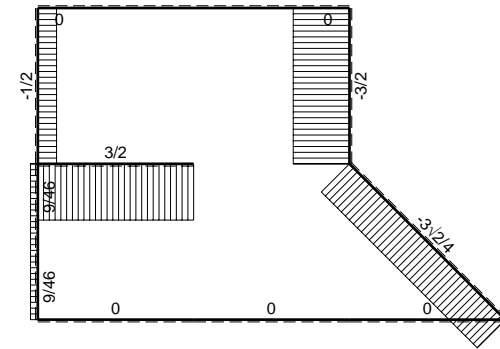
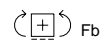
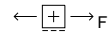
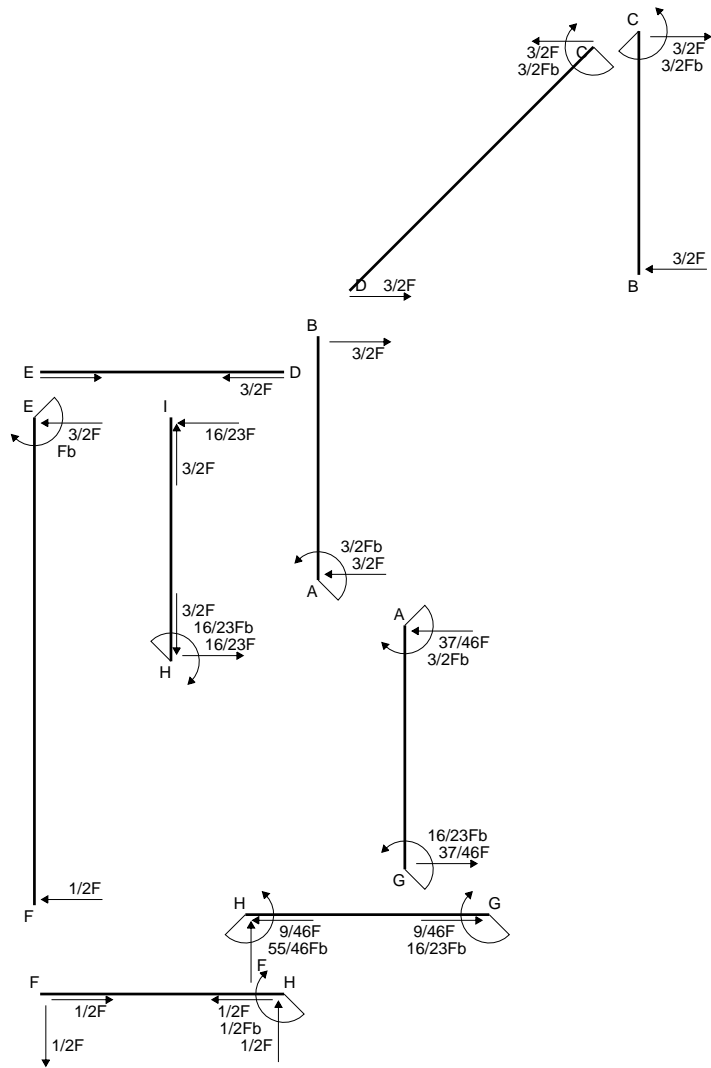
$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/6 Fb^2/EJ$$

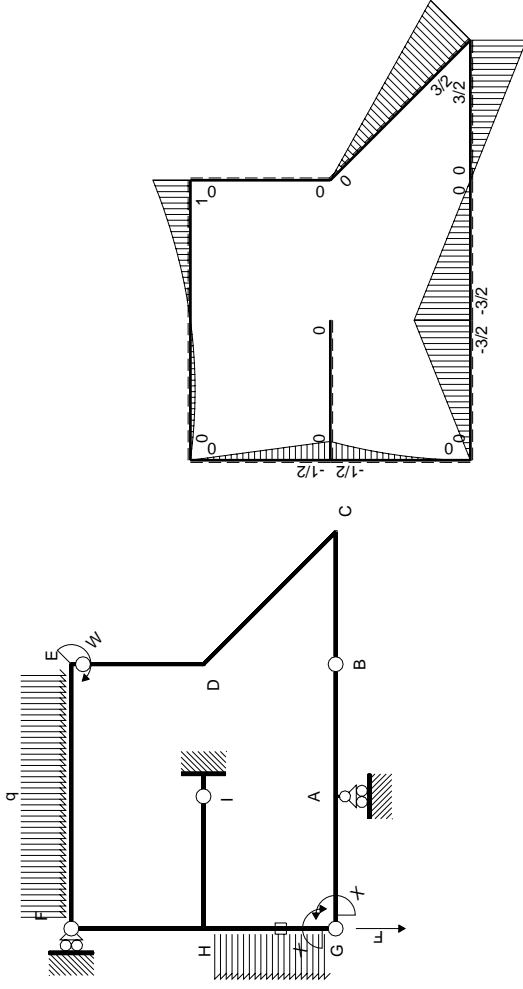
$$L_{GH}^{x_0} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

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

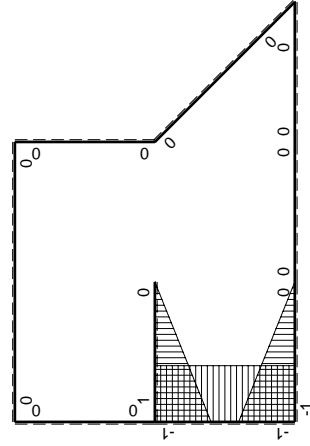


- A = 176.6 mm²
- J_u = 74388. mm⁴
- J_v = 18662. mm⁴
- J_i = 155.6 mm⁴
- y_o = 12.53 mm
- y_g = 29.25 mm
- T_y = -635. N
- M_x = 508000. Nmm
- x_m = 12. mm
- u_m = -12. mm
- v_m = -29.25 mm
- σ_m = -Mv/J_u = 199.7 N/mm²
- x_c = 24. mm
- v_c = -29.25 mm
- σ_c = -Mv/J_u = 199.7 N/mm²
- τ_c = TS_i/tJ_u = 10.79 N/mm²
- τ_g = TS_i/tJ_u = 10.79 N/mm²
- t_c = 1270. mm
- σ_o = √σ²+3τ² = 200.6 N/mm²





M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-3/2Fb+3/2Fx$	0	0	0	0
BA b	0	$3/2Fx$	0	0	0	0
BC b	0	$3/2Fx$	0	0	0	0
CB b	0	$-3/2Fb+3/2Fx$	0	0	0	0
CD $\sqrt{2}b$	0	$3/2Fb-3\sqrt{2}/4Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	$Fb-3/2Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$1/2Fx-1/2qx^2$	0	0	0	0
GA b	$-1+x/b$	$-3/2Fx$	$3/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/4Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$3/2Fb-3/2Fx$	$3/2Fx-3/2Fx^2/b$	x^2/b^2		
FH b	0	$-1/2Fx$	0	0	0	0
HF b	0	$1/2Fb-1/2Fx$	0	0	0	0
HI b	$1-x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
IH b	$-x/b$	0	0	x^2/b^2	0	
HG b	-1	$-1/2Fb+Fx-1/2qx^2$	$1/2Fb-Fx+1/2Fx^2/b$	1	$1/6Fb^2/EJ$	Xb/EJ
GH b	1	$1/2qx^2$	$1/2Fx^2/b$	1		
HG	elongazione asta $N_{1HG^{\pm HG}} \pm HG$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{0A}+XV_{1A})/k_A$				$-3/4Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-4/3Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica X=W _{GA}				$16/23Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

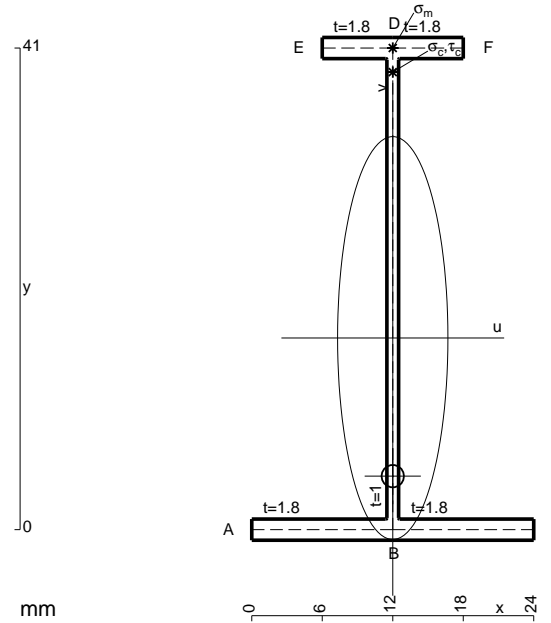
$$L_{HG}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

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

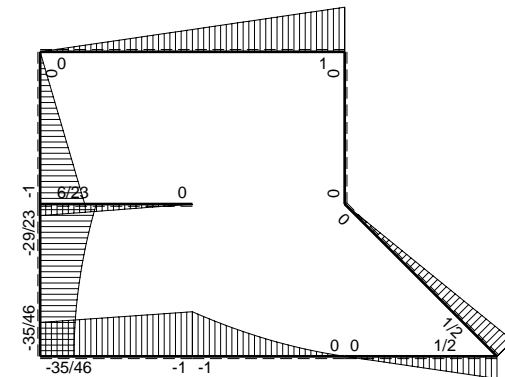
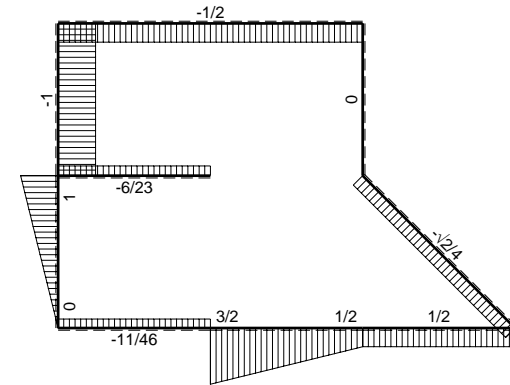
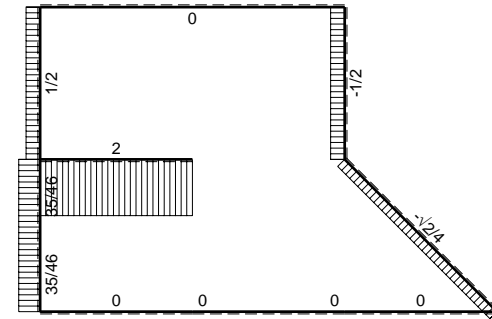
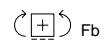
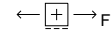
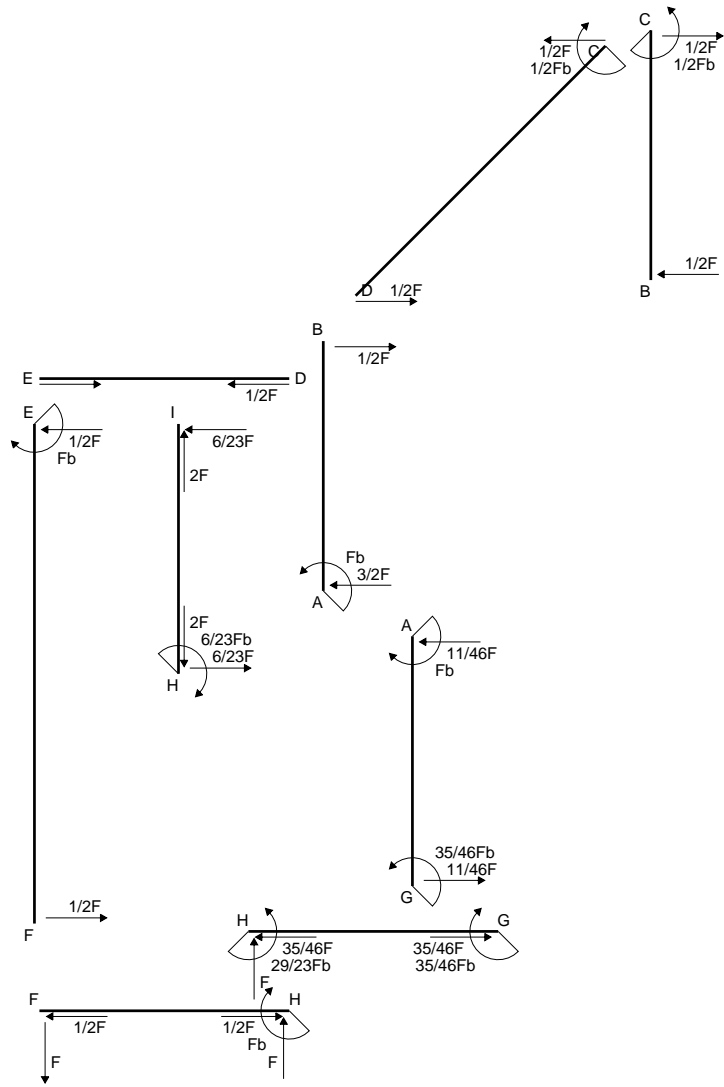
$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/6 Fb^2/EJ$$

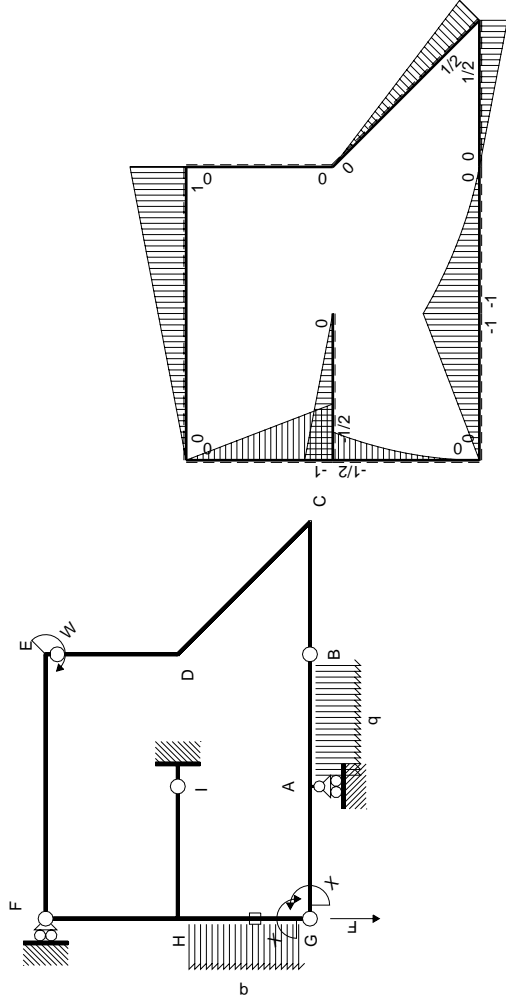
$$L_{GH}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

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

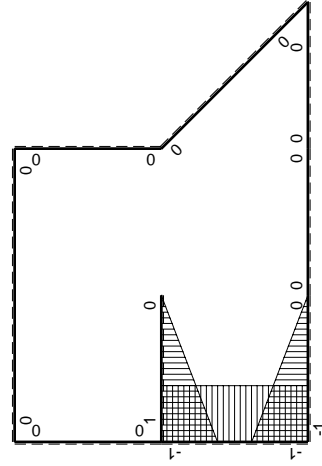


- A = 105.8 mm²
- J_u = 31122. mm⁴
- J_v = 2333. mm⁴
- J_t = 83.65 mm⁴
- y_o = -11.76 mm
- y_g = 16.31 mm
- T_y = 690. N
- M_x = -262200. Nmm
- x_m = 12. mm
- y_m = 41. mm
- v_m = 24.69 mm
- σ_m = -Mv/J_u = 208. N/mm²
- y_c = 2. mm
- u_c = -12. mm
- v_c = -14.31 mm
- σ_c = -Mv/J_u = 208. N/mm²
- τ_c = TS/tJ_u = 11.82 N/mm²
- τ_g = TS/tJ_u = 11.82 N/mm²
- t_c = 460. mm
- σ_o = √σ²+3τ² = 209. N/mm²





M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-Fb+3/2Fx-1/2qx^2$	0	0	0	0
BA b	0	$1/2Fx+1/2qx^2$	0	0	0	0
BC b	0	$1/2Fx$	0	0	0	0
CB b	0	$-1/2Fb+1/2Fx$	0	0	0	0
CD $\sqrt{2}b$	0	$1/2Fb-\sqrt{2}/4Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	$Fb-1/2Fx$	0	0	0	0
FE 2b	0	$-1/2Fx$	0	0	0	0
GA b	$-1+x/b$	$-Fx$	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$Fb-Fx$	$Fx-Fx^2/b$	x^2/b^2	$1/6Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$-Fx$	0	0	0	0
HF b	0	$Fb-Fx$	0	0	0	0
HI b	$1-x/b$	$-1/2Fb+1/2Fx$	$-1/2Fb+Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$1/2Fx$	$-1/2Fx^2/b$	x^2/b^2	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	$-1/2Fb+Fx-1/2qx^2$	$1/2Fb-Fx+1/2Fx^2/b$	1	$1/6Fb^2/EJ$	Xb/EJ
GH b	1	$1/2qx^2$	$1/2Fx^2/b$	1	$1/6Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG^{\pm}HG^{\pm}HG}$					
A	molla nodo $-V_{1A}(V_{0A}+XV_{1A})/k_A$					
	totali					
	iperstatica X=W _{GA}					
	35/46Fb					

Sviluppi di calcolo iperstatica

M_x flessione da iperstatica X=1

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

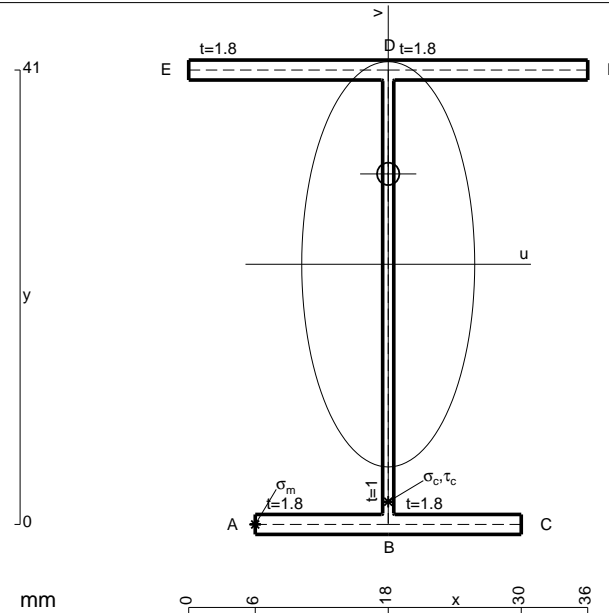
$$L_{HG}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

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

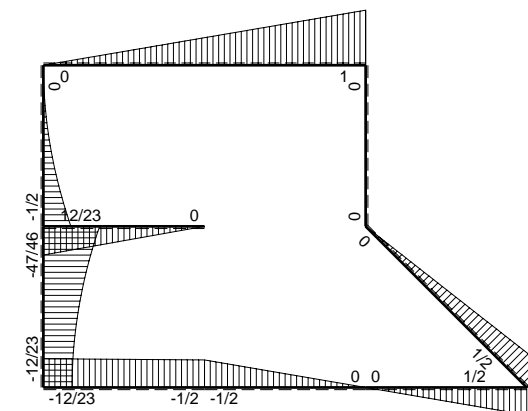
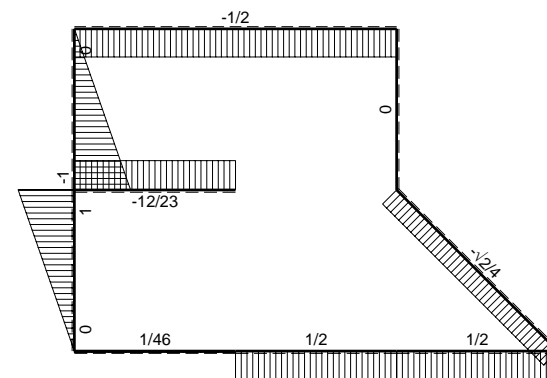
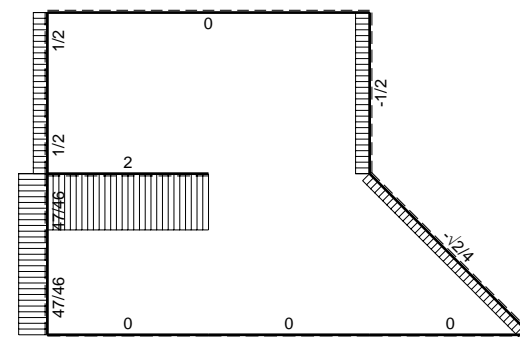
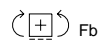
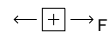
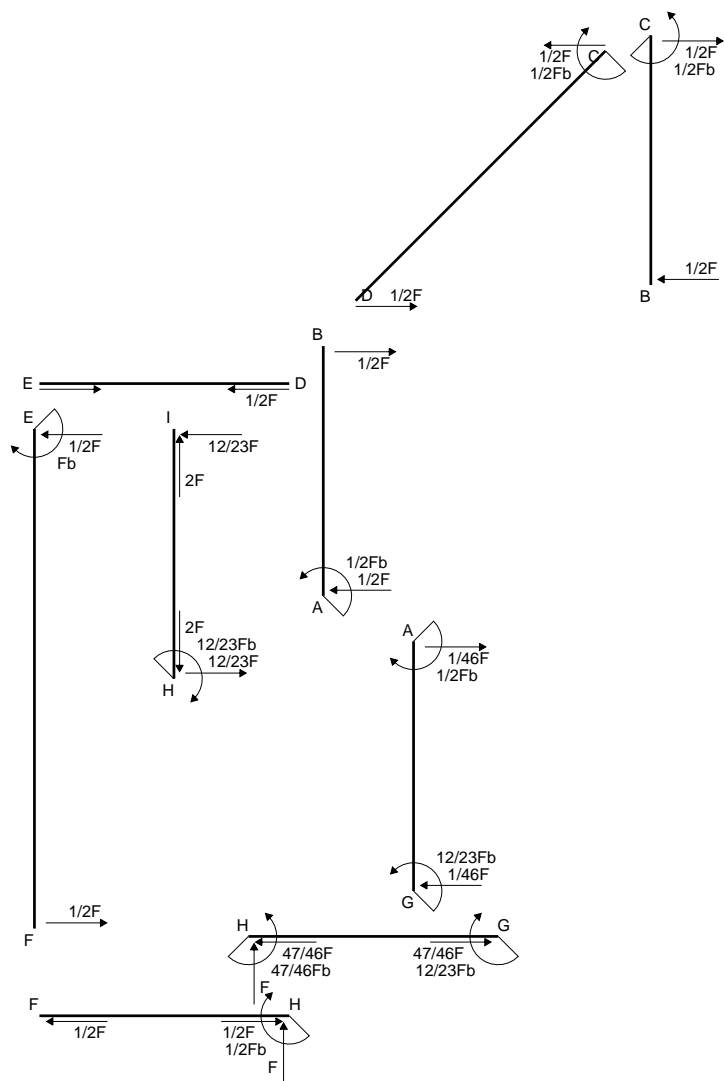
$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/6 Fb^2/EJ$$

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

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



- A = 149. mm²
- J_u = 49815. mm⁴
- J_v = 9072. mm⁴
- J_i = 130.3 mm⁴
- y_o = 8.157 mm
- y_g = 23.47 mm
- T_y = 1665. N
- M_x = -466200. Nmm
- x_m = 6. mm
- u_m = -12. mm
- v_m = -23.47 mm
- σ_m = -Mv/J_u = -219.7 N/mm²
- x_c = 18. mm
- v_c = -23.47 mm
- σ_c = -Mv/J_v = -219.7 N/mm²
- τ_c = TS'/tJ_u = 33.89 N/mm²
- τ_g = TS'/tJ_v = 33.89 N/mm²
- t_c = 1110. mm
- σ_o = √σ²+3τ² = 227.4 N/mm²



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

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

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

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

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

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

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

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

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

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

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

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

$$L_{GA}^{x_0} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

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

$$L_{AG}^{x_0} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

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

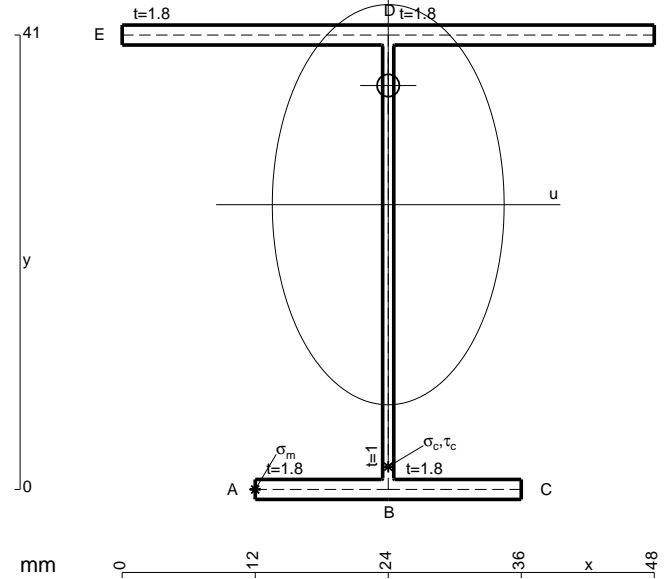
$$L_{HG}^{x_0} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

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

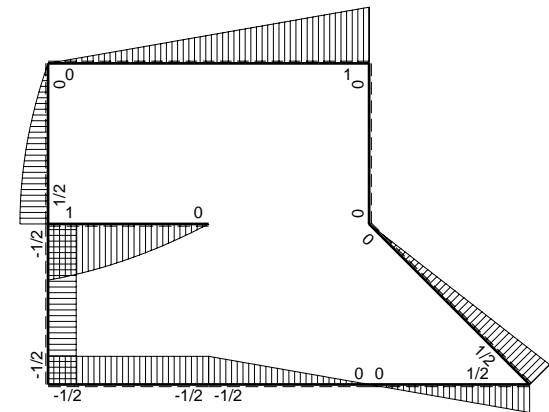
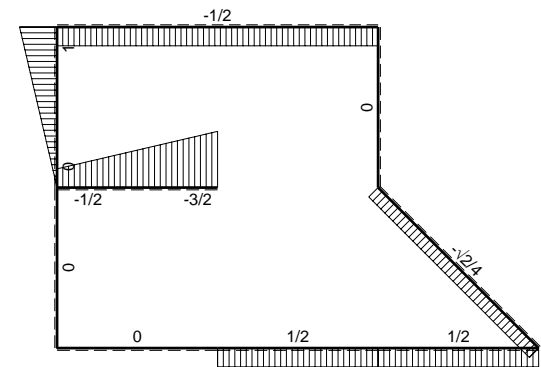
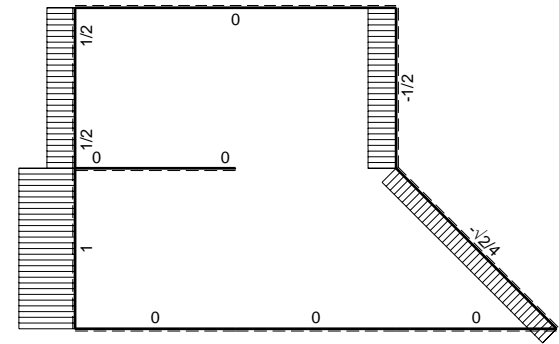
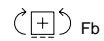
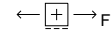
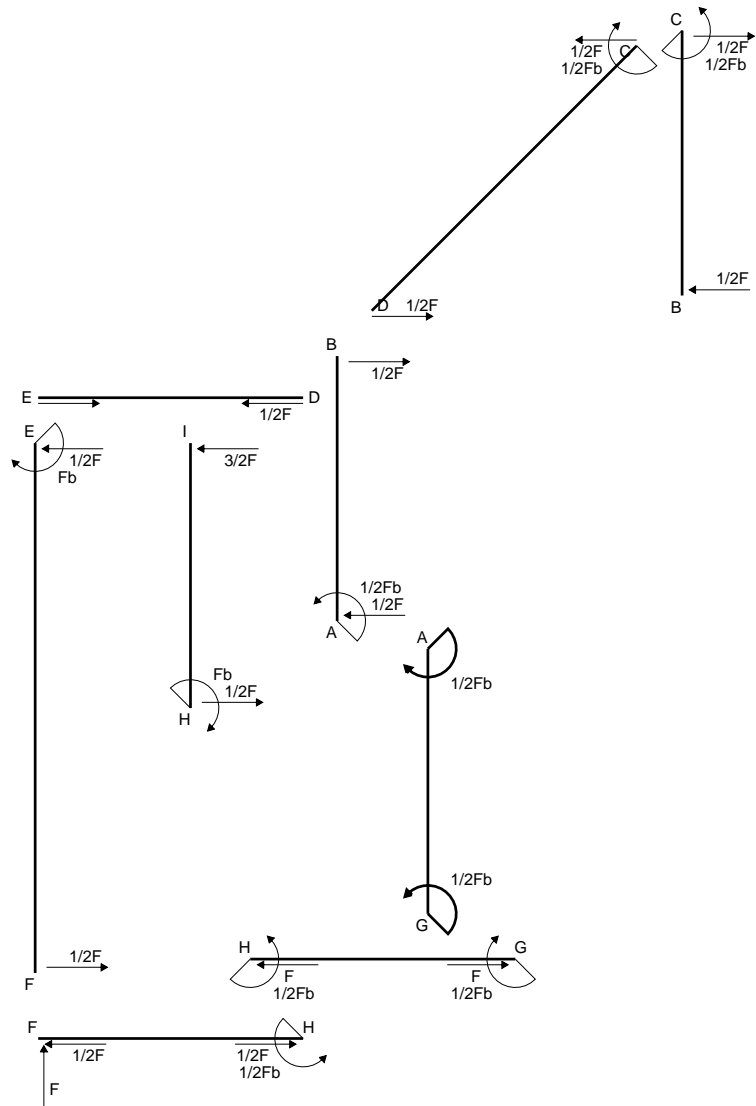
$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/6 Fb^2/EJ$$

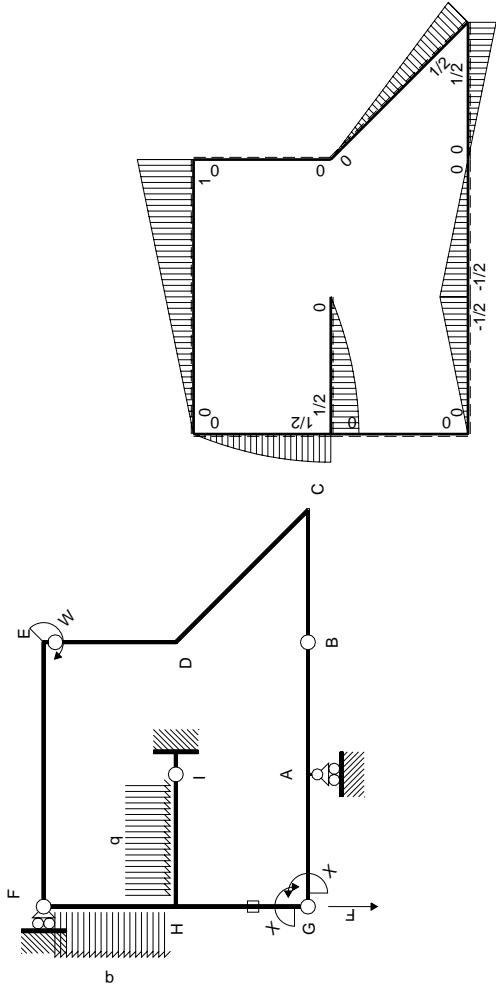
$$L_{GH}^{x_0} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

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



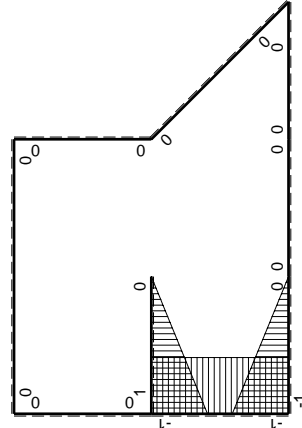
- A = 170.6 mm²
- J_u = 55611. mm⁴
- J_v = 18662. mm⁴
- J_i = 153.6 mm⁴
- y_o = 10.75 mm
- y_g = 25.69 mm
- T_y = -550. N
- M_x = 495000. Nmm
- x_m = 12. mm
- u_m = -12. mm
- v_m = -25.69 mm
- σ_m = -Mv/J_u = 228.7 N/mm²
- x_c = 24. mm
- v_c = -25.69 mm
- σ_c = -Mv/J_u = 228.7 N/mm²
- τ_c = TS_i/tJ_u = 10.98 N/mm²
- τ_g = TS_i/tJ_u = 10.98 N/mm²
- t_c = 1100. mm
- σ_o = √σ²+3τ² = 229.5 N/mm²





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	$-1/2Fb+1/2Fx$	0	0	0	0
BA b	0	$1/2Fx$	0	0		
BC b	0	$1/2Fx$	0	0	0	0
CB b	0	$-1/2Fb+1/2Fx$	0	0		
CD $\sqrt{2}b$	0	$1/2Fb-\sqrt{2}/4Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0		
EF 2b	0	$Fb-1/2Fx$	0	0	0	0
FE 2b	0	$-1/2Fx$	0	0		
GA b	$-1+x/b$	$-1/2Fx$	$1/2Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$1/2Fb-1/2Fx$	$1/2Fx-1/2Fx^2/b$	x^2/b^2		
FH b	0	$Fx-1/2qx^2$	0	0	0	0
HF b	0	$-1/2Fb+1/2qx^2$	0	0		
HI b	$1-x/b$	$1/2Fb-1/2qx^2$	$1/2Fb-1/2Fx-1/2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$5/24Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$-Fx+1/2qx^2$	$Fx^2/b-1/2qx^3/b$	x^2/b^2		
HG b	-1	0	0	1	0	Xb/EJ
GH b	1	0	0	1		
HG	elongazione asta $N_{1HG} \epsilon_{HG} L_{HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{0A}+XV_{1A})/k_A$				$-1/4Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-23/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$1/2Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

$$L_{GA}^{x_0} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[1/4 x^2/b - 1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

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

$$L_{AG}^{x_0} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[1/4 x^2/b - 1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

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

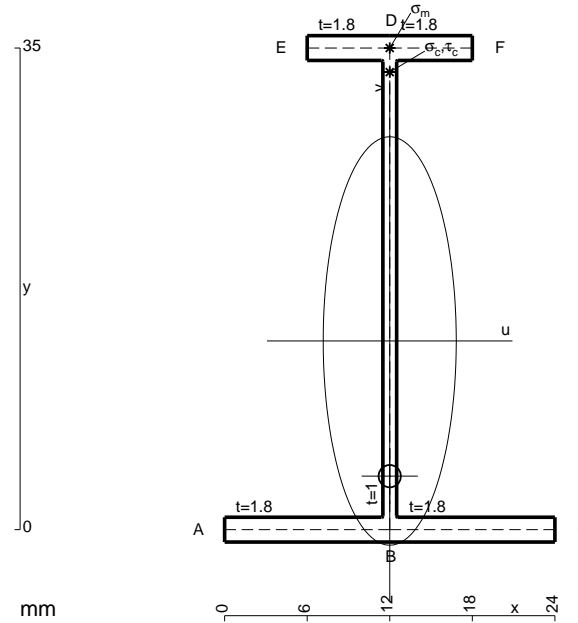
$$L_{HI}^{x_0} = \int_0^b (1/2 - 1/2 x/b - 1/2 x^2/b^2 + 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx$$

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

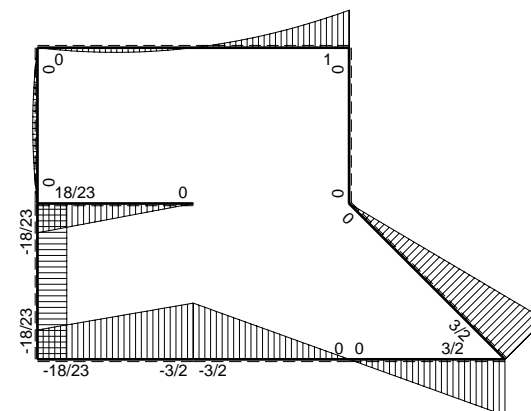
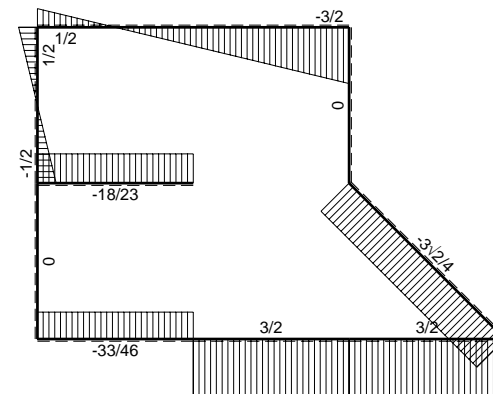
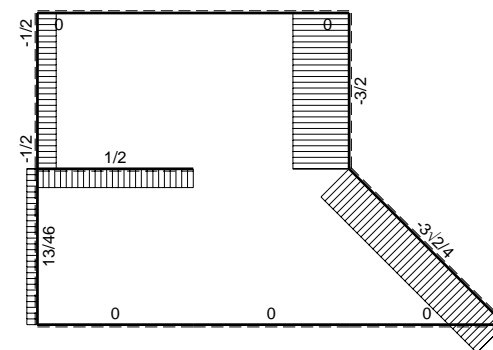
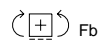
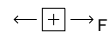
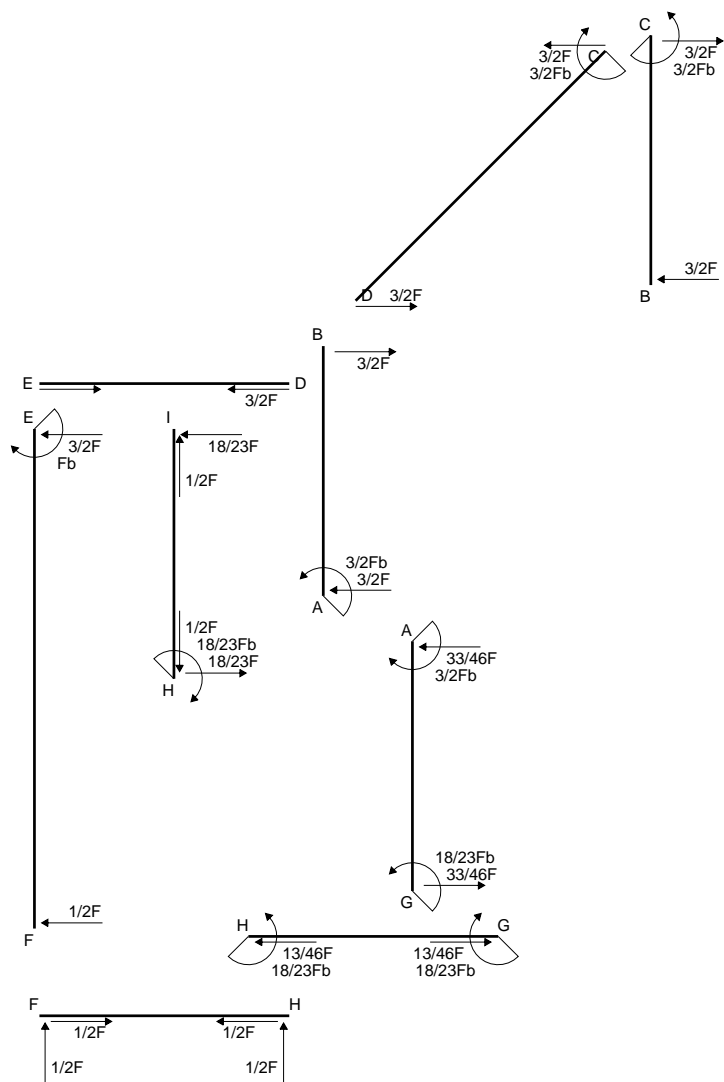
$$= (1/2 b - 1/4 b - 1/6 b + 1/8 b) \cdot Fb \cdot 1/EJ = 5/24 \cdot Fb^2/EJ$$

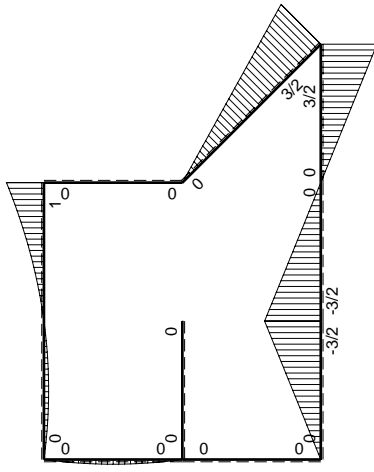
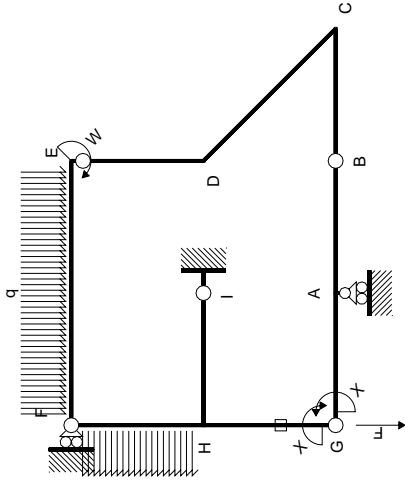
$$L_{IH}^{x_0} = \int_0^b (x^2/b^2 - 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[1/3 x^3/b^2 - 1/8 x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

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

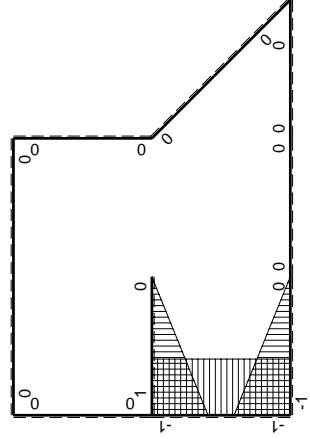


- A = 99.8 mm²
- J_u = 21986. mm⁴
- J_v = 2333. mm⁴
- J_i = 81.65 mm⁴
- y_o = -9.824 mm
- y_g = 13.71 mm
- T_y = -295. N
- M_x = 247800. Nmm
- x_m = 12. mm
- y_m = 35. mm
- v_m = 21.29 mm
- σ_m = -Mv/J_u = -239.9 N/mm²
- y_c = 2. mm
- u_c = -12. mm
- v_c = -11.71 mm
- σ_c = -Mv/J_u = -239.9 N/mm²
- τ_c = TS_v/tJ_u = 6.17 N/mm²
- τ_g = TS_v/tJ_u = 6.17 N/mm²
- t_c = 590. mm
- σ_o = √σ²+3τ² = 240.2 N/mm²





M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-3/2Fb+3/2Fx$	0	0	0	0
BA b	0	$3/2Fx$	0	0	0	0
BC b	0	$3/2Fx$	0	0	0	0
CB b	0	$-3/2Fb+3/2Fx$	0	0	0	0
CD $\sqrt{2}b$	0	$3/2Fb-3\sqrt{2}/4Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	$Fb-3/2Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$1/2Fx-1/2qx^2$	0	0	0	0
GA b	$-1+x/b$	$-3/2Fx$	$3/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/4Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$3/2Fb-3/2Fx$	$3/2Fx-3/2Fx^2/b$	x^2/b^2	0	0
FH b	0	$1/2Fx-1/2qx^2$	0	0	0	0
HF b	0	$-1/2Fx+1/2qx^2$	0	0	0	0
HI b	$1-x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
IH b	$-x/b$	0	0	x^2/b^2	0	0
HG b	-1	0	0	1	0	Xb/EJ
GH b	1	0	0	1	0	0
HG	elongazione asta $N_{1HG^{\pm}HG^{\mp}HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{0A}+XV_{1A})/k_A$				$-3/4Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-3/2Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$18/23Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

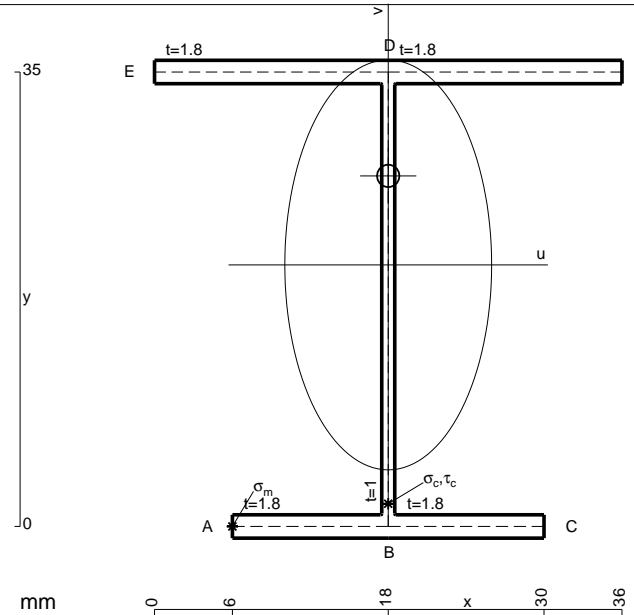
$$= (b) 1/EJ = b/EJ$$

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

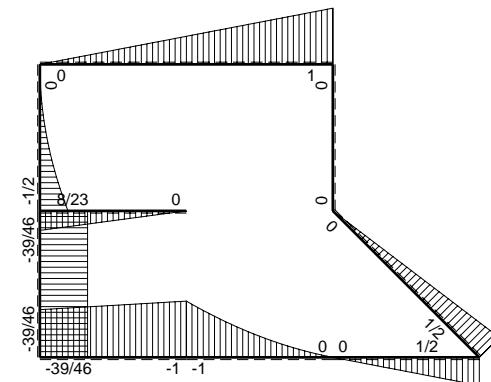
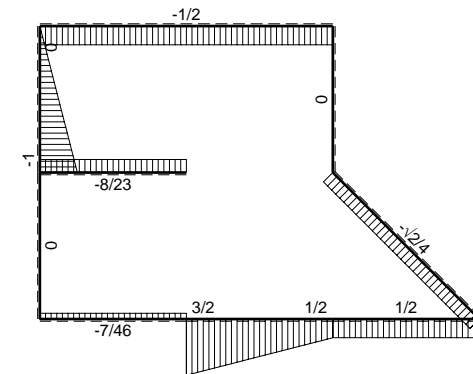
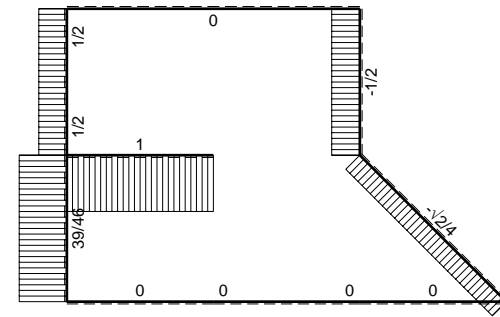
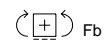
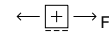
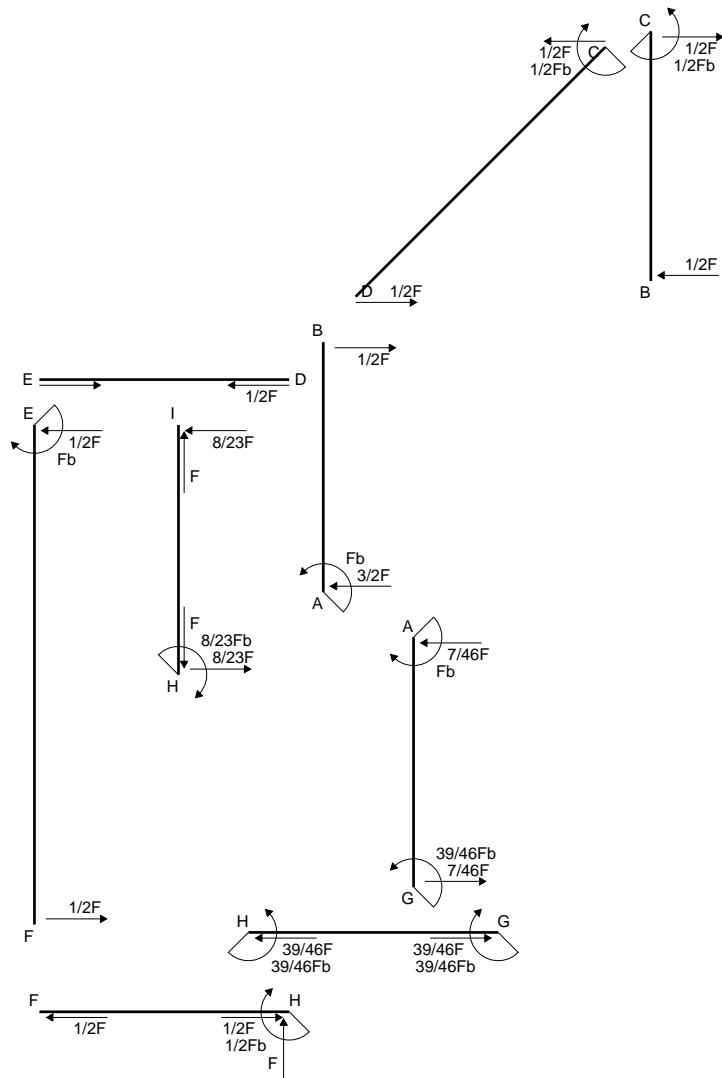
$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

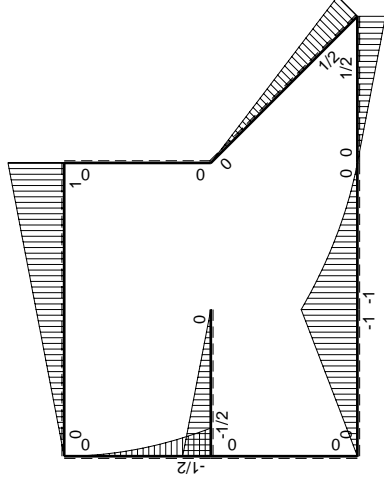
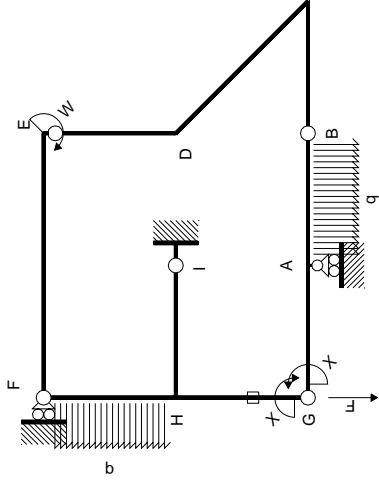
$$L_{AG}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

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

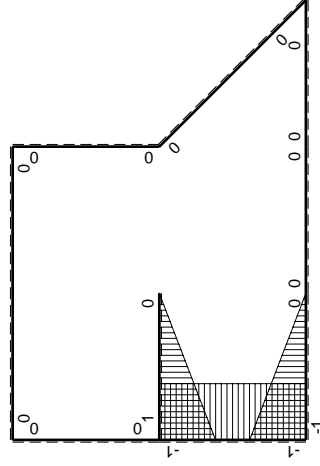


- A = 143. mm²
- J_u = 35649. mm⁴
- J_v = 9072. mm⁴
- J_i = 128.3 mm⁴
- y_o = 6.857 mm
- y_g = 20.14 mm
- T_y = 780. N
- M_x = -351000. Nmm
- x_m = 6. mm
- u_m = -12. mm
- v_m = -20.14 mm
- σ_m = -Mv/J_u = -198.3 N/mm²
- x_c = 18. mm
- v_c = -20.14 mm
- σ_c = -Mv/J_u = -198.3 N/mm²
- τ_c = TS'/tJ_u = 19.04 N/mm²
- τ_g = TS'/tJ_u = 19.04 N/mm²
- t_c = 520. mm
- σ_o = √σ²+3τ² = 201.1 N/mm²





M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-Fb+3/2Fx-1/2qx^2$	0	0	0	0
BA b	0	$1/2Fx+1/2qx^2$	0	0	0	0
BC b	0	$1/2Fx$	0	0	0	0
CB b	0	$-1/2Fb+1/2Fx$	0	0	0	0
CD $\sqrt{2}b$	0	$1/2Fb-\sqrt{2}/4Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	$Fb-1/2Fx$	0	0	0	0
FE 2b	0	$-1/2Fx$	0	0	0	0
GA b	$-1+x/b$	$-Fx$	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$Fb-Fx$	$Fx-Fx^2/b$	x^2/b^2		
FH b	0	$-1/2qx^2$	0	0	0	0
HF b	0	$1/2Fb-Fx+1/2qx^2$	0	0	0	0
HI b	$1-x/b$	$-1/2Fb+1/2Fx$	$-1/2Fb+Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$1/2Fx$	$-1/2Fx^2/b$	x^2/b^2		
HG b	-1	0	0	1	0	Xb/EJ
GH b	1	0	0	1	0	Xb/EJ
HG	elongazione asta $N_{1HG^{\pm}HG^{\pm}HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{0A}+XV_{1A})/k_A$				$-5/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-13/8Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$39/46Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

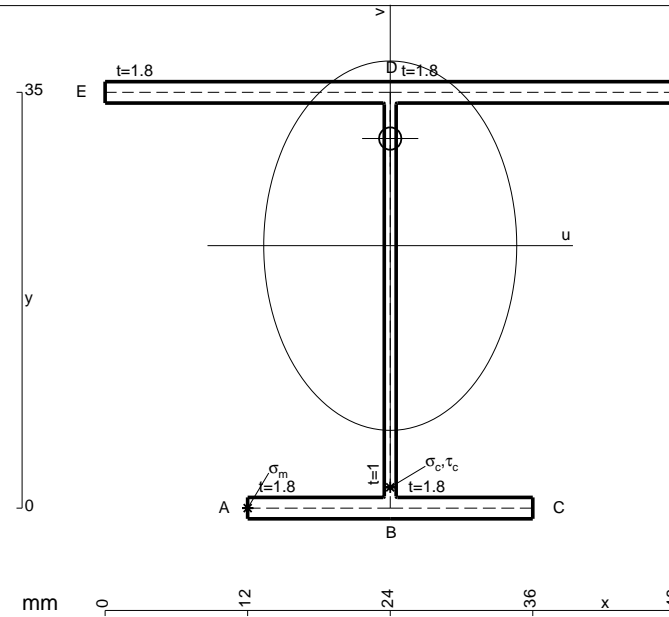
$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

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

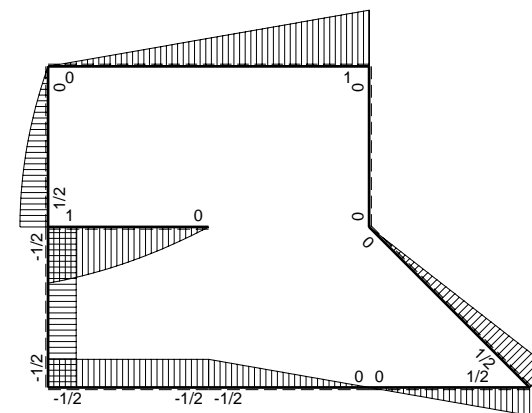
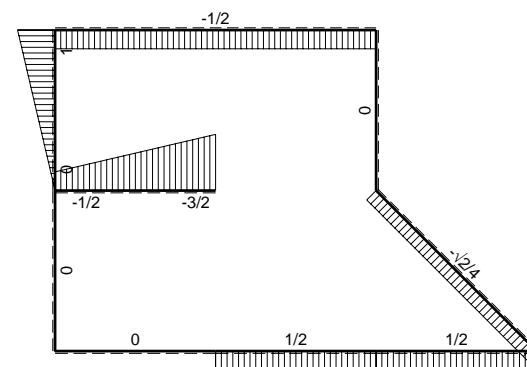
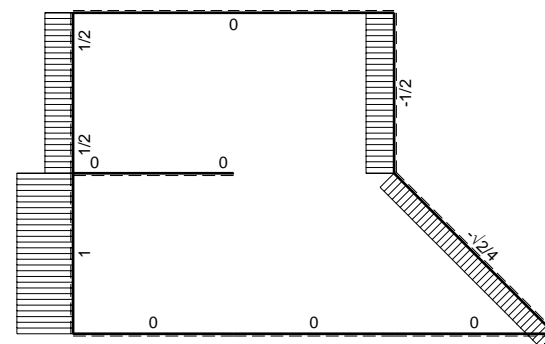
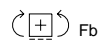
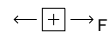
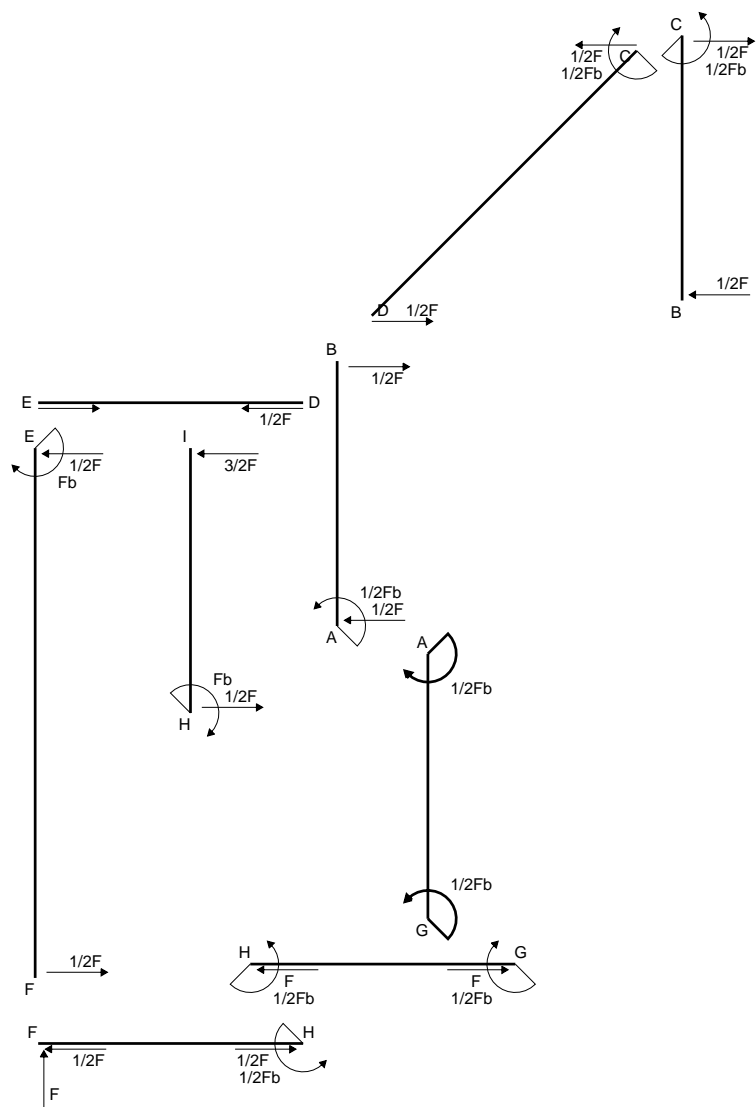
$$= (-1/2 b + 1/2 b - 1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

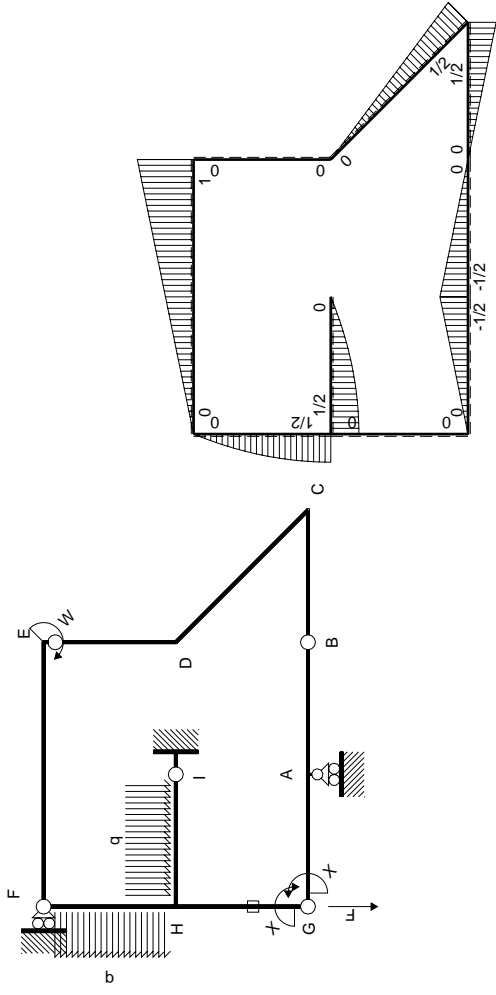
$$L_{IH}^{xo} = \int_0^b (-1/2 x^2/b^2) Fb 1/EJ dx = [-1/6 x^3/b^2]_0^b Fb 1/EJ$$

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



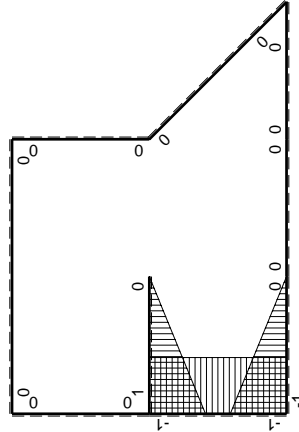
- A = 164.6 mm²
- J_u = 39791. mm⁴
- J_v = 18662. mm⁴
- J_i = 151.6 mm⁴
- y_o = 9.018 mm
- y_g = 22.09 mm
- T_y = 1170. N
- M_x = -374400. Nmm
- x_m = 12. mm
- u_m = -12. mm
- v_m = -22.09 mm
- σ_m = -Mv/J_u = -207.9 N/mm²
- x_c = 24. mm
- v_c = -22.09 mm
- σ_c = -Mv/J_u = -207.9 N/mm²
- τ_c = TS'/tJ_u = 28.06 N/mm²
- τ_g = TS'/tJ_u = 28.06 N/mm²
- t_c = 780. mm
- σ_o = √σ²+3τ² = 213.5 N/mm²





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

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

→	$M_x(x)$	$M_o(x)$	$M_x M_o$	$M_x M_x$	$\int M_x M_o / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	$-1/2Fb+1/2Fx$	0	0	0	0
BA b	0	$1/2Fx$	0	0	0	0
BC b	0	$1/2Fx$	0	0	0	0
CB b	0	$-1/2Fb+1/2Fx$	0	0	0	0
CD $\sqrt{2}b$	0	$1/2Fb-\sqrt{2}/4Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	$Fb-1/2Fx$	0	0	0	0
FE 2b	0	$-1/2Fx$	0	0	0	0
GA b	$-1+x/b$	$-1/2Fx$	$1/2Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$1/2Fb-1/2Fx$	$1/2Fx-1/2Fx^2/b$	x^2/b^2		
FH b	0	$Fx-1/2qx^2$	0	0	0	0
HF b	0	$-1/2Fb+1/2qx^2$	0	0	0	0
HI b	$1-x/b$	$1/2Fb-1/2qx^2$	$1/2Fb-1/2Fx-1/2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$5/24Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$-Fx+1/2qx^2$	$Fx^2/b-1/2qx^3/b$	x^2/b^2		
HG b	-1	0	0	1	0	Xb/EJ
GH b	1	0	0	1	0	
HG	elongazione asta $N_{1HG} \epsilon_{HG} L_{HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{oA}+XV_{1A})/k_A$				$-1/4Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-23/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$1/2Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

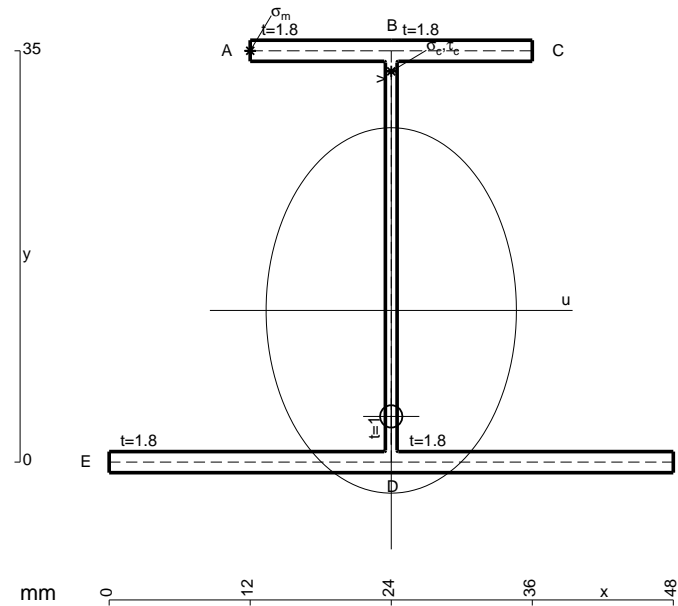
$$L_{HI}^{xo} = \int_0^b (1/2 - 1/2 x/b - 1/2 x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx$$

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

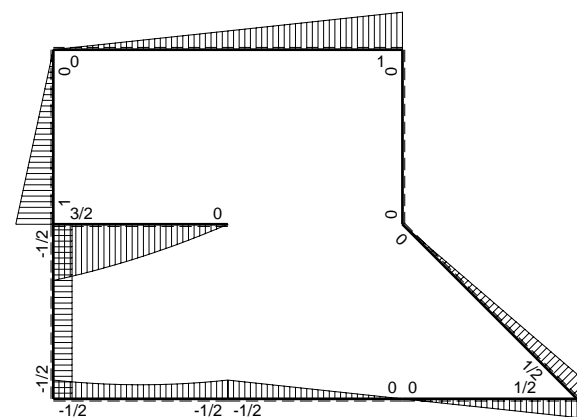
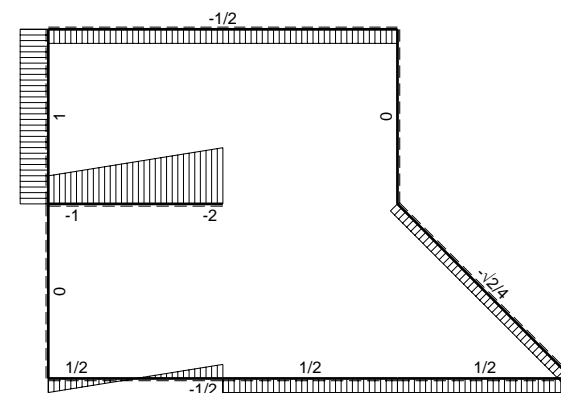
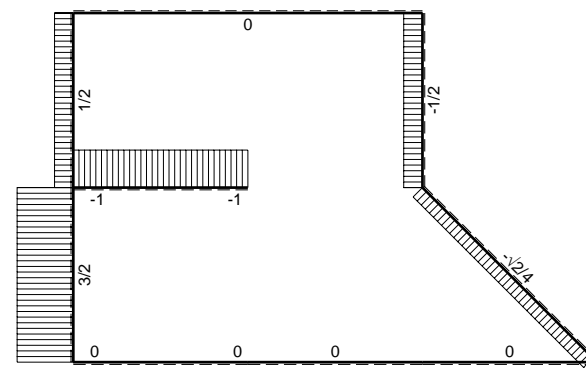
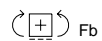
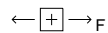
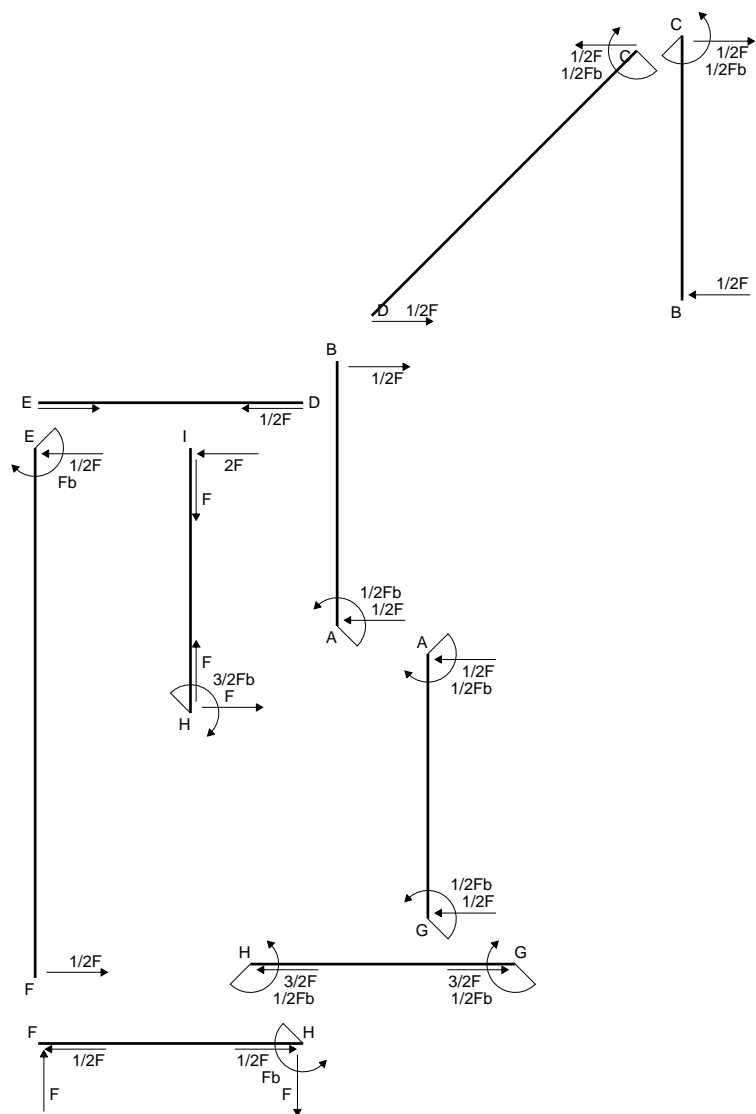
$$= (1/2 b - 1/4 b - 1/6 b + 1/8 b) Fb 1/EJ = 5/24 Fb^2/EJ$$

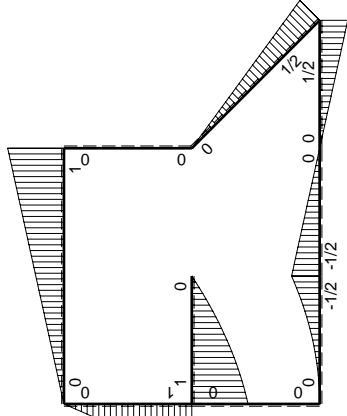
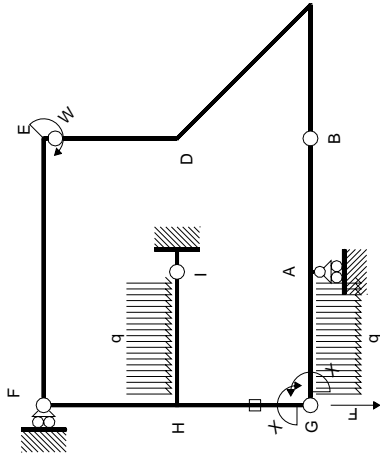
$$L_{IH}^{xo} = \int_0^b (x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [1/3 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

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



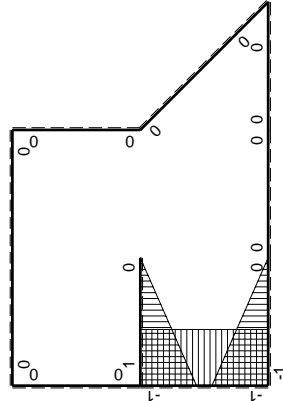
- A = 164.6 mm²
- J_u = 39791. mm⁴
- J_v = 18662. mm⁴
- J_y = 151.6 mm⁴
- y_o = -9.018 mm
- y_g = 12.91 mm
- T_y = -385. N
- M_x = 392700. Nmm
- x_m = 12. mm
- y_m = 35. mm
- u_m = -12. mm
- v_m = 22.09 mm
- σ_m = -Mv/J_u = -218. N/mm²
- x_c = 24. mm
- y_c = 35. mm
- v_c = 22.09 mm
- σ_c = -Mv/J_u = -218. N/mm²
- τ_c = TS_y/tJ_u = 9.235 N/mm²
- τ_g = TS_y/tJ_u = 9.235 N/mm²
- t_c = 770. mm
- σ_o = √σ²+3τ² = 218.6 N/mm²





Schema di calcolo iperstatico

(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-1/2Fb+1/2Fx	0	0	0	0
BA b	0	1/2Fx	0	0	0	0
BC b	0	1/2Fx	0	0	0	0
CB b	0	-1/2Fb+1/2Fx	0	0	0	0
CD 1/2b	0	1/2Fb-1/24Fx	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	Fb-1/2Fx	0	0	0	0
FE 2b	0	-1/2Fx	0	0	0	0
GA b	-1+x/b	-1/2qx ²	1/2Fx ² /b-1/2qx ³ /b	1-2x/b+x ² /b ²	1/24Fb ² /EJ	1/3Xb/EJ
AG b	x/b	1/2Fb-Fx+1/2qx ²	1/2Fx-Fx ² /b+1/2qx ³ /b	x ² /b ²	0	0
FH b	0	Fx	0	0	0	0
HF b	0	-Fb+Fx	0	0	0	0
HI b	1-x/b	Fb-1/2Fx-1/2qx ²	Fb-3/2Fx+1/2qx ² /b	1-2x/b+x ² /b ²	3/8Fb ² /EJ	1/3Xb/EJ
IH b	-x/b	-3/2Fx+1/2qx ²	3/2Fx ² /b-1/2qx ³ /b	x ² /b ²	0	0
HG b	-1	0	0	1	0	Xb/EJ
GH b	1	0	0	1	0	0
HG	elongazione asta $N_{1HG} = N_{HG} - HG$				-Fb ² /EJ	
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$				-3/8Fb ² /EJ	1/4Xb/EJ
	totali				-23/24Fb ² /EJ	23/12Xb/EJ
	iperstatica X=W _{GA}				1/2Fb	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

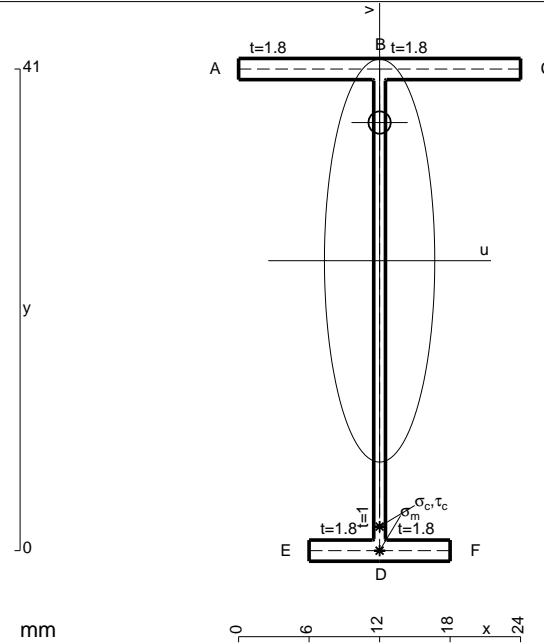
$$= (1/4 b - 1/3 b + 1/8 b) \cdot Fb \cdot 1/EJ = 1/24 \cdot Fb^2/EJ$$

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

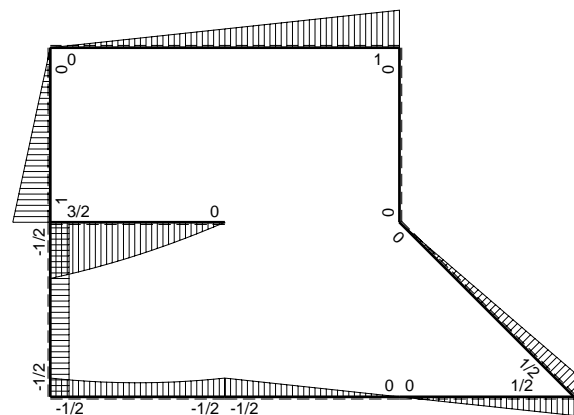
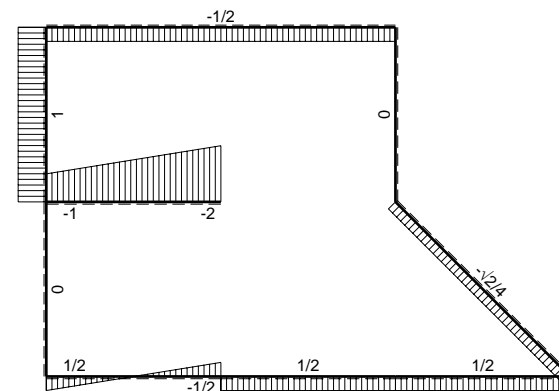
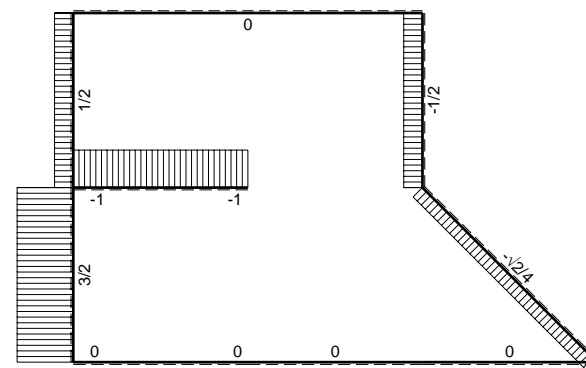
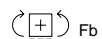
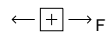
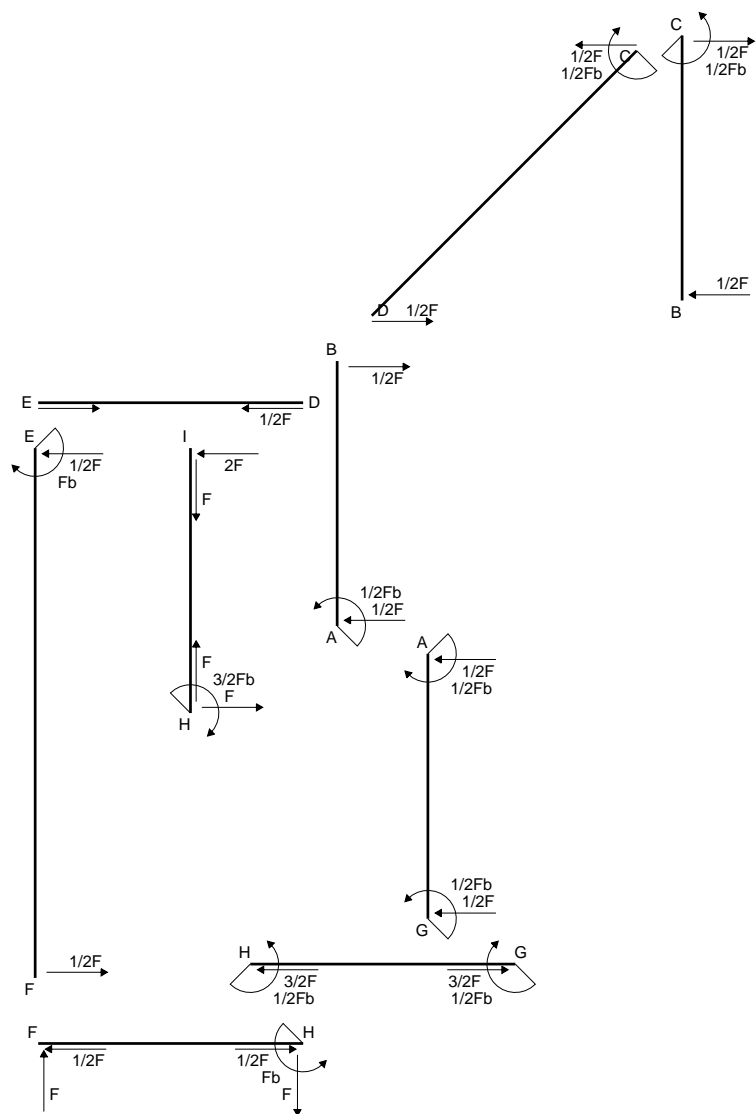
$$= (b - 3/4 b + 1/8 b) \cdot Fb \cdot 1/EJ = 3/8 \cdot Fb^2/EJ$$

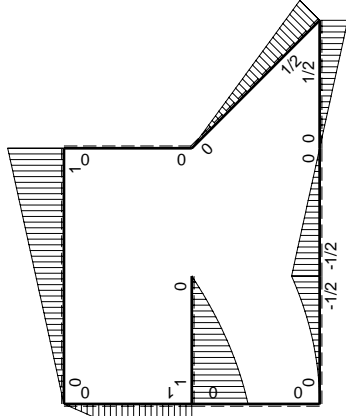
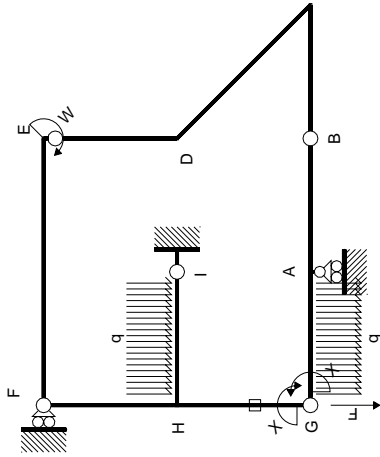
$$L_{IH}^{xo} = \int_0^b (3/2 x^2/b^2 - 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[1/2 x^3/b^2 - 1/8 x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

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



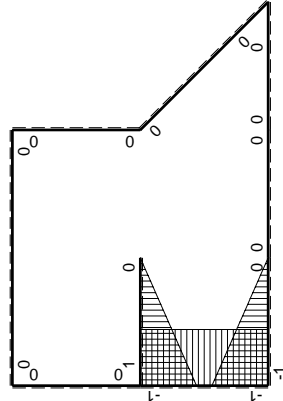
- A = 105.8 mm²
- J_u = 31122. mm⁴
- J_v = 2333. mm⁴
- J_t = 83.65 mm⁴
- y_o = 11.76 mm
- y_g = 24.69 mm
- N = 225. N
- T_y = 450. N
- M_x = 283500. Nmm
- x_m = 12. mm
- v_m = -24.69 mm
- σ_m = N/A - Mv/J_u = 227. N/mm²
- y_c = 3. mm
- u_c = -12. mm
- v_c = -21.69 mm
- σ_c = N/A - Mv/J_u = 227. N/mm²
- τ_c = TS_y/tJ_u = 7.71 N/mm²
- τ_g = TS_y/tJ_u = 7.71 N/mm²
- t_c = 450. mm
- σ_o = √σ² + 3τ² = 227.4 N/mm²





Schema di calcolo iperstatico

(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$	
AB b	0	$-1/2Fb+1/2Fx$	0	0	0	0	
BA b	0	$1/2Fx$	0	0	0	0	
BC b	0	$1/2Fx$	0	0	0	0	
CB b	0	$-1/2Fb+1/2Fx$	0	0	0	0	
CD $\sqrt{2}b$	0	$1/2Fb-\sqrt{2}/4Fx$	0	0	0	0	
DE b	0	0	0	0	0	0	
ED b	0	0	0	0	0	0	
EF 2b	0	$Fb-1/2Fx$	0	0	0	0	
FE 2b	0	$-1/2Fx$	0	0	0	0	
GA b	$-1+x/b$	$-1/2qx^2$	$1/2Fx^2/b-1/2qx^3/b$	$1-2x/b+x^2/b^2$	$1/24Fb^2/EJ$	$1/3Xb/EJ$	
AG b	x/b	$1/2Fb-Fx+1/2qx^2$	$1/2Fx^2/b+1/2qx^3/b$	x^2/b^2	$1/24Fb^2/EJ$	$1/3Xb/EJ$	
FH b	0	Fx	0	0	0	0	
HF b	0	$-Fb+Fx$	0	0	0	0	
HI b	$1-x/b$	$Fb-1/2Fx-1/2qx^2$	$Fb-3/2Fx+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$3/8Fb^2/EJ$	$1/3Xb/EJ$	
IH b	$-x/b$	$-3/2Fx+1/2qx^2$	$3/2Fx^2/b-1/2qx^3/b$	x^2/b^2	$3/8Fb^2/EJ$	$1/3Xb/EJ$	
HG b	-1	0	0	1	0	Xb/EJ	
GH b	1	0	0	1	0	Xb/EJ	
HG	elongazione asta $N_{1HG}^{\pm HG} \pm HG$						
A	molla nodo $-V_{1A}(V_{GA}+XV_{1A})/k_A$						
	totali						
	iperstatica X=W _{GA}						

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

$$L_{GH}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{GA}^{x_0} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[1/6 x^3/b^2 - 1/8 x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/6 b - 1/8 b) \cdot Fb \cdot 1/EJ = 1/24 \cdot Fb^2/EJ$$

$$L_{AG}^{x_0} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

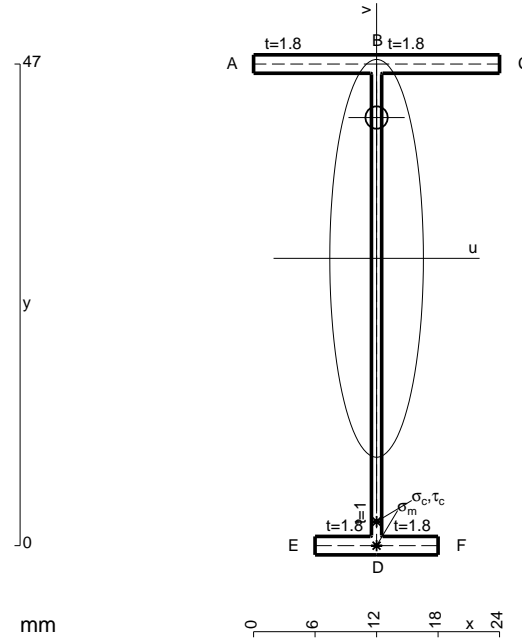
$$= (1/4 b - 1/3 b + 1/8 b) \cdot Fb \cdot 1/EJ = 1/24 \cdot Fb^2/EJ$$

$$L_{HI}^{x_0} = \int_0^b (1 - 3/2 x/b + 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[x - 3/4 x^2/b + 1/8 x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

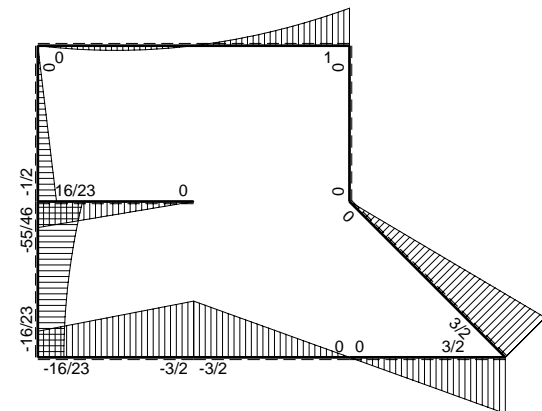
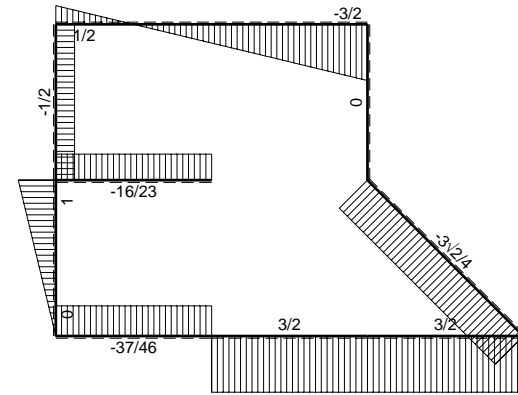
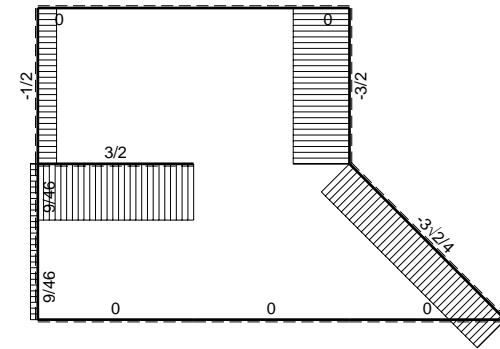
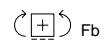
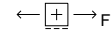
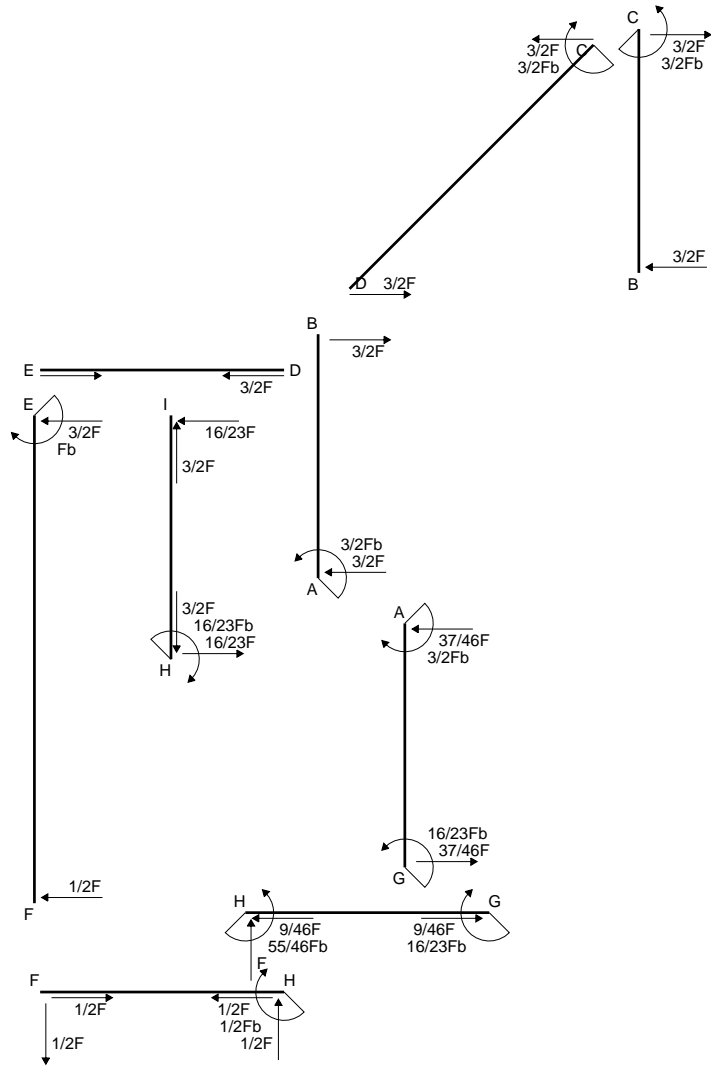
$$= (b - 3/4 b + 1/8 b) \cdot Fb \cdot 1/EJ = 3/8 \cdot Fb^2/EJ$$

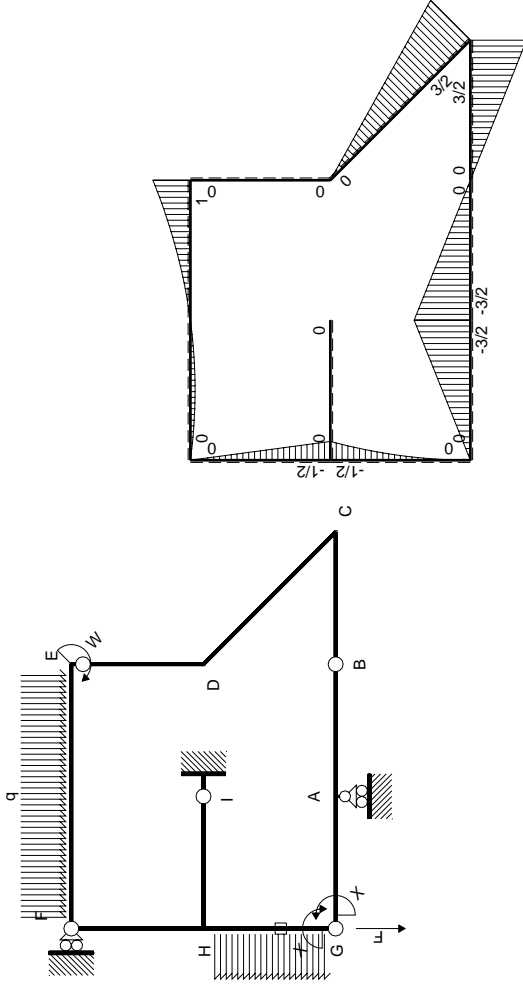
$$L_{IH}^{x_0} = \int_0^b (3/2 x^2/b^2 - 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[1/2 x^3/b^2 - 1/8 x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/8 b) \cdot Fb \cdot 1/EJ = 3/8 \cdot Fb^2/EJ$$

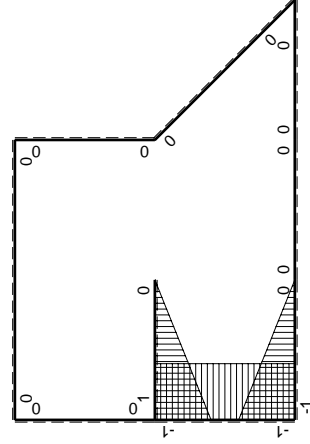


- A = 111.8 mm²
- J_u = 42133. mm⁴
- J_v = 2333. mm⁴
- J_t = 85.65 mm⁴
- y_o = 13.74 mm
- y_g = 28.04 mm
- N = 235. N
- T_y = 470. N
- M_x = 357200. Nmm
- x_m = 12. mm
- v_m = -28.04 mm
- σ_m = N/A - Mv/J_u = 239.8 N/mm²
- y_c = 3. mm
- u_c = -12. mm
- v_c = -25.04 mm
- σ_c = N/A - Mv/J_u = 239.8 N/mm²
- τ_c = TS_t/tJ_u = 6.756 N/mm²
- τ_g = TS_t/tJ_u = 6.756 N/mm²
- t_c = 470. mm
- σ_o = √σ² + 3τ² = 240.1 N/mm²





M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-3/2Fb+3/2Fx$	0	0	0	0
BA b	0	$3/2Fx$	0	0	0	0
BC b	0	$3/2Fx$	0	0	0	0
CB b	0	$-3/2Fb+3/2Fx$	0	0	0	0
CD $\sqrt{2}b$	0	$3/2Fb-3\sqrt{2}/4Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	$Fb-3/2Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$1/2Fx-1/2qx^2$	0	0	0	0
GA b	$-1+x/b$	$-3/2Fx$	$3/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/4Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$3/2Fb-3/2Fx$	$3/2Fx-3/2Fx^2/b$	x^2/b^2		
FH b	0	$-1/2Fx$	0	0	0	0
HF b	0	$1/2Fb-1/2Fx$	0	0	0	0
HI b	$1-x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
IH b	$-x/b$	0	0	x^2/b^2	0	
HG b	-1	$-1/2Fb+Fx-1/2qx^2$	$1/2Fb-Fx+1/2Fx^2/b$	1	$1/6Fb^2/EJ$	Xb/EJ
GH b	1	$1/2qx^2$	$1/2Fx^2/b$	1		
HG	elongazione asta $N_{1HG^{\pm HG}} \pm HG$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$				$-3/4Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-4/3Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica X=W _{GA}				$16/23Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

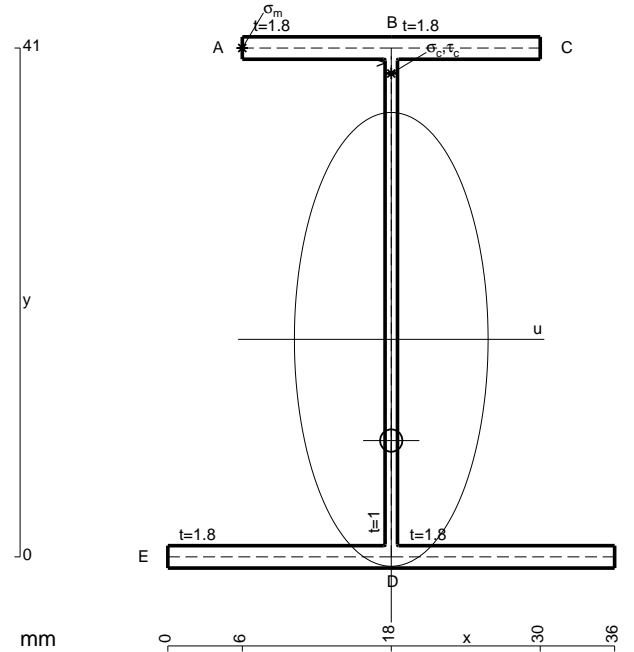
$$L_{HG}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

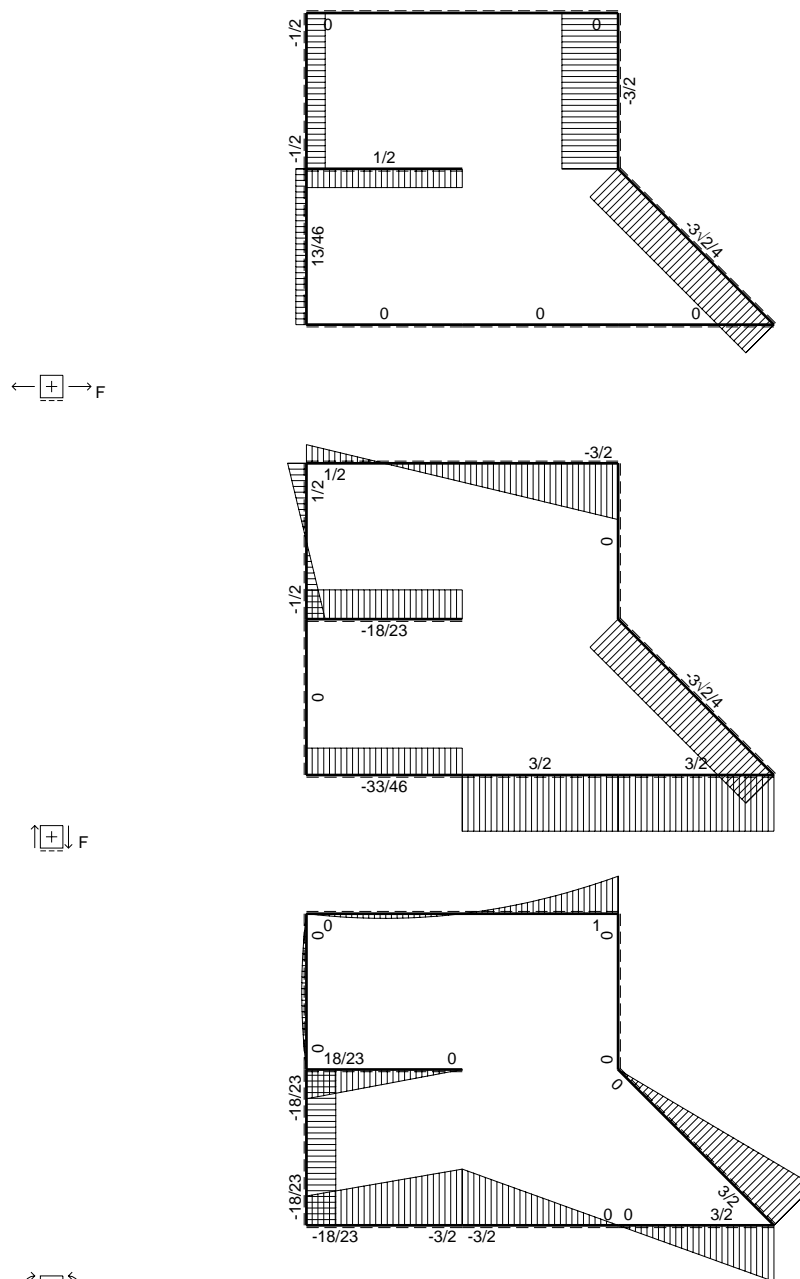
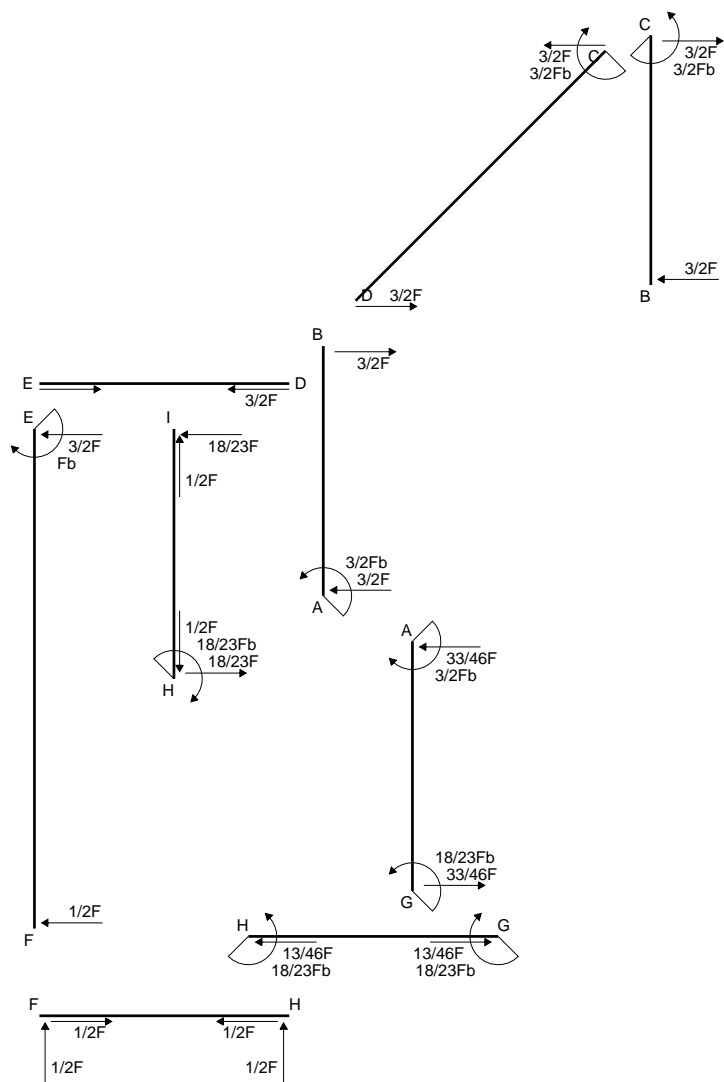
$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/6 Fb^2/EJ$$

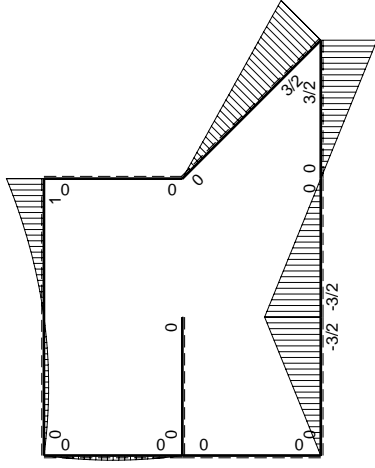
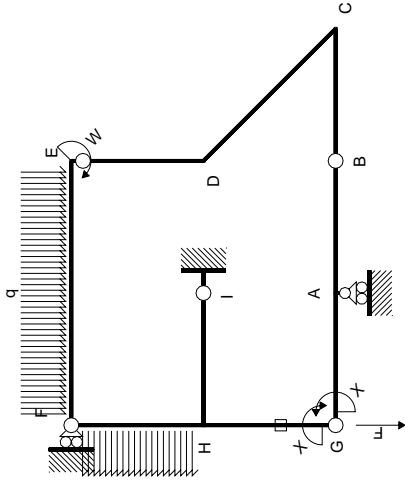
$$L_{GH}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/6 Fb^2/EJ$$

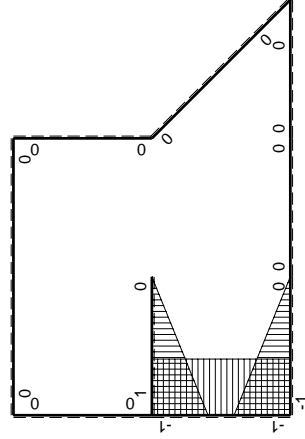


- A = 149. mm²
- J_u = 49815. mm⁴
- J_v = 9072. mm⁴
- J_i = 130.3 mm⁴
- y_o = -8.157 mm
- y_g = 17.53 mm
- T_y = 1200. N
- M_x = -42000. Nmm
- x_m = 6. mm
- y_m = 41. mm
- u_m = -12. mm
- v_m = 23.47 mm
- σ_m = -Mv/J_u = 197.9 N/mm²
- x_c = 18. mm
- y_c = 41. mm
- v_c = 23.47 mm
- σ_c = -Mv/J_u = 197.9 N/mm²
- τ_c = TS_y/tJ_u = 24.43 N/mm²
- τ_g = TS_y/tJ_u = 24.43 N/mm²
- t_c = 800. mm
- σ_o = √σ²+3τ² = 202.4 N/mm²





(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-3/2Fb+3/2Fx$	0	0	0	0
BA b	0	$3/2Fx$	0	0	0	0
BC b	0	$3/2Fx$	0	0	0	0
CB b	0	$-3/2Fb+3/2Fx$	0	0	0	0
CD $\sqrt{2}b$	0	$3/2Fb-3\sqrt{2}/4Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	$Fb-3/2Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$1/2Fx-1/2qx^2$	0	0	0	0
GA b	$-1+x/b$	$-3/2Fx$	$3/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/4Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$3/2Fb-3/2Fx$	$3/2Fx-3/2Fx^2/b$	x^2/b^2	0	0
FH b	0	$1/2Fx-1/2qx^2$	0	0	0	0
HF b	0	$-1/2Fx+1/2qx^2$	0	0	0	0
HI b	$1-x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
IH b	$-x/b$	0	0	x^2/b^2	0	0
HG b	-1	0	0	1	0	Xb/EJ
GH b	1	0	0	1	0	0
HG	elongazione asta $N_{1HG^{\pm}HG^{\mp}HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{GA}+XV_{1A})/k_A$				$-3/4Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-3/2Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$18/23Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

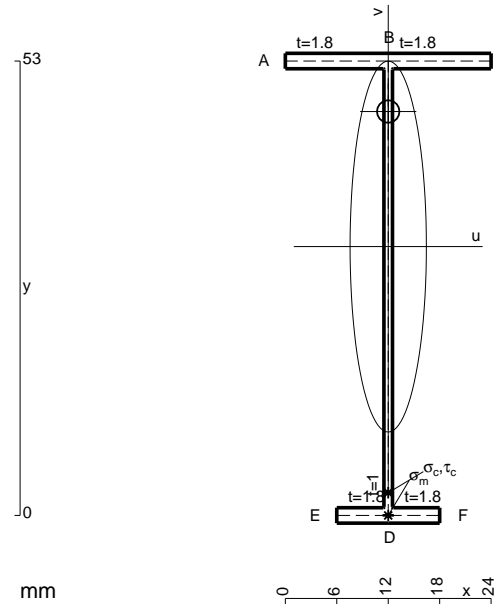
$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[3/4 x^2/b - 1/2 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

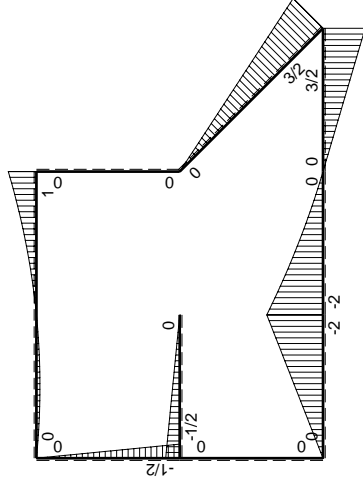
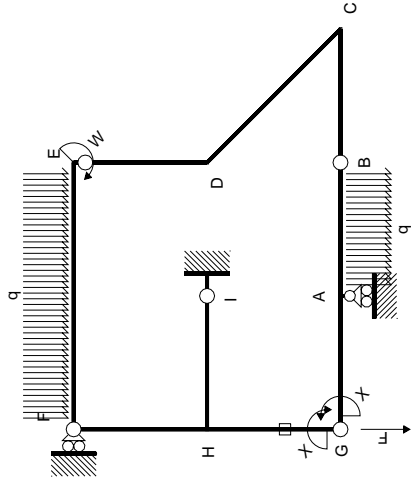
$$= (3/4 b - 1/2 b) \cdot Fb \cdot 1/EJ = 1/4 \cdot Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[3/4 x^2/b - 1/2 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

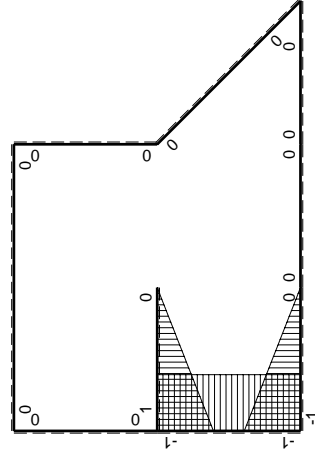
$$= (3/4 b - 1/2 b) \cdot Fb \cdot 1/EJ = 1/4 \cdot Fb^2/EJ$$



- A = 117.8 mm²
- J_u = 55131. mm⁴
- J_v = 2333. mm⁴
- J_i = 87.65 mm⁴
- y_o = 15.75 mm
- y_g = 31.36 mm
- T_y = 750. N
- M_x = -367500. Nmm
- x_m = 12. mm
- v_m = -31.36 mm
- σ_m = -Mv/J_u = -209. N/mm²
- y_c = 3. mm
- u_c = -12. mm
- v_c = -28.36 mm
- σ_c = -Mv/J_u = -209. N/mm²
- τ_c = TS_i/t_u = 9.215 N/mm²
- τ_g = TS_i/t_u = 9.215 N/mm²
- t_c = 500. mm
- σ_o = √(σ² + 3τ²) = 209.6 N/mm²



(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-2Fb+5/2Fx-1/2qx^2$	0	0	0	0
BA b	0	$3/2Fx+1/2qx^2$	0	0	0	0
BC b	0	$3/2Fx$	0	0	0	0
CB b	0	$-3/2Fb+3/2Fx$	0	0	0	0
CD $\sqrt{2}b$	0	$3/2Fb-3\sqrt{2}/4Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	$Fb-3/2Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$1/2Fx-1/2qx^2$	0	0	0	0
GA b	$-1+x/b$	$-2Fx$	$2Fx-2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/3Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$2Fb-2Fx$	$2Fx-2Fx^2/b$	x^2/b^2	$1/3Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$-1/2Fx$	0	0	0	0
HF b	0	$1/2Fb-1/2Fx$	0	0	0	0
HI b	$1-x/b$	$-1/2Fb+1/2Fx$	$-1/2Fb+Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$1/2Fx$	$-1/2Fx^2/b$	x^2/b^2	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	0	0	1	0	Xb/EJ
GH b	1	0	0	1	0	Xb/EJ
HG	elongazione asta $N_{1HG}^{\pm HG} \pm HG$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{0A}+XV_{1A})/k_A$				$-9/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-47/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica X=W _{GA}				$47/46Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{x_0} = \int_0^b (2x/b - 2x^2/b^2) Fb 1/EJ dx = [x^2/b - 2/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 2/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{AG}^{x_0} = \int_0^b (2x/b - 2x^2/b^2) Fb 1/EJ dx = [x^2/b - 2/3 x^3/b^2]_0^b Fb 1/EJ$$

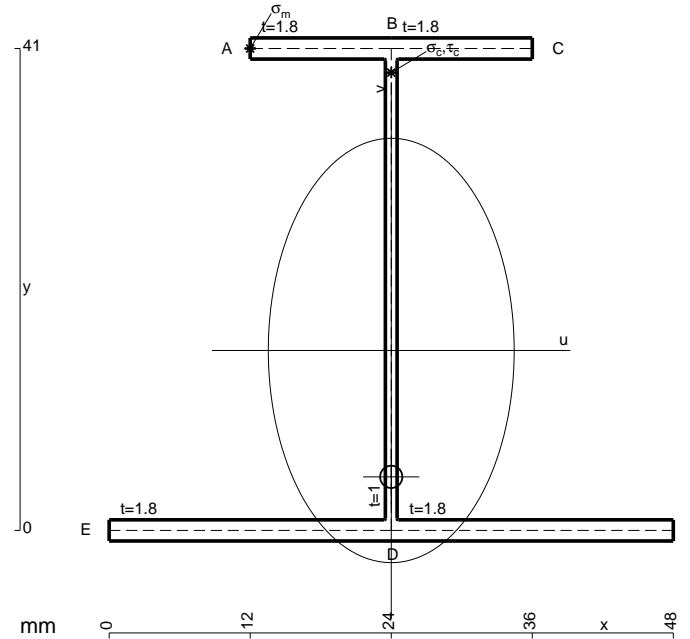
$$= (b - 2/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{HI}^{x_0} = \int_0^b (-1/2 + x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + 1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

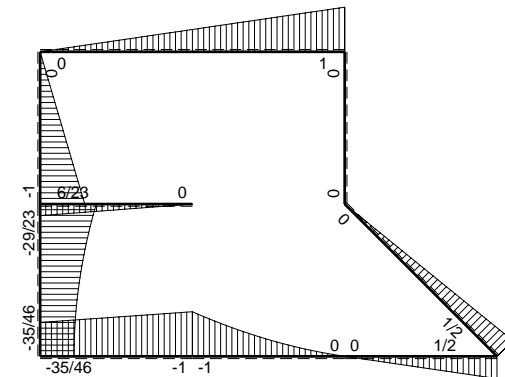
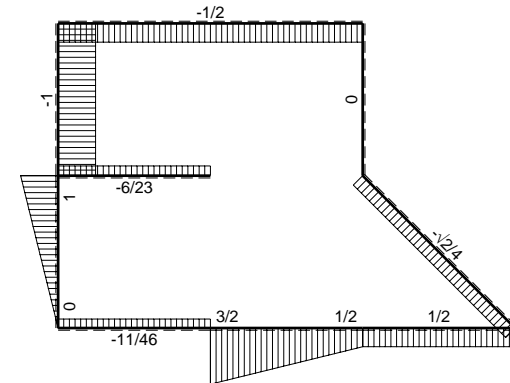
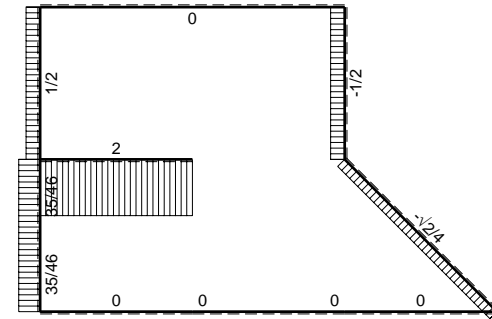
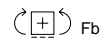
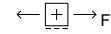
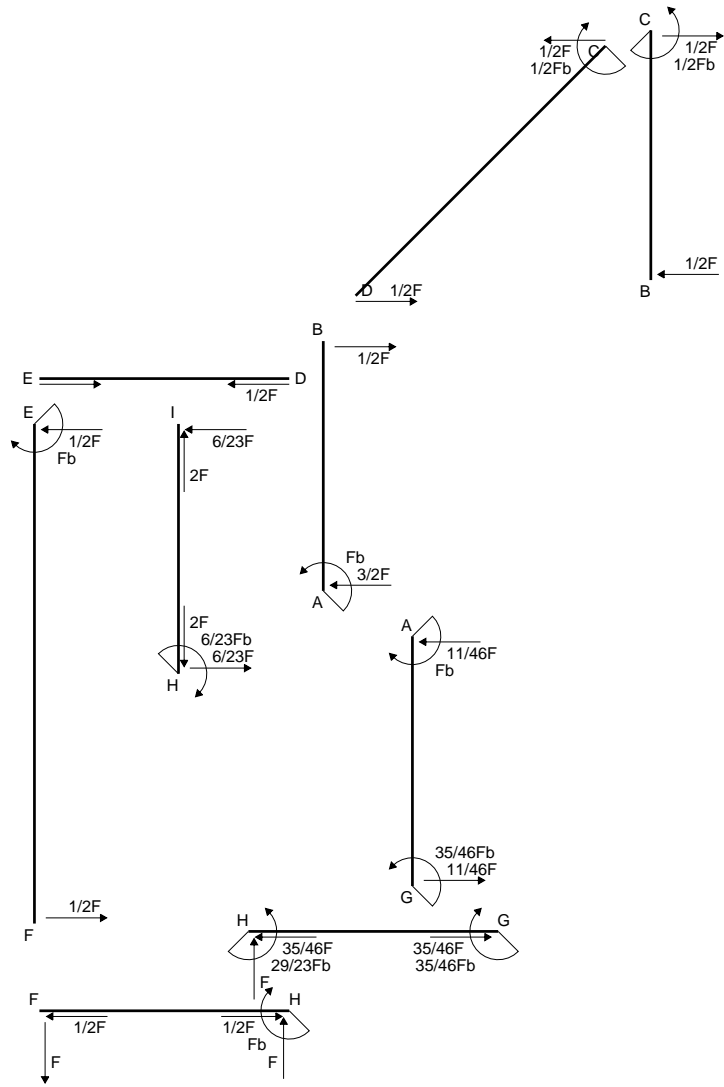
$$= (-1/2 b + 1/2 b - 1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

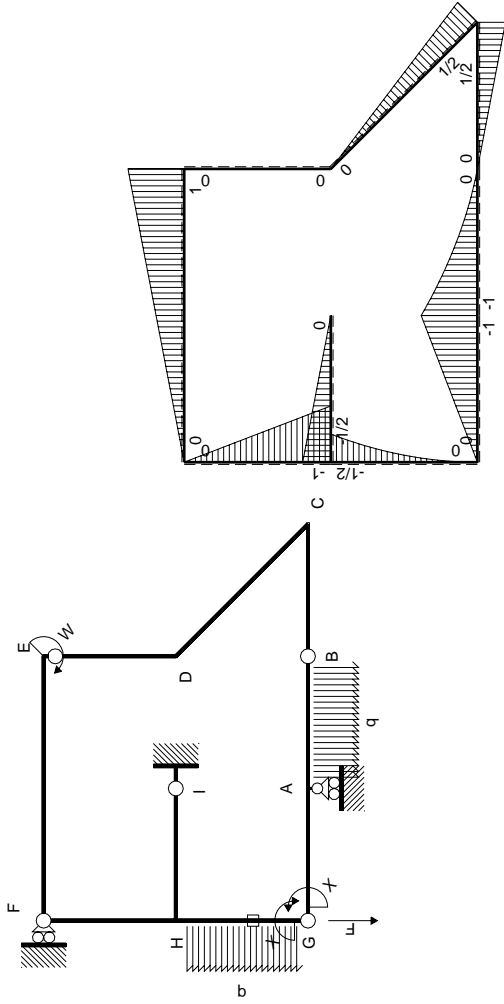
$$L_{IH}^{x_0} = \int_0^b (-1/2 x^2/b^2) Fb 1/EJ dx = [-1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

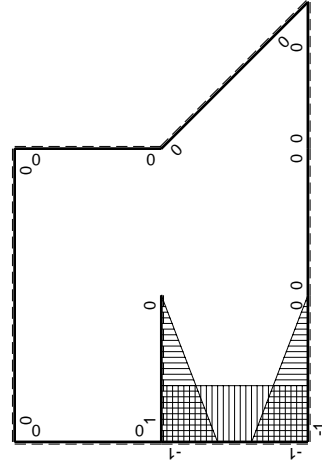


- A = 170.6 mm²
- J_u = 55611. mm⁴
- J_v = 18662. mm⁴
- J_i = 153.6 mm⁴
- y_o = -10.75 mm
- y_g = 15.31 mm
- T_y = 1400. N
- M_x = -470400. Nmm
- x_m = 12. mm
- y_m = 41. mm
- u_m = -12. mm
- v_m = 25.69 mm
- σ_m = -Mv/J_u = 217.3 N/mm²
- x_c = 24. mm
- y_c = 41. mm
- v_c = 25.69 mm
- σ_c = -Mv/J_u = 217.3 N/mm²
- τ_c = TS'/tJ_u = 27.94 N/mm²
- τ_g = TS'/tJ_u = 27.94 N/mm²
- t_c = 560. mm
- σ_o = √(σ²+3τ²) = 222.6 N/mm²





M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-Fb+3/2Fx-1/2qx^2$	0	0	0	0
BA b	0	$1/2Fx+1/2qx^2$	0	0	0	0
BC b	0	$1/2Fx$	0	0	0	0
CB b	0	$-1/2Fb+1/2Fx$	0	0	0	0
CD $\sqrt{2}b$	0	$1/2Fb-1/24Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	$Fb-1/2Fx$	0	0	0	0
FE 2b	0	$-1/2Fx$	0	0	0	0
GA b	$-1+x/b$	$-Fx$	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$Fb-Fx$	$Fx-Fx^2/b$	x^2/b^2		
FH b	0	$-Fx$	0	0	0	0
HF b	0	$Fb-Fx$	0	0	0	0
HI b	$1-x/b$	$-1/2Fb+1/2Fx$	$-1/2Fb+Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$1/2Fx$	$-1/2Fx^2/b$	x^2/b^2		
HG b	-1	$-1/2Fb+Fx-1/2qx^2$	$1/2Fb-Fx+1/2Fx^2/b$	1	$1/6Fb^2/EJ$	Xb/EJ
GH b	1	$1/2qx^2$	$1/2Fx^2/b$	1		
HG	elongazione asta $N_{1HG^{\pm}HG^{\pm}HG}$					
A	molla nodo $-V_{1A}(V_{GA}+XV_{1A})/k_A$					
	totali					
	iperstatica $X=W_{GA}$					
	35/46Fb					

Sviluppi di calcolo iperstatica

M_x flessione da iperstatica $X=1$

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (-1/2 + x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + 1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + 1/2 b - 1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (-1/2 x^2/b^2) Fb 1/EJ dx = [-1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

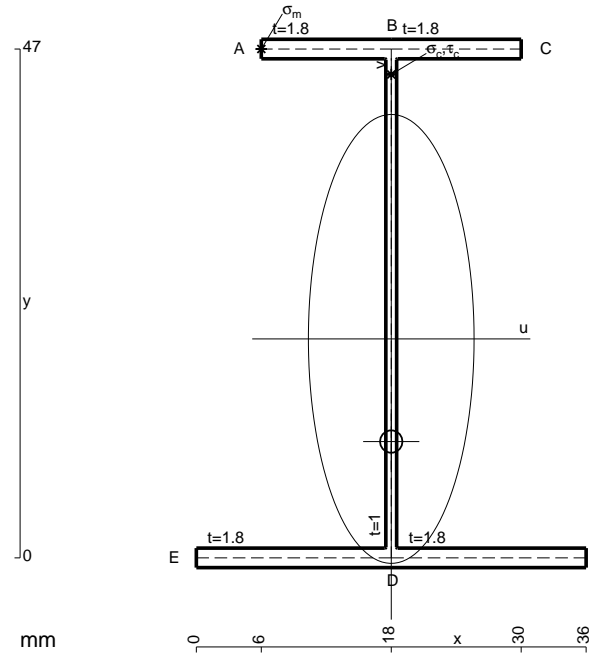
$$L_{HG}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

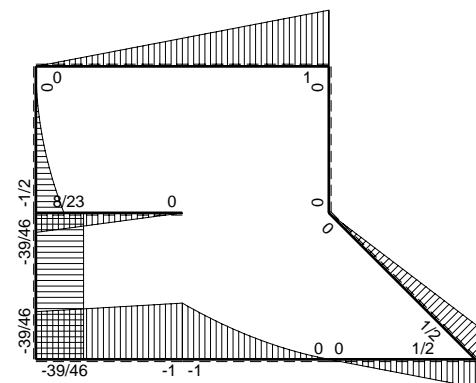
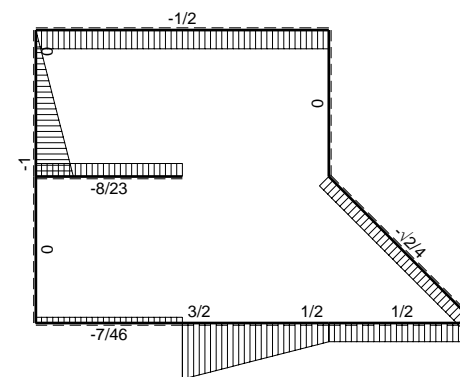
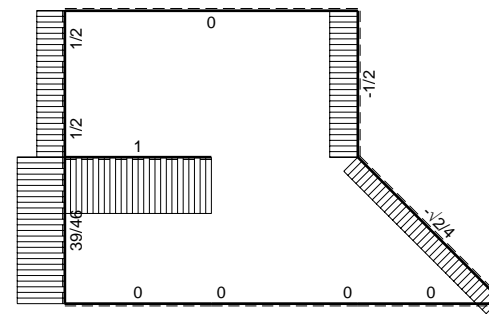
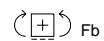
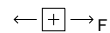
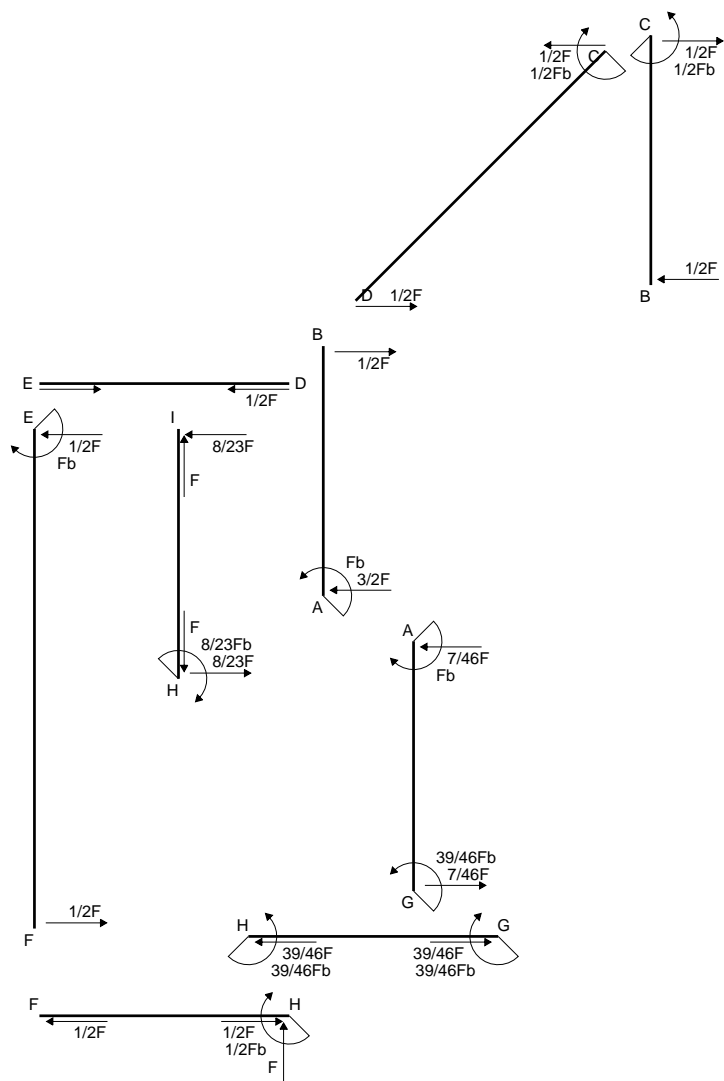
$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/6 Fb^2/EJ$$

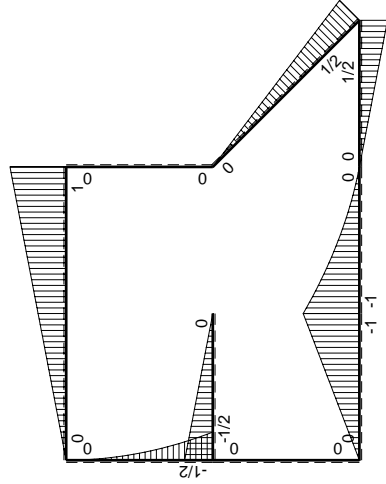
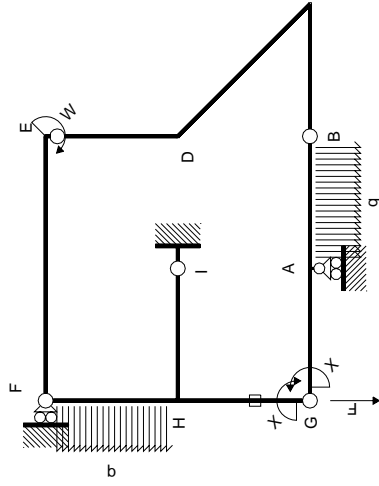
$$L_{GH}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/6 Fb^2/EJ$$

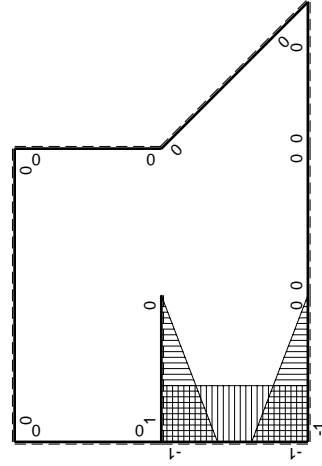


- A = 155. mm²
- J_u = 66633. mm⁴
- J_v = 9072. mm⁴
- J_i = 132.3 mm⁴
- y_o = -9.482 mm
- y_g = 20.23 mm
- T_y = 1650. N
- M_x = -572000. Nmm
- x_m = 6. mm
- y_m = 47. mm
- u_m = -12. mm
- v_m = 26.77 mm
- σ_m = -Mv/J_u = 229.8 N/mm²
- x_c = 18. mm
- y_c = 47. mm
- v_c = 26.77 mm
- σ_c = -Mv/J_u = 229.8 N/mm²
- τ_c = TS_y/J_u = 28.64 N/mm²
- τ_g = TS_y/J_u = 28.64 N/mm²
- t_c = 1100. mm
- σ_o = √(σ²+3τ²) = 235.1 N/mm²





M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-Fb+3/2Fx-1/2qx^2$	0	0	0	0
BA b	0	$1/2Fx+1/2qx^2$	0	0	0	0
BC b	0	$1/2Fx$	0	0	0	0
CB b	0	$-1/2Fb+1/2Fx$	0	0	0	0
CD $\sqrt{2}b$	0	$1/2Fb-1/24Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	$Fb-1/2Fx$	0	0	0	0
FE 2b	0	$-1/2Fx$	0	0	0	0
GA b	$-1+x/b$	$-Fx$	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$Fb-Fx$	$Fx-Fx^2/b$	x^2/b^2	$1/6Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$-1/2qx^2$	0	0	0	0
HF b	0	$1/2Fb-Fx+1/2qx^2$	0	0	0	0
HI b	$1-x/b$	$-1/2Fb+1/2Fx$	$-1/2Fb+Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$1/2Fx$	$-1/2Fx^2/b$	x^2/b^2	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	0	0	1	0	Xb/EJ
GH b	1	0	0	1	0	Xb/EJ
HG	elongazione asta $N_{1HG^{\pm HG}} \pm HG$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{0A}+XV_{1A})/k_A$				$-5/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-13/8Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica X=W _{GA}				$39/46Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

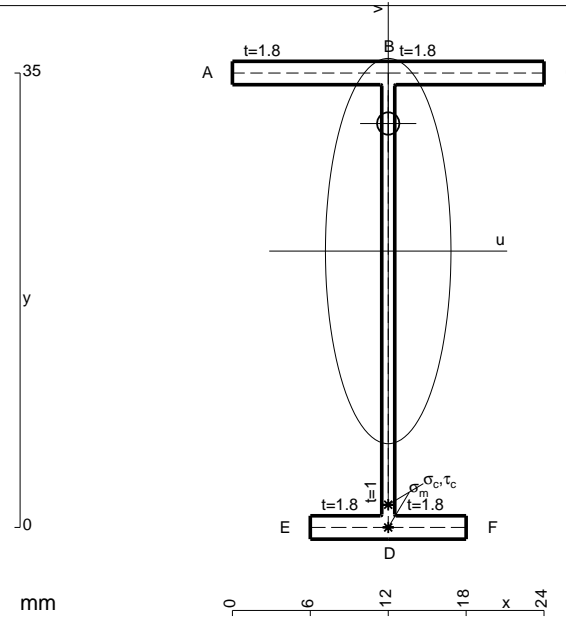
$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (-1/2 + x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + 1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

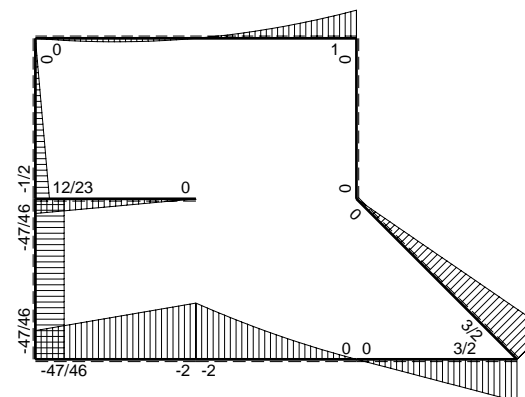
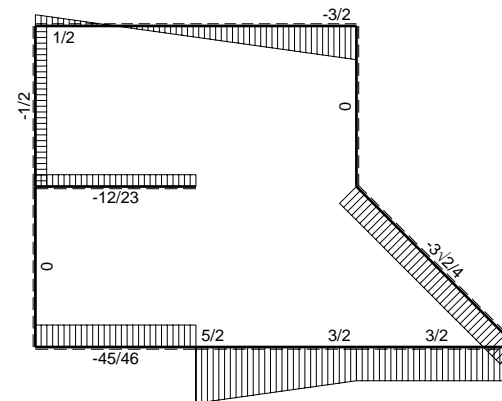
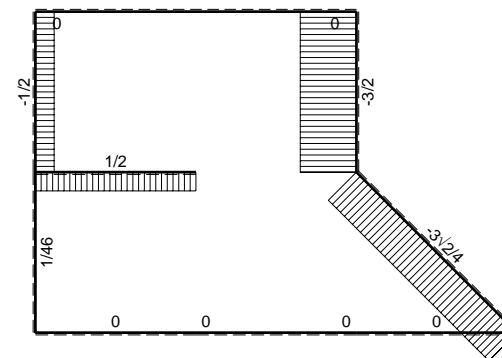
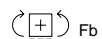
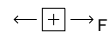
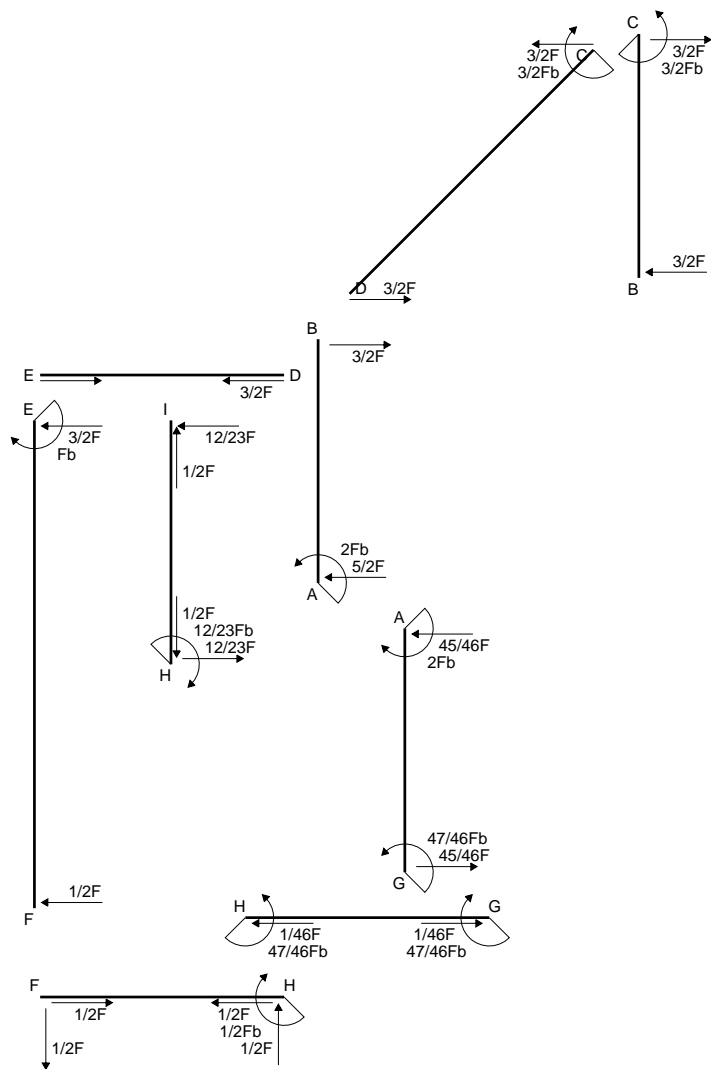
$$= (-1/2 b + 1/2 b - 1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

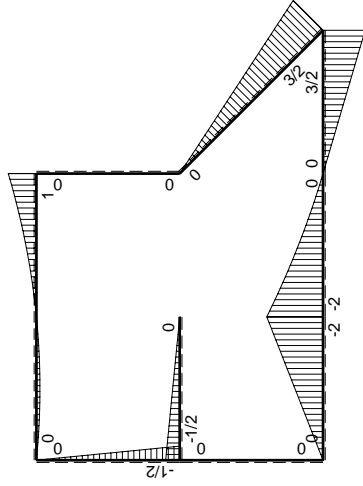
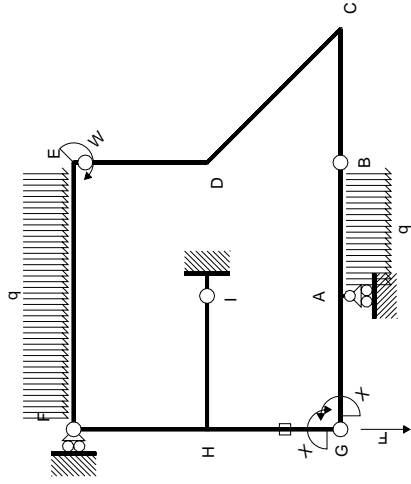
$$L_{IH}^{xo} = \int_0^b (-1/2 x^2/b^2) Fb 1/EJ dx = [-1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

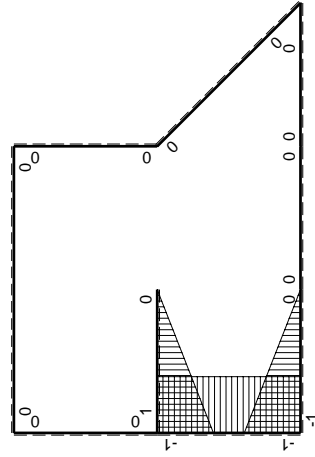


- A = 99.8 mm²
- J_u = 21986. mm⁴
- J_v = 2333. mm⁴
- J_i = 81.65 mm⁴
- y_o = 9.824 mm
- y_g = 21.29 mm
- T_y = 885. N
- M_x = -247800. Nmm
- x_m = 12. mm
- v_m = -21.29 mm
- σ_m = -Mv/J_u = -239.9 N/mm²
- y_c = 3. mm
- u_c = -12. mm
- v_c = -18.29 mm
- σ_c = -Mv/J_u = -239.9 N/mm²
- τ_c = TS'/tJ_u = 18.51 N/mm²
- τ_g = TS'/tJ_u = 18.51 N/mm²
- t_c = 590. mm
- σ_o = √σ²+3τ² = 242.1 N/mm²





M₀ flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	M _x (x)	M ₀ (x)	M _x M ₀	M _x M _x	∫M _x M ₀ /EJdx	∫XM _x M _x /EJdx
AB b	0	-2Fb+5/2Fx-1/2qx ²	0	0	0	0
BA b	0	3/2Fx+1/2qx ²	0	0	0	0
BC b	0	3/2Fx	0	0	0	0
CB b	0	-3/2Fb+3/2Fx	0	0	0	0
CD √2b	0	3/2Fb-3√2/4Fx	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	Fb-3/2Fx+1/2qx ²	0	0	0	0
FE 2b	0	1/2Fx-1/2qx ²	0	0	0	0
GA b	-1+x/b	-2Fx	2Fx-2Fx ² /b	1-2x/b+x ² /b ²	1/3Fb ² /EJ	1/3Xb/EJ
AG b	x/b	2Fb-2Fx	2Fx-2Fx ² /b	x ² /b ²	1/3Fb ² /EJ	1/3Xb/EJ
FH b	0	-1/2Fx	0	0	0	0
HF b	0	1/2Fb-1/2Fx	0	0	0	0
HI b	1-x/b	-1/2Fb+1/2Fx	-1/2Fb+Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	-1/6Fb ² /EJ	1/3Xb/EJ
IH b	-x/b	1/2Fx	-1/2Fx ² /b	x ² /b ²	-1/6Fb ² /EJ	1/3Xb/EJ
HG b	-1	0	0	1	0	Xb/EJ
GH b	1	0	0	1	0	Xb/EJ
HG	elongazione asta N _{1HG} ^{±HG} -HG				-Fb ² /EJ	
A	molla nodo -V _{1A} (V _{GA} +XV _{1A})/k _A				-9/8Fb ² /EJ	1/4Xb/EJ
	totali				-47/24Fb ² /EJ	23/12Xb/EJ
	iperstatica X=W _{GA}				47/46Fb	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (2x/b - 2x^2/b^2) Fb 1/EJ dx = [x^2/b - 2/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 2/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (2x/b - 2x^2/b^2) Fb 1/EJ dx = [x^2/b - 2/3 x^3/b^2]_0^b Fb 1/EJ$$

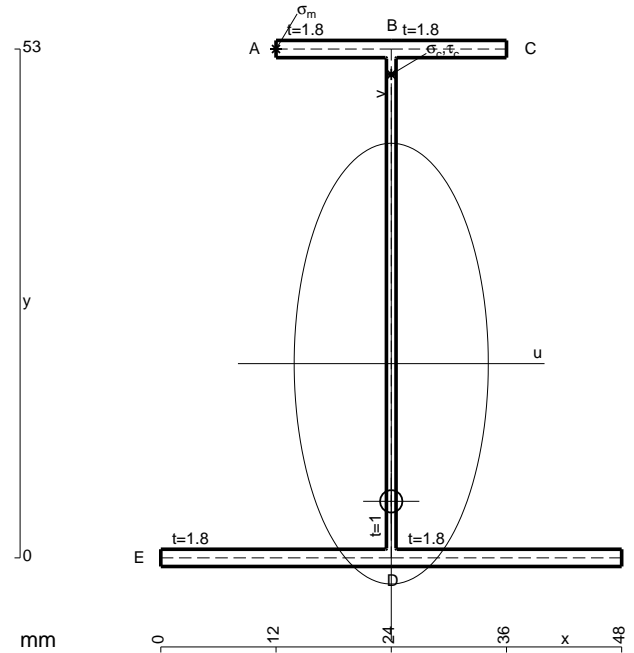
$$= (b - 2/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (-1/2 + x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + 1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

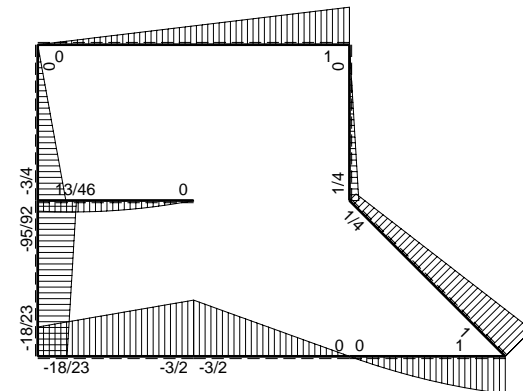
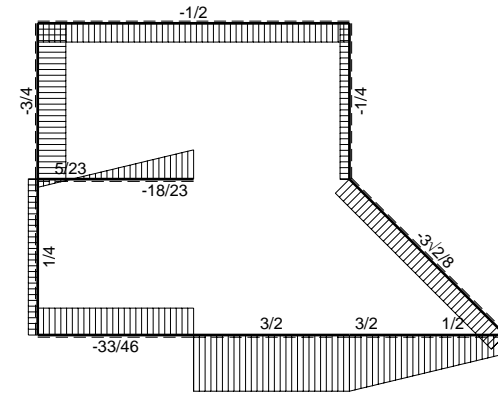
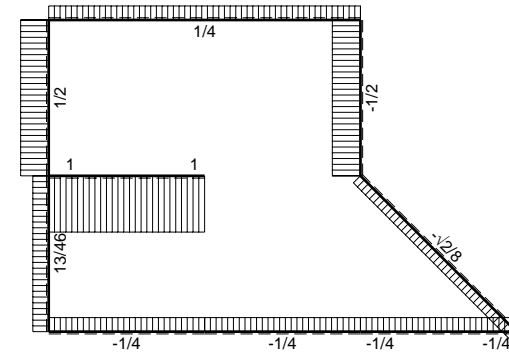
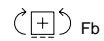
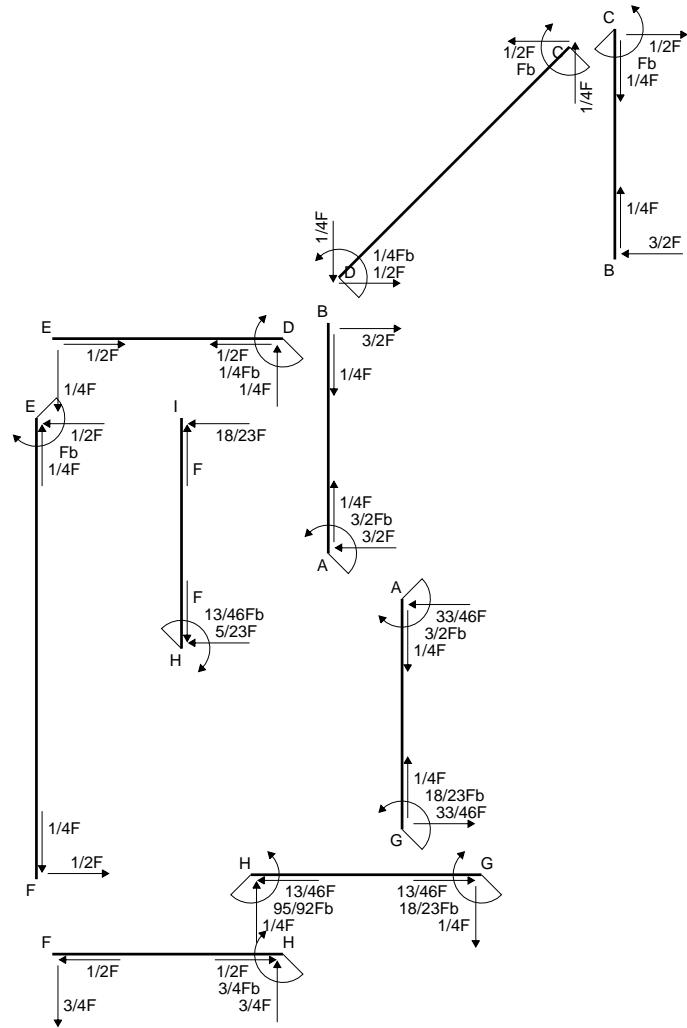
$$= (-1/2 b + 1/2 b - 1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

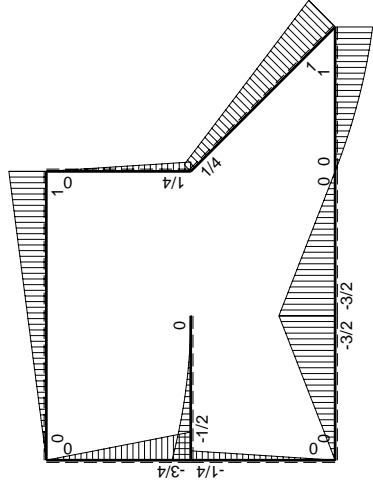
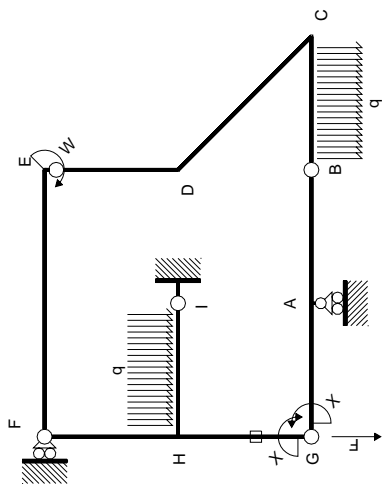
$$L_{IH}^{xo} = \int_0^b (-1/2 x^2/b^2) Fb 1/EJ dx = [-1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

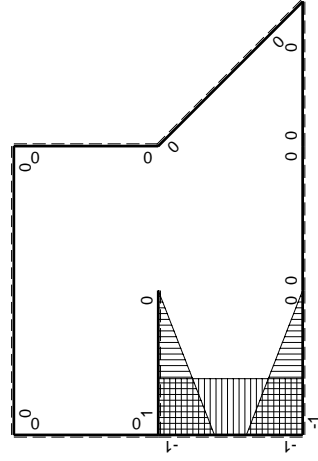


- A = 182.6 mm²
- J_u = 96241. mm⁴
- J_v = 18662. mm⁴
- J_i = 157.6 mm⁴
- y_o = -14.34 mm
- y_g = 20.23 mm
- T_y = 1075. N
- M_x = -576200. Nmm
- x_m = 12. mm
- y_m = 53. mm
- u_m = -12. mm
- v_m = 32.77 mm
- σ_m = -Mv/J_u = 196.2 N/mm²
- x_c = 24. mm
- y_c = 53. mm
- v_c = 32.77 mm
- σ_c = -Mv/J_u = 196.2 N/mm²
- τ_c = TS'/tJ_u = 15.81 N/mm²
- τ_g = TS'/tJ_u = 15.81 N/mm²
- t_c = 430. mm
- σ_o = √σ²+3τ² = 198.1 N/mm²





M_0 , flessione da carichi assegnati



M_x , flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

→	$M_x(x)$	$M_o(x)$	$M_x M_o$	$M_x M_x$	$\int M_x M_o / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	$-3/2Fb+3/2Fx$	0	0	0	0
BA b	0	$3/2Fx$	0	0	0	0
BC b	0	$3/2Fx-1/2qx^2$	0	0	0	0
CB b	0	$-Fb+1/2Fx+1/2qx^2$	0	0	0	0
CD $\sqrt{2}b$	0	$Fb-3\sqrt{2}/8Fx$	0	0	0	0
DE b	0	$1/4Fb-1/4Fx$	0	0	0	0
ED b	0	$-1/4Fx$	0	0	0	0
EF 2b	0	$Fb-1/2Fx$	0	0	0	0
FE 2b	0	$-1/2Fx$	0	0	0	0
GA b	$-1+x/b$	$-3/2Fx$	$3/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/4Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$3/2Fb-3/2Fx$	$3/2Fx-3/2Fx^2/b$	x^2/b^2		
FH b	0	$-3/4Fx$	0	0	0	0
HF b	0	$3/4Fb-3/4Fx$	0	0	0	0
HI b	$1-x/b$	$-1/2Fb+Fx-1/2qx^2$	$-1/2Fb+3/2Fx-3/2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$-1/8Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$1/2qx^2$	$-1/2qx^3/b$	x^2/b^2		
HG b	-1	$-1/4Fb+1/4Fx$	$1/4Fb-1/4Fx$	1	$1/8Fb^2/EJ$	Xb/EJ
GH b	1	$1/4Fx$	$1/4Fx$	1		
HG	elongazione asta $N_{1HG} \epsilon_{HG} L_{HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{oA}+XV_{1A})/k_A$				$-3/4Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-3/2Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$18/23Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (-1/2 + 3/2 x/b - 3/2 x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx$$

$$= [-1/2 x + 3/4 x^2/b - 1/2 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (-1/2 b + 3/4 b - 1/2 b + 1/8 b) Fb 1/EJ = -1/8 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (-1/2 x^3/b^3) Fb 1/EJ dx = [-1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (-1/8 b) Fb 1/EJ = -1/8 Fb^2/EJ$$

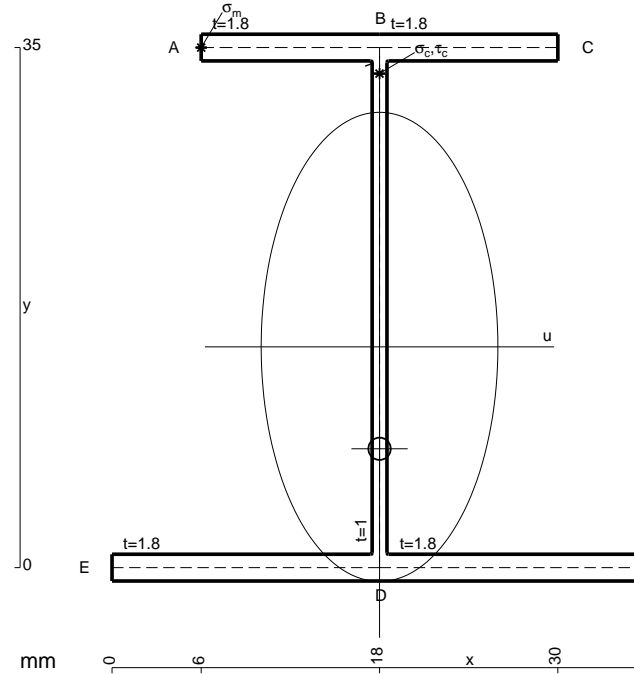
$$L_{HG}^{xo} = \int_0^b (1/4 - 1/4 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/4 x - 1/8 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

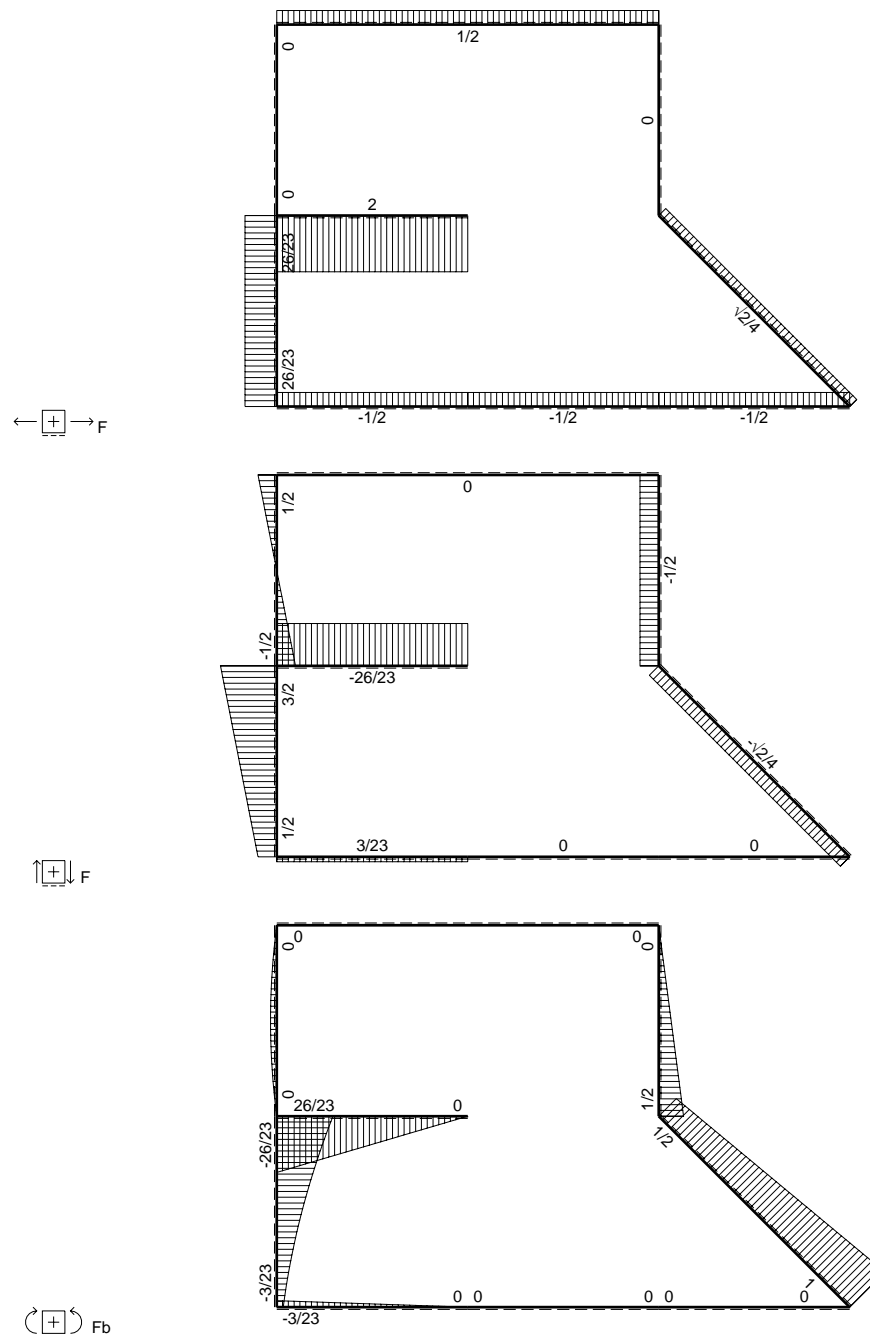
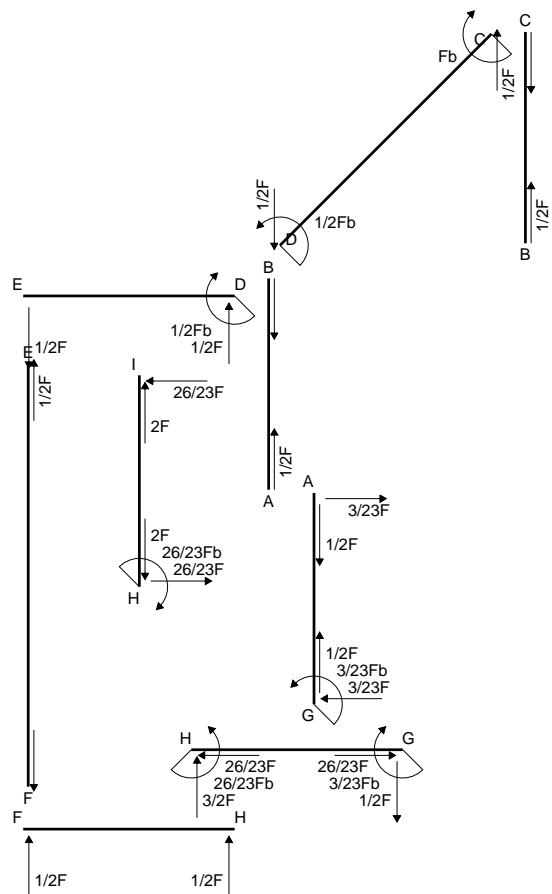
$$= (1/4 b - 1/8 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -7/8 Fb^2/EJ$$

$$L_{GH}^{xo} = \int_0^b (1/4 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/8 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/8 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -7/8 Fb^2/EJ$$



- A = 143. mm²
- J_u = 35649. mm⁴
- J_v = 9072. mm⁴
- J_t = 128.3 mm⁴
- y_o = -6.857 mm
- y_g = 14.86 mm
- N = -127.5 N
- T_y = 765. N
- M_x = -367200. Nmm
- x_m = 6. mm
- y_m = 35. mm
- u_m = -12. mm
- v_m = 20.14 mm
- σ_m = N/A - Mv/J_u = 206.6 N/mm²
- x_c = 18. mm
- y_c = 35. mm
- v_c = 20.14 mm
- σ_c = N/A - Mv/J_u = 206.6 N/mm²
- τ_c = TS'/tJ_u = 18.67 N/mm²
- τ_g = TS'/tJ_u = 18.67 N/mm²
- t_c = 510. mm
- σ_o = √(σ² + 3τ²) = 209.1 N/mm²



$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{HI}^{x_0} = \int_0^b (1 - 2x/b + x^2/b^2) Fb 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - b + 1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{IH}^{x_0} = \int_0^b (x^2/b^2) Fb 1/EJ dx = [1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{HG}^{x_0} = \int_0^b (1 - 3/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

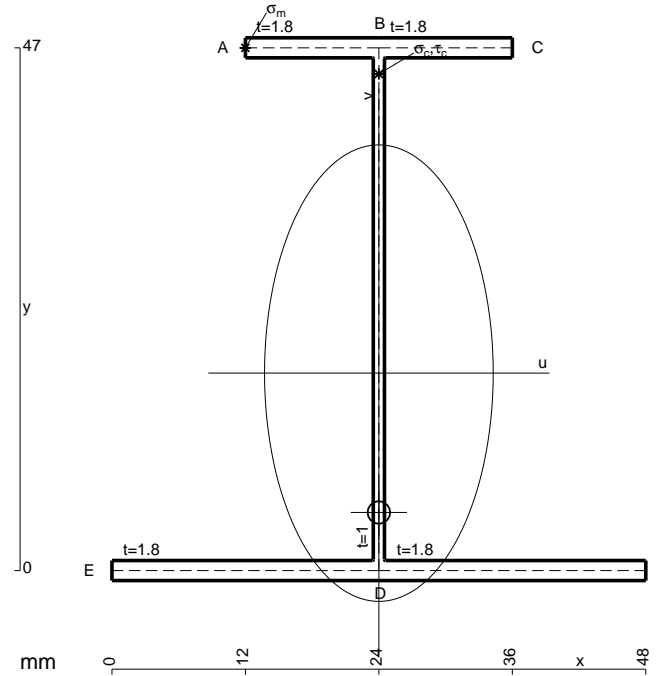
$$= [x - 3/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (b - 3/4 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -7/12 Fb^2/EJ$$

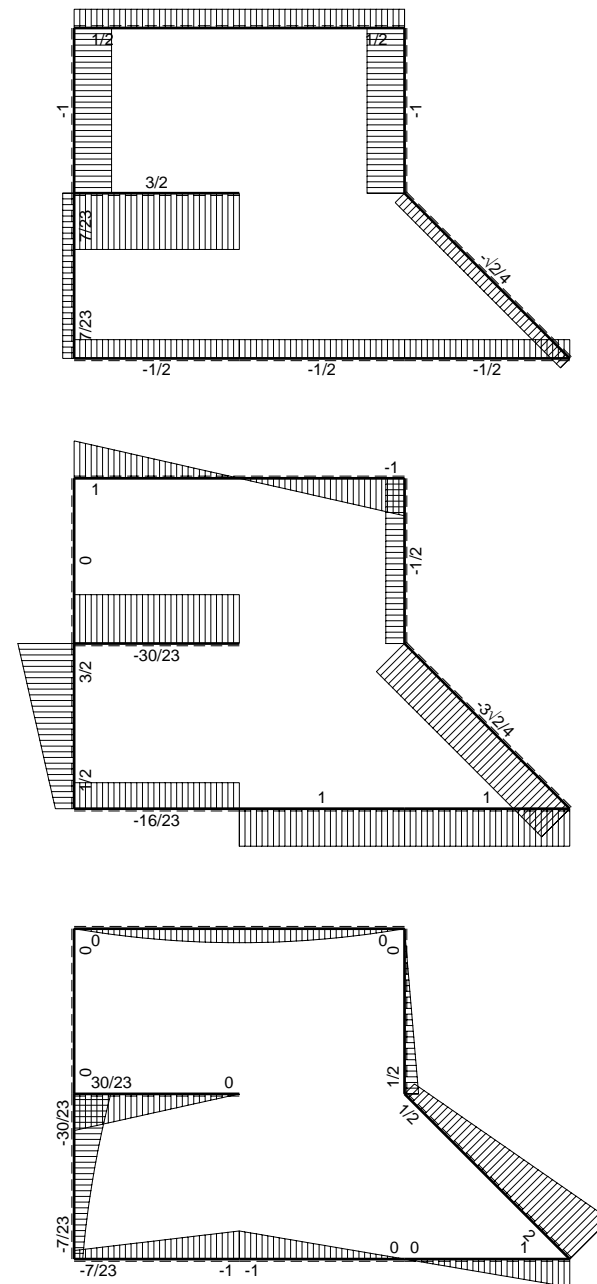
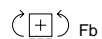
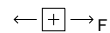
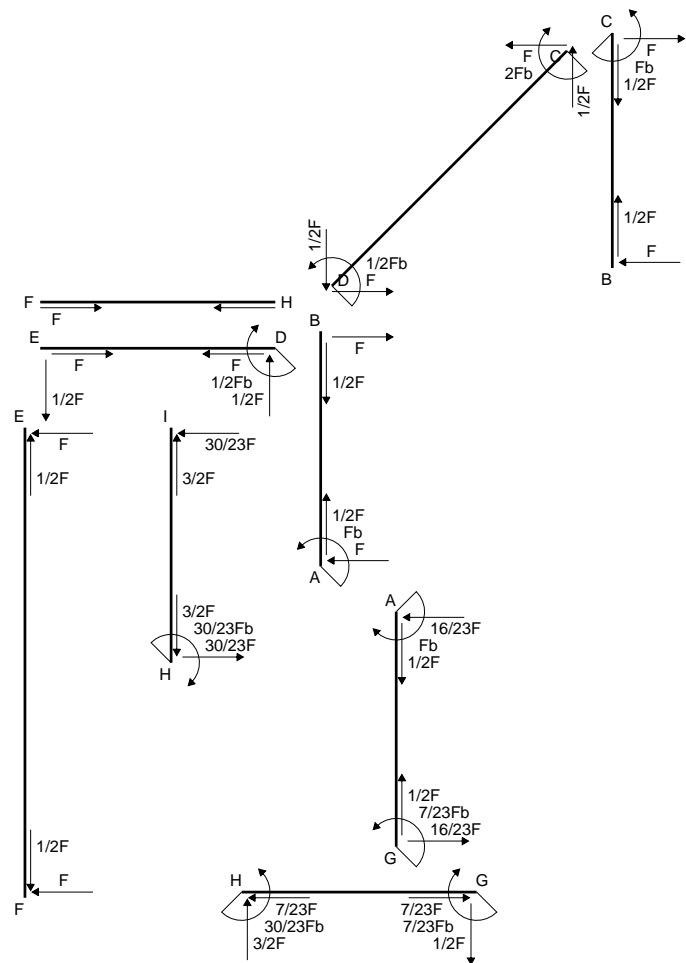
$$L_{GH}^{x_0} = \int_0^b (1/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

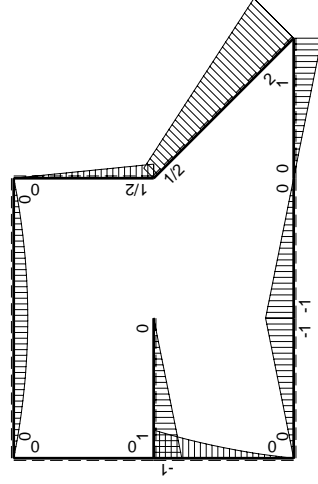
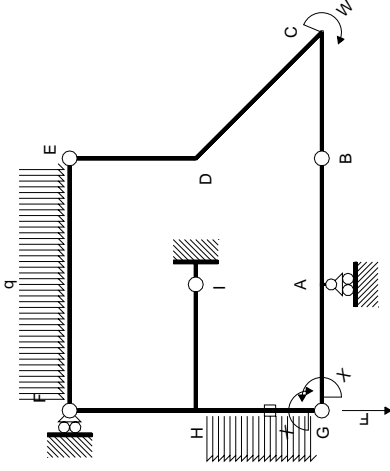
$$= [1/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/4 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -7/12 Fb^2/EJ$$

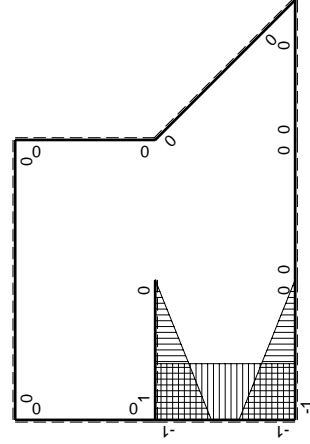


- A = 176.6 mm²
- J_u = 74388. mm⁴
- J_v = 18662. mm⁴
- J_I = 155.6 mm⁴
- y_o = -12.53 mm
- y_g = 17.75 mm
- N = 289.9 N
- T_y = -289.9 N
- M_x = 557600. Nmm
- x_m = 12. mm
- y_m = 47. mm
- u_m = -12. mm
- v_m = 29.25 mm
- σ_m = N/A-Mv/J_u = -217.6 N/mm²
- x_c = 24. mm
- y_c = 47. mm
- v_c = 29.25 mm
- σ_c = N/A-Mv/J_u = -217.6 N/mm²
- τ_c = TS/tJ_u = 4.924 N/mm²
- τ_g = TS/tJ_u = 4.924 N/mm²
- t_c = 820. mm
- σ_o = √σ²+3τ² = 217.8 N/mm²





(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$	
AB b	0	-Fb+Fx	0	0	0	0	
BA b	0	Fx	0	0	0	0	
BC b	0	Fx	0	0	0	0	
CB b	0	-Fb+Fx	0	0	0	0	
CD $\sqrt{2}b$	0	$2Fb-3\sqrt{2}/4Fx$	0	0	0	0	
DE b	0	$1/2Fb-1/2Fx$	0	0	0	0	
ED b	0	-1/2Fx	0	0	0	0	
EF 2b	0	$-Fx+1/2qx^2$	0	0	0	0	
FE 2b	0	$Fx-1/2qx^2$	0	0	0	0	
GA b	-1+x/b	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$	
AG b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2	$1/6Fb^2/EJ$	$1/3Xb/EJ$	
FH b	0	0	0	0	0	0	
HF b	0	0	0	0	0	0	
HI b	1-x/b	Fb-Fx	$Fb-2Fx+Fx^2/b$	$1-2x/b+x^2/b^2$	$1/3Fb^2/EJ$	$1/3Xb/EJ$	
IH b	-x/b	-Fx	Fx^2/b	x^2/b^2	$1/3Fb^2/EJ$	$1/3Xb/EJ$	
HG b	-1	$-Fb+3/2Fx-1/2qx^2$	$Fb-3/2Fx+1/2Fx^2/b$	1	$5/12Fb^2/EJ$	Xb/EJ	
GH b	1	$1/2Fx+1/2qx^2$	$1/2Fx+1/2Fx^2/b$	1	$7/12Fb^2/EJ$	$23/12Xb/EJ$	
HG	elongazione asta $N_{1HG^{\pm}HG^{\pm}HG}$						
A	molla nodo $-V_{1A}(V_{GA}+XV_{1A})/k_A$						
	totali						
	iperstatica $X=W_{GA}$						

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1 - 2x/b + x^2/b^2) Fb 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - b + 1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (x^2/b^2) Fb 1/EJ dx = [1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (1 - 3/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

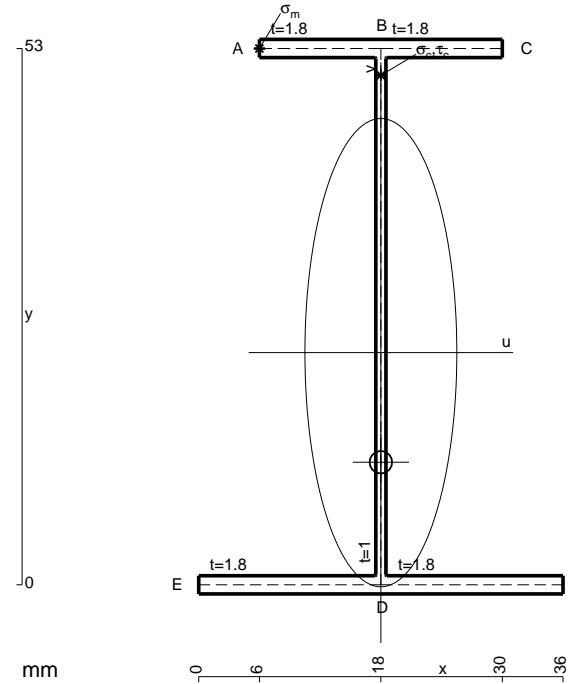
$$= [x - 3/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (b - 3/4 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -7/12 Fb^2/EJ$$

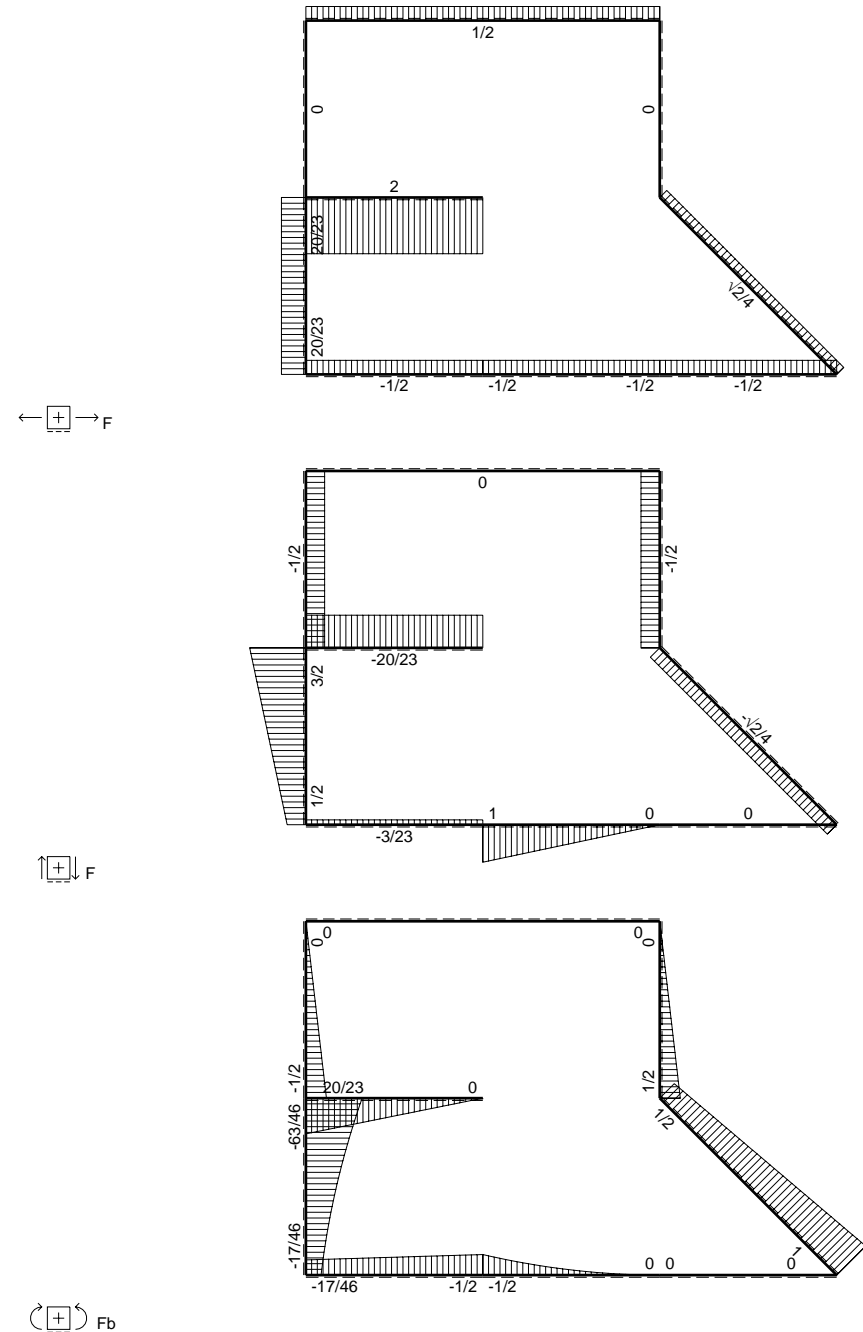
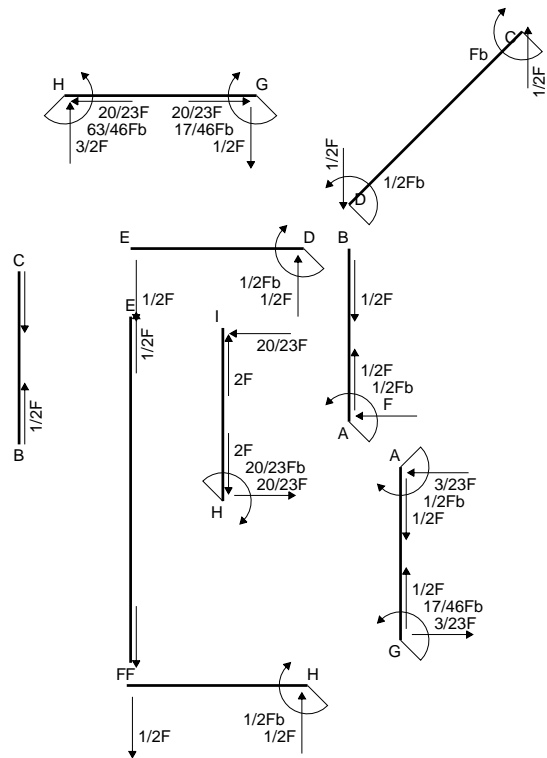
$$L_{GH}^{xo} = \int_0^b (1/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

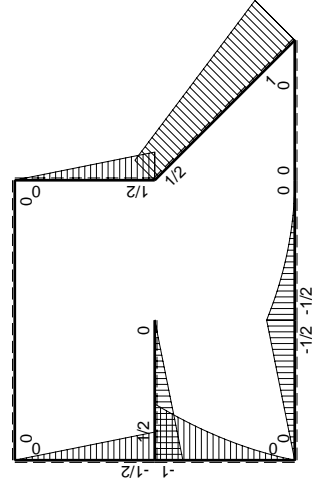
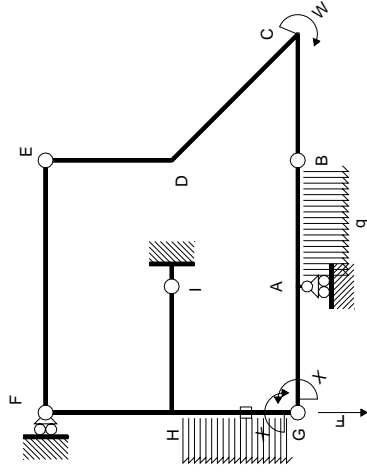
$$= [1/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/4 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -7/12 Fb^2/EJ$$

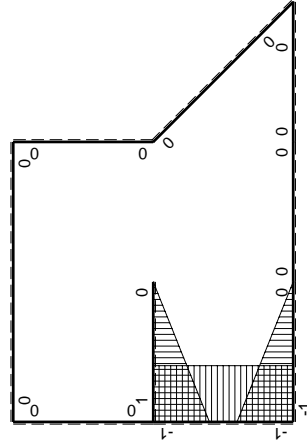


- A = 161. mm²
- J_u = 86214. mm⁴
- J_v = 9072. mm⁴
- J_t = 134.3 mm⁴
- y_o = -10.83 mm
- y_g = 22.94 mm
- N = -141.4 N
- T_y = -424.3 N
- M_x = 648000. Nmm
- x_m = 6. mm
- y_m = 53. mm
- u_m = -12. mm
- v_m = 30.06 mm
- σ_m = N/A - Mv/J_u = -226.8 N/mm²
- x_c = 18. mm
- y_c = 53. mm
- v_c = 30.06 mm
- σ_c = N/A - Mv/J_u = -226.8 N/mm²
- τ_c = TS_y/tJ_u = 6.389 N/mm²
- τ_g = TS_y/tJ_u = 6.389 N/mm²
- t_c = 400. mm
- σ_o = √σ² + 3τ² = 227. N/mm²





M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-1/2Fb + Fx - 1/2qx^2$	0	0	0	0
BA b	0	$1/2qx^2$	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	$Fb - \sqrt{2}/4Fx$	0	0	0	0
DE b	0	$1/2Fb - 1/2Fx$	0	0	0	0
ED b	0	$-1/2Fx$	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$-1/2Fx$	$1/2Fx - 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$1/2Fb - 1/2Fx$	$1/2Fx - 1/2Fx^2/b$	x^2/b^2	$1/12Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$-1/2Fx$	0	0	0	0
HF b	0	$1/2Fb - 1/2Fx$	0	0	0	0
HI b	$1-x/b$	$1/2Fb - 1/2Fx$	$1/2Fb - Fx + 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$-1/2Fx$	$1/2Fx^2/b$	x^2/b^2	$1/12Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	$-Fb + 3/2Fx - 1/2qx^2$	$Fb - 3/2Fx + 1/2Fx^2/b$	1	$5/12Fb^2/EJ$	Xb/EJ
GH b	1	$1/2Fx + 1/2qx^2$	$1/2Fx + 1/2Fx^2/b$	1	$5/12Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG} = N_{HG} + HG$					
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$					
	totali					
	iperstatica $X=W_{GA}$					
	17/46Fb					

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{x_0} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{AG}^{x_0} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{HI}^{x_0} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{IH}^{x_0} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{HG}^{x_0} = \int_0^b (1 - 3/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

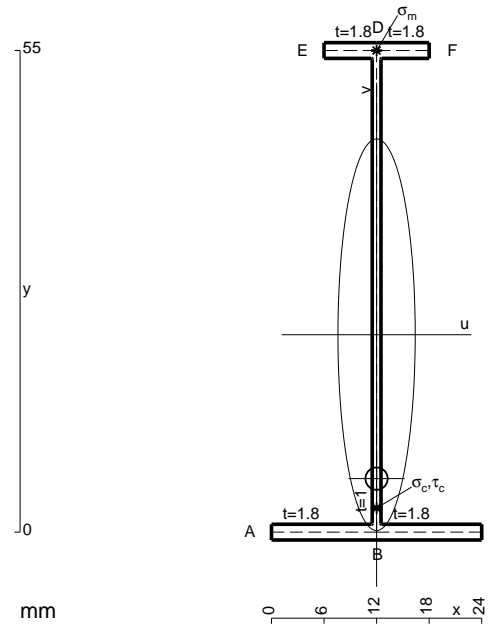
$$= [x - 3/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (b - 3/4 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -7/12 Fb^2/EJ$$

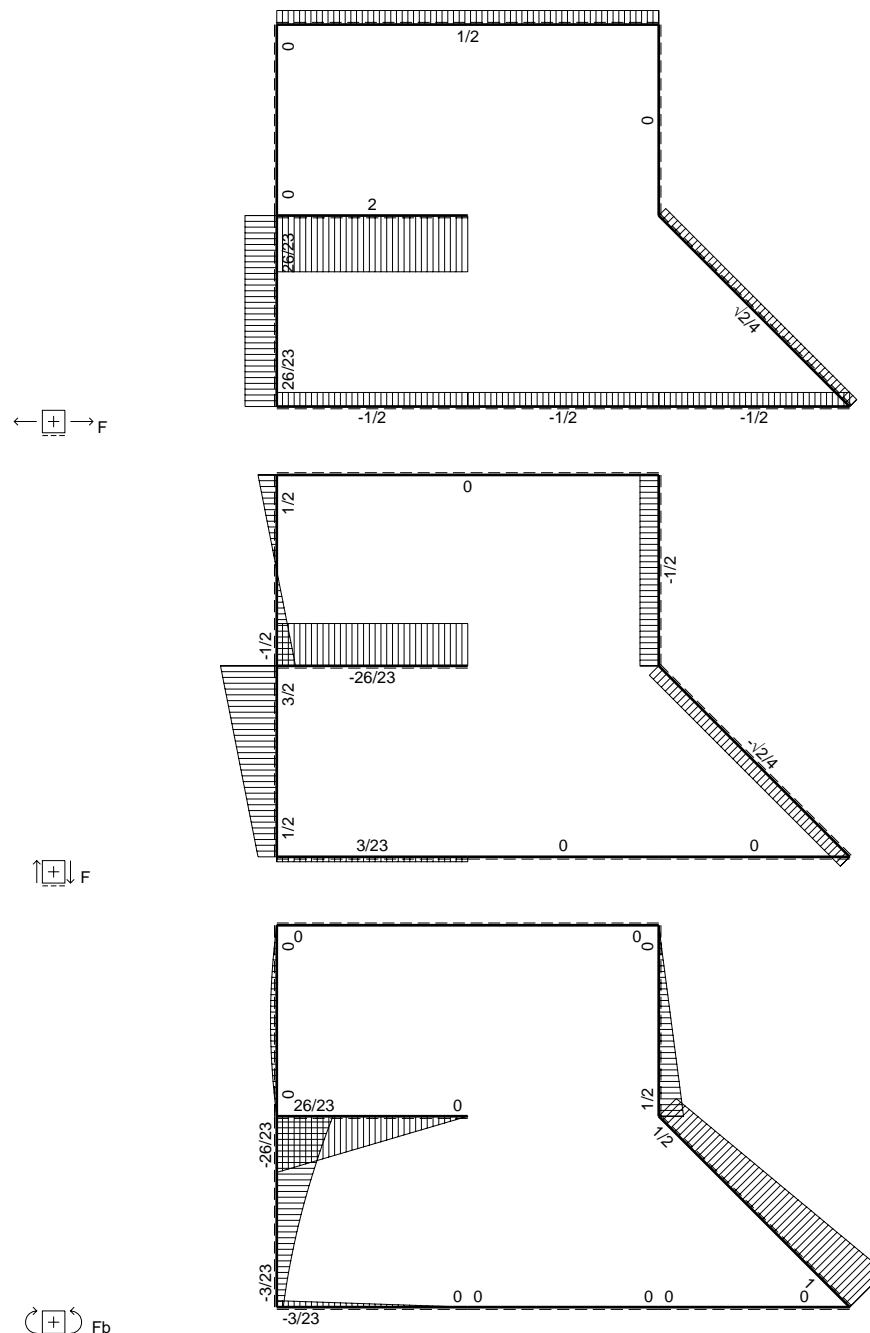
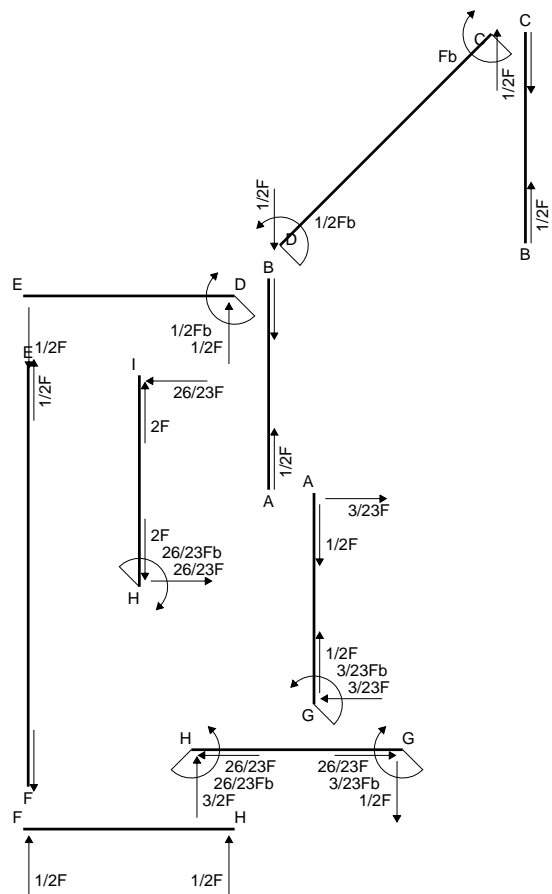
$$L_{GH}^{x_0} = \int_0^b (1/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

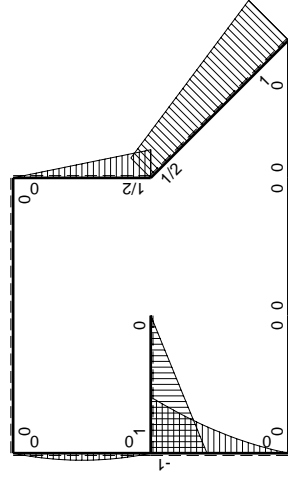
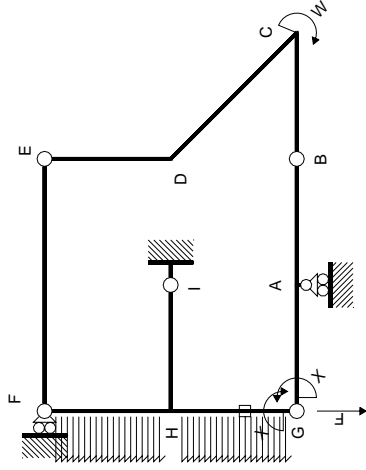
$$= [1/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/4 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -7/12 Fb^2/EJ$$

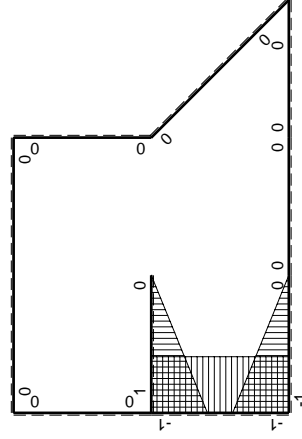


- A = 119.8 mm²
- J_u = 59924. mm⁴
- J_v = 2333. mm⁴
- J_t = 88.32 mm⁴
- y_o = -16.43 mm
- y_g = 22.54 mm
- N = -505. N
- T_y = 1010. N
- M_x = -449450. Nmm
- x_m = 12. mm
- y_m = 55. mm
- v_m = 32.46 mm
- σ_m = N/A-Mv/J_u = 239.2 N/mm²
- x_c = 12. mm
- v_c = -22.54 mm
- σ_c = N/A-Mv/J_u = -173.3 N/mm²
- τ_c = TS/tJ_u = 16.41 N/mm²
- τ_g = TS/tJ_u = 16.41 N/mm²
- t_c = 1010. mm
- σ_o = √σ²+3τ² = 175.6 N/mm²





M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	0	0	0	0	0
BA b	0	0	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	$Fb - \sqrt{2}/4Fx$	0	0	0	0
DE b	0	$1/2Fb - 1/2Fx$	0	0	0	0
ED b	0	$-1/2Fx$	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
AG b	x/b	0	0	x^2/b^2	0	$1/3Xb/EJ$
FH b	0	$1/2Fx - 1/2qx^2$	0	0	0	0
HF b	0	$-1/2Fx + 1/2qx^2$	0	0	0	0
HI b	$1-x/b$	$Fb - Fx$	$Fb - 2Fx + Fx^2/b$	$1 - 2x/b + x^2/b^2$	$1/3Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$-Fx$	Fx^2/b	x^2/b^2	$5/12Fb^2/EJ$	Xb/EJ
HG b	-1	$-Fb + 3/2Fx - 1/2qx^2$	$Fb - 3/2Fx + 1/2Fx^2/b$	1	$-Fb^2/EJ$	
GH b	1	$1/2Fx + 1/2qx^2$	$1/2Fx + 1/2Fx^2/b$	1	$-1/4Fb^2/EJ$	$23/12Xb/EJ$
HG	elongazione asta $N_{1HG} = N_{HG} + HG$					
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$					
	totali					
	iperstatica X=W _{GA}					

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{HI}^{x_0} = \int_0^b (1 - 2x/b + x^2/b^2) Fb 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - b + 1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{IH}^{x_0} = \int_0^b (x^2/b^2) Fb 1/EJ dx = [1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{HG}^{x_0} = \int_0^b (1 - 3/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

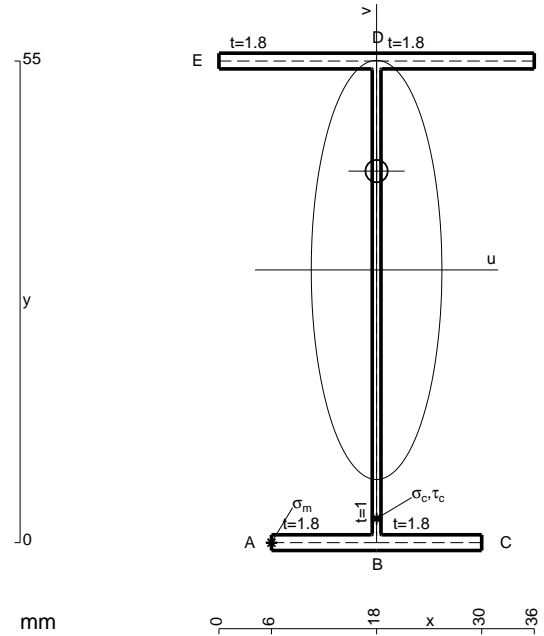
$$= [x - 3/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (b - 3/4 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -7/12 Fb^2/EJ$$

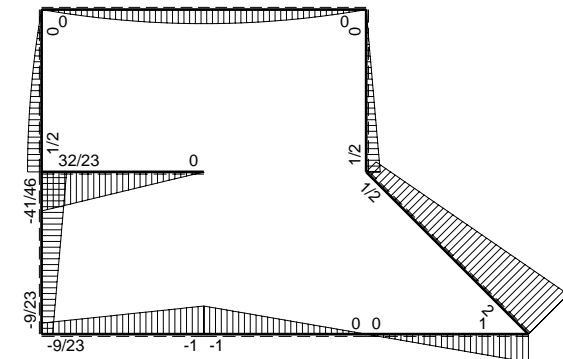
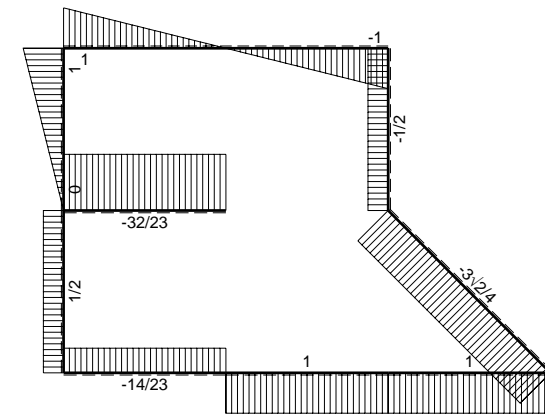
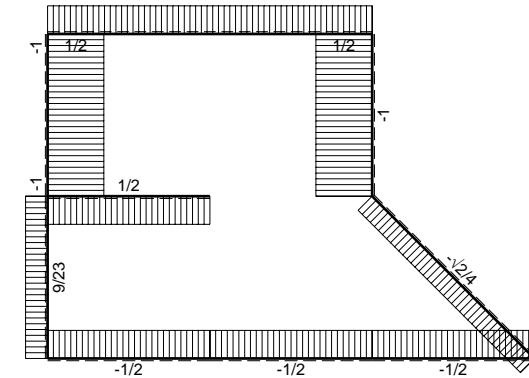
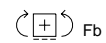
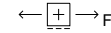
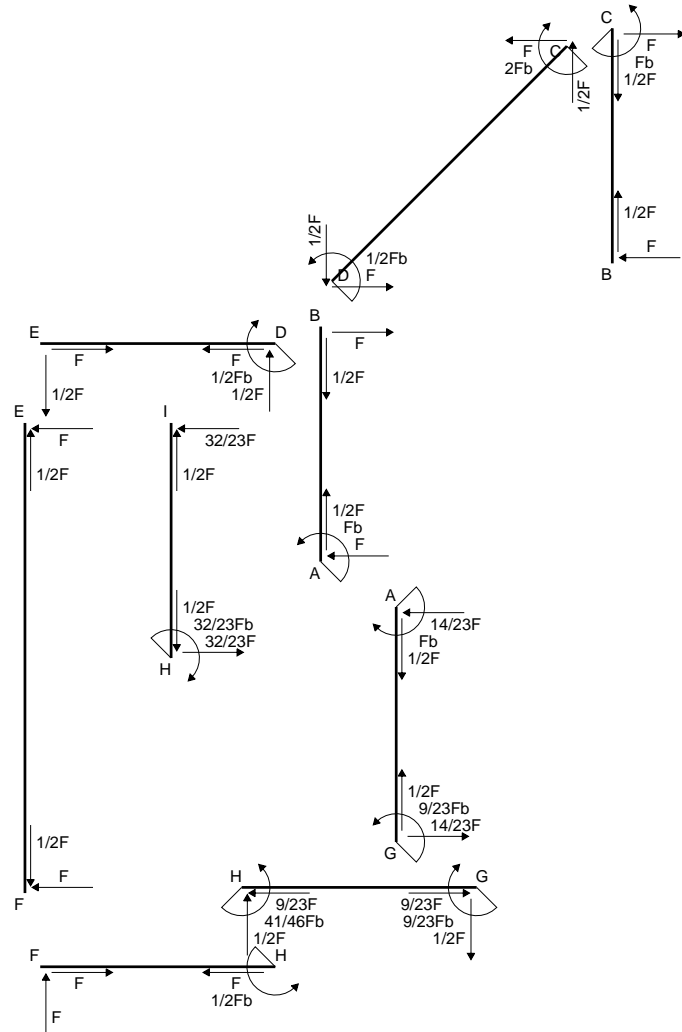
$$L_{GH}^{x_0} = \int_0^b (1/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

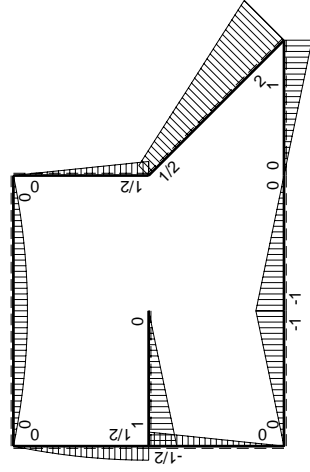
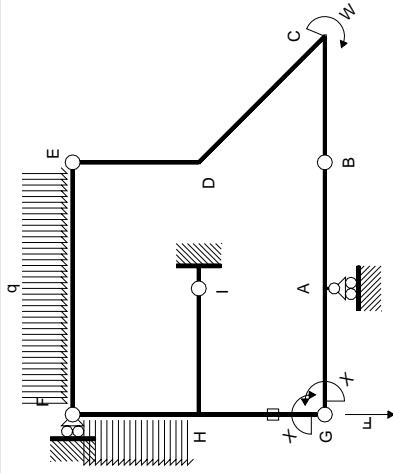
$$= [1/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/4 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -7/12 Fb^2/EJ$$

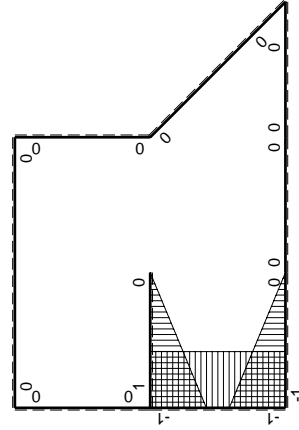


- A = 163. mm²
- J_u = 93375. mm⁴
- J_v = 9072. mm⁴
- J_t = 135. mm⁴
- y_o = 11.28 mm
- y_g = 31.14 mm
- N = 441.9 N
- T_y = -441.9 N
- M_x = 587500. Nmm
- x_m = 6. mm
- u_m = -12. mm
- v_m = -31.14 mm
- σ_m = N/A-Mv/J_u = 198.7 N/mm²
- x_c = 18. mm
- v_c = -31.14 mm
- σ_c = N/A-Mv/J_u = 198.7 N/mm²
- τ_c = TS^t/tJ_u = 6.368 N/mm²
- τ_g = TS^t/tJ_u = 6.368 N/mm²
- t_c = 1250. mm
- σ_o = √σ²+3τ² = 199. N/mm²





M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-Fb+Fx	0	0	0	0
BA b	0	Fx	0	0	0	0
BC b	0	Fx	0	0	0	0
CB b	0	-Fb+Fx	0	0	0	0
CD $\sqrt{2}b$	0	$2Fb-3\sqrt{2}/4Fx$	0	0	0	0
DE b	0	$1/2Fb-1/2Fx$	0	0	0	0
ED b	0	-1/2Fx	0	0	0	0
EF 2b	0	$-Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$Fx-1/2qx^2$	0	0	0	0
GA b	-1+x/b	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2		
FH b	0	$Fx-1/2qx^2$	0	0	0	0
HF b	0	$-1/2Fb+1/2qx^2$	0	0	0	0
HI b	1-x/b	Fb-Fx	$Fb-2Fx+Fx^2/b$	$1-2x/b+x^2/b^2$	$1/3Fb^2/EJ$	$1/3Xb/EJ$
IH b	-x/b	-Fx	Fx^2/b	x^2/b^2		
HG b	-1	$-1/2Fb+1/2Fx$	$1/2Fb-1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
GH b	1	$1/2Fx$	$1/2Fx$	1		
HG	elongazione asta $N_{1HG}^{HG} = \frac{1}{E} \int \frac{dN}{A}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$				$-1/2Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-3/4Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica X=W _{GA}				$9/23Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1 - 2x/b + x^2/b^2) Fb 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - b + 1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (x^2/b^2) Fb 1/EJ dx = [1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

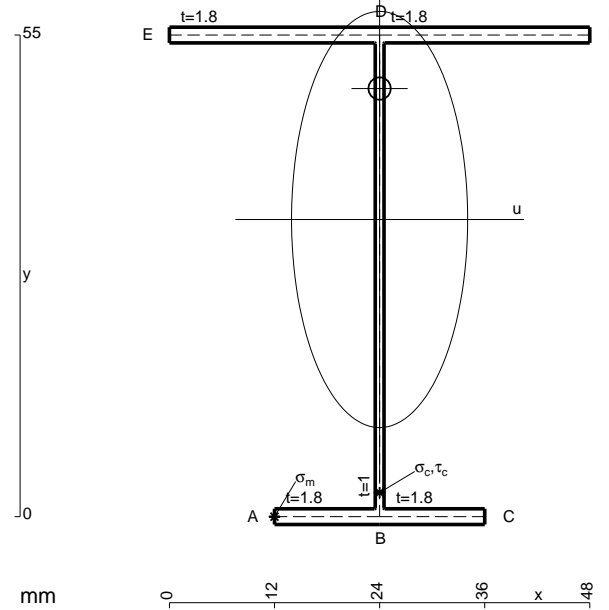
$$L_{HG}^{xo} = \int_0^b (1/2 - 1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/2 x - 1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

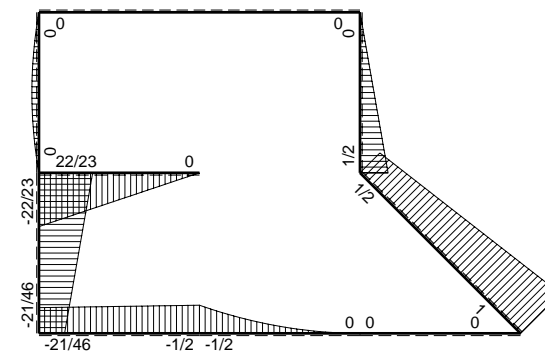
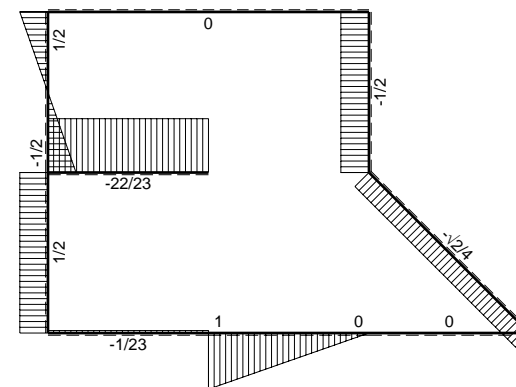
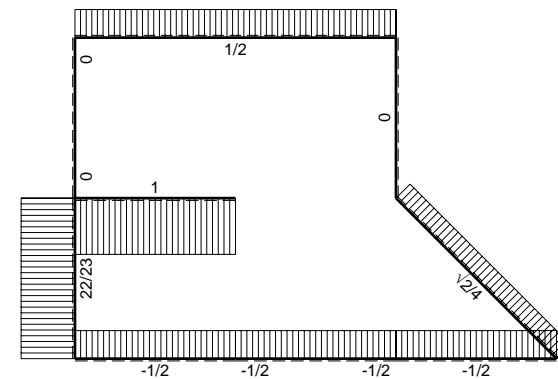
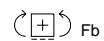
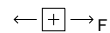
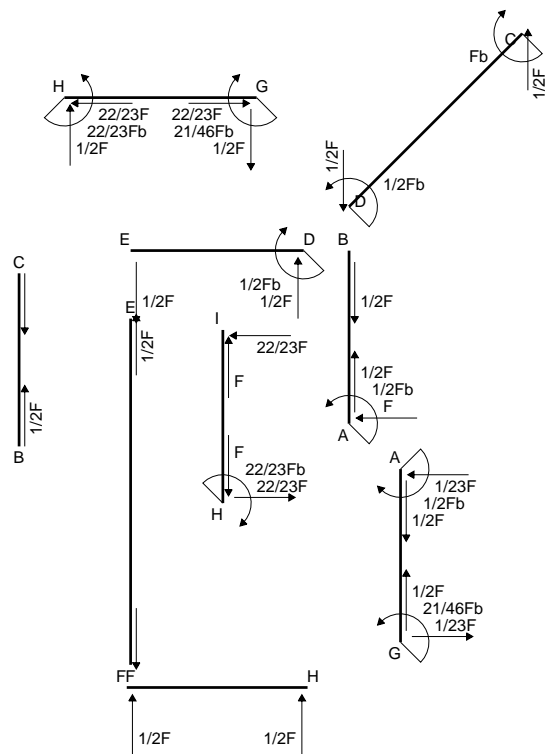
$$= (1/2 b - 1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$

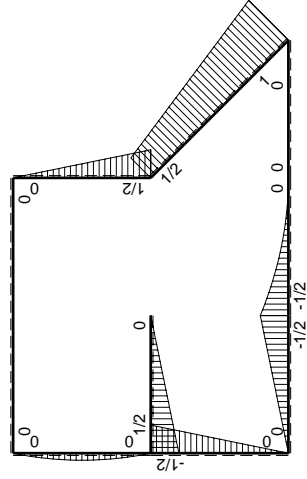
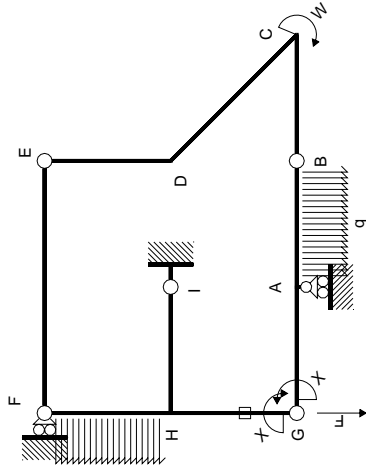
$$L_{GH}^{xo} = \int_0^b (1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$

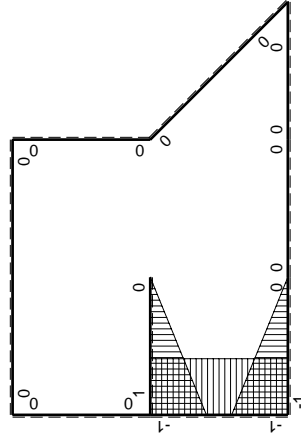


- A = 184.6 mm²
- J_u = 104229. mm⁴
- J_v = 18662. mm⁴
- J_i = 158.3 mm⁴
- y_o = 14.95 mm
- y_g = 33.94 mm
- N = -222.7 N
- T_y = -668.2 N
- M_x = 642600. Nmm
- x_m = 12. mm
- u_m = -12. mm
- v_m = -33.94 mm
- σ_m = N/A-Mv/J_u = 208. N/mm²
- x_c = 24. mm
- v_c = -33.94 mm
- σ_c = N/A-Mv/J_u = 208. N/mm²
- τ_c = TS_v/tJ_u = 9.399 N/mm²
- τ_g = TS_v/tJ_u = 9.399 N/mm²
- t_c = 630. mm
- σ_o = √σ²+3τ² = 208.7 N/mm²





M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-1/2Fb + Fx - 1/2qx^2$	0	0	0	0
BA b	0	$1/2qx^2$	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	$Fb - \sqrt{2}/4Fx$	0	0	0	0
DE b	0	$1/2Fb - 1/2Fx$	0	0	0	0
ED b	0	$-1/2Fx$	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$-1/2Fx$	$1/2Fx - 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$1/2Fb - 1/2Fx$	$1/2Fx - 1/2Fx^2/b$	x^2/b^2		
FH b	0	$1/2Fx - 1/2qx^2$	0	0	0	0
HF b	0	$-1/2Fx + 1/2qx^2$	0	0	0	0
HI b	$1-x/b$	$1/2Fb - 1/2Fx$	$1/2Fb - Fx + 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$-1/2Fx$	$1/2Fx^2/b$	x^2/b^2		
HG b	-1	$-1/2Fb + 1/2Fx$	$1/2Fb - 1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
GH b	1	$1/2Fx$	$1/2Fx$	1		
HG	elongazione asta $N_{1HG} = N_{HG} - HG$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$				$-3/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-7/8Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$21/46Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

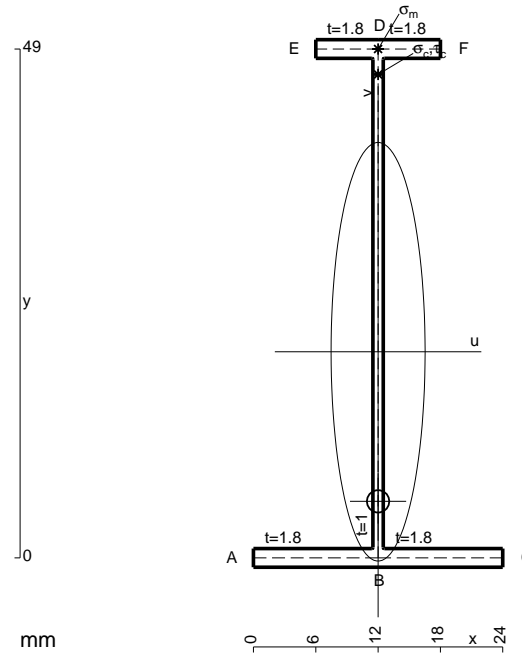
$$L_{HG}^{xo} = \int_0^b (1/2 - 1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/2 x - 1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

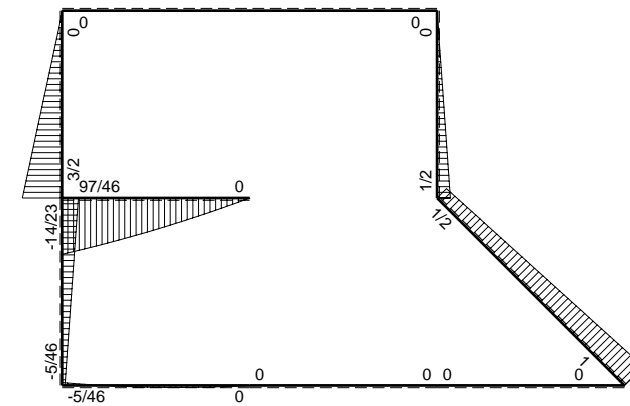
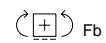
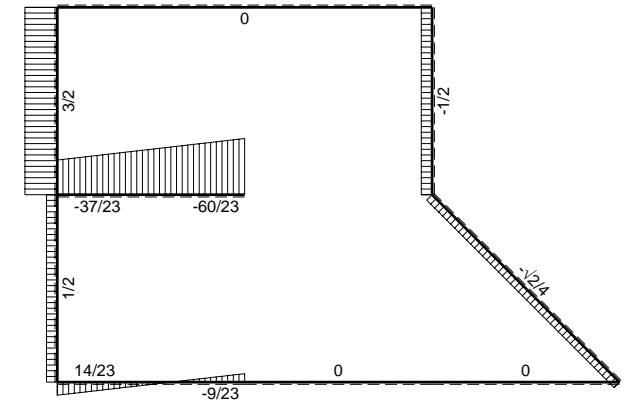
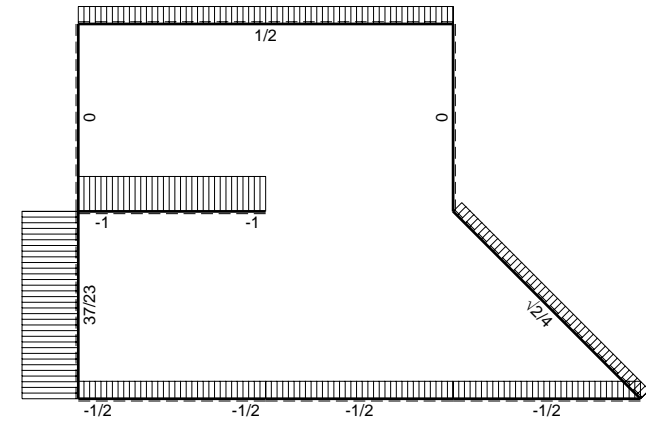
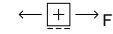
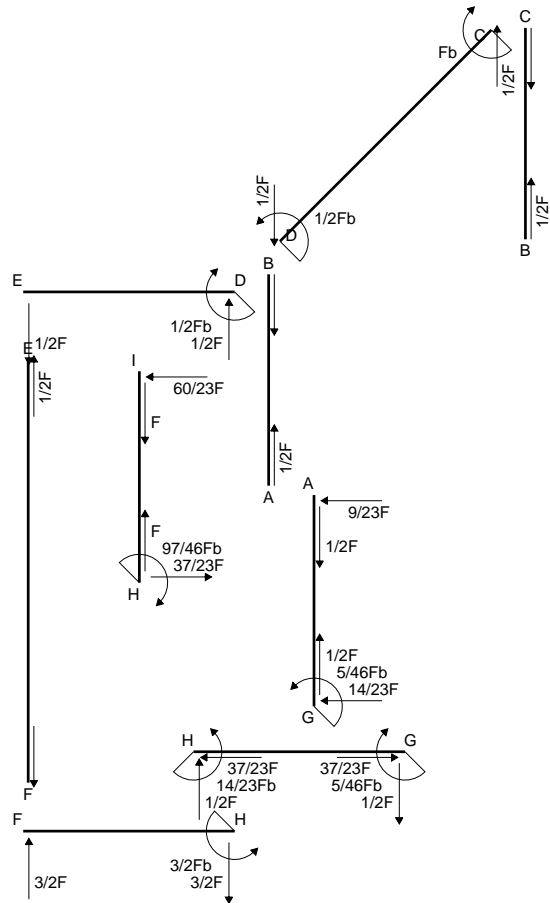
$$= (1/2 b - 1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$

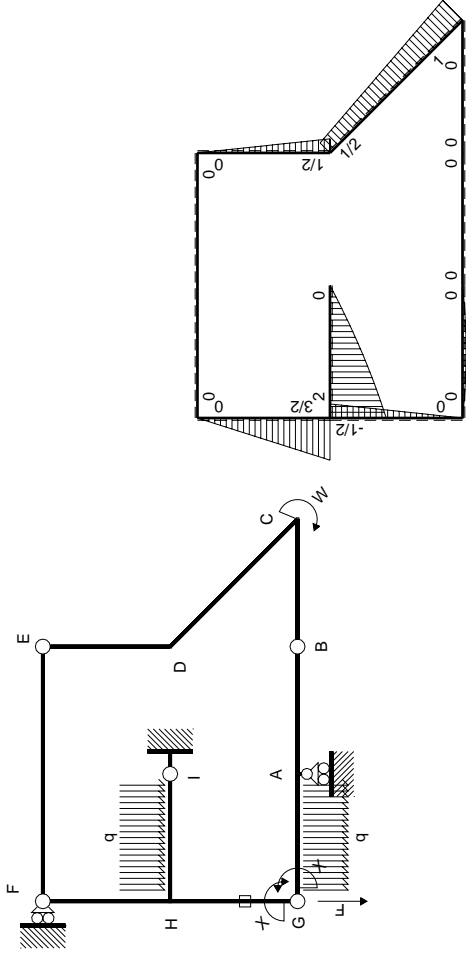
$$L_{GH}^{xo} = \int_0^b (1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$



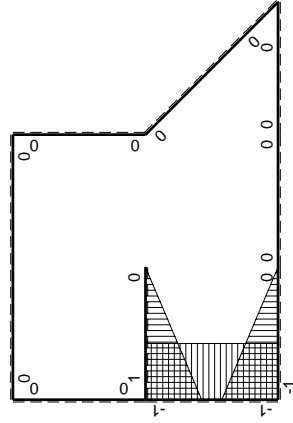
- A = 113.8 mm²
- J_u = 46239. mm⁴
- J_v = 2333. mm⁴
- J_t = 86.32 mm⁴
- y_o = -14.41 mm
- y_g = 19.85 mm
- N = -715. N
- T_y = 1430. N
- M_x = -357500. Nmm
- x_m = 12. mm
- y_m = 49. mm
- v_m = 29.15 mm
- σ_m = N/A-Mv/J_u = 219.1 N/mm²
- y_c = 2. mm
- u_c = -12. mm
- v_c = -17.85 mm
- σ_c = N/A-Mv/J_u = 219.1 N/mm²
- τ_c = TS_v/tJ_u = 19.47 N/mm²
- τ_g = TS_v/tJ_u = 19.47 N/mm²
- t_c = 1430. mm
- σ_o = √σ²+3τ² = 221.7 N/mm²





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{GA}$

→	$M_x(x)$	$M_o(x)$	$M_x M_o$	$M_x M_x$	$\int M_x M_o / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	0	0	0	0	0
BA b	0	0	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	$Fb - \sqrt{2}/4Fx$	0	0	0	0
DE b	0	$1/2Fb - 1/2Fx$	0	0	0	0
ED b	0	$-1/2Fx$	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$1/2Fx - 1/2qx^2$	$-1/2Fx + Fx^2/b - 1/2qx^3/b$	$1-2x/b+x^2/b^2$	$-1/24Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$-1/2Fx + 1/2qx^2$	$-1/2Fx^2/b + 1/2qx^3/b$	x^2/b^2	$-1/24Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$3/2Fx$	0	0	0	0
HF b	0	$-3/2Fb + 3/2Fx$	0	0	0	0
HI b	$1-x/b$	$2Fb - 3/2Fx - 1/2qx^2$	$2Fb - 7/2Fx + Fx^2/b + 1/2qx^3/b$	$1-2x/b+x^2/b^2$	$17/24Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$-5/2Fx + 1/2qx^2$	$5/2Fx^2/b - 1/2qx^3/b$	x^2/b^2	$17/24Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	$-1/2Fb + 1/2Fx$	$1/2Fb - 1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
GH b	1	$1/2Fx$	$1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG} \epsilon_{HG} L_{HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{oA} + XV_{1A})/k_A$				$-1/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-5/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$5/46Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (-1/2 x/b + x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [-1/4 x^2/b + 1/3 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (-1/4 b + 1/3 b - 1/8 b) Fb 1/EJ = -1/24 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (-1/2 x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [-1/6 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (-1/6 b + 1/8 b) Fb 1/EJ = -1/24 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (2 - 7/2 x/b + x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [2x - 7/4 x^2/b + 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (2b - 7/4 b + 1/3 b + 1/8 b) Fb 1/EJ = 17/24 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (5/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [5/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (5/6 b - 1/8 b) Fb 1/EJ = 17/24 Fb^2/EJ$$

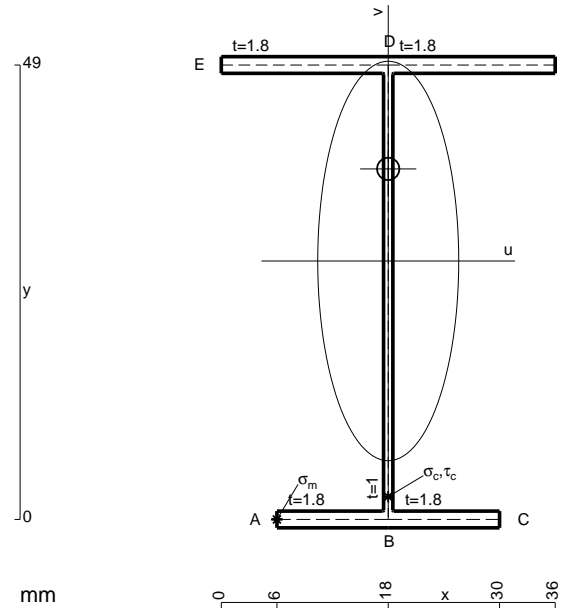
$$L_{HG}^{xo} = \int_0^b (1/2 - 1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/2 x - 1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

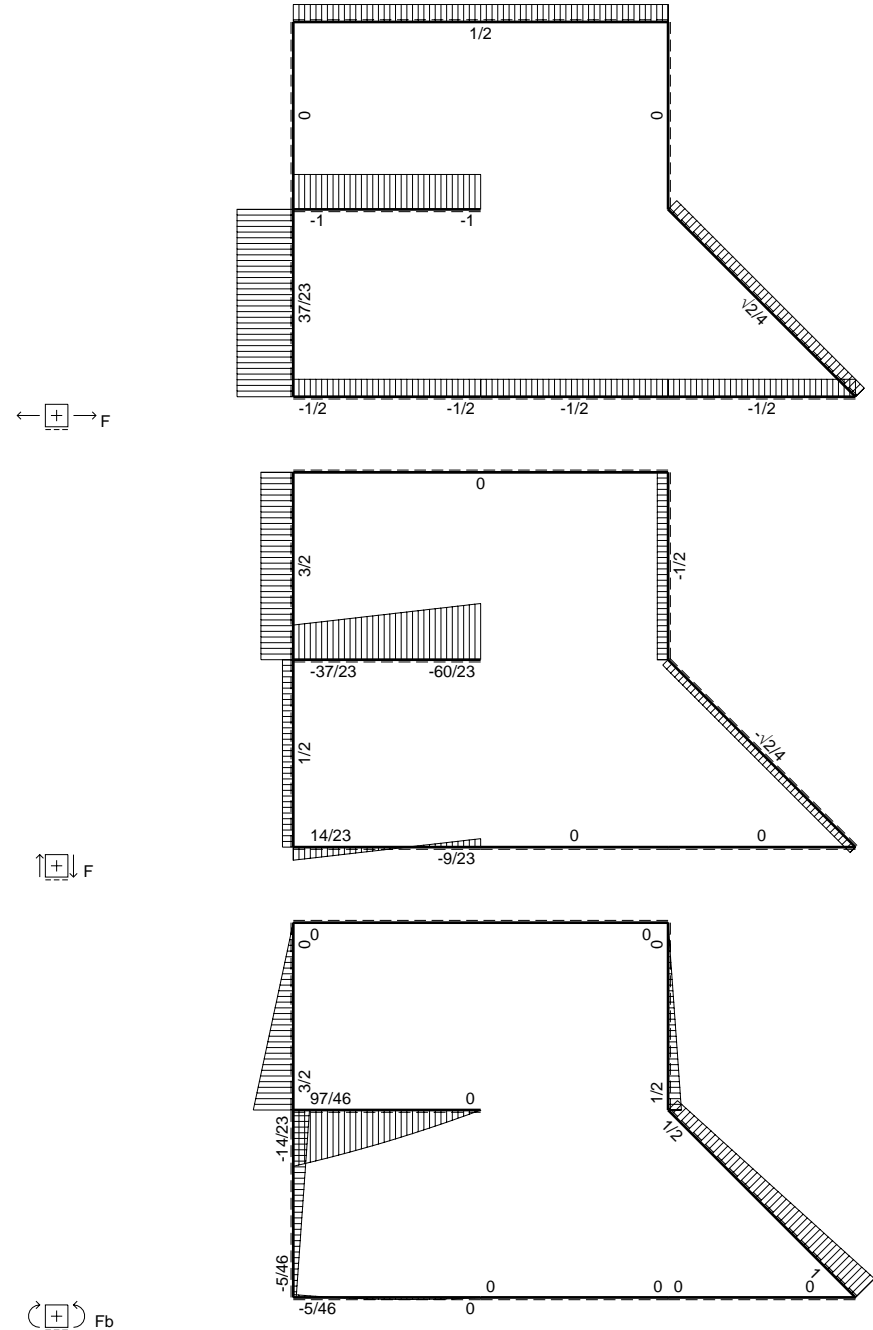
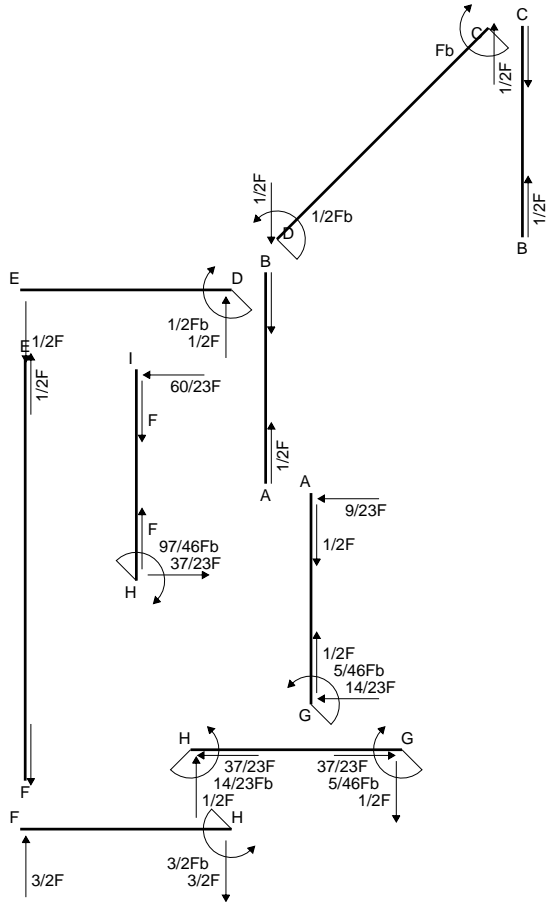
$$= (1/2 b - 1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$

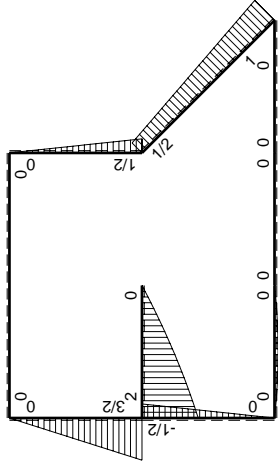
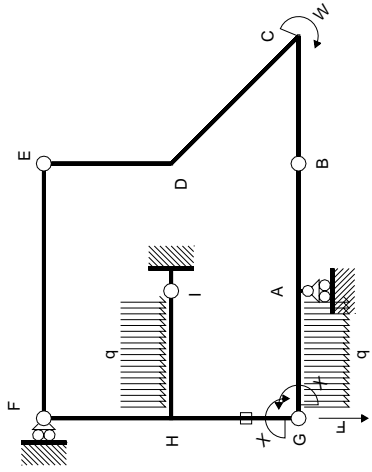
$$L_{GH}^{xo} = \int_0^b (1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$



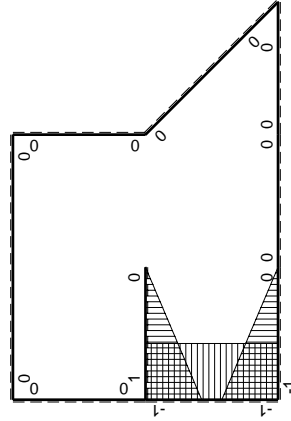
- A = 157. mm²
- J_u = 72847. mm⁴
- J_v = 9072. mm⁴
- J_i = 133. mm⁴
- y_o = 9.929 mm
- y_g = 27.87 mm
- T_y = 1110. N
- M_x = 599400. Nmm
- x_m = 6. mm
- u_m = -12. mm
- v_m = -27.87 mm
- σ_m = -Mv/J_u = 229.3 N/mm²
- x_c = 18. mm
- v_c = -27.87 mm
- σ_c = -Mv/J_u = 229.3 N/mm²
- τ_c = TS_i/tJ_u = 18.35 N/mm²
- τ_g = TS_i/tJ_u = 18.35 N/mm²
- t_c = 740. mm
- σ_o = √σ²+3τ² = 231.5 N/mm²





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_1 flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

→	$M_x(x)$	$M_o(x)$	$M_x M_o$	$M_x M_x$	$\int M_x M_o / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	0	0	0	0	0
BA b	0	0	0	0		
BC b	0	0	0	0	0	0
CB b	0	0	0	0		
CD $\sqrt{2}b$	0	$Fb - \sqrt{2}/4Fx$	0	0	0	0
DE b	0	$1/2Fb - 1/2Fx$	0	0	0	0
ED b	0	$-1/2Fx$	0	0		
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0		
GA b	$-1+x/b$	$1/2Fx - 1/2qx^2$	$-1/2Fx + Fx^2/b - 1/2qx^3/b$	$1-2x/b+x^2/b^2$	$-1/24Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$-1/2Fx + 1/2qx^2$	$-1/2Fx^2/b + 1/2qx^3/b$	x^2/b^2		
FH b	0	$3/2Fx$	0	0	0	0
HF b	0	$-3/2Fb + 3/2Fx$	0	0		
HI b	$1-x/b$	$2Fb - 3/2Fx - 1/2qx^2$	$2Fb - 7/2Fx + Fx^2/b + 1/2qx^3/b$	$1-2x/b+x^2/b^2$	$17/24Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$-5/2Fx + 1/2qx^2$	$5/2Fx^2/b - 1/2qx^3/b$	x^2/b^2		
HG b	-1	$-1/2Fb + 1/2Fx$	$1/2Fb - 1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
GH b	1	$1/2Fx$	$1/2Fx$	1		
HG	elongazione asta $N_{1HG} \epsilon_{HG} L_{HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{oA} + XV_{1A})/k_A$				$-1/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-5/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$5/46Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{x_0} = \int_0^b (-1/2 x/b + x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [-1/4 x^2/b + 1/3 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (-1/4 b + 1/3 b - 1/8 b) Fb 1/EJ = -1/24 Fb^2/EJ$$

$$L_{AG}^{x_0} = \int_0^b (-1/2 x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [-1/6 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (-1/6 b + 1/8 b) Fb 1/EJ = -1/24 Fb^2/EJ$$

$$L_{HI}^{x_0} = \int_0^b (2 - 7/2 x/b + x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [2x - 7/4 x^2/b + 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (2b - 7/4 b + 1/3 b + 1/8 b) Fb 1/EJ = 17/24 Fb^2/EJ$$

$$L_{IH}^{x_0} = \int_0^b (5/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [5/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (5/6 b - 1/8 b) Fb 1/EJ = 17/24 Fb^2/EJ$$

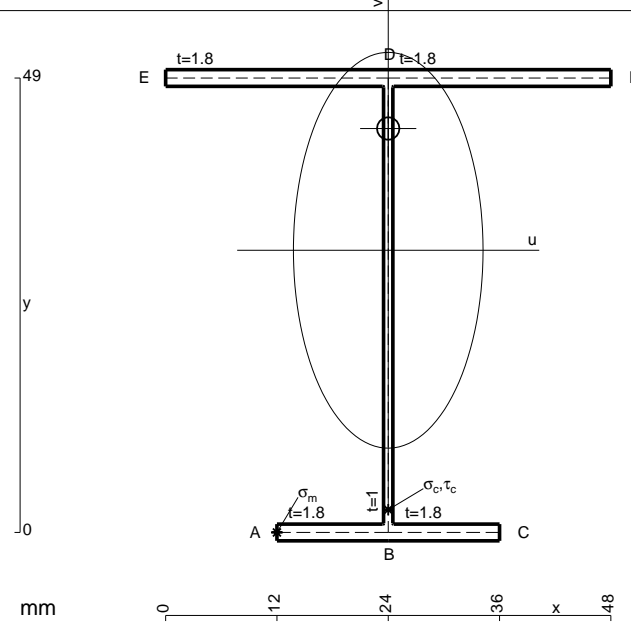
$$L_{HG}^{x_0} = \int_0^b (1/2 - 1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/2 x - 1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

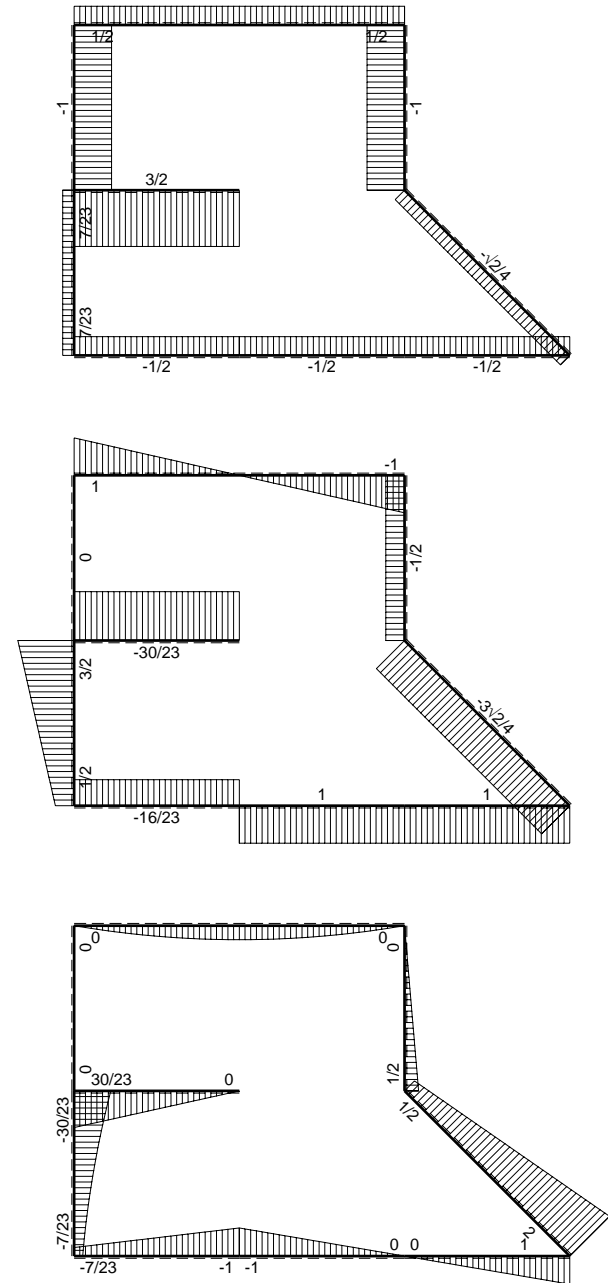
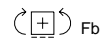
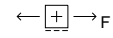
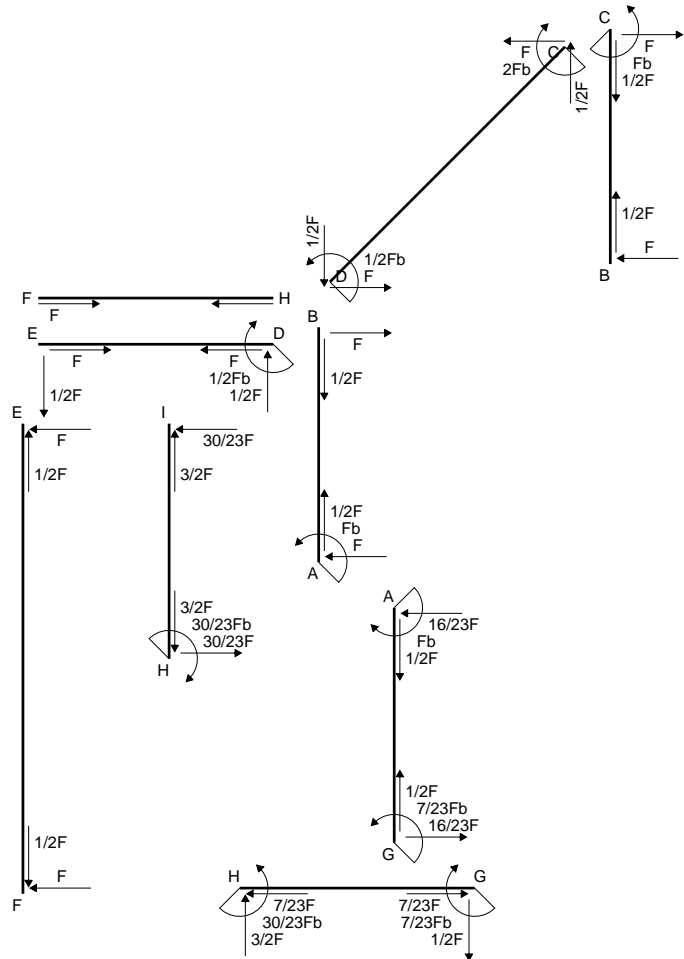
$$= (1/2 b - 1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$

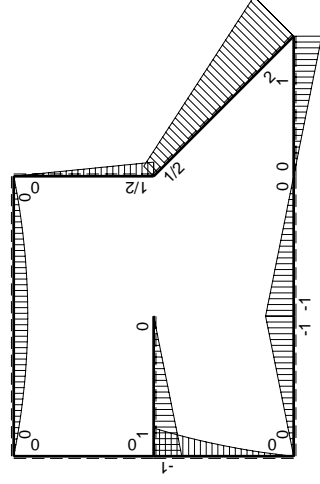
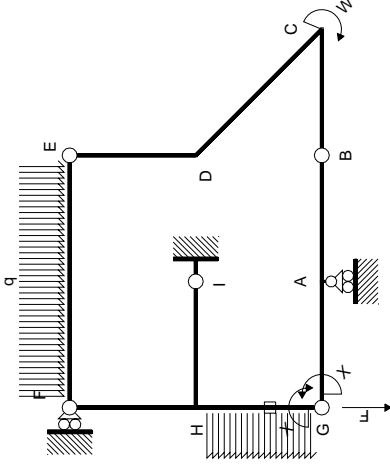
$$L_{GH}^{x_0} = \int_0^b (1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$

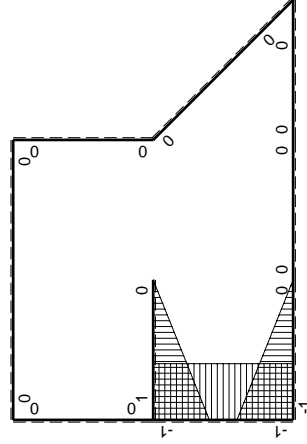


- A = 178.6 mm²
- J_u = 81324. mm⁴
- J_v = 18662. mm⁴
- J_i = 156.3 mm⁴
- y_o = 13.13 mm
- y_g = 30.43 mm
- T_y = 1095. N
- M_x = 635100. Nmm
- x_m = 12. mm
- u_m = -12. mm
- v_m = -30.43 mm
- σ_m = -Mv/J_u = 237.6 N/mm²
- x_c = 24. mm
- v_c = -30.43 mm
- σ_c = -Mv/J_u = 237.6 N/mm²
- τ_c = TS_v/tJ_u = 17.7 N/mm²
- τ_g = TS_v/tJ_u = 17.7 N/mm²
- t_c = 730. mm
- σ_o = √σ²+3τ² = 239.6 N/mm²





(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-Fb+Fx	0	0	0	0
BA b	0	Fx	0	0	0	0
BC b	0	Fx	0	0	0	0
CB b	0	-Fb+Fx	0	0	0	0
CD $\sqrt{2}b$	0	$2Fb-3\sqrt{2}/4Fx$	0	0	0	0
DE b	0	$1/2Fb-1/2Fx$	0	0	0	0
ED b	0	-1/2Fx	0	0	0	0
EF 2b	0	$-Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$Fx-1/2qx^2$	0	0	0	0
GA b	-1+x/b	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2	$1/6Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	0	0	0	0	0
HF b	0	0	0	0	0	0
HI b	1-x/b	Fb-Fx	$Fb-2Fx+Fx^2/b$	$1-2x/b+x^2/b^2$	$1/3Fb^2/EJ$	$1/3Xb/EJ$
IH b	-x/b	-Fx	Fx^2/b	x^2/b^2	$5/12Fb^2/EJ$	Xb/EJ
HG b	-1	$-Fb+3/2Fx-1/2qx^2$	$Fb-3/2Fx+1/2Fx^2/b$	1	$-Fb^2/EJ$	$1/4Xb/EJ$
GH b	1	$1/2Fx+1/2qx^2$	$1/2Fx+1/2Fx^2/b$	1	$-7/12Fb^2/EJ$	$23/12Xb/EJ$
HG	elongazione asta $N_{1HG^{\pm}HG^{\pm}HG}$					
A	molla nodo $-V_{1A}(V_{0A}+XV_{1A})/k_A$					
	totali					
	iperstatica $X=W_{GA}$					

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[1/2 x^2/b - 1/3 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[1/2 x^2/b - 1/3 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot Fb \cdot 1/EJ = 1/3 \cdot Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[1/3 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/3 b) \cdot Fb \cdot 1/EJ = 1/3 \cdot Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (1 - 3/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ$$

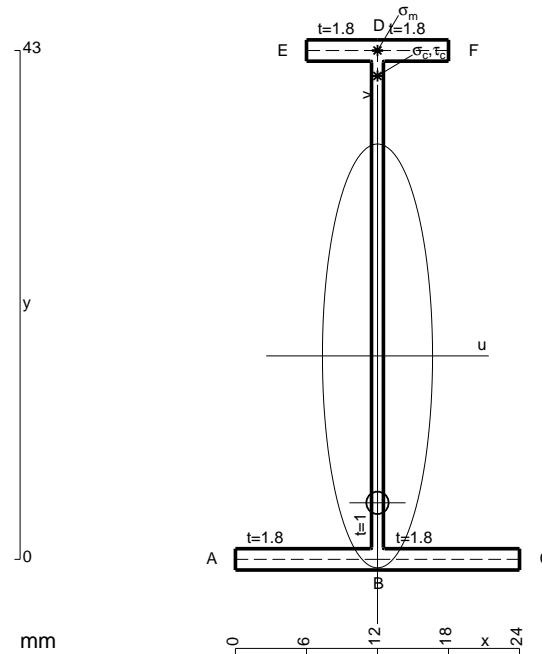
$$= \left[x - 3/4 x^2/b + 1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ$$

$$= (b - 3/4 b + 1/6 b) \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ = -7/12 \cdot Fb^2/EJ$$

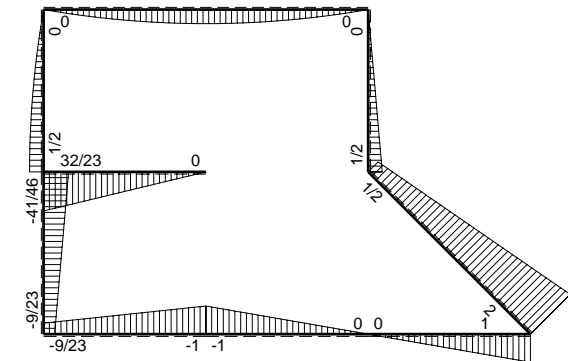
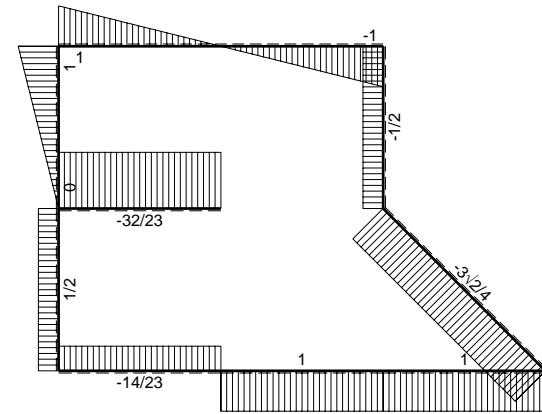
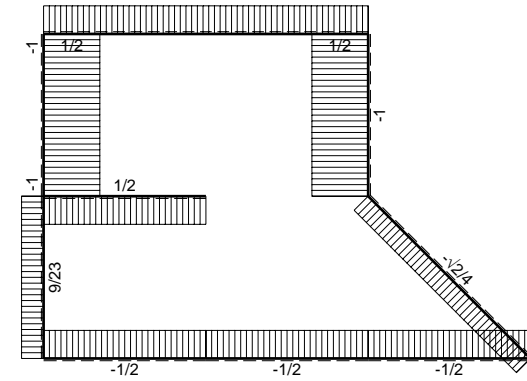
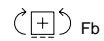
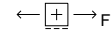
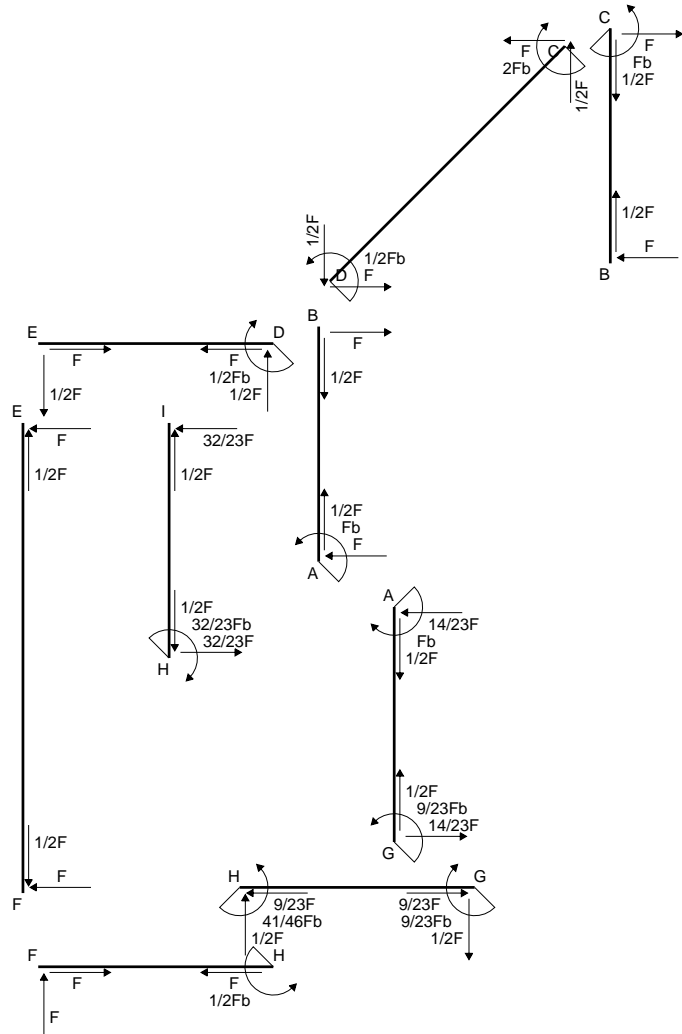
$$L_{GH}^{xo} = \int_0^b (1/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ$$

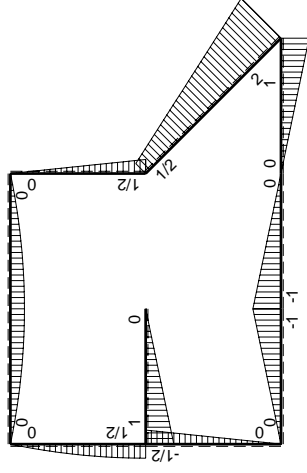
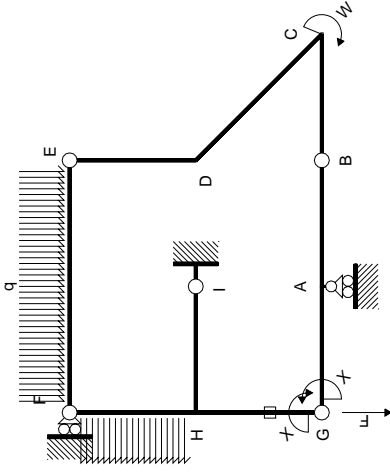
$$= \left[1/4 x^2/b + 1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ$$

$$= (1/4 b + 1/6 b) \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ = -7/12 \cdot Fb^2/EJ$$

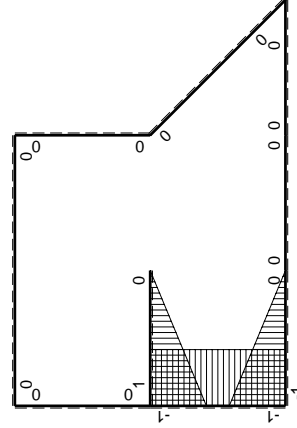


- A = 107.8 mm²
- J_u = 34579. mm⁴
- J_v = 2333. mm⁴
- J_t = 84.32 mm⁴
- y_o = -12.41 mm
- y_g = 17.19 mm
- N = -84.85 N
- T_y = -254.6 N
- M_x = 264000. Nmm
- x_m = 12. mm
- y_m = 43. mm
- v_m = 25.81 mm
- σ_m = N/A-Mv/J_u = -197.8 N/mm²
- y_c = 2. mm
- u_c = -12. mm
- v_c = -15.19 mm
- σ_c = N/A-Mv/J_u = -197.8 N/mm²
- τ_c = TS'/tJ_u = 4.104 N/mm²
- τ_g = TS'/tJ_u = 4.104 N/mm²
- t_c = 240. mm
- σ_o = √σ²+3τ² = 198. N/mm²





M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-Fb+Fx	0	0	0	0
BA b	0	Fx	0	0	0	0
BC b	0	Fx	0	0	0	0
CB b	0	-Fb+Fx	0	0	0	0
CD $\sqrt{2}b$	0	$2Fb-3\sqrt{2}/4Fx$	0	0	0	0
DE b	0	$1/2Fb-1/2Fx$	0	0	0	0
ED b	0	-1/2Fx	0	0	0	0
EF 2b	0	$-Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$Fx-1/2qx^2$	0	0	0	0
GA b	-1+x/b	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2		
FH b	0	$Fx-1/2qx^2$	0	0	0	0
HF b	0	$-1/2Fb+1/2qx^2$	0	0	0	0
HI b	1-x/b	Fb-Fx	$Fb-2Fx+Fx^2/b$	$1-2x/b+x^2/b^2$	$1/3Fb^2/EJ$	$1/3Xb/EJ$
IH b	-x/b	-Fx	Fx^2/b	x^2/b^2		
HG b	-1	$-1/2Fb+1/2Fx$	$1/2Fb-1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
GH b	1	$1/2Fx$	$1/2Fx$	1		
HG	elongazione asta $N_{1HG}^{HG} = \frac{1}{E} \int \frac{dN}{A}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$				$-1/2Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-3/4Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica X=W _{GA}				$9/23Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1 - 2x/b + x^2/b^2) Fb 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - b + 1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (x^2/b^2) Fb 1/EJ dx = [1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

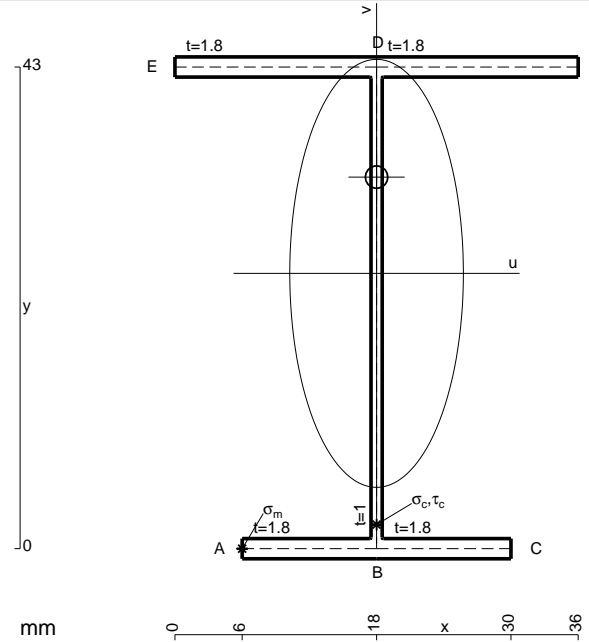
$$L_{HG}^{xo} = \int_0^b (1/2 - 1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/2 x - 1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/2 b - 1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$

$$L_{GH}^{xo} = \int_0^b (1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$



- A = 151. mm²
- J_u = 55120. mm⁴
- J_v = 9072. mm⁴
- J_t = 131. mm⁴
- y_o = 8.596 mm
- y_g = 24.58 mm
- N = -141.4 N
- T_y = -424.3 N
- M_x = 472000. Nmm
- x_m = 6. mm
- u_m = -12. mm
- v_m = -24.58 mm
- σ_m = N/A - Mv/J_u = 209.5 N/mm²
- x_c = 18. mm
- v_c = -24.58 mm
- σ_c = N/A - Mv/J_u = 209.5 N/mm²
- τ_c = TS_v/tJ_u = 8.172 N/mm²
- τ_g = TS_v/tJ_u = 8.172 N/mm²
- t_c = 400. mm
- σ_o = √(σ² + 3τ²) = 210. N/mm²

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

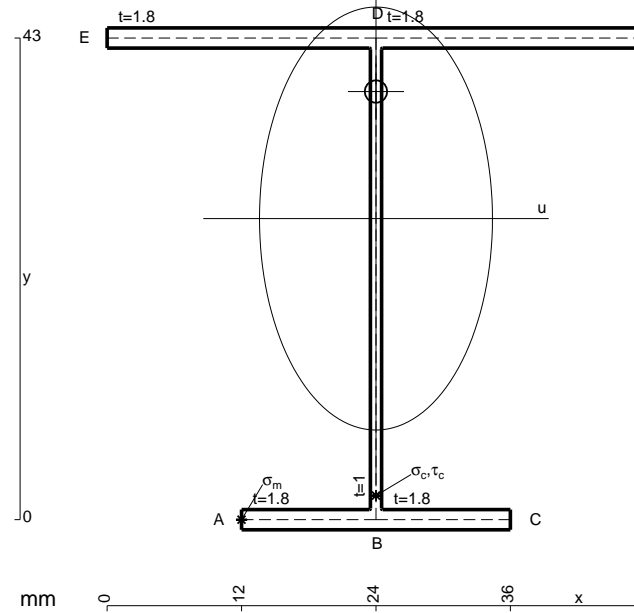
$$L_{HG}^{xo} = \int_0^b (1/2 - 1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/2 x - 1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

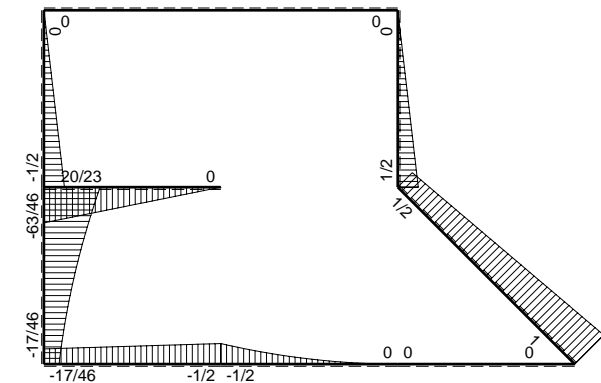
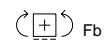
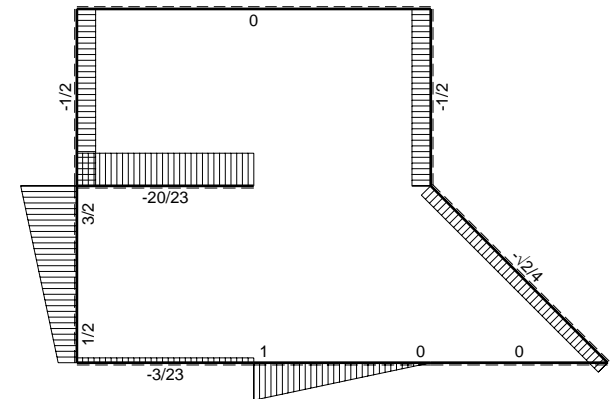
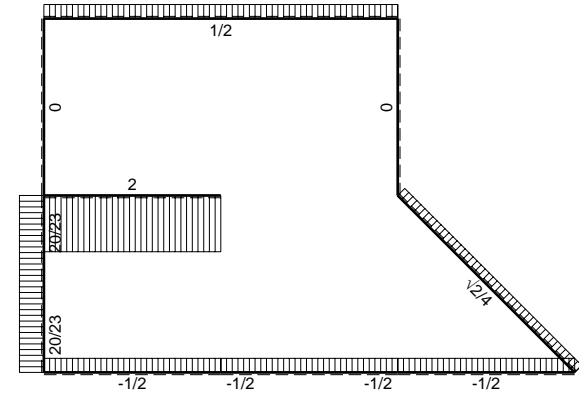
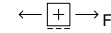
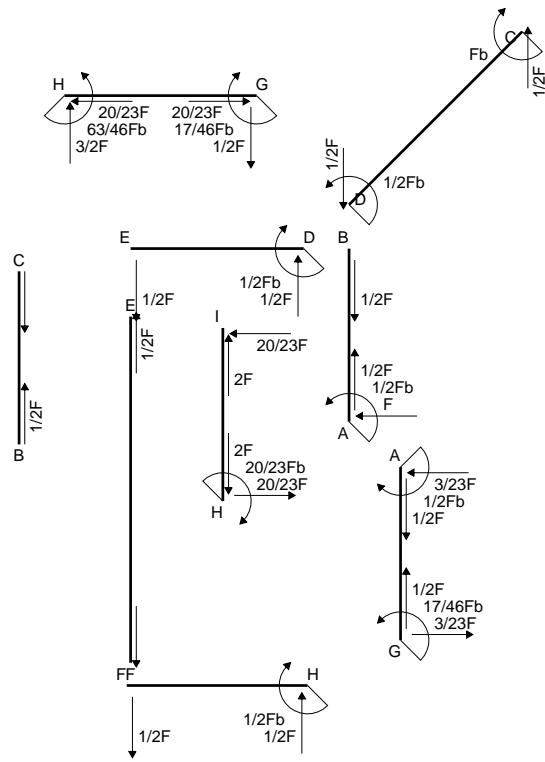
$$= (1/2 b - 1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$

$$L_{GH}^{xo} = \int_0^b (1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$



- A = 172.6 mm²
- J_u = 61535. mm⁴
- J_v = 18662. mm⁴
- J_I = 154.3 mm⁴
- y_o = 11.34 mm
- y_g = 26.88 mm
- N = -265. N
- T_y = 1060. N
- M_x = -492900. Nmm
- x_m = 12. mm
- u_m = -12. mm
- v_m = -26.88 mm
- σ_m = N/A-Mv/J_u = -216.9 N/mm²
- x_c = 24. mm
- v_c = -26.88 mm
- σ_c = N/A-Mv/J_u = -216.9 N/mm²
- τ_c = TS'/tJ_u = 20. N/mm²
- τ_g = TS'/tJ_u = 20. N/mm²
- t_c = 530. mm
- σ_o = √σ²+3τ² = 219.6 N/mm²



$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (1 - 3/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

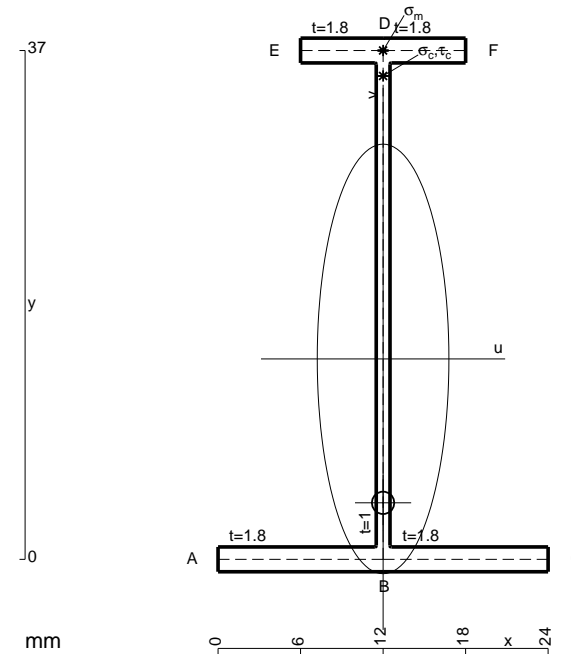
$$= [x - 3/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (b - 3/4 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -7/12 Fb^2/EJ$$

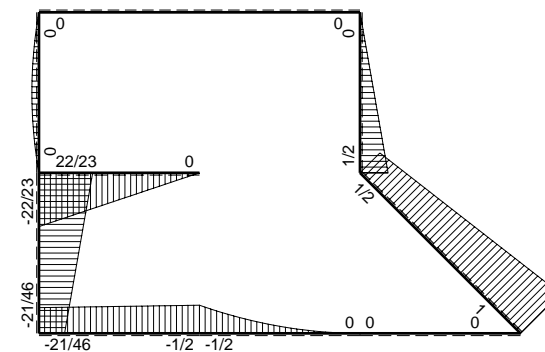
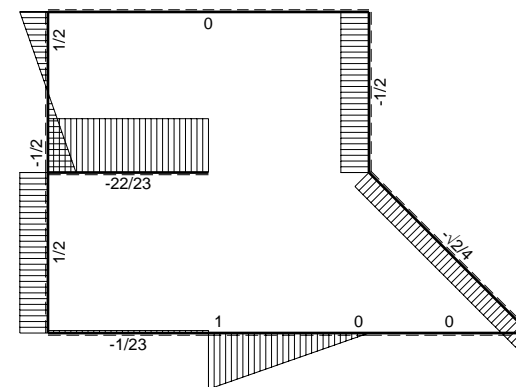
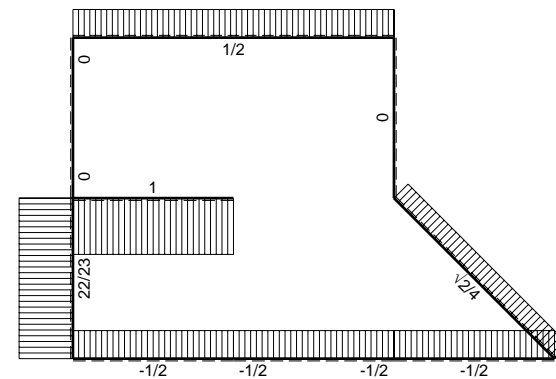
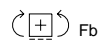
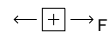
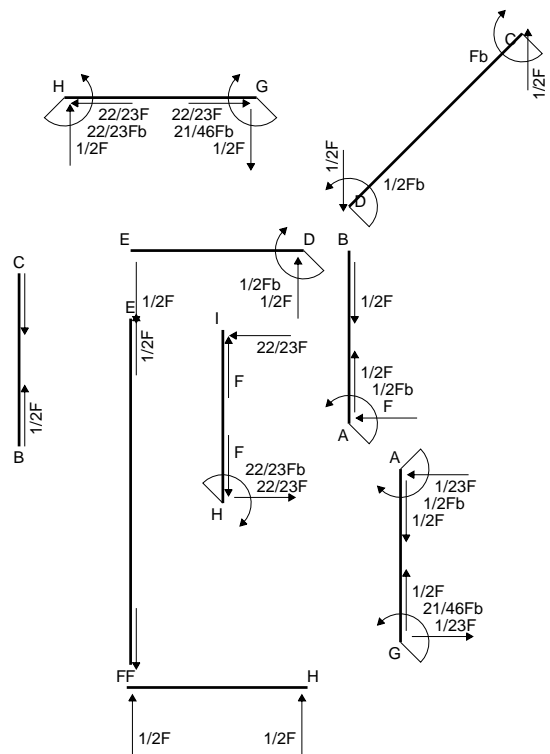
$$L_{GH}^{xo} = \int_0^b (1/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

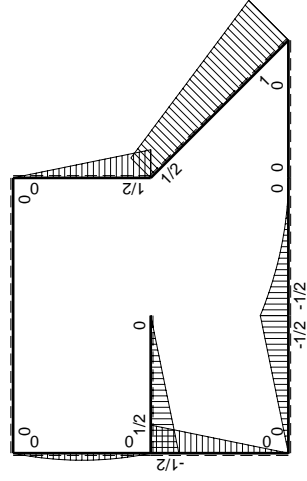
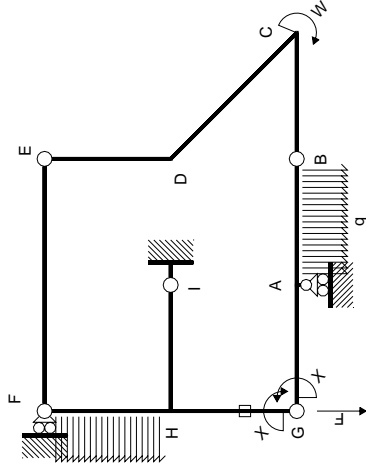
$$= [1/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/4 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -7/12 Fb^2/EJ$$

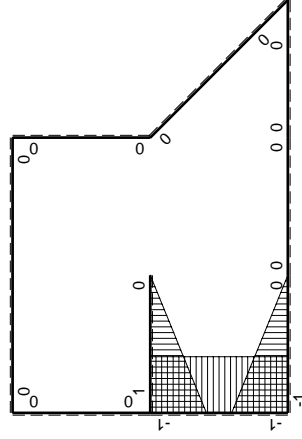


- A = 101.8 mm²
- J_u = 24830. mm⁴
- J_v = 2333. mm⁴
- J_t = 82.32 mm⁴
- y_o = -10.46 mm
- y_g = 14.57 mm
- N = -470. N
- T_y = 940. N
- M_x = -258500. Nmm
- x_m = 12. mm
- y_m = 37. mm
- v_m = 22.43 mm
- σ_m = N/A-Mv/J_u = 228.8 N/mm²
- y_c = 2. mm
- u_c = -12. mm
- v_c = -12.57 mm
- σ_c = N/A-Mv/J_u = 228.8 N/mm²
- τ_c = TS'/tJ_u = 18.34 N/mm²
- τ_g = TS'/tJ_u = 18.34 N/mm²
- t_c = 940. mm
- σ_o = √σ²+3τ² = 231. N/mm²





M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$	
AB b	0	$-1/2Fb + Fx - 1/2qx^2$	0	0	0	0	
BA b	0	$1/2qx^2$	0	0	0	0	
BC b	0	0	0	0	0	0	
CB b	0	0	0	0	0	0	
CD $\sqrt{2}b$	0	$Fb - \sqrt{2}/4Fx$	0	0	0	0	
DE b	0	$1/2Fb - 1/2Fx$	0	0	0	0	
ED b	0	$-1/2Fx$	0	0	0	0	
EF 2b	0	0	0	0	0	0	
FE 2b	0	0	0	0	0	0	
GA b	$-1+x/b$	$-1/2Fx$	$1/2Fx - 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$	
AG b	x/b	$1/2Fb - 1/2Fx$	$1/2Fx - 1/2Fx^2/b$	x^2/b^2			
FH b	0	$1/2Fx - 1/2qx^2$	0	0	0	0	
HF b	0	$-1/2Fx + 1/2qx^2$	0	0	0	0	
HI b	$1-x/b$	$1/2Fb - 1/2Fx$	$1/2Fb - Fx + 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$	
IH b	$-x/b$	$-1/2Fx$	$1/2Fx^2/b$	x^2/b^2			
HG b	-1	$-1/2Fb + 1/2Fx$	$1/2Fb - 1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ	
GH b	1	$1/2Fx$	$1/2Fx$	1			
HG	elongazione asta $N_{1HG} = N_{HG} - HG$						
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$						
	totali						
	iperstatica $X=W_{GA}$						
					21/46Fb		

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

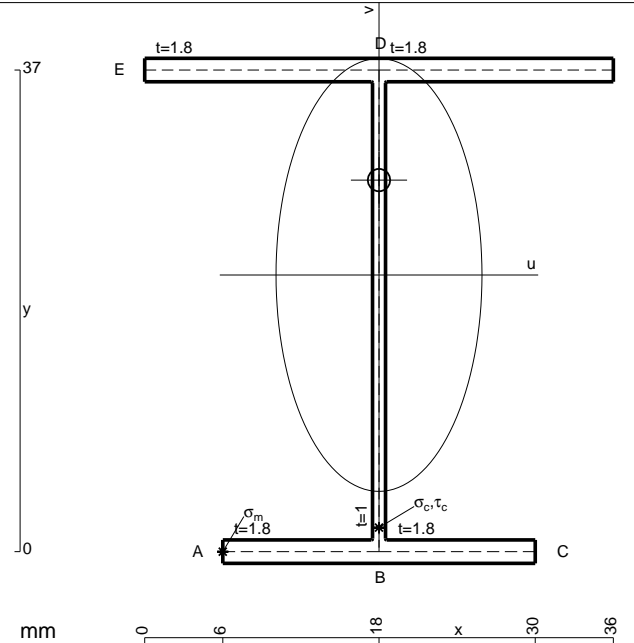
$$L_{HG}^{xo} = \int_0^b (1/2 - 1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/2 x - 1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

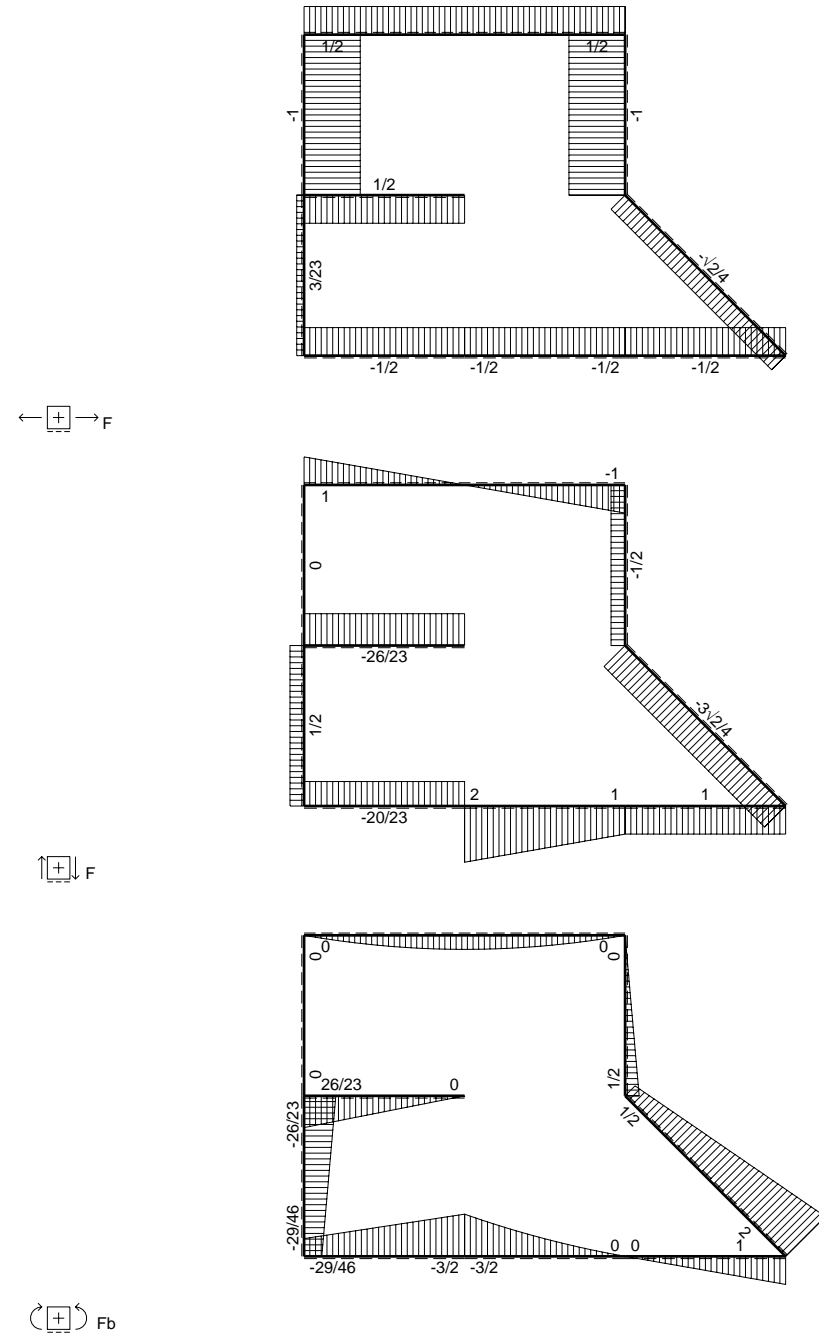
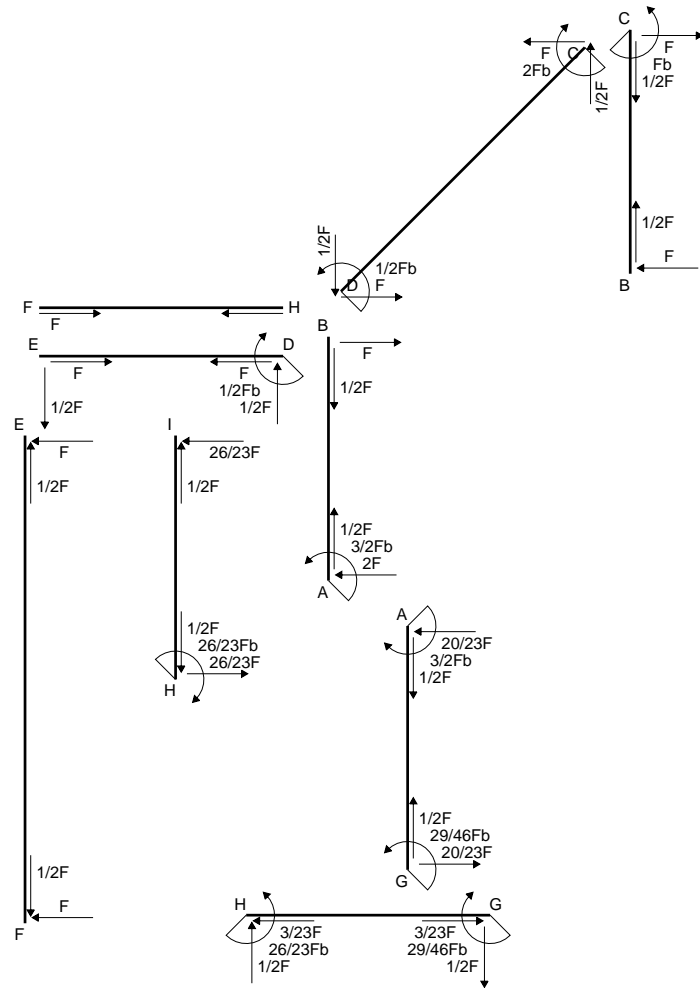
$$= (1/2 b - 1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$

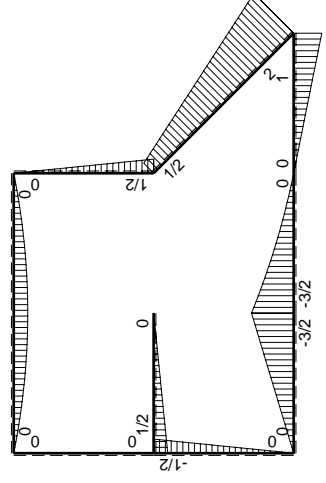
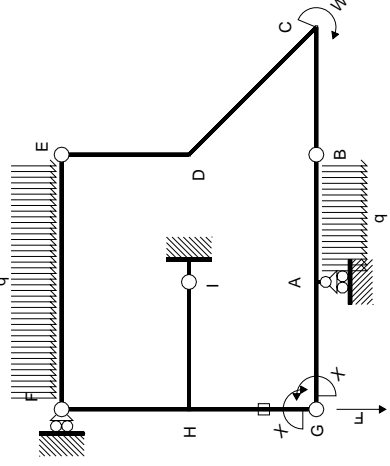
$$L_{GH}^{xo} = \int_0^b (1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$

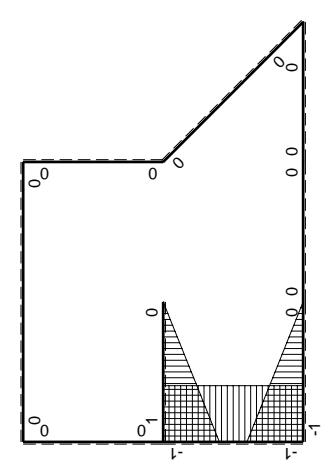


- A = 145. mm²
- J_u = 40083. mm⁴
- J_v = 9072. mm⁴
- J_I = 129. mm⁴
- y_o = 7.287 mm
- y_g = 21.26 mm
- N = -760. N
- T_y = 1520. N
- M_x = -440800. Nmm
- x_m = 6. mm
- u_m = -12. mm
- v_m = -21.26 mm
- σ_m = N/A - Mv/J_u = -239. N/mm²
- x_c = 18. mm
- v_c = -21.26 mm
- σ_c = N/A - Mv/J_u = -239. N/mm²
- τ_c = TS_v/tJ_u = 34.82 N/mm²
- τ_g = TS_v/tJ_u = 34.82 N/mm²
- t_c = 1520. mm
- σ_o = √σ² + 3τ² = 246.5 N/mm²





M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int M_x M_x / E J dx$
AB b	0	$-3/2 Fb + 2Fx - 1/2 qx^2$	0	0	0	0
BA b	0	$Fx + 1/2 qx^2$	0	0	0	0
BC b	0	Fx	0	0	0	0
CB b	0	$-Fb + Fx$	0	0	0	0
CD $\sqrt{2}b$	0	$2Fb - 3\sqrt{2}/4 Fx$	0	0	0	0
DE b	0	$1/2 Fb - 1/2 Fx$	0	0	0	0
ED b	0	$-1/2 Fx$	0	0	0	0
EF 2b	0	$-Fx + 1/2 qx^2$	0	0	0	0
FE 2b	0	$Fx - 1/2 qx^2$	0	0	0	0
GA b	$-1 + x/b$	$-3/2 Fx$	$3/2 Fx - 3/2 Fx^2 / b$	$1 - 2x/b + x^2 / b^2$	$1/4 Fb^2 / EJ$	$1/3 Xb / EJ$
AG b	x/b	$3/2 Fb - 3/2 Fx$	$3/2 Fx - 3/2 Fx^2 / b$	x^2 / b^2	$1/4 Fb^2 / EJ$	$1/3 Xb / EJ$
FH b	0	0	0	0	0	0
HF b	0	0	0	0	0	0
HI b	$1 - x/b$	$1/2 Fb - 1/2 Fx$	$1/2 Fb - Fx + 1/2 Fx^2 / b$	$1 - 2x/b + x^2 / b^2$	$1/6 Fb^2 / EJ$	$1/3 Xb / EJ$
IH b	$-x/b$	$-1/2 Fx$	$1/2 Fx^2 / b$	x^2 / b^2	$1/4 Fb^2 / EJ$	Xb / EJ
HG b	-1	$-1/2 Fb + 1/2 Fx$	$1/2 Fb - 1/2 Fx$	1	$1/4 Fb^2 / EJ$	Xb / EJ
GH b	1	$1/2 Fx$	$1/2 Fx$	1	$1/4 Fb^2 / EJ$	Xb / EJ
HG	elongazione asta $N_{1HG^{\pm}HG^{\pm}HG}$				$-Fb^2 / EJ$	
A	molla nodo $-V_{1A}(V_{0A} + XV_{1A}) / k_A$				$-7/8 Fb^2 / EJ$	$1/4 Xb / EJ$
totali					$-29/24 Fb^2 / EJ$	$23/12 Xb / EJ$
iperstatica X=W _{GA}					$29/46 Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{x_0} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{AG}^{x_0} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{HI}^{x_0} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{IH}^{x_0} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

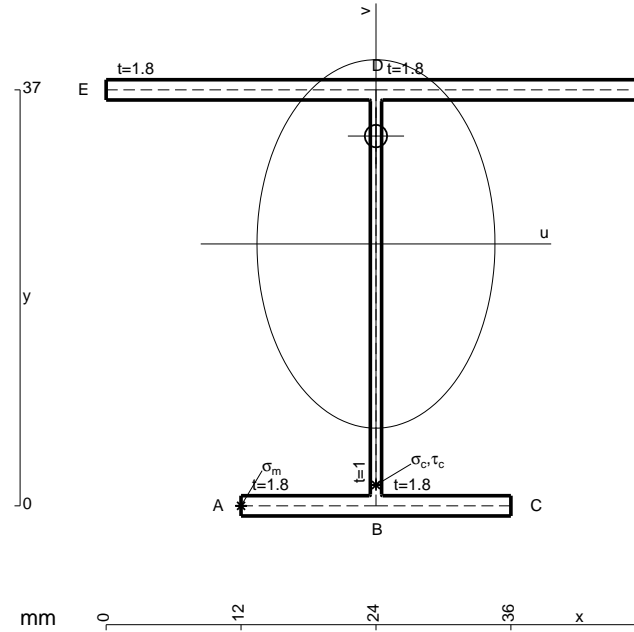
$$L_{HG}^{x_0} = \int_0^b (1/2 - 1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/2 x - 1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

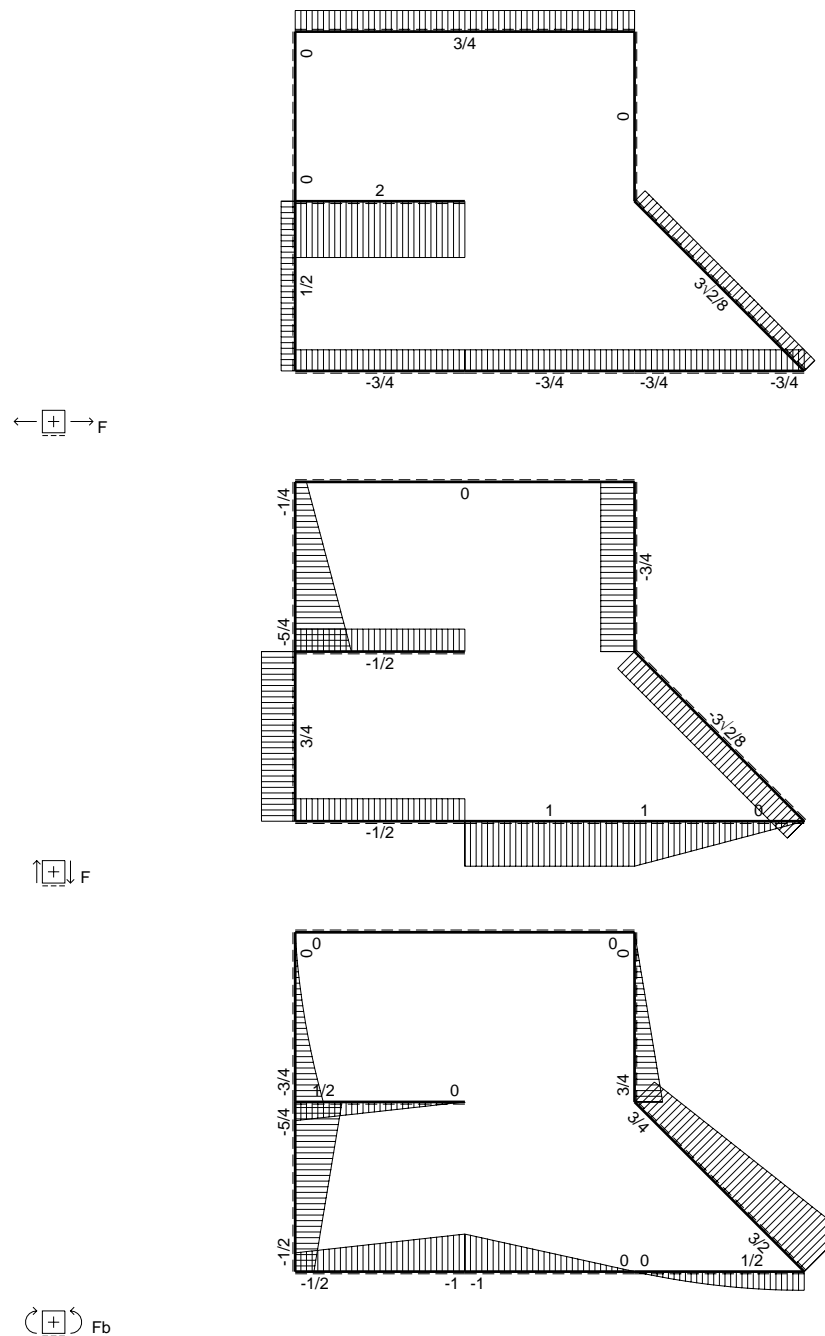
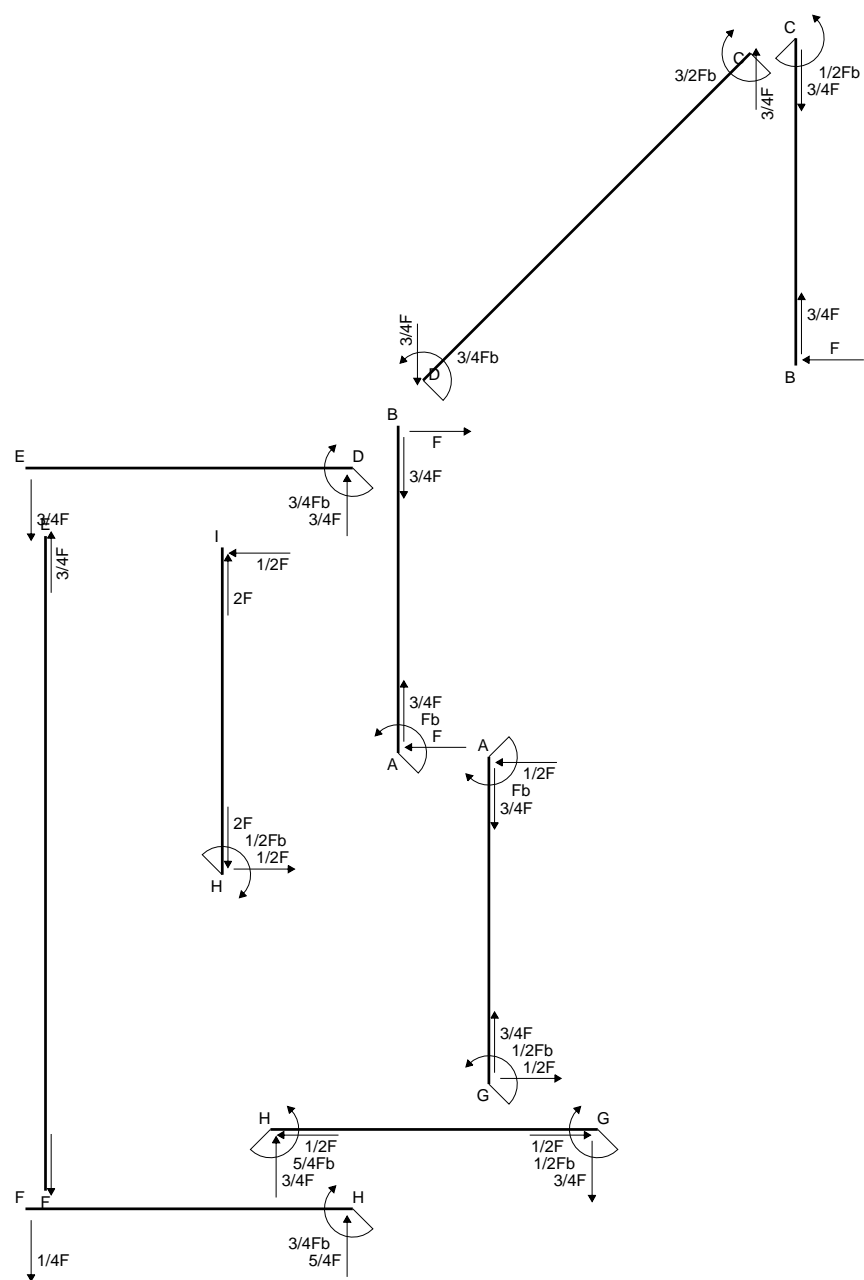
$$= (1/2 b - 1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$

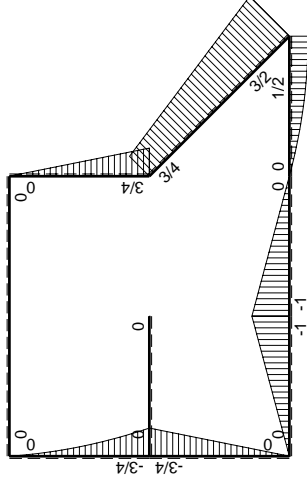
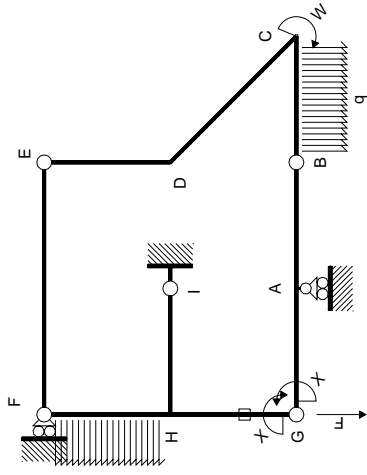
$$L_{GH}^{x_0} = \int_0^b (1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$

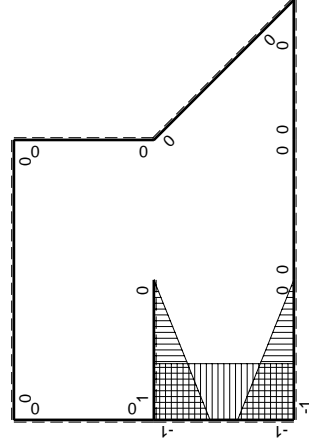


- A = 166.6 mm²
- J_u = 44743. mm⁴
- J_v = 18662. mm⁴
- J_t = 152.3 mm⁴
- y_o = 9.592 mm
- y_g = 23.3 mm
- N = -405. N
- T_y = 1620. N
- M_x = -376650. Nmm
- x_m = 12. mm
- u_m = -12. mm
- v_m = -23.3 mm
- σ_m = N/A-Mv/J_u = -198.5 N/mm²
- x_c = 24. mm
- v_c = -23.3 mm
- σ_c = N/A-Mv/J_u = -198.5 N/mm²
- τ_c = TS_t/tJ_u = 36.44 N/mm²
- τ_g = TS_t/tJ_u = 36.44 N/mm²
- t_c = 810. mm
- σ_o = √σ²+3τ² = 208.3 N/mm²





M₀ flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{GA}

→	M _x (x)	M ₀ (x)	M _x M ₀	M _x M _x	∫M _x M ₀ /EJdx	∫XM _x M ₀ /EJdx
AB b	0	-Fb+Fx	0	0	0	0
BA b	0	Fx	0	0	0	0
BC b	0	Fx-1/2qx ²	0	0	0	0
CB b	0	-1/2Fb+1/2qx ²	0	0	0	0
CD 1/2b	0	3/2Fb-3√2/8Fx	0	0	0	0
DE b	0	3/4Fb-3/4Fx	0	0	0	0
ED b	0	-3/4Fx	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	-1+x/b	-Fx	Fx-Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
AG b	x/b	Fb-Fx	Fx-Fx ² /b	x ² /b ²		
FH b	0	-1/4Fx-1/2qx ²	0	0	0	0
HF b	0	3/4Fb-5/4Fx+1/2qx ²	0	0	0	0
HI b	1-x/b	0	0	1-2x/b+x ² /b ²		1/3Xb/EJ
IH b	-x/b	0	0	x ² /b ²		
HG b	-1	-3/4Fb+3/4Fx	3/4Fb-3/4Fx	1	3/8Fb ² /EJ	Xb/EJ
GH b	1	3/4Fx	3/4Fx	1		
HG	elongazione asta N _{1HG⁺HG⁻HG}				-Fb ² /EJ	
A	molla nodo -V _{1A} (V _{0A} +XV _{1A})/k _A				-1/2Fb ² /EJ	1/4Xb/EJ
	totali				-23/24Fb ² /EJ	23/12Xb/EJ
	iperstatica X=W _{GA}				1/2Fb	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{x_0} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{AG}^{x_0} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

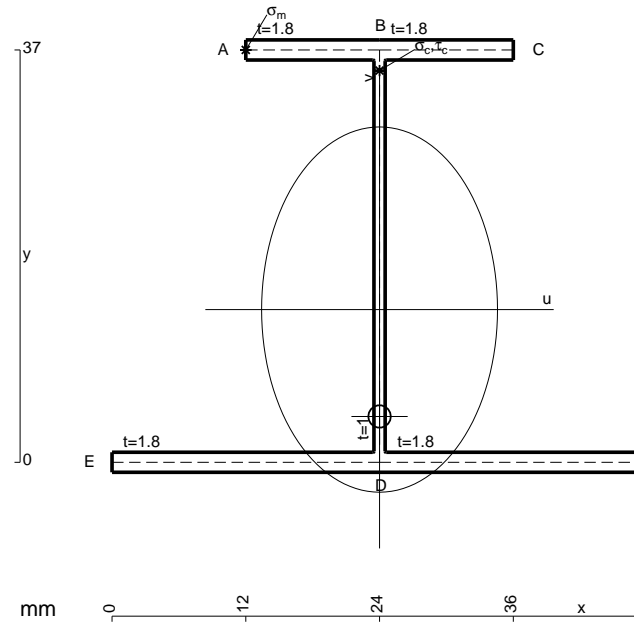
$$L_{HG}^{x_0} = \int_0^b (3/4 - 3/4 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [3/4 x - 3/8 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

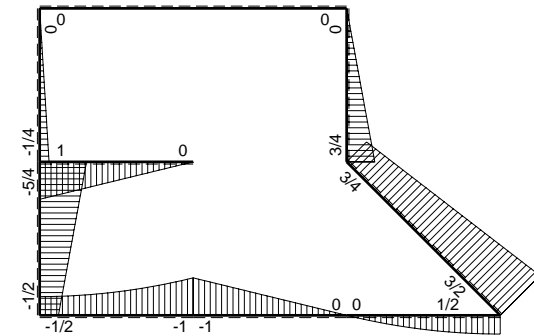
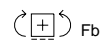
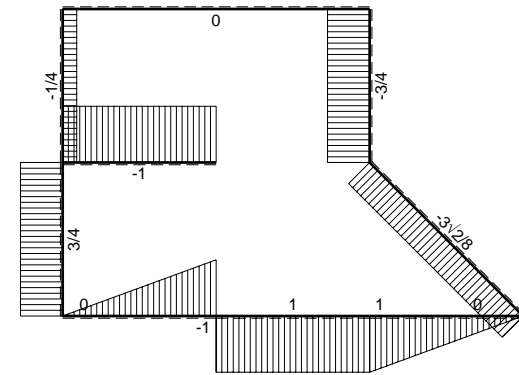
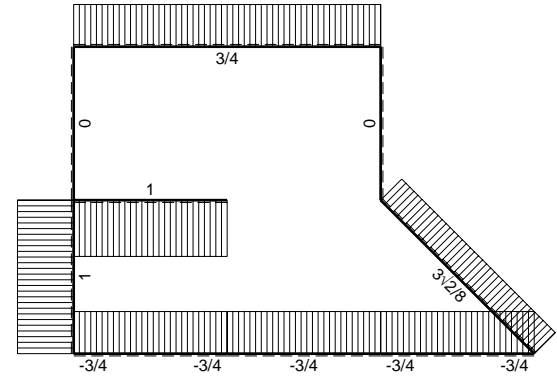
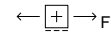
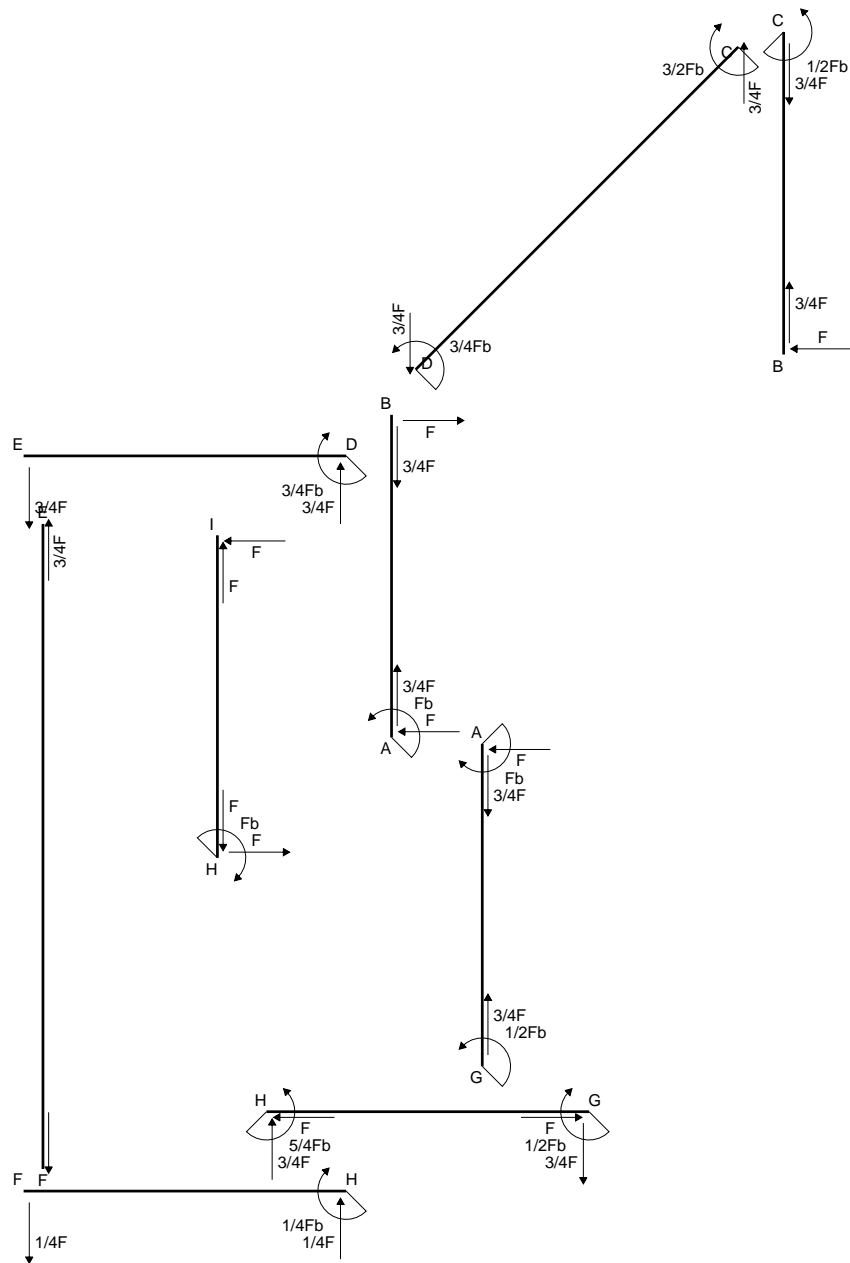
$$= (3/4 b - 3/8 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/8 Fb^2/EJ$$

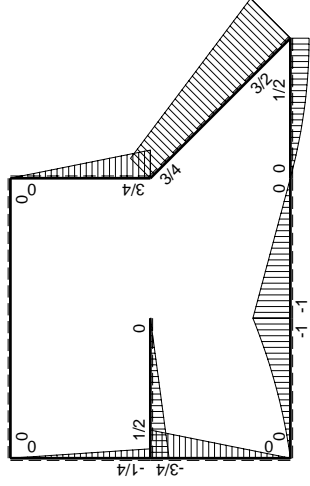
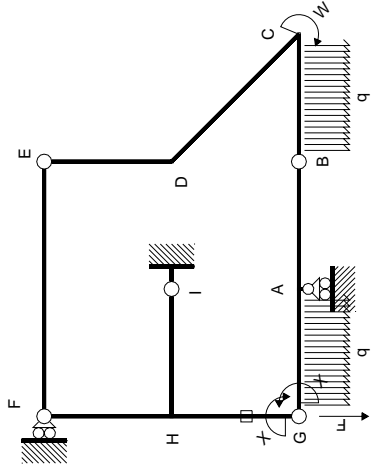
$$L_{GH}^{x_0} = \int_0^b (3/4 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [3/8 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (3/8 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/8 Fb^2/EJ$$

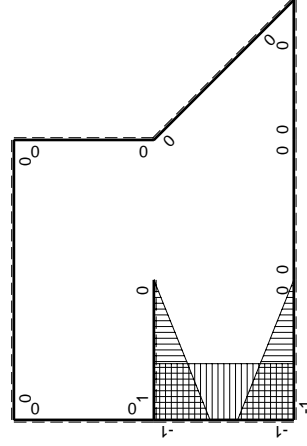


- A = 166.6 mm²
- J_u = 44743. mm⁴
- J_v = 18662. mm⁴
- J_t = 152.3 mm⁴
- y_o = -9.592 mm
- y_g = 13.7 mm
- N = -907.5 N
- T_y = 1210. N
- M_x = -411400. Nmm
- x_m = 12. mm
- y_m = 37. mm
- u_m = -12. mm
- v_m = 23.3 mm
- σ_m = N/A-Mv/J_u = 208.8 N/mm²
- x_c = 24. mm
- y_c = 37. mm
- v_c = 23.3 mm
- σ_c = N/A-Mv/J_u = 208.8 N/mm²
- τ_c = TS'/tJ_u = 27.22 N/mm²
- τ_g = TS'/tJ_u = 27.22 N/mm²
- t_c = 1210. mm
- σ_o = √σ²+3τ² = 214. N/mm²





M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-Fb+Fx	0	0	0	0
BA b	0	Fx	0	0	0	0
BC b	0	Fx-1/2qx ²	0	0	0	0
CB b	0	-1/2Fb+1/2qx ²	0	0	0	0
CD 1/2b	0	3/2Fb-3√1/8Fx	0	0	0	0
DE b	0	3/4Fb-3/4Fx	0	0	0	0
ED b	0	-3/4Fx	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	-1+x/b	-1/2Fx-1/2qx ²	1/2Fx-1/2qx ³ /b	1-2x/b+x ² /b ²	1/8Fb ² /EJ	1/3Xb/EJ
AG b	x/b	Fb-3/2Fx+1/2qx ²	Fx-3/2Fx ² /b+1/2qx ³ /b	x ² /b ²	1/8Fb ² /EJ	1/3Xb/EJ
FH b	0	-1/4Fx	0	0	0	0
HF b	0	1/4Fb-1/4Fx	0	0	0	0
HI b	1-x/b	1/2Fb-1/2Fx	1/2Fb-Fx+1/2Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
IH b	-x/b	-1/2Fx	1/2Fx ² /b	x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
HG b	-1	-3/4Fb+3/4Fx	3/4Fb-3/4Fx	1	3/8Fb ² /EJ	Xb/EJ
GH b	1	3/4Fx	3/4Fx	1	3/8Fb ² /EJ	Xb/EJ
HG	elongazione asta N _{1,HG^SHG-HG}				-Fb ² /EJ	
A	molla nodo -V _{1A} (V _{GA} +XV _{1A})/k _A				-5/8Fb ² /EJ	1/4Xb/EJ
totali					-23/24Fb ² /EJ	23/12Xb/EJ
iperstatica X=W _{GA}					1/2Fb	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (1/2 x/b - 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[1/4 x^2/b - 1/8 x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b - 1/8 b) \cdot Fb \cdot 1/EJ = 1/8 \cdot Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (x/b - 3/2 x^2/b^2 + 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[1/2 x^2/b - 1/2 x^3/b^2 + 1/8 x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/2 b + 1/8 b) \cdot Fb \cdot 1/EJ = 1/8 \cdot Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[1/2 x - 1/2 x^2/b + 1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/6 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

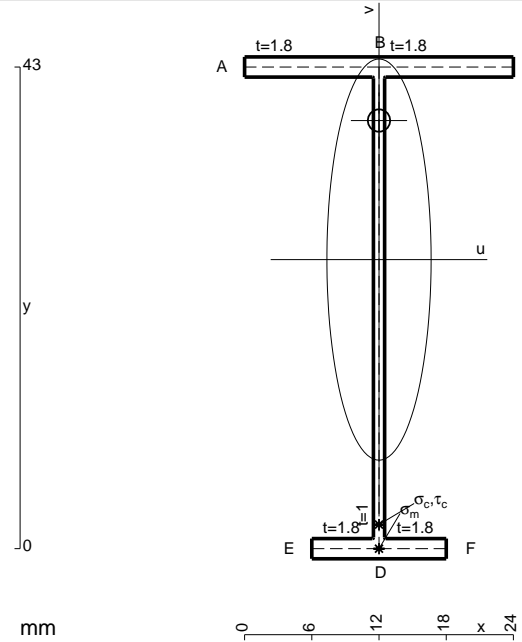
$$L_{HG}^{xo} = \int_0^b (3/4 - 3/4 x/b) \cdot Fb \cdot 1/EJ \, dx - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ$$

$$= \left[3/4 x - 3/8 x^2/b \right]_0^b \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ$$

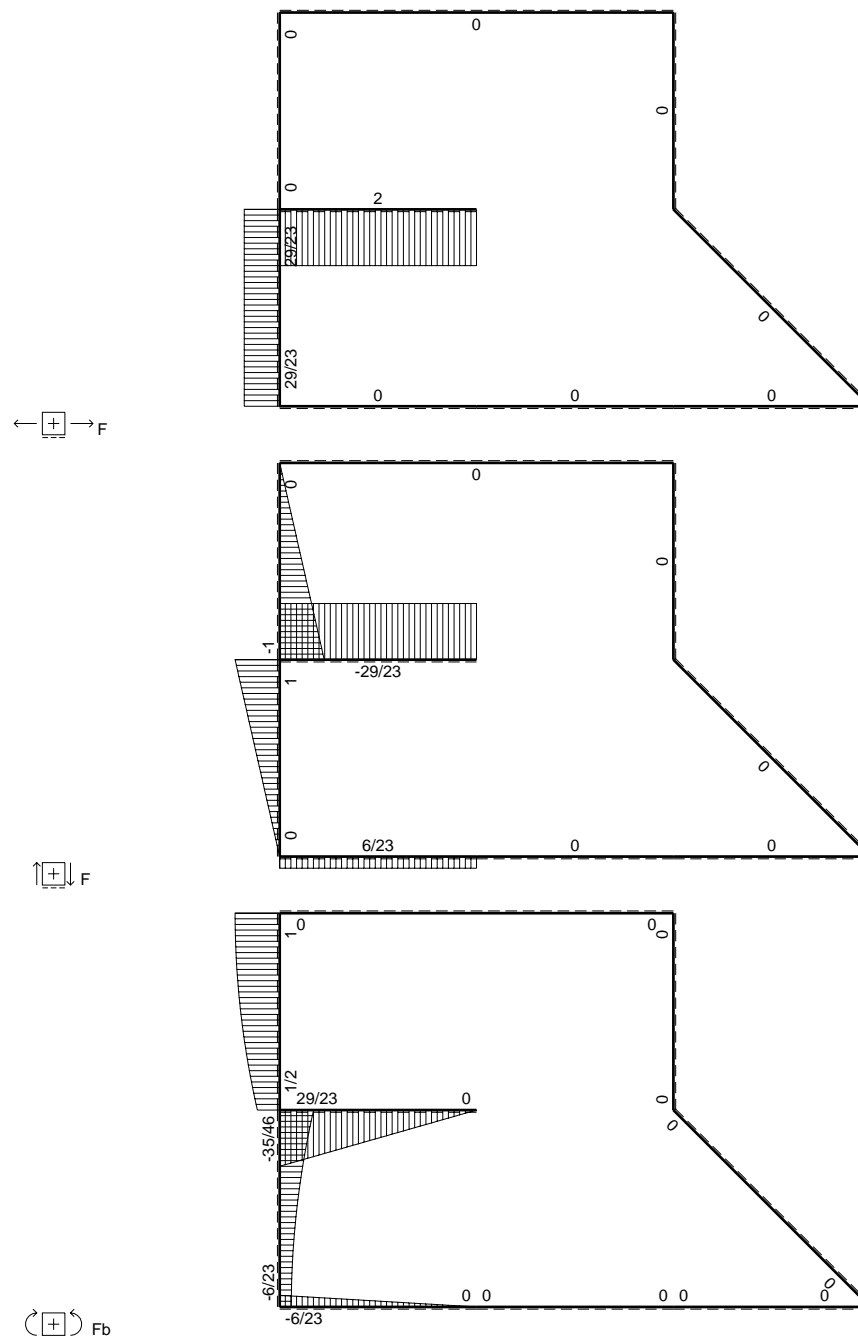
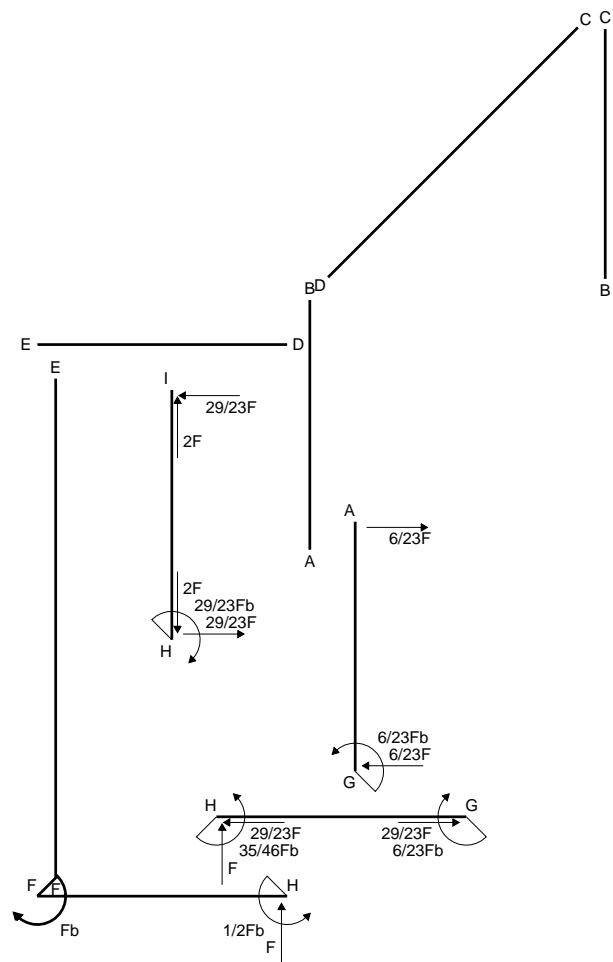
$$= (3/4 b - 3/8 b) \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ = -5/8 \cdot Fb^2/EJ$$

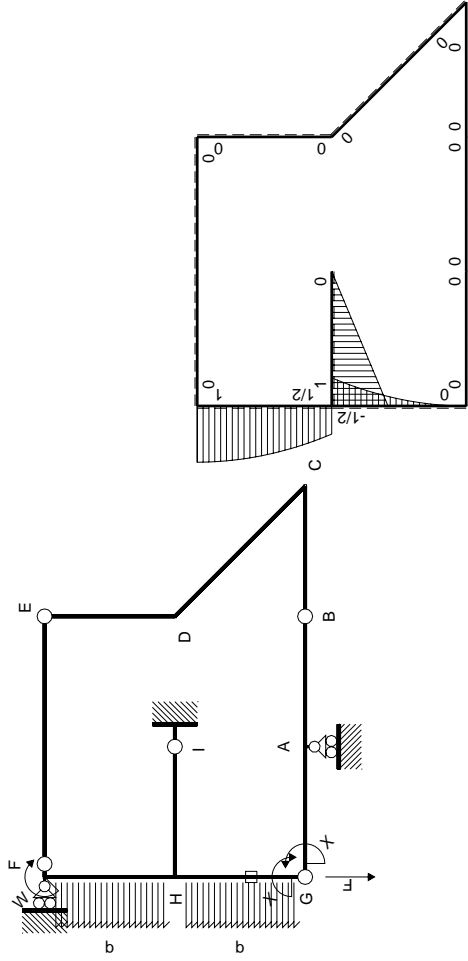
$$L_{GH}^{xo} = \int_0^b (3/4 x/b) \cdot Fb \cdot 1/EJ \, dx - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ = \left[3/8 x^2/b \right]_0^b \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ$$

$$= (3/8 b) \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ = -5/8 \cdot Fb^2/EJ$$



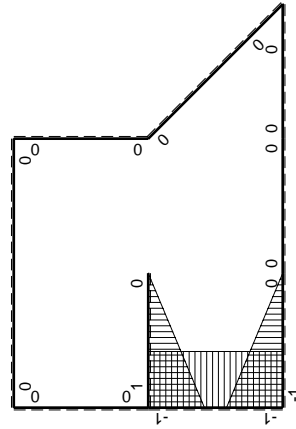
- A = 107.8 mm²
- J_u = 34579. mm⁴
- J_v = 2333. mm⁴
- J_I = 84.32 mm⁴
- y_o = 12.41 mm
- y_g = 25.81 mm
- N = -487.5 N
- T_y = 650. N
- M_x = -286000. Nmm
- x_m = 12. mm
- v_m = -25.81 mm
- σ_m = N/A-Mv/J_u = -218. N/mm²
- y_c = 3. mm
- u_c = -12. mm
- v_c = -22.81 mm
- σ_c = N/A-Mv/J_u = -218. N/mm²
- τ_c = TS_v/tJ_u = 10.48 N/mm²
- τ_g = TS_v/tJ_u = 10.48 N/mm²
- t_c = 650. mm
- σ_o = √σ²+3τ² = 218.7 N/mm²





Schema di calcolo iperstatico

(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	M _x (x)	M ₀ (x)	M _x M ₀	M _x M _x	∫M _x M ₀ /EJdx	∫XM _x M _x /EJdx
AB b	0	0	0	0	0	0
BA b	0	0	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD √2b	0	0	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	-1+x/b	0	0	1-2x/b+x ² /b ²	0	1/3Xb/EJ
AG b	x/b	0	0	x ² /b ²	0	0
FH b	0	Fb-1/2qx ²	0	0	0	0
HF b	0	-1/2Fb-Fx+1/2qx ²	0	0	0	0
HI b	1-x/b	Fb-Fx	Fb-2Fx+Fx ² /b	1-2x/b+x ² /b ²	1/3Fb ² /EJ	1/3Xb/EJ
IH b	-x/b	-Fx	Fx ² /b	x ² /b ²	1/6Fb ² /EJ	Xb/EJ
HG b	-1	-1/2Fb+Fx-1/2qx ²	1/2Fb-Fx+1/2Fx ² /b	1	1/6Fb ² /EJ	Xb/EJ
GH b	1	1/2qx ²	1/2Fx ² /b	1	1/6Fb ² /EJ	Xb/EJ
HG	elongazione asta N _{1HG⁺HG⁻} HG					
A	molla nodo -V _{1A} (V _{GA} +XV _{1A})/k _A					
	totali					
	iperstatica X=W _{GA}					

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{HI}^{xo} = \int_0^b (1 - 2x/b + x^2/b^2) Fb 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - b + 1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (x^2/b^2) Fb 1/EJ dx = [1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

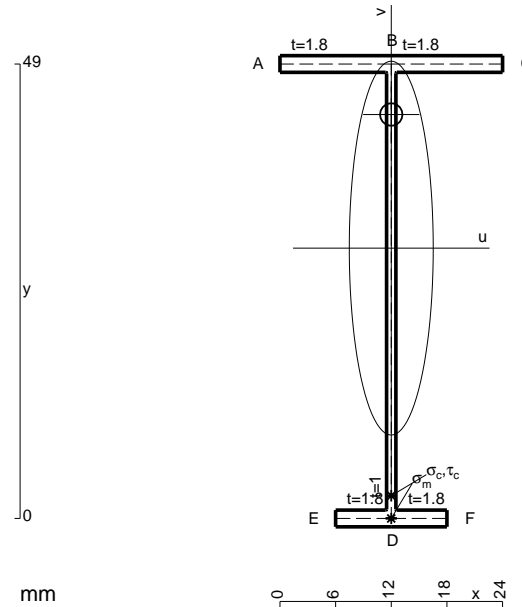
$$L_{HG}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

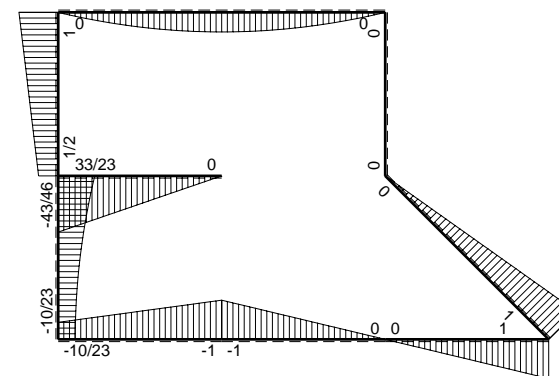
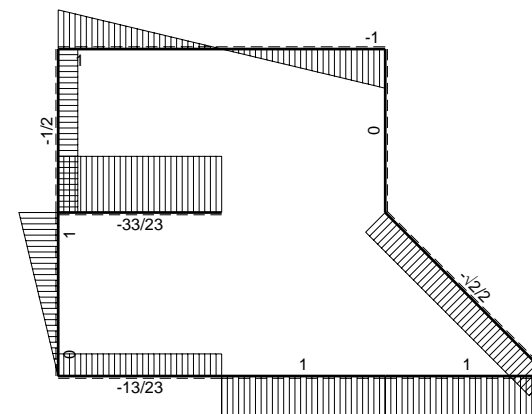
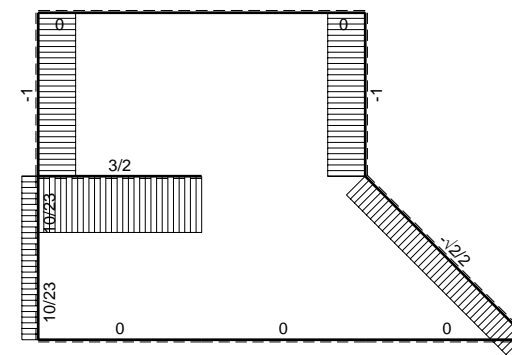
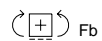
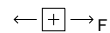
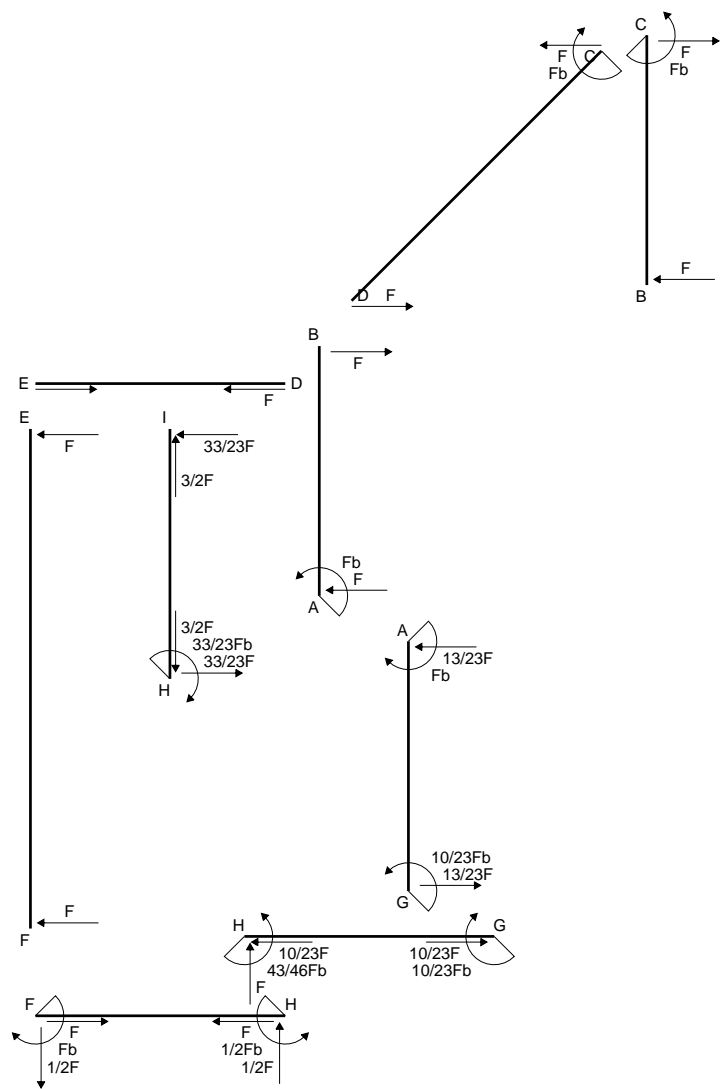
$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/6 Fb^2/EJ$$

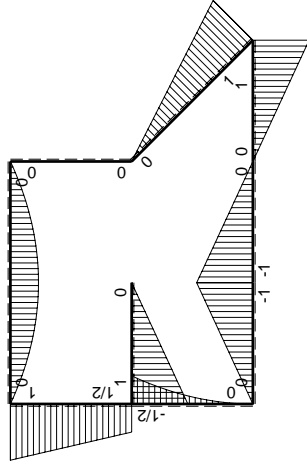
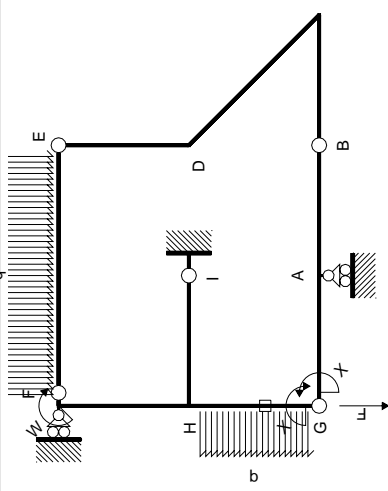
$$L_{GH}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/6 Fb^2/EJ$$



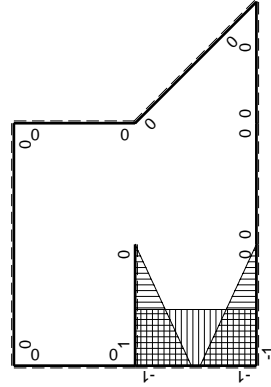
- A = 113.8 mm²
- J_u = 46239. mm⁴
- J_v = 2333. mm⁴
- J_t = 86.32 mm⁴
- y_o = 14.41 mm
- y_g = 29.15 mm
- T_y = -1350. N
- M_x = 364500. Nmm
- x_m = 12. mm
- v_m = -29.15 mm
- σ_m = -Mv/J_u = 229.8 N/mm²
- y_c = 3. mm
- u_c = -12. mm
- v_c = -26.15 mm
- σ_c = -Mv/J_u = 229.8 N/mm²
- τ_c = TS¹/tJ_u = 18.38 N/mm²
- τ_g = TS¹/tJ_u = 18.38 N/mm²
- t_c = 1350. mm
- σ_o = √σ²+3τ² = 232. N/mm²





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$	
AB b	0	-Fb+Fx	0	0	0	0	
BA b	0	Fx	0	0	0	0	
BC b	0	Fx	0	0	0	0	
CB b	0	-Fb+Fx	0	0	0	0	
CD $\sqrt{2}b$	0	Fb- $\sqrt{2}/2Fx$	0	0	0	0	
DE b	0	0	0	0	0	0	
ED b	0	0	0	0	0	0	
EF 2b	0	-Fx+ $1/2qx^2$	0	0	0	0	
FE 2b	0	Fx- $1/2qx^2$	0	0	0	0	
GA b	-1+x/b	-Fx	Fx-Fx ² /b	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$	
AG b	x/b	Fb-Fx	Fx-Fx ² /b	x^2/b^2	$1/6Fb^2/EJ$	$1/3Xb/EJ$	
FH b	0	Fb- $1/2Fx$	0	0	0	0	
HF b	0	- $1/2Fb-1/2Fx$	0	0	0	0	
HI b	1-x/b	Fb-Fx	Fb-2Fx+Fx ² /b	$1-2x/b+x^2/b^2$	$1/3Fb^2/EJ$	$1/3Xb/EJ$	
IH b	-x/b	-Fx	Fx ² /b	x^2/b^2	$1/6Fb^2/EJ$	Xb/EJ	
HG b	-1	- $1/2Fb+Fx-1/2qx^2$	$1/2Fb-Fx+1/2Fx^2/b$	1	$1/6Fb^2/EJ$	Xb/EJ	
GH b	1	$1/2qx^2$	$1/2Fx^2/b$	1	$1/6Fb^2/EJ$	Xb/EJ	
HG	elongazione asta $N_{1HG}^{HG} = -HG$						
A	molla nodo $-V_{1A}(V_{0A} + XV_{1A})/k_A$						
	totali						
	iperstatica X=W _{GA}						

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{x_0} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{AG}^{x_0} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{HI}^{x_0} = \int_0^b (1 - 2x/b + x^2/b^2) Fb 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - b + 1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{IH}^{x_0} = \int_0^b (x^2/b^2) Fb 1/EJ dx = [1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

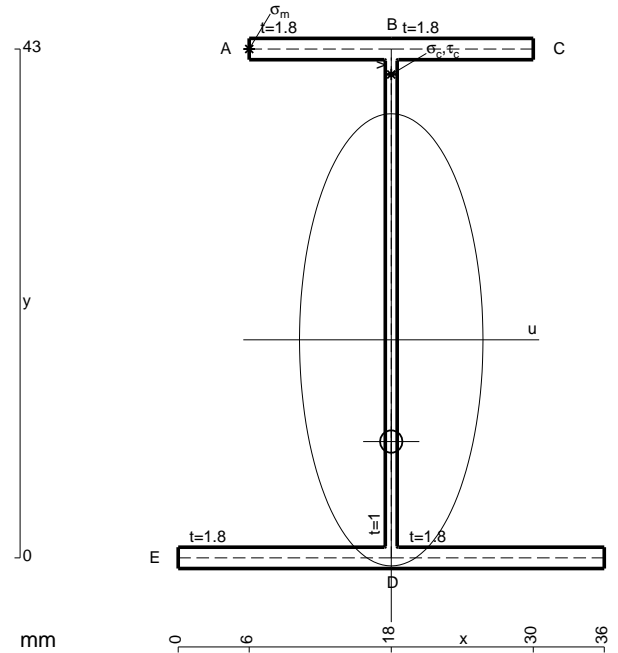
$$L_{HG}^{x_0} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 \cdot (-1) \cdot (-1) Fb^2/EJ$$

$$= [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 \cdot (-1) \cdot (-1) Fb^2/EJ$$

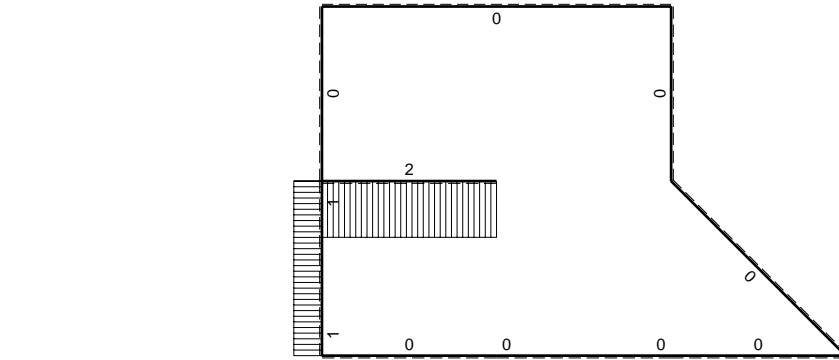
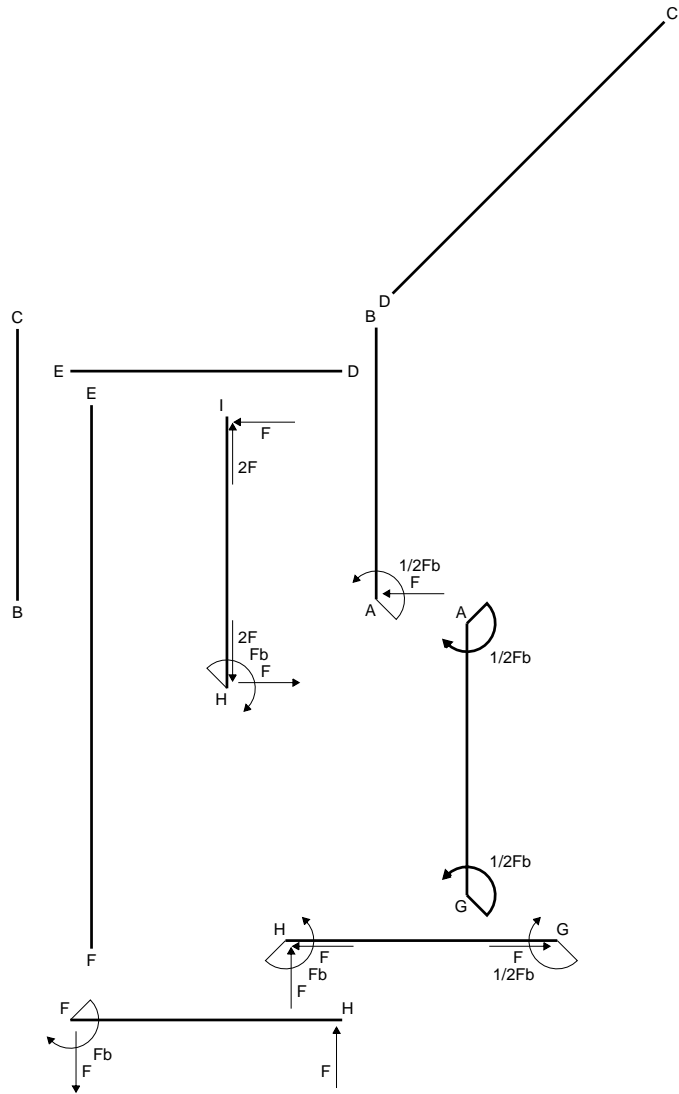
$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ - 1 \cdot (-1) \cdot (-1) Fb^2/EJ = -5/6 Fb^2/EJ$$

$$L_{GH}^{x_0} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx - 1 \cdot (-1) \cdot (-1) Fb^2/EJ = [1/6 x^3/b^2]_0^b Fb 1/EJ - 1 \cdot (-1) \cdot (-1) Fb^2/EJ$$

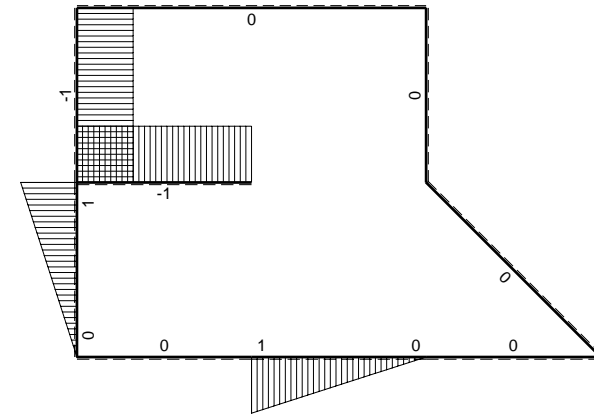
$$= (1/6 b) Fb 1/EJ - 1 \cdot (-1) \cdot (-1) Fb^2/EJ = -5/6 Fb^2/EJ$$



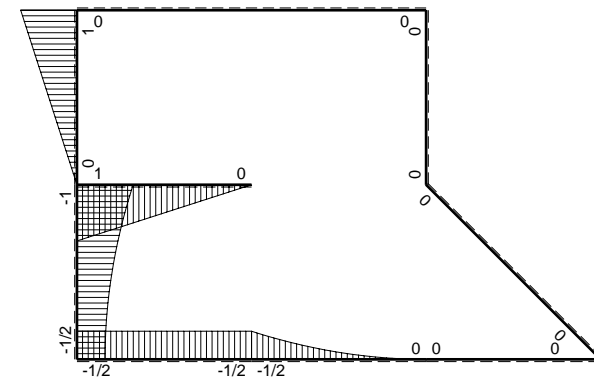
- A = 151. mm²
- J_u = 55120. mm⁴
- J_v = 9072. mm⁴
- J_i = 131. mm⁴
- y_o = -8.596 mm
- y_g = 18.42 mm
- T_y = 1050. N
- M_x = -535500. Nmm
- x_m = 6. mm
- y_m = 43. mm
- u_m = -12. mm
- v_m = 24.58 mm
- σ_m = -M_v/J_u = 238.8 N/mm²
- x_c = 18. mm
- y_c = 43. mm
- v_c = 24.58 mm
- σ_c = -M_v/J_u = 238.8 N/mm²
- τ_c = T_S/t_{J_u} = 20.22 N/mm²
- τ_g = T_S/t_{J_u} = 20.22 N/mm²
- t_c = 1050. mm
- σ_o = √σ²+3τ² = 241.3 N/mm²



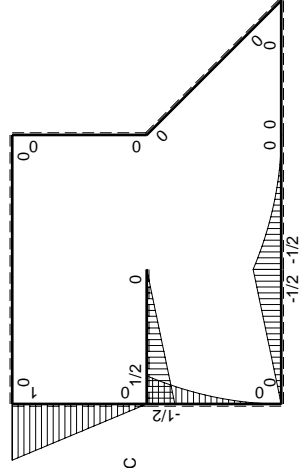
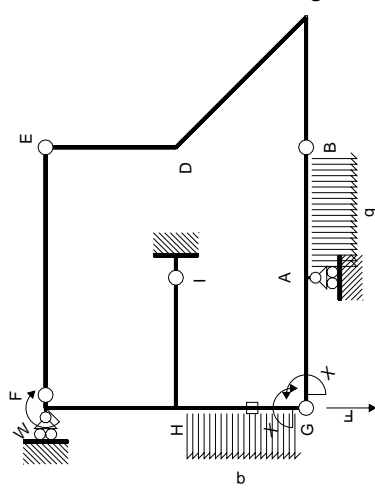
← ⊕ → F



↑ ⊕ ↓ F

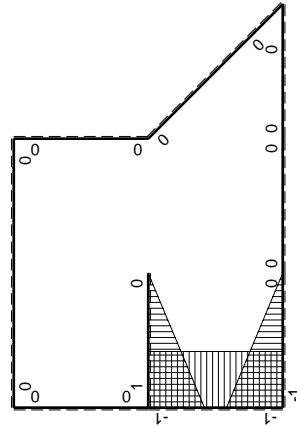


⊙ ⊕ ⊙ Fb



Schema di calcolo iperstatico

(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-1/2Fb + Fx - 1/2qx^2$	0	0	0	0
BA b	0	$1/2qx^2$	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	0	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$-1/2Fx$	$1/2Fx - 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$1/2Fb - 1/2Fx$	$1/2Fx - 1/2Fx^2/b$	x^2/b^2	$1/12Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$Fb - Fx$	0	0	0	0
HF b	0	$-Fx$	0	0	0	0
HI b	$1-x/b$	$1/2Fb - 1/2Fx$	$1/2Fb - Fx + 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$-1/2Fx$	$1/2Fx^2/b$	x^2/b^2	$1/6Fb^2/EJ$	Xb/EJ
HG b	-1	$-1/2Fb + Fx - 1/2qx^2$	$1/2Fb - Fx + 1/2Fx^2/b$	1	$1/6Fb^2/EJ$	Xb/EJ
GH b	1	$1/2qx^2$	$1/2Fx^2/b$	1	$1/6Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG^{\pm}HG^{\mp}HG}$					
A	molla nodo $-V_{1A}(V_{0A} + XV_{1A})/k_A$					
	totali					
	iperstatica X=W _{GA}					

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

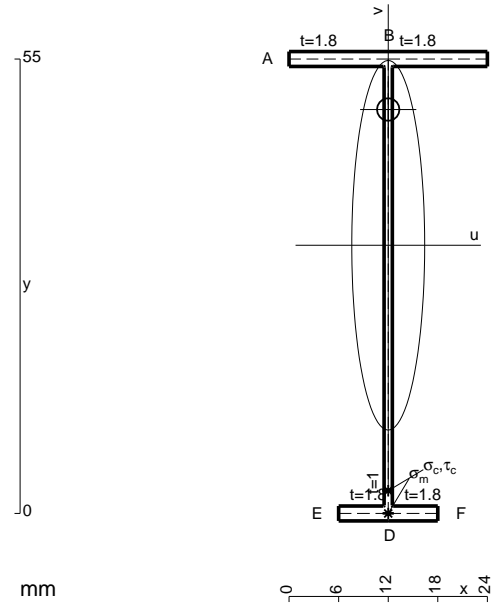
$$L_{HG}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

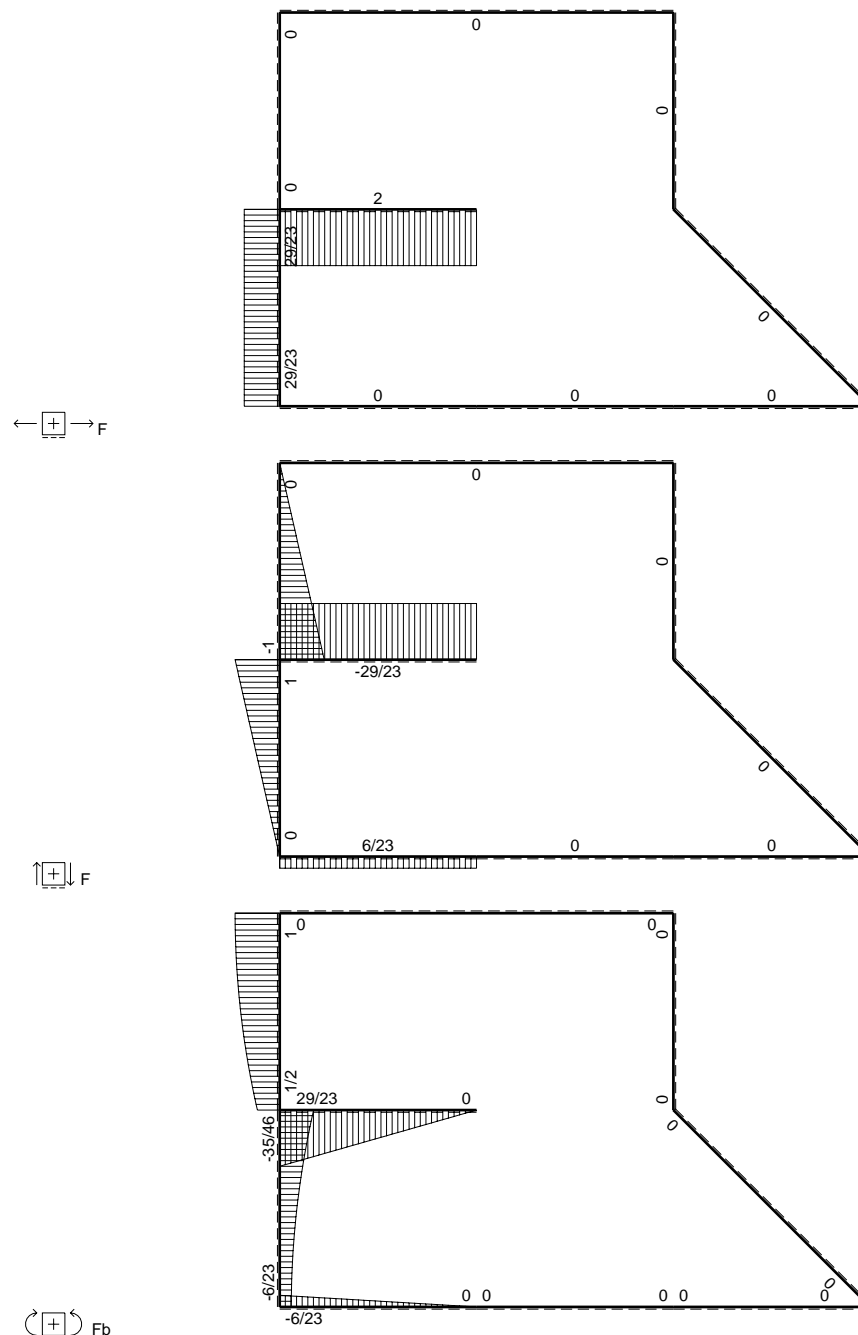
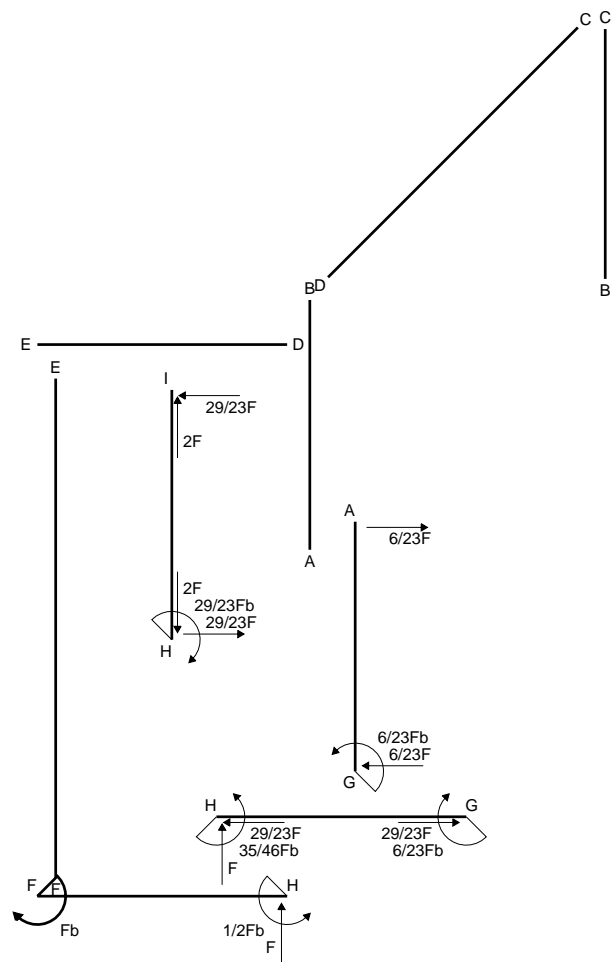
$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/6 Fb^2/EJ$$

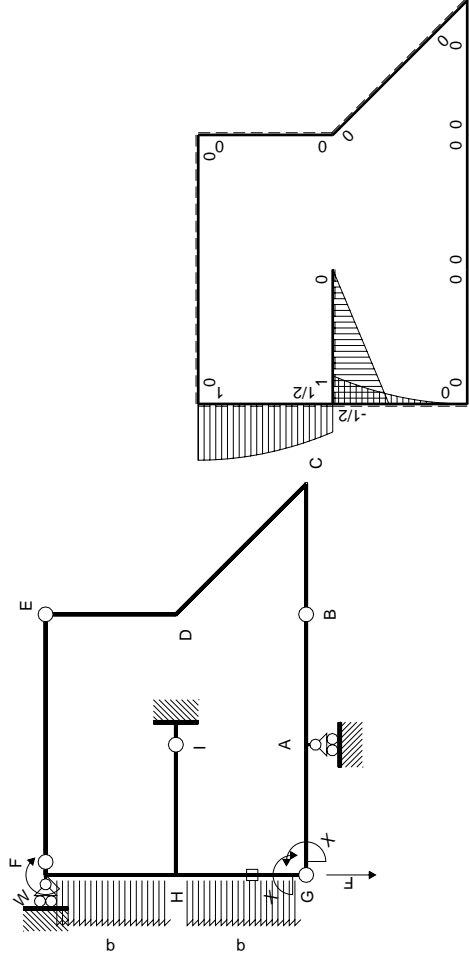
$$L_{GH}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/6 Fb^2/EJ$$



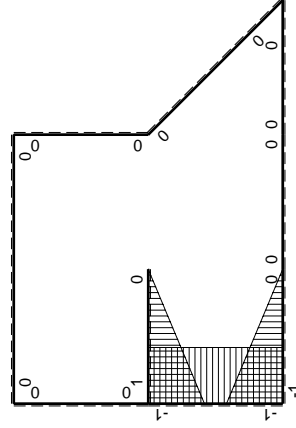
- A = 119.8 mm²
- J_u = 59924. mm⁴
- J_v = 2333. mm⁴
- J_i = 88.32 mm⁴
- y_o = 16.43 mm
- y_g = 32.46 mm
- T_y = -520. N
- M_x = 364000. Nmm
- x_m = 12. mm
- v_m = -32.46 mm
- σ_m = -Mv/J_u = 197.2 N/mm²
- y_c = 3. mm
- u_c = -12. mm
- v_c = -29.46 mm
- σ_c = -Mv/J_u = 197.2 N/mm²
- τ_c = TS_i/tJ_u = 6.084 N/mm²
- τ_g = TS_i/tJ_u = 6.084 N/mm²
- t_c = 520. mm
- σ_o = √σ²+3τ² = 197.4 N/mm²





Schema di calcolo iperstatico

(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$	
AB b	0	0	0	0	0	0	
BA b	0	0	0	0	0	0	
BC b	0	0	0	0	0	0	
CB b	0	0	0	0	0	0	
CD $\sqrt{2}b$	0	0	0	0	0	0	
DE b	0	0	0	0	0	0	
ED b	0	0	0	0	0	0	
EF 2b	0	0	0	0	0	0	
FE 2b	0	0	0	0	0	0	
GA b	-1+x/b	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$	
AG b	x/b	0	0	x^2/b^2	0	0	
FH b	0	$Fb-1/2qx^2$	0	0	0	0	
HF b	0	$-1/2Fb-Fx+1/2qx^2$	0	0	0	0	
HI b	1-x/b	$Fb-Fx$	$Fb-2Fx+Fx^2/b$	$1-2x/b+x^2/b^2$	$1/3Fb^2/EJ$	$1/3Xb/EJ$	
IH b	-x/b	-Fx	Fx^2/b	x^2/b^2	$1/6Fb^2/EJ$	Xb/EJ	
HG b	-1	$-1/2Fb+Fx-1/2qx^2$	$1/2Fb-Fx+1/2Fx^2/b$	1	$1/6Fb^2/EJ$	Xb/EJ	
GH b	1	$1/2qx^2$	$1/2Fx^2/b$	1	$1/6Fb^2/EJ$	Xb/EJ	
HG	elongazione asta $N_{1HG^{\pm}HG^{\pm}HG}$						
A	molla nodo $-V_{1A}(V_{0A}+XV_{1A})/k_A$						
totali						$-1/2Fb^2/EJ$	$23/12Xb/EJ$
iperstatica X=W _{GA}						$6/23Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{HI}^{x_0} = \int_0^b (1 - 2x/b + x^2/b^2) Fb 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - b + 1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{IH}^{x_0} = \int_0^b (x^2/b^2) Fb 1/EJ dx = [1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

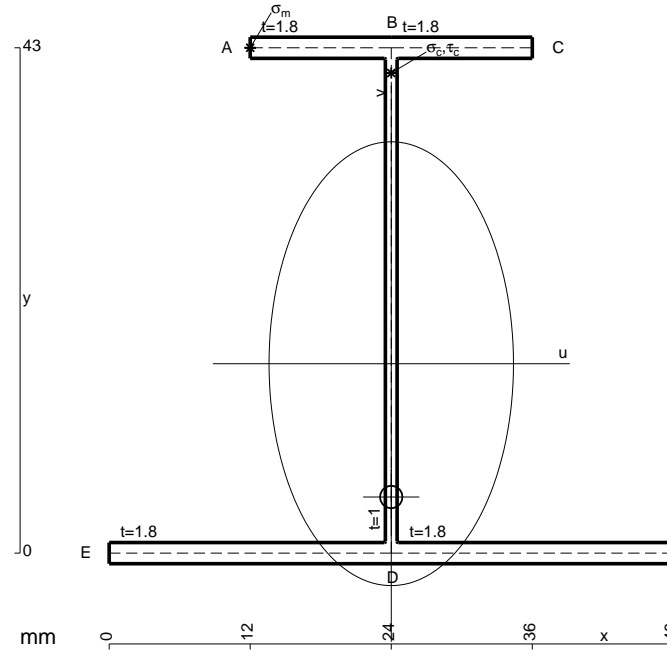
$$L_{HG}^{x_0} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

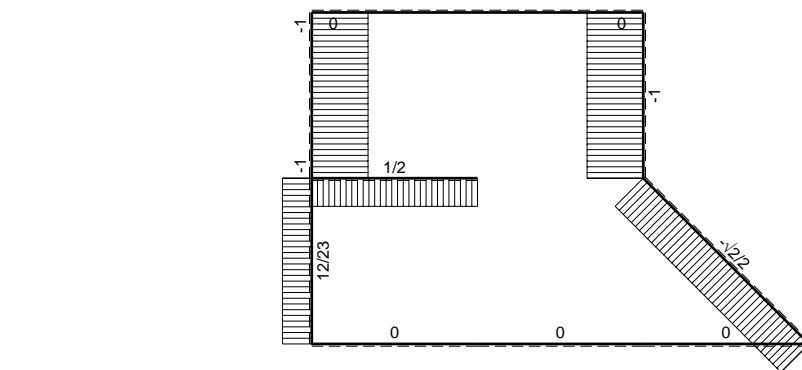
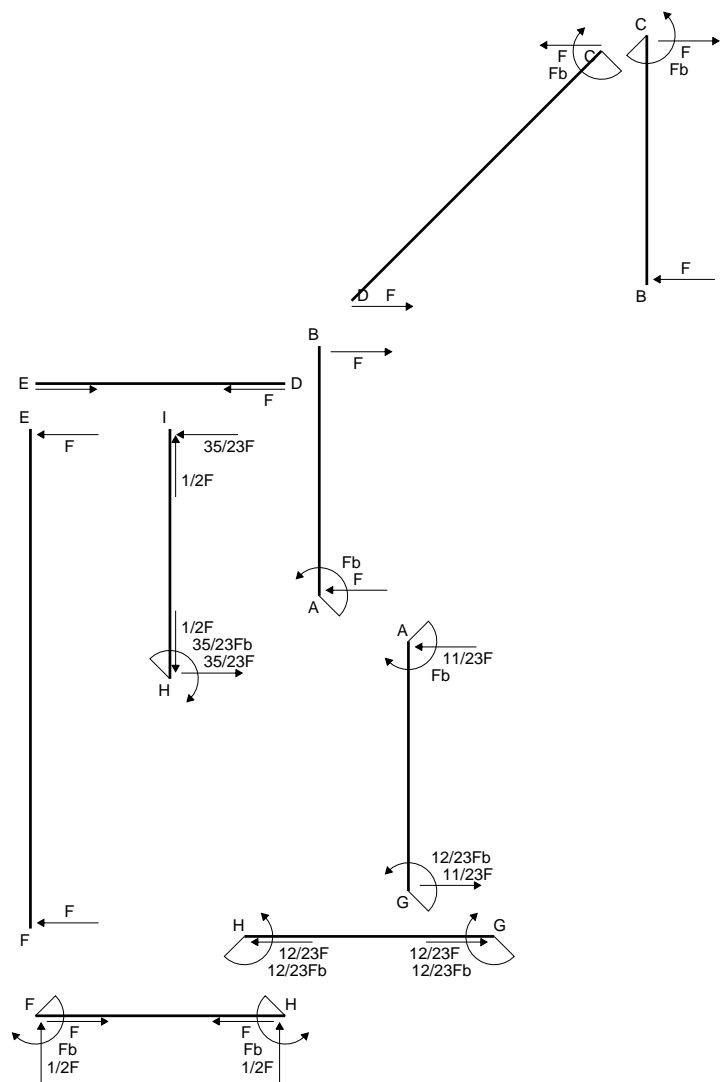
$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/6 Fb^2/EJ$$

$$L_{GH}^{x_0} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

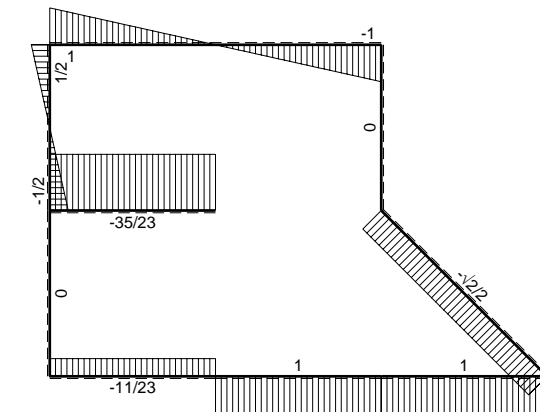
$$= (1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/6 Fb^2/EJ$$



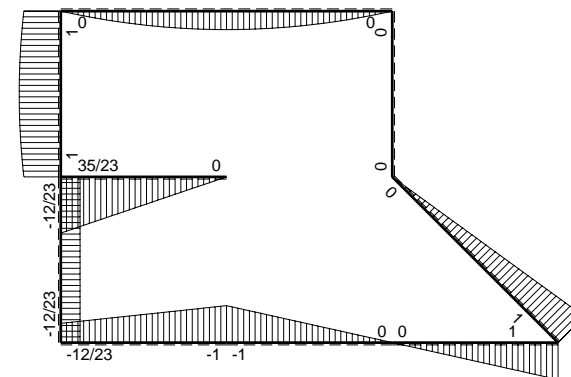
- A = 172.6 mm²
- J_u = 61535. mm⁴
- J_v = 18662. mm⁴
- J_t = 154.3 mm⁴
- y_o = -11.34 mm
- y_g = 16.12 mm
- T_y = -1620. N
- M_x = 477900. Nmm
- x_m = 12. mm
- y_m = 43. mm
- u_m = -12. mm
- v_m = 26.88 mm
- σ_m = -Mv/J_u = -208.8 N/mm²
- x_c = 24. mm
- y_c = 43. mm
- v_c = 26.88 mm
- σ_c = -Mv/J_u = -208.8 N/mm²
- τ_c = TS'/tJ_u = 30.57 N/mm²
- τ_g = TS'/tJ_u = 30.57 N/mm²
- t_c = 1620. mm
- σ_o = √σ²+3τ² = 215.4 N/mm²



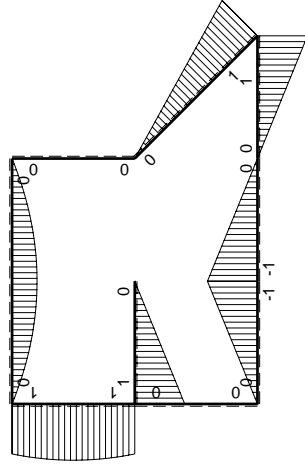
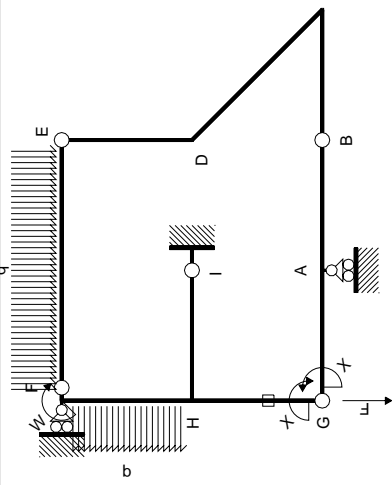
← ⊕ → F



↑ ⊕ ↓ F

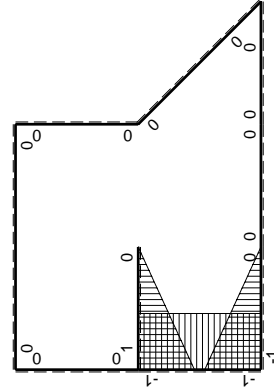


⊕ ⊖ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-Fb+Fx	0	0	0	0
BA b	0	Fx	0	0	0	0
BC b	0	Fx	0	0	0	0
CB b	0	-Fb+Fx	0	0	0	0
CD $\sqrt{2}b$	0	$Fb-\sqrt{2}/2Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	$-Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$Fx-1/2qx^2$	0	0	0	0
GA b	-1+x/b	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2	$1/6Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$Fb+1/2Fx-1/2qx^2$	0	0	0	0
HF b	0	$-Fb-1/2Fx+1/2qx^2$	0	0	0	0
HI b	1-x/b	Fb-Fx	$Fb-2Fx+Fx^2/b$	$1-2x/b+x^2/b^2$	$1/3Fb^2/EJ$	$1/3Xb/EJ$
IH b	-x/b	-Fx	Fx^2/b	x^2/b^2	0	0
HG b	-1	0	0	1	0	Xb/EJ
GH b	1	0	0	1	0	Xb/EJ
HG	elongazione asta $N_{1HG^{\pm}HG^{\pm}HG}$				-Fb ² /EJ	
A	molla nodo $-V_{1A}(V_{0A}+XV_{1A})/k_A$				-1/2Fb ² /EJ	1/4Xb/EJ
	totali				-Fb ² /EJ	23/12Xb/EJ
	iperstatica $X=W_{GA}$				12/23Fb	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[1/2 x^2/b - 1/3 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[1/2 x^2/b - 1/3 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

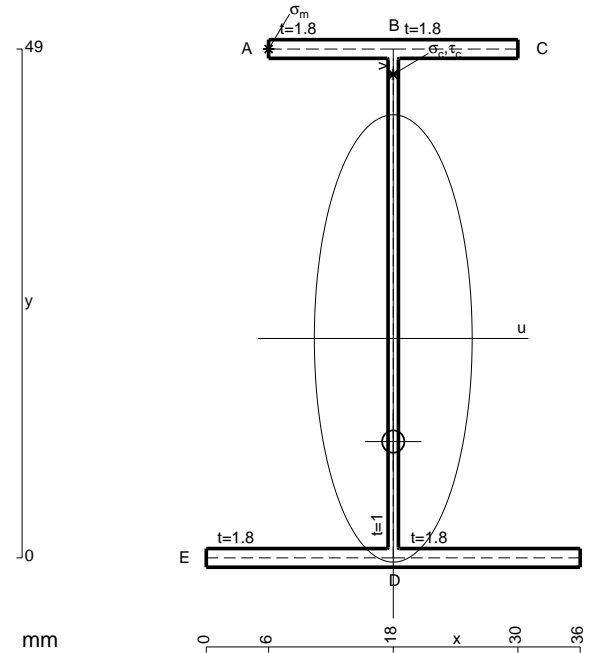
$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

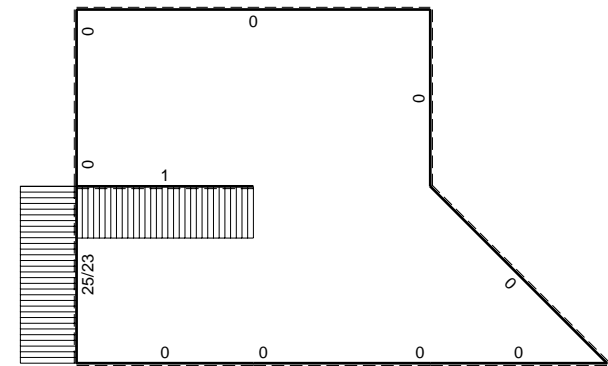
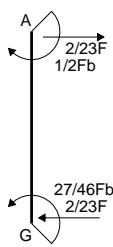
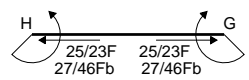
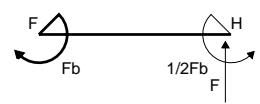
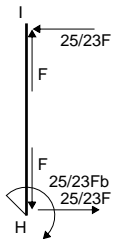
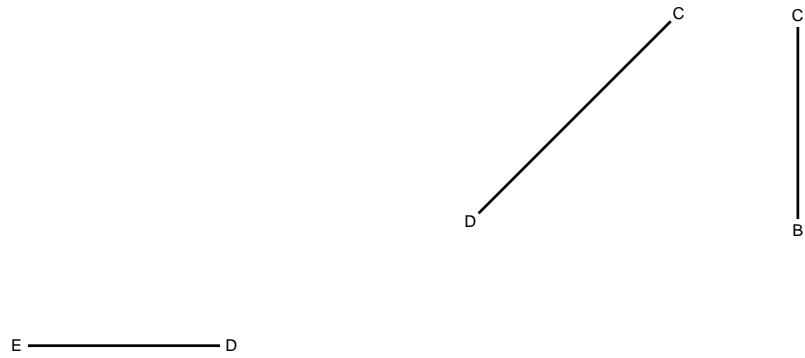
$$= (b - b + 1/3 b) \cdot Fb \cdot 1/EJ = 1/3 \cdot Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[1/3 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

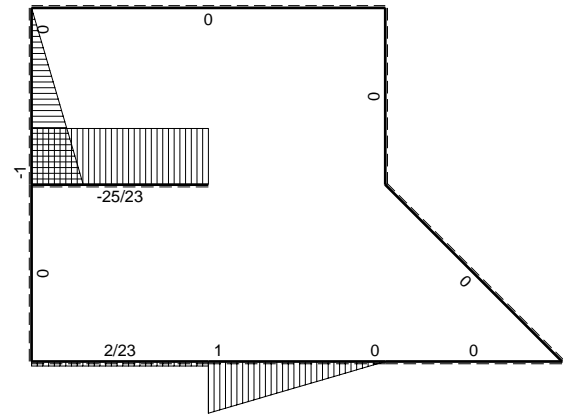
$$= (1/3 b) \cdot Fb \cdot 1/EJ = 1/3 \cdot Fb^2/EJ$$



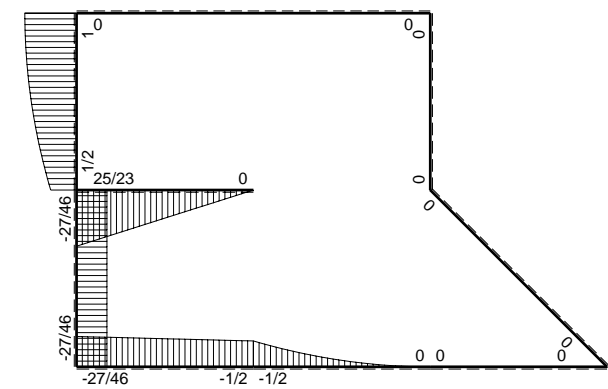
- A = 157. mm²
- J_u = 72847. mm⁴
- J_v = 9072. mm⁴
- J_i = 133. mm⁴
- y_o = -9.929 mm
- y_g = 21.13 mm
- T_y = 800. N
- M_x = -568000. Nmm
- x_m = 6. mm
- y_m = 49. mm
- u_m = -12. mm
- v_m = 27.87 mm
- σ_m = -M_y/J_u = 217.3 N/mm²
- x_c = 18. mm
- y_c = 49. mm
- v_c = 27.87 mm
- σ_c = -M_y/J_u = 217.3 N/mm²
- τ_c = T_S/t_{J_u} = 13.22 N/mm²
- τ_g = T_S/t_{J_u} = 13.22 N/mm²
- t_c = 800. mm
- σ_o = √(σ²+3τ²) = 218.5 N/mm²



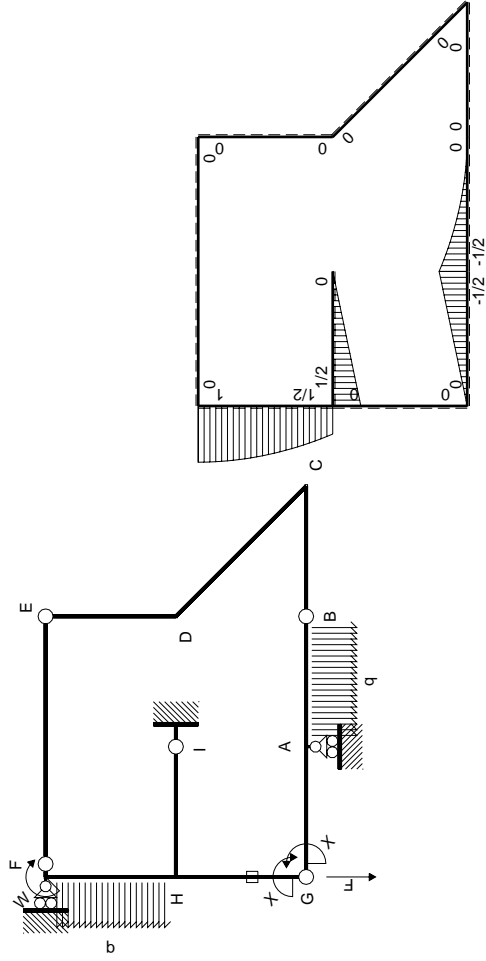
← ⊕ → F



↑ ⊕ ↓ F

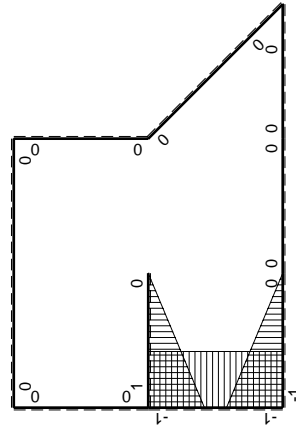


⊕ ⊖ Fb



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-1/2Fb + Fx - 1/2qx^2$	0	0	0	0
BA b	0	$1/2qx^2$	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	0	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$-1/2Fx$	$1/2Fx - 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$1/2Fb - 1/2Fx$	$1/2Fx - 1/2Fx^2/b$	x^2/b^2		
FH b	0	$Fb - 1/2qx^2$	0	0	0	0
HF b	0	$-1/2Fb - Fx + 1/2qx^2$	0	0	0	0
HI b	$1-x/b$	$1/2Fb - 1/2Fx$	$1/2Fb - Fx + 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$-1/2Fx$	$1/2Fx^2/b$	x^2/b^2		
HG b	-1	0	0	1	0	Xb/EJ
GH b	1	0	0	1	0	Xb/EJ
HG	elongazione asta $N_{1HG^+HG^-HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{0A} + XV_{1A})/k_A$				$-3/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-9/8Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica X=W _{GA}				$27/46Fb$	

Sviluppi di calcolo iperstatica

M_x flessione da iperstatica X=1

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

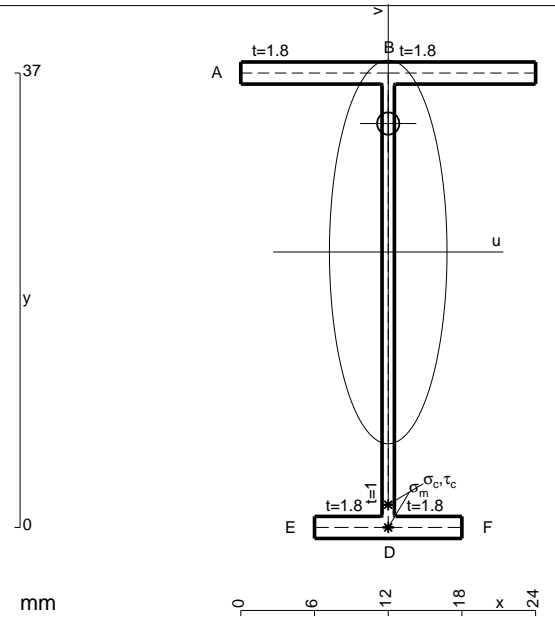
$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

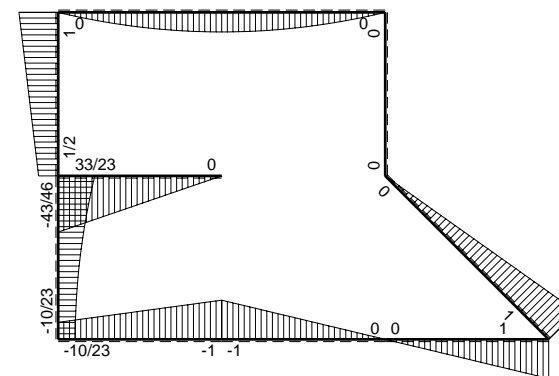
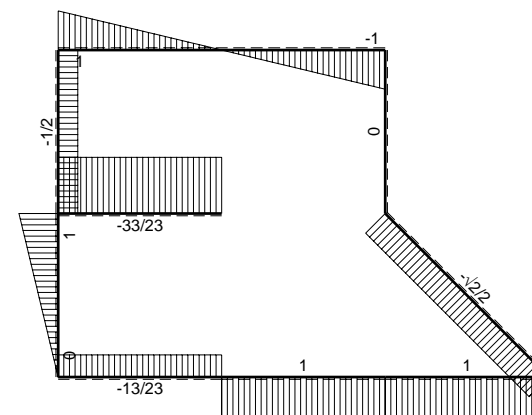
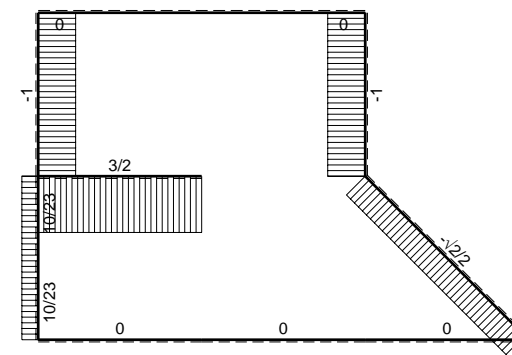
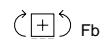
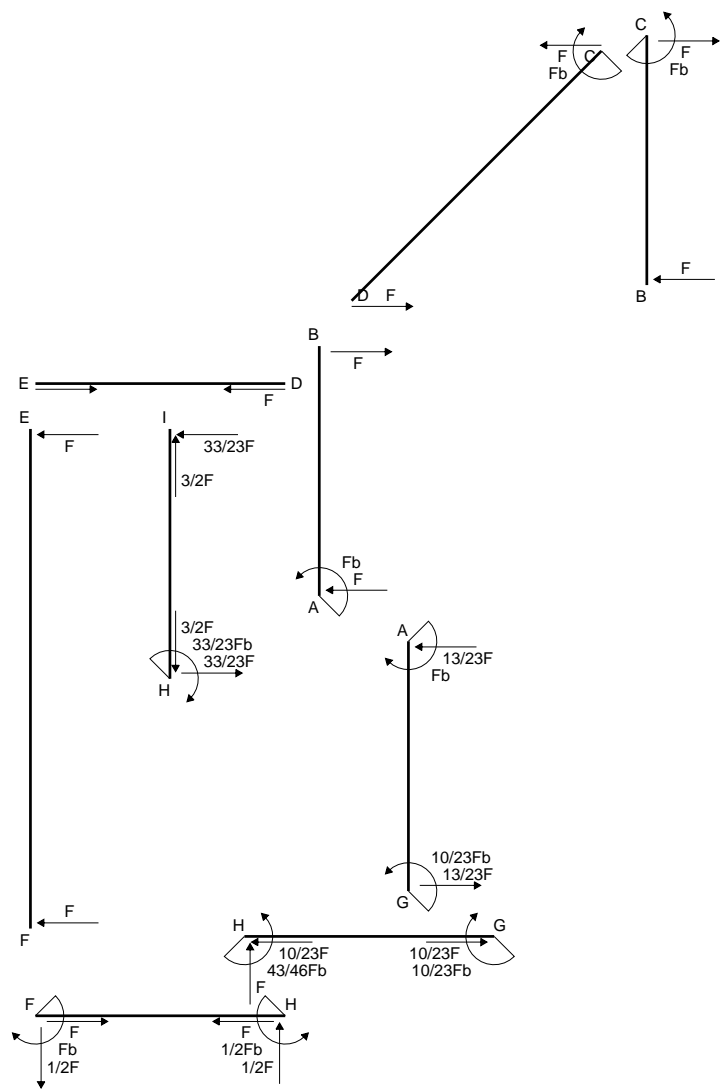
$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

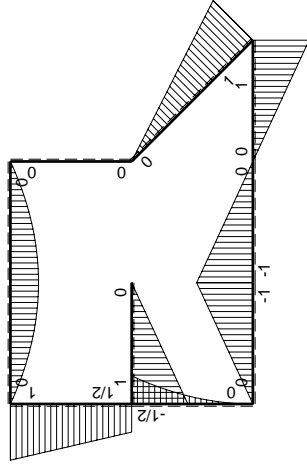
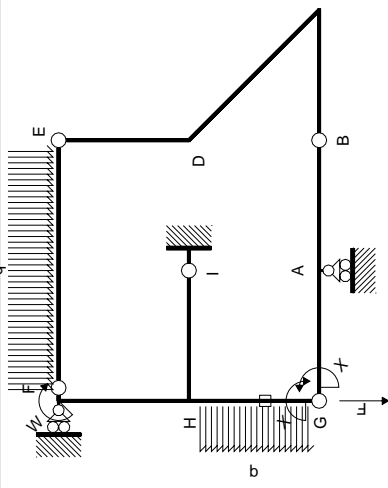
$$L_{IH}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$



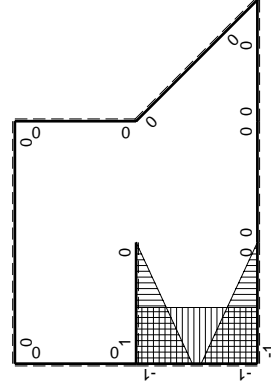
- A = 101.8 mm²
- J_u = 24830. mm⁴
- J_v = 2333. mm⁴
- J_i = 82.32 mm⁴
- y_o = 10.46 mm
- y_g = 22.43 mm
- T_y = 920. N
- M_x = -253000. Nmm
- x_m = 12. mm
- v_m = -22.43 mm
- σ_m = -Mv/J_u = -228.5 N/mm²
- y_c = 3. mm
- u_c = -12. mm
- v_c = -19.43 mm
- σ_c = -Mv/J_u = -228.5 N/mm²
- τ_c = TS_v/tJ_u = 17.95 N/mm²
- τ_g = TS_v/tJ_u = 17.95 N/mm²
- t_c = 920. mm
- σ_o = √σ²+3τ² = 230.6 N/mm²





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	M _x (x)	M ₀ (x)	M _x M ₀	M _x M ₀	M _x M ₀	∫M _x M ₀ /EJdx	∫XM _x M ₀ /EJdx
AB b	0	-Fb+Fx	0	0	0	0	0
BA b	0	Fx	0	0	0	0	0
BC b	0	Fx	0	0	0	0	0
CB b	0	-Fb+Fx	0	0	0	0	0
CD √2b	0	Fb-√2/2Fx	0	0	0	0	0
DE b	0	0	0	0	0	0	0
ED b	0	0	0	0	0	0	0
EF 2b	0	-Fx+1/2qx ²	0	0	0	0	0
FE 2b	0	Fx-1/2qx ²	0	0	0	0	0
GA b	-1+x/b	-Fx	Fx-Fx ² /b	Fx-Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
AG b	x/b	Fb-Fx	Fb-Fx	Fx-Fx ² /b	x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
FH b	0	Fb-1/2Fx	0	0	0	0	0
HF b	0	-1/2Fb-1/2Fx	0	0	0	0	0
HI b	1-x/b	Fb-Fx	Fb-2Fx+Fx ² /b	Fx ² /b	1-2x/b+x ² /b ²	1/3Fb ² /EJ	1/3Xb/EJ
IH b	-x/b	-Fx	Fx ² /b	Fx ² /b	x ² /b ²	1/6Fb ² /EJ	Xb/EJ
HG b	-1	-1/2Fb+Fx-1/2qx ²	1/2Fb-Fx+1/2Fx ² /b	1/2Fx ² /b	1	1/6Fb ² /EJ	Xb/EJ
GH b	1	1/2qx ²	1/2Fx ² /b	1/2Fx ² /b	1	1/6Fb ² /EJ	Xb/EJ
HG	elongazione asta N _{1HG⁺HG⁻}					-Fb ² /EJ	
A	molla nodo -V _{1A} (V _{0A} +XV _{1A})/k _A					-1/2Fb ² /EJ	1/4Xb/EJ
	totali					-5/6Fb ² /EJ	23/12Xb/EJ
	iperstatica X=W _{GA}					10/23Fb	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1 - 2x/b + x^2/b^2) Fb 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - b + 1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (x^2/b^2) Fb 1/EJ dx = [1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

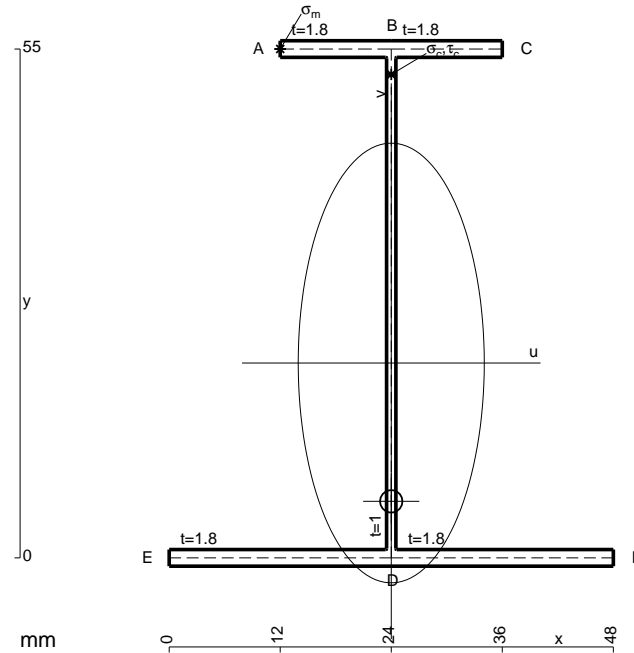
$$L_{HG}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

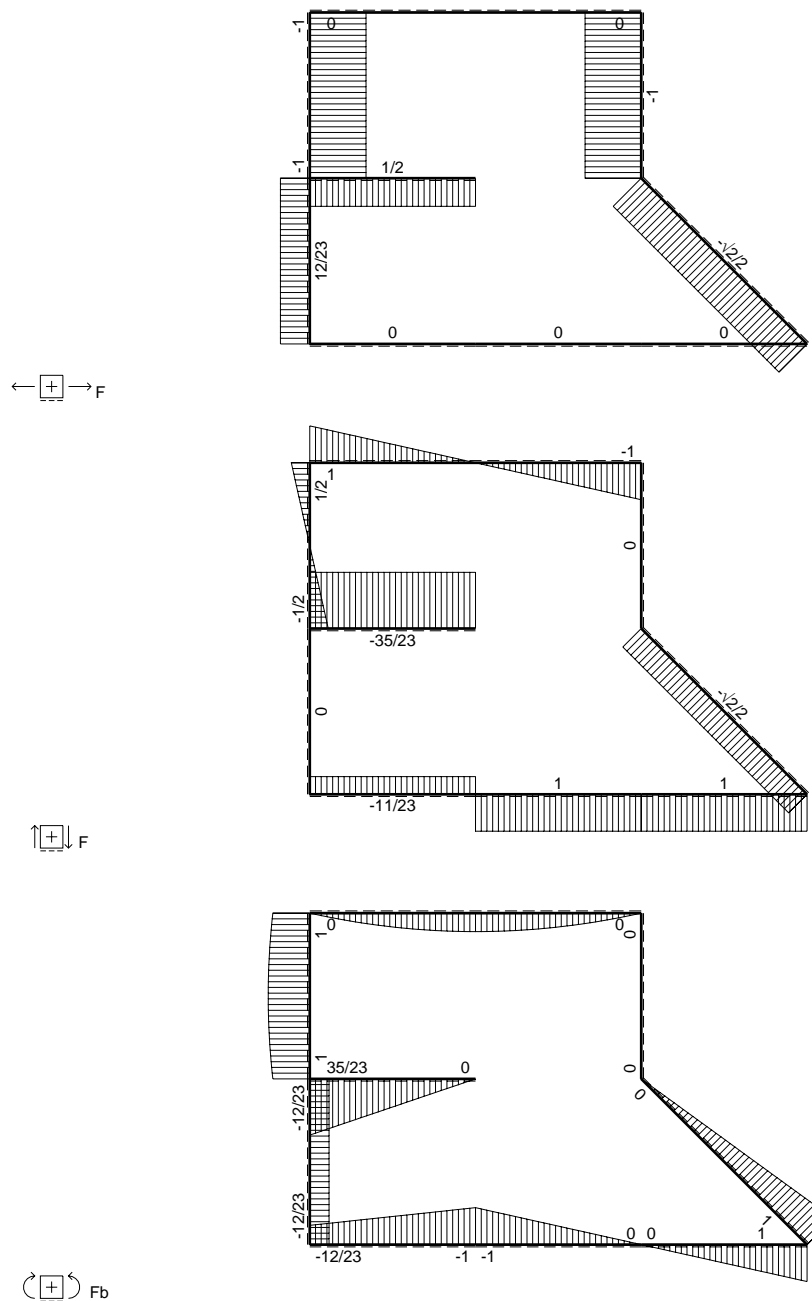
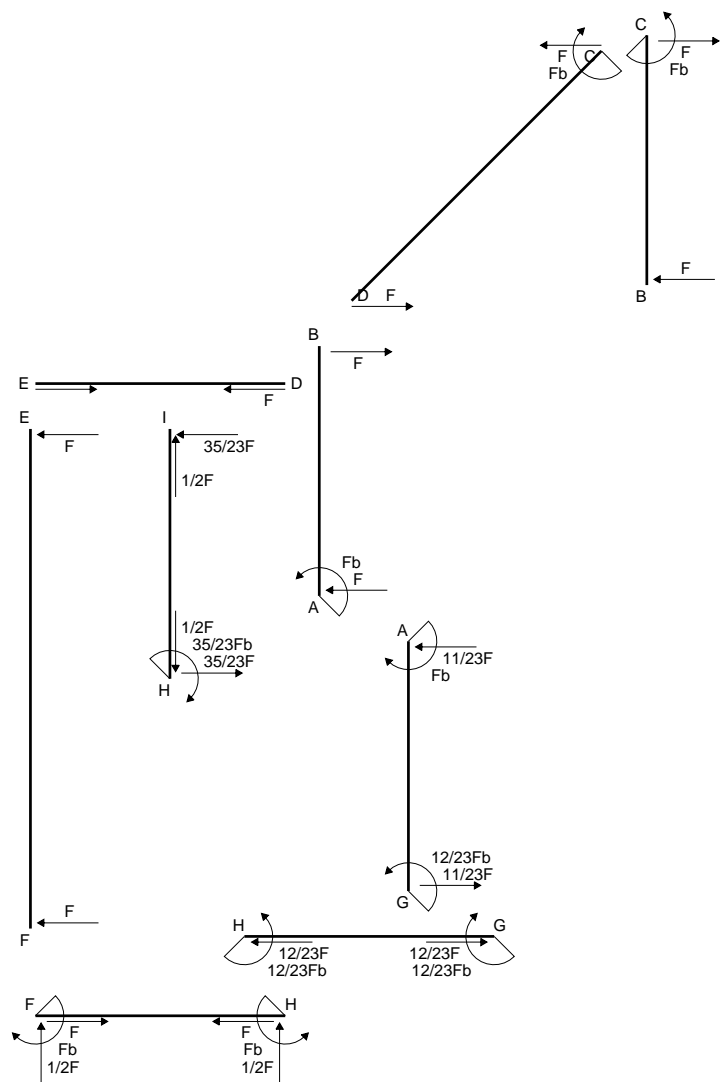
$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/6 Fb^2/EJ$$

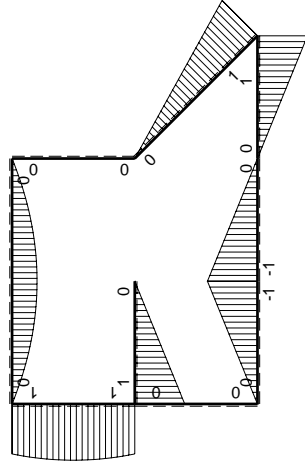
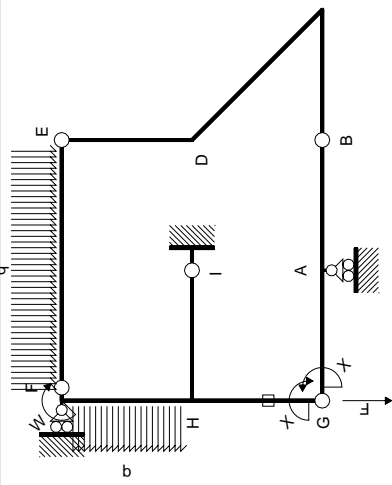
$$L_{GH}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/6 Fb^2/EJ$$



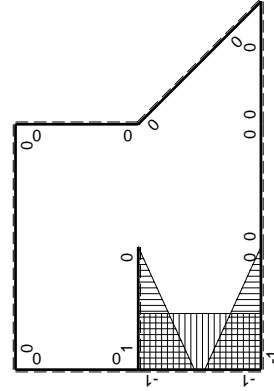
- A = 184.6 mm²
- J_u = 104229. mm⁴
- J_v = 18662. mm⁴
- J_i = 158.3 mm⁴
- y_o = -14.95 mm
- y_g = 21.06 mm
- T_y = 820. N
- M_x = -729800. Nmm
- x_m = 12. mm
- y_m = 55. mm
- u_m = -12. mm
- v_m = 33.94 mm
- σ_m = -Mv/J_u = 237.6 N/mm²
- x_c = 24. mm
- y_c = 55. mm
- v_c = 33.94 mm
- σ_c = -Mv/J_u = 237.6 N/mm²
- τ_c = TS/tJ_u = 11.53 N/mm²
- τ_g = TS/tJ_u = 11.53 N/mm²
- t_c = 820. mm
- σ_o = √σ²+3τ² = 238.5 N/mm²





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-Fb+Fx	0	0	0	0
BA b	0	Fx	0	0	0	0
BC b	0	Fx	0	0	0	0
CB b	0	-Fb+Fx	0	0	0	0
CD $\sqrt{2}b$	0	$Fb-\sqrt{2}/2Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	$-Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$Fx-1/2qx^2$	0	0	0	0
GA b	-1+x/b	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2	$1/6Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$Fb+1/2Fx-1/2qx^2$	0	0	0	0
HF b	0	$-Fb-1/2Fx+1/2qx^2$	0	0	0	0
HI b	1-x/b	Fb-Fx	$Fb-2Fx+Fx^2/b$	$1-2x/b+x^2/b^2$	$1/3Fb^2/EJ$	$1/3Xb/EJ$
IH b	-x/b	-Fx	Fx^2/b	x^2/b^2	$1/3Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	0	0	1	0	Xb/EJ
GH b	1	0	0	1	0	Xb/EJ
HG	elongazione asta $N_{1HG^+HG^-HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{0A}+XV_{1A})/k_A$				$-1/2Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$12/23Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

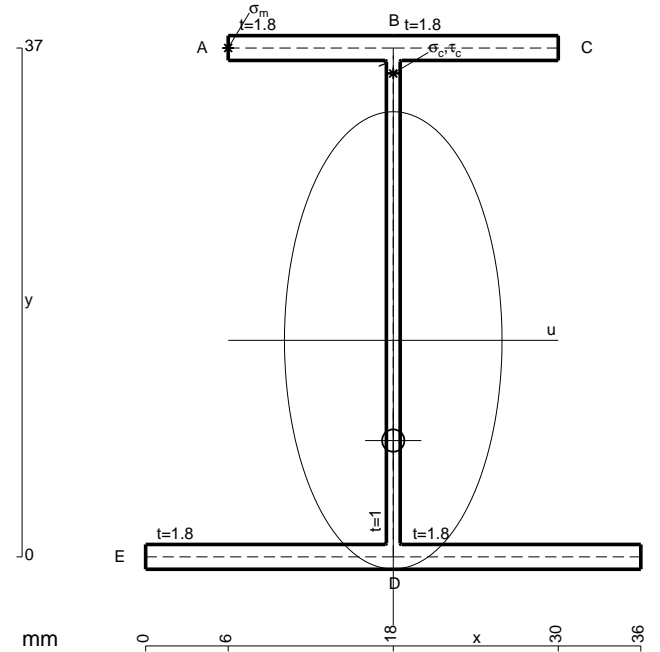
$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1 - 2x/b + x^2/b^2) Fb 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b Fb 1/EJ$$

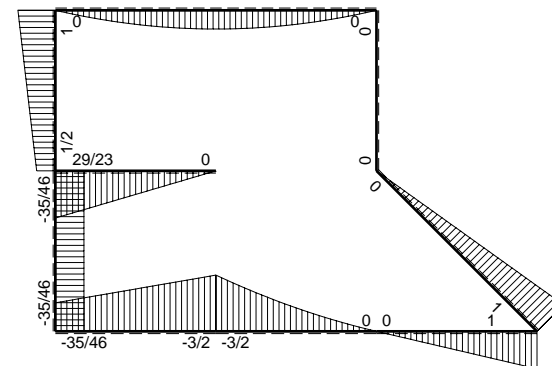
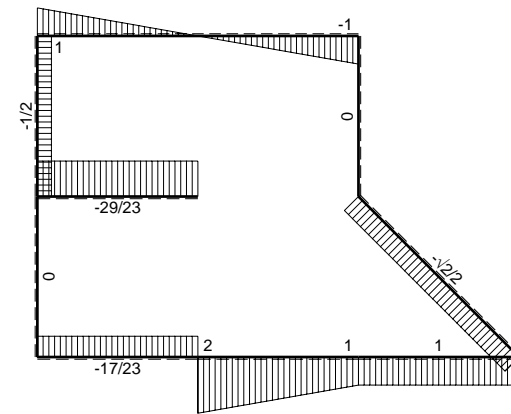
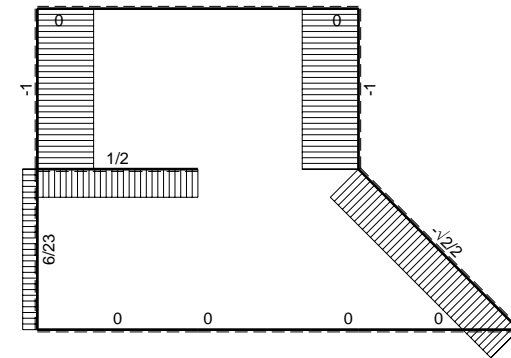
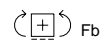
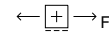
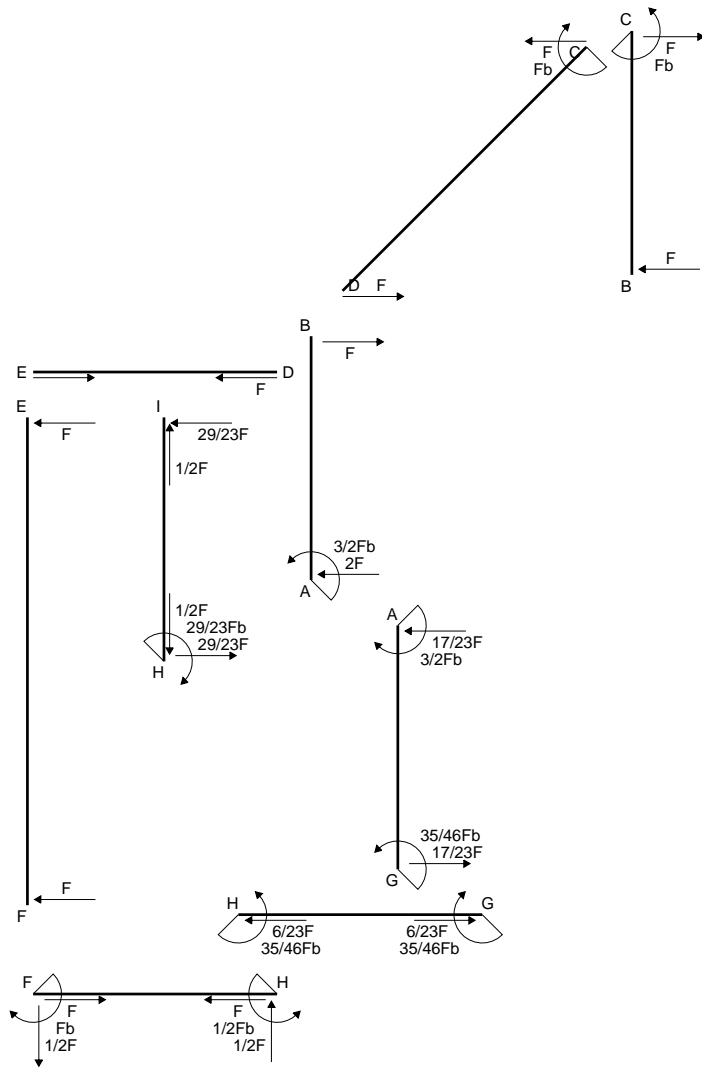
$$= (b - b + 1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

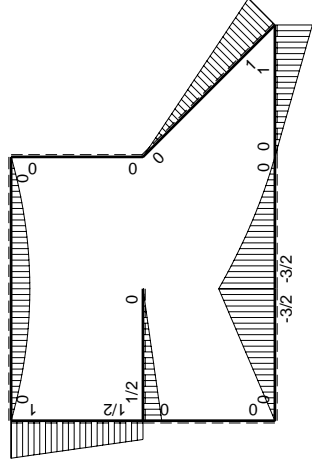
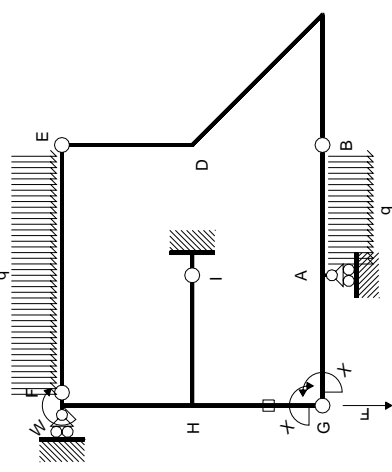
$$L_{IH}^{xo} = \int_0^b (x^2/b^2) Fb 1/EJ dx = [1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$



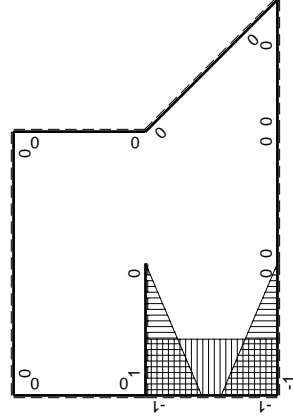
- A = 145. mm²
- J_u = 40083. mm⁴
- J_v = 9072. mm⁴
- J_i = 129. mm⁴
- y_o = -7.287 mm
- y_g = 15.74 mm
- T_y = 1210. N
- M_x = -375100. Nmm
- x_m = 6. mm
- y_m = 37. mm
- u_m = -12. mm
- v_m = 21.26 mm
- σ_m = -Mv/J_u = 198.9 N/mm²
- x_c = 18. mm
- y_c = 37. mm
- v_c = 21.26 mm
- σ_c = -Mv/J_u = 198.9 N/mm²
- τ_c = TS/tJ_u = 27.72 N/mm²
- τ_g = TS/tJ_u = 27.72 N/mm²
- t_c = 1210. mm
- σ_o = √σ²+3τ² = 204.6 N/mm²





Schema di calcolo iperstatico

(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int M_x M_x / E J dx$
AB b	0	$-3/2Fb+2Fx-1/2qx^2$	0	0	0	0
BA b	0	$Fx+1/2qx^2$	0	0	0	0
BC b	0	Fx	0	0	0	0
CB b	0	$-Fb+Fx$	0	0	0	0
CD $\sqrt{2}b$	0	$Fb-\sqrt{2}/2Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	$-Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$Fx-1/2qx^2$	0	0	0	0
GA b	$-1+x/b$	$-3/2Fx$	$3/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/4Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$3/2Fb-3/2Fx$	$3/2Fx-3/2Fx^2/b$	x^2/b^2	$1/4Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$Fb-1/2Fx$	0	0	0	0
HF b	0	$-1/2Fb-1/2Fx$	0	0	0	0
HI b	$1-x/b$	$1/2Fb-1/2Fx$	$1/2Fb-Fx+1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$-1/2Fx$	$1/2Fx^2/b$	x^2/b^2	$1/6Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	0	0	1	0	Xb/EJ
GH b	1	0	0	1	0	Xb/EJ
HG	elongazione asta $N_{1HG}^{\pm HG} \pm HG$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{0A}+XV_{1A})/k_A$				$-7/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-35/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica X=W _{GA}				$35/46Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{x_0} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{AG}^{x_0} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

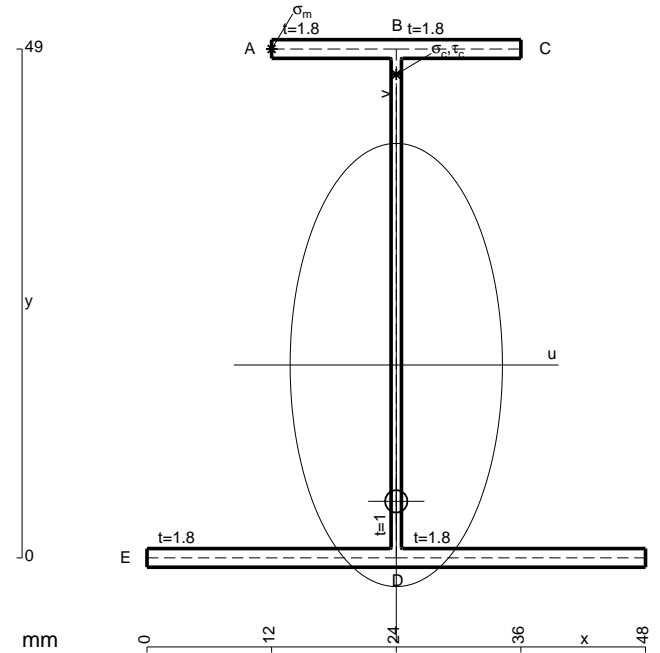
$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{HI}^{x_0} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

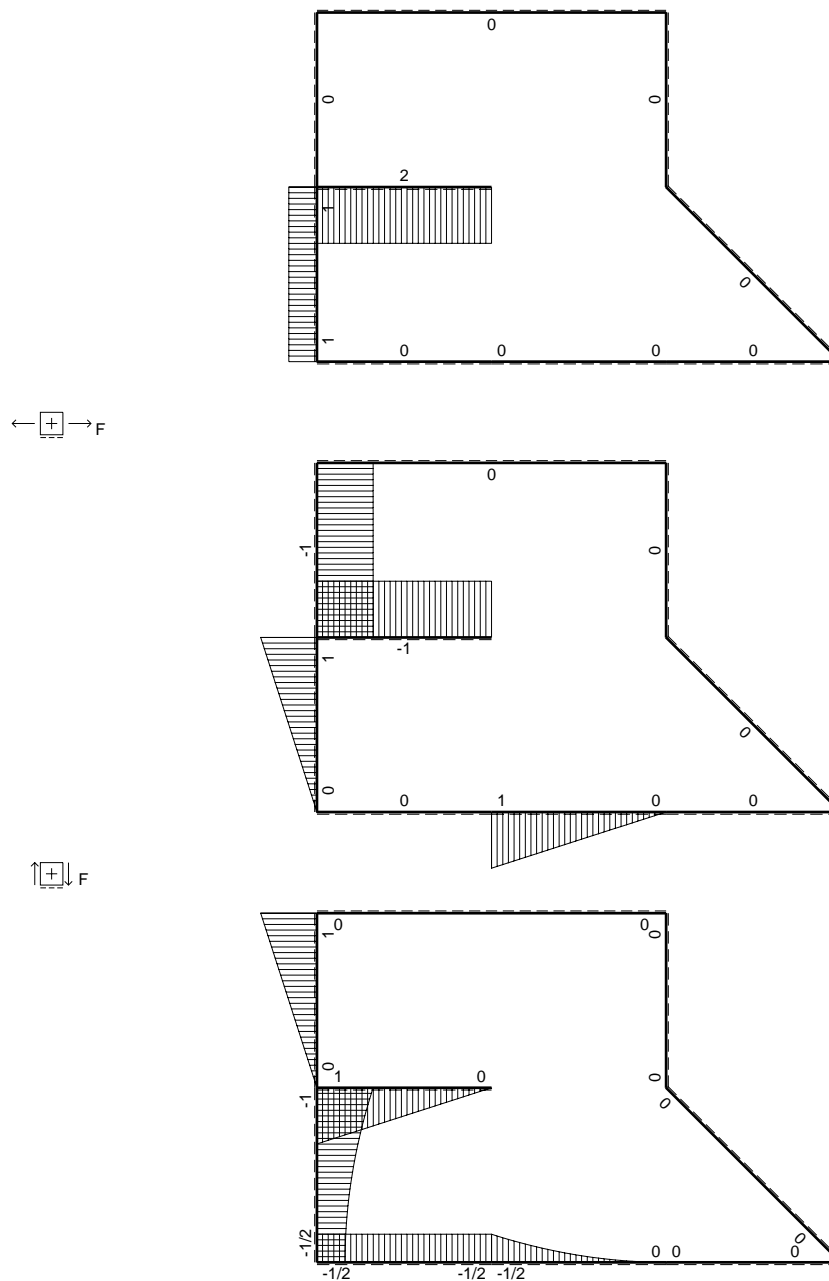
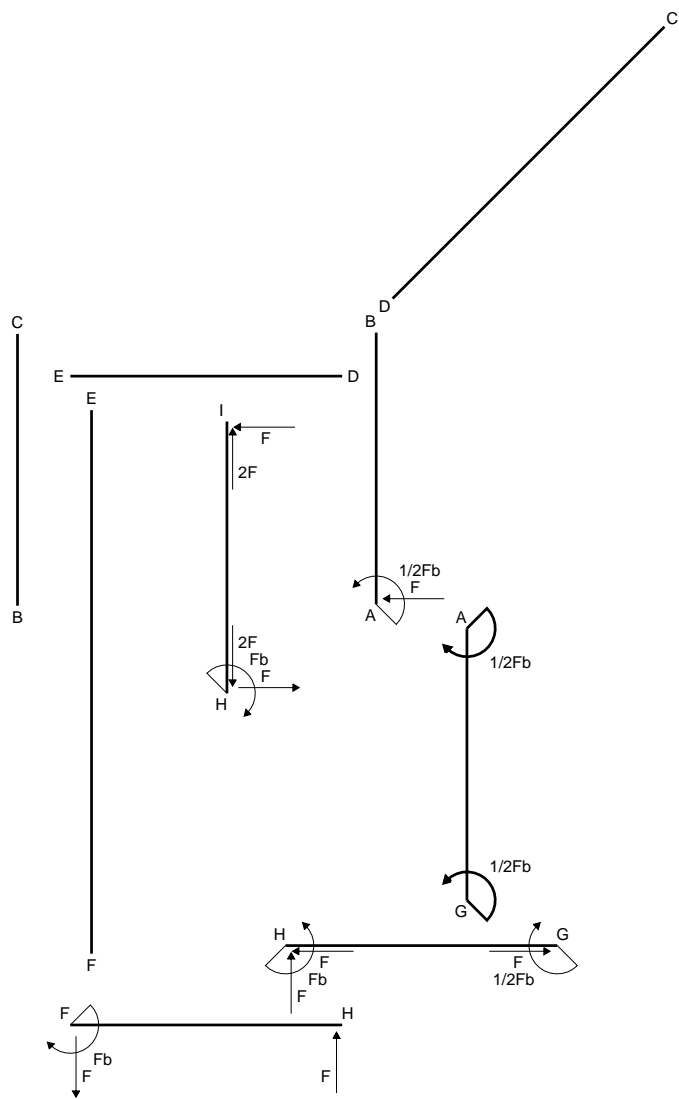
$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{IH}^{x_0} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

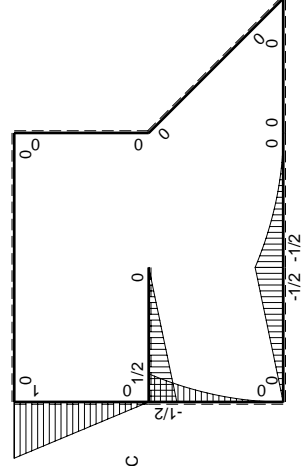
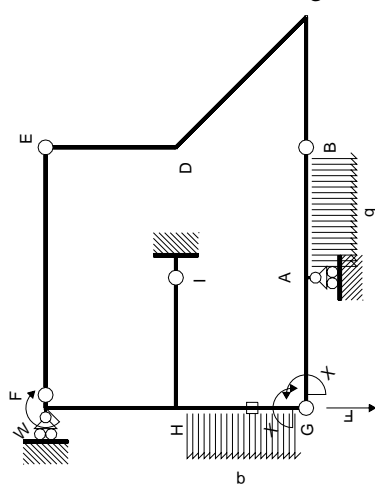
$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$



- A = 178.6 mm²
- J_u = 81324. mm⁴
- J_v = 18662. mm⁴
- J_t = 156.3 mm⁴
- y_o = -13.13 mm
- y_g = 18.57 mm
- T_y = 1620. N
- M_x = -558900. Nmm
- x_m = 12. mm
- y_m = 49. mm
- u_m = -12. mm
- v_m = 30.43 mm
- σ_m = -Mv/J_u = 209.1 N/mm²
- x_c = 24. mm
- y_c = 49. mm
- v_c = 30.43 mm
- σ_c = -Mv/J_u = 209.1 N/mm²
- τ_c = TS/tJ_u = 26.18 N/mm²
- τ_g = TS/tJ_u = 26.18 N/mm²
- t_c = 810. mm
- σ_o = √σ²+3τ² = 214. N/mm²

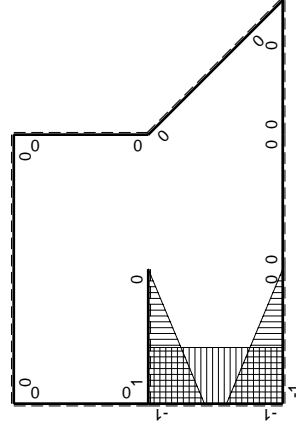


$\left(\begin{array}{c} \oplus \\ \oplus \end{array} \right) F_b$



Schema di calcolo iperstatico

(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-1/2Fb + Fx - 1/2qx^2$	0	0	0	0
BA b	0	$1/2qx^2$	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	0	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$-1/2Fx$	$1/2Fx - 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$1/2Fb - 1/2Fx$	$1/2Fx - 1/2Fx^2/b$	x^2/b^2	$1/12Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$Fb - Fx$	0	0	0	0
HF b	0	$-Fx$	0	0	0	0
HI b	$1-x/b$	$1/2Fb - 1/2Fx$	$1/2Fb - Fx + 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$-1/2Fx$	$1/2Fx^2/b$	x^2/b^2	$1/6Fb^2/EJ$	Xb/EJ
HG b	-1	$-1/2Fb + Fx - 1/2qx^2$	$1/2Fb - Fx + 1/2Fx^2/b$	1	$1/6Fb^2/EJ$	Xb/EJ
GH b	1	$1/2qx^2$	$1/2Fx^2/b$	1	$1/6Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG^5HG^4HG}$					
A	molla nodo $-V_{1A}(V_{0A} + XV_{1A})/k_A$					
	totali					
	iperstatica X=W _{GA}					

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

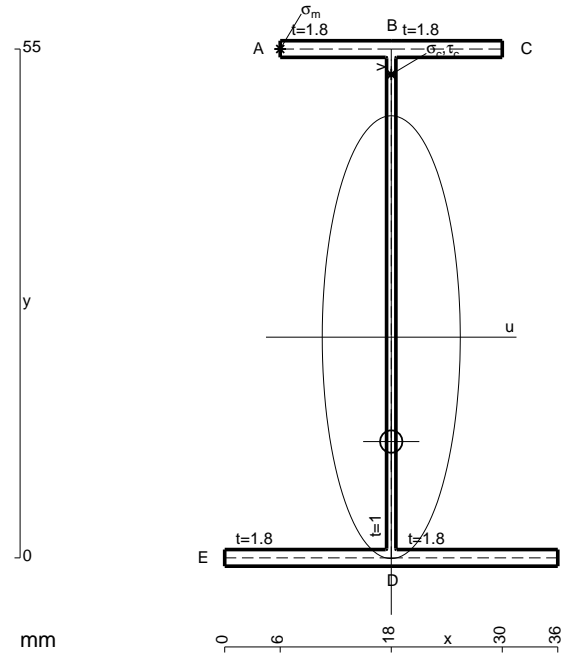
$$L_{HG}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

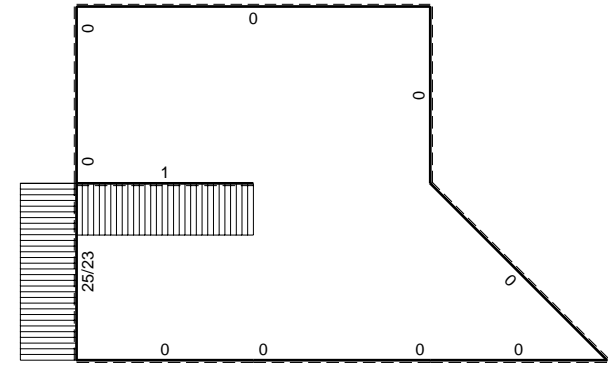
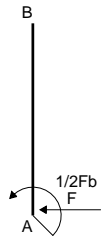
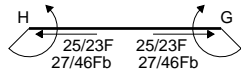
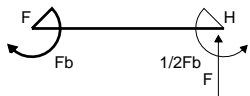
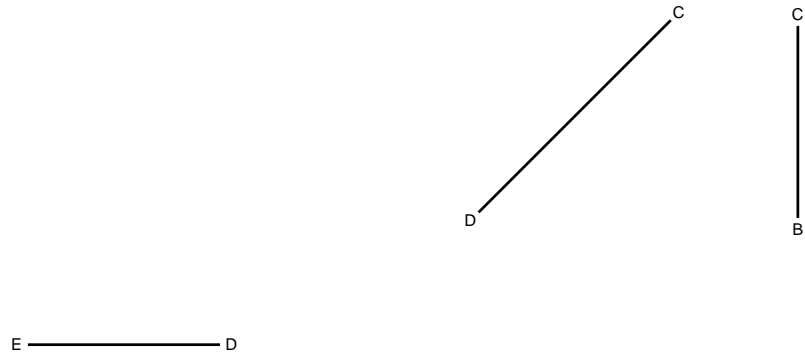
$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/6 Fb^2/EJ$$

$$L_{GH}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

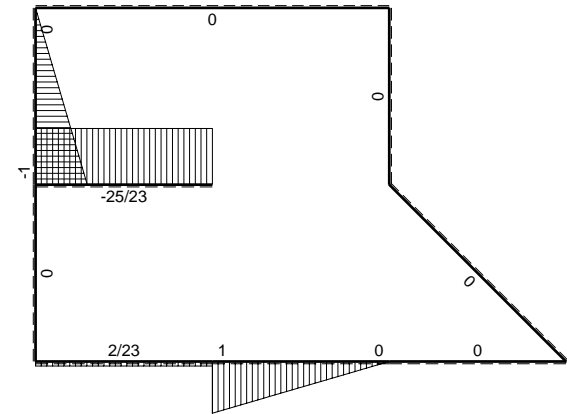
$$= (1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/6 Fb^2/EJ$$



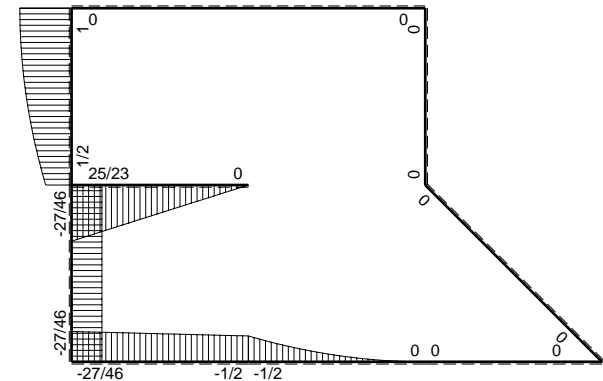
- A = 163. mm²
- J_u = 93375. mm⁴
- J_v = 9072. mm⁴
- J_i = 135. mm⁴
- y_o = -11.28 mm
- y_g = 23.86 mm
- T_y = -1170. N
- M_x = 655200. Nmm
- x_m = 6. mm
- y_m = 55. mm
- u_m = -12. mm
- v_m = 31.14 mm
- σ_m = -M_y/J_u = -218.5 N/mm²
- x_c = 18. mm
- y_c = 55. mm
- v_c = 31.14 mm
- σ_c = -M_y/J_u = -218.5 N/mm²
- τ_c = T_S/tJ_v = 16.86 N/mm²
- τ_g = T_S/tJ_v = 16.86 N/mm²
- t_c = 1170. mm
- σ_o = √σ²+3τ² = 220.5 N/mm²



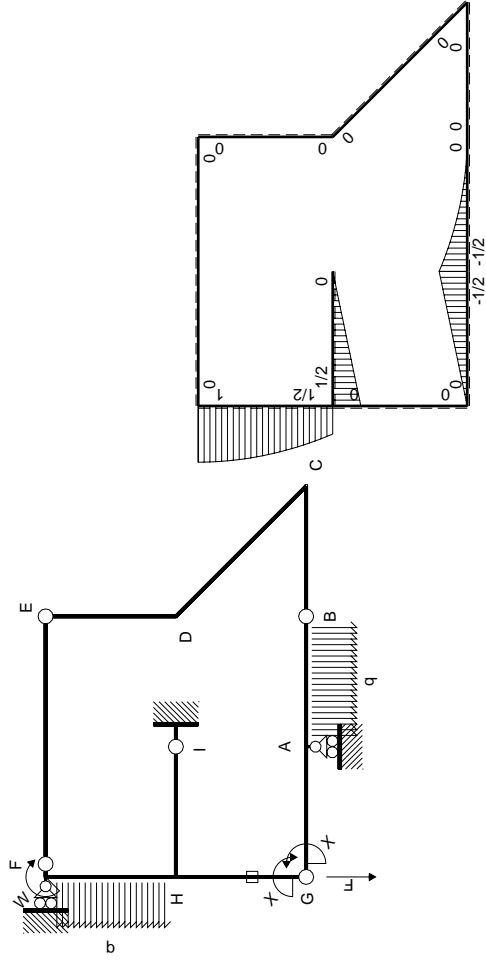
← ⊕ → F



↑ ⊕ ↓ F

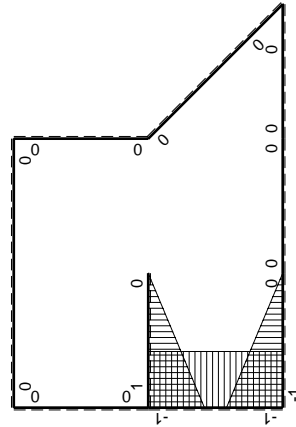


⊕ ⊖ Fb



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-1/2Fb + Fx - 1/2qx^2$	0	0	0	0
BA b	0	$1/2qx^2$	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	0	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$-1/2Fx$	$1/2Fx - 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$1/2Fb - 1/2Fx$	$1/2Fx - 1/2Fx^2/b$	x^2/b^2		
FH b	0	$Fb - 1/2qx^2$	0	0	0	0
HF b	0	$-1/2Fb - Fx + 1/2qx^2$	0	0	0	0
HI b	$1-x/b$	$1/2Fb - 1/2Fx$	$1/2Fb - Fx + 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$-1/2Fx$	$1/2Fx^2/b$	x^2/b^2		
HG b	-1	0	0	1	0	Xb/EJ
GH b	1	0	0	1	0	Xb/EJ
HG	elongazione asta $N_{1HG^+HG^-HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{0A} + XV_{1A})/k_A$				$-3/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-9/8Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica X=W _{GA}				$27/46Fb$	

Sviluppi di calcolo iperstatica

M_x flessione da iperstatica X=1

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

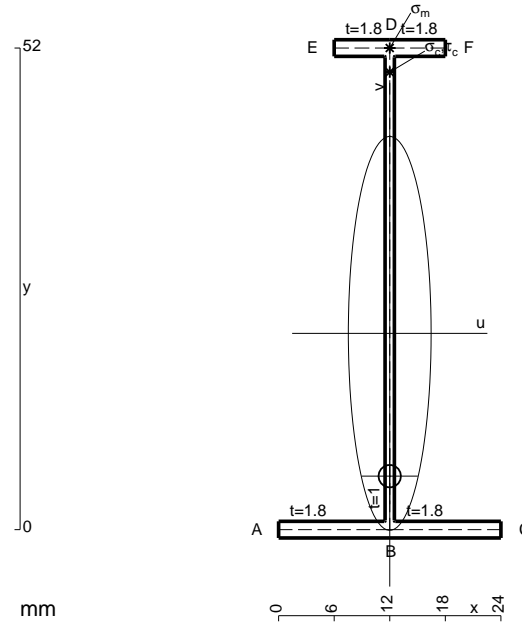
$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

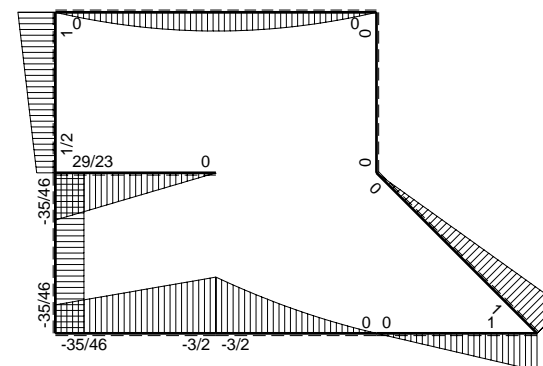
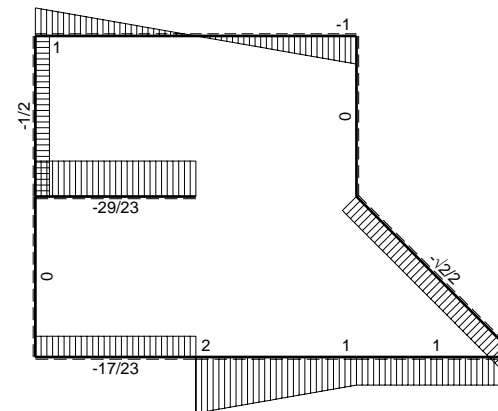
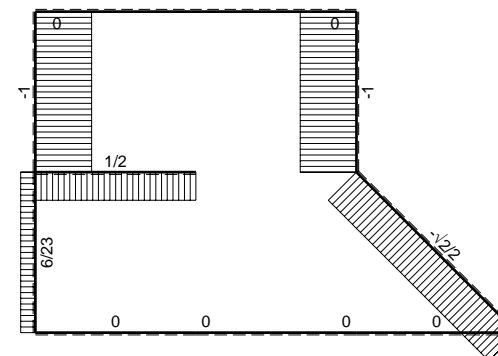
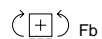
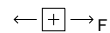
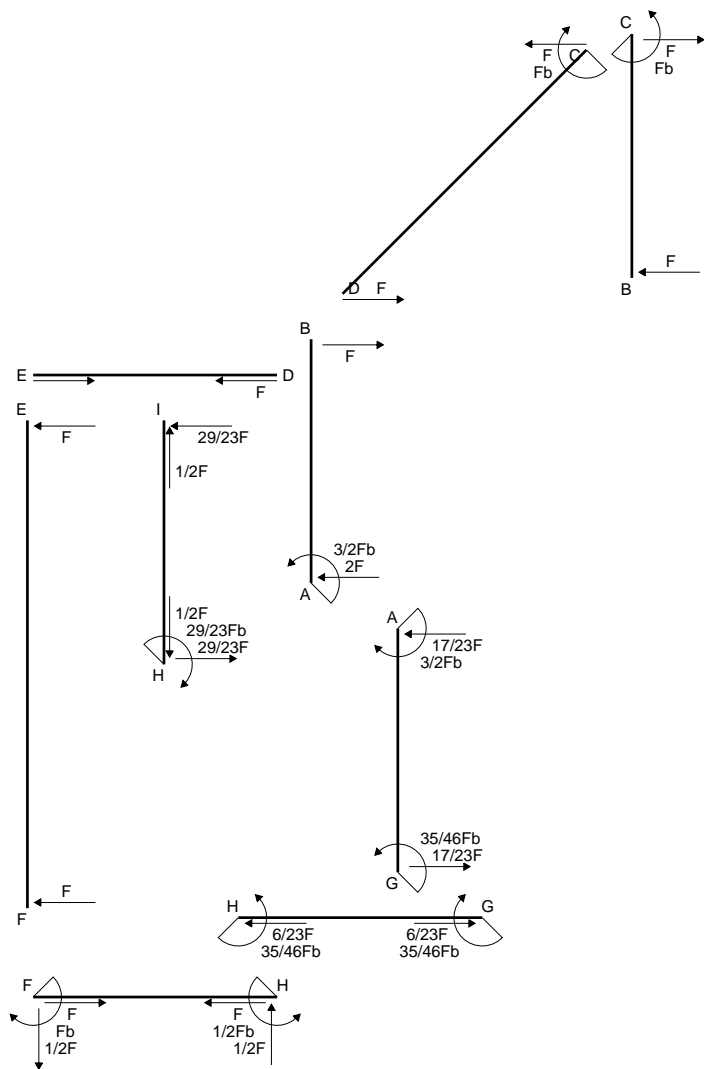
$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

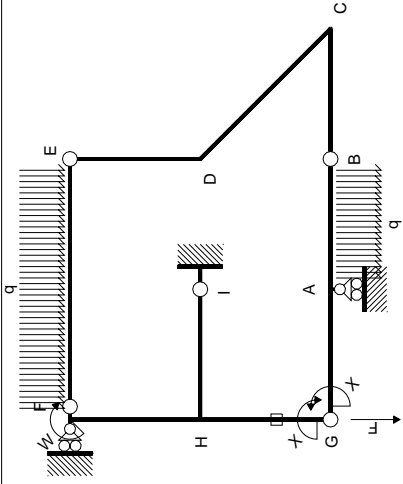
$$L_{IH}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$



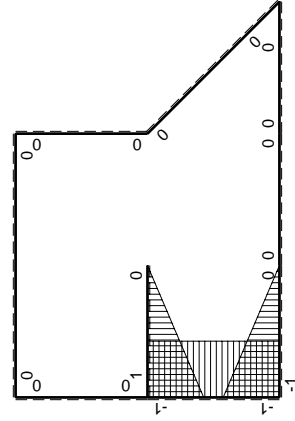
- A = 116.8 mm²
- J_u = 52822. mm⁴
- J_v = 2333. mm⁴
- J_i = 87.32 mm⁴
- y_o = -15.41 mm
- y_g = 21.19 mm
- T_y = 1380. N
- M_x = -393300. Nmm
- x_m = 12. mm
- y_m = 52. mm
- v_m = 30.81 mm
- σ_m = -Mv/J_u = 229.4 N/mm²
- y_c = 2. mm
- u_c = -12. mm
- v_c = -19.19 mm
- σ_c = -Mv/J_u = 229.4 N/mm²
- τ_c = TS_i/tJ_u = 17.39 N/mm²
- τ_g = TS_i/tJ_u = 17.39 N/mm²
- t_c = 1380. mm
- σ_o = √σ²+3τ² = 231.4 N/mm²





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-3/2Fb+2Fx-1/2qx^2$	0	0	0	0
BA b	0	$Fx+1/2qx^2$	0	0	0	0
BC b	0	Fx	0	0	0	0
CB b	0	$-Fb+Fx$	0	0	0	0
CD $\sqrt{2}b$	0	$Fb-\sqrt{2}/2Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	$-Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$Fx-1/2qx^2$	0	0	0	0
GA b	$-1+x/b$	$-3/2Fx$	$3/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/4Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$3/2Fb-3/2Fx$	$3/2Fx-3/2Fx^2/b$	x^2/b^2	$1/4Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$Fb-1/2Fx$	0	0	0	0
HF b	0	$-1/2Fb-1/2Fx$	0	0	0	0
HI b	$1-x/b$	$1/2Fb-1/2Fx$	$1/2Fb-Fx+1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$-1/2Fx$	$1/2Fx^2/b$	x^2/b^2	$1/6Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	0	0	1	0	Xb/EJ
GH b	1	0	0	1	0	Xb/EJ
HG	elongazione asta $N_{1HG} \pm HG \pm HG$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{GA}+XV_{1A})/k_A$				$-7/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-35/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$35/46Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

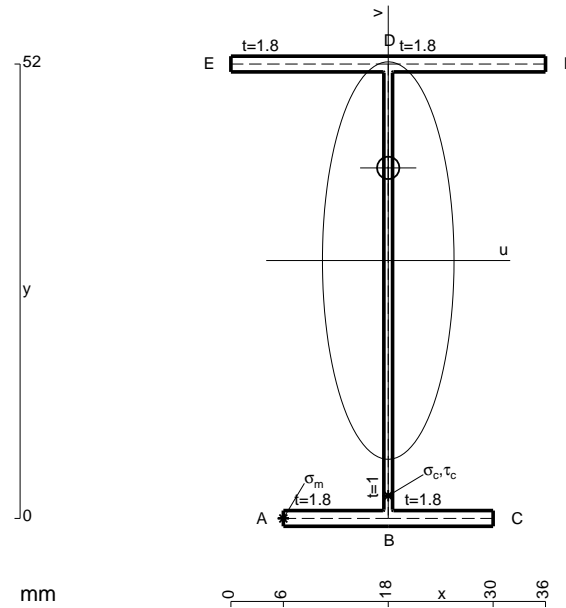
$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

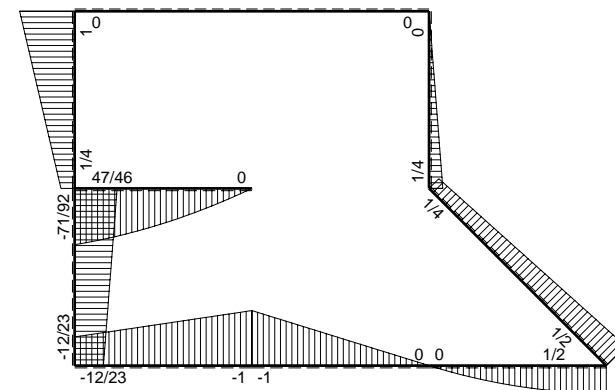
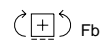
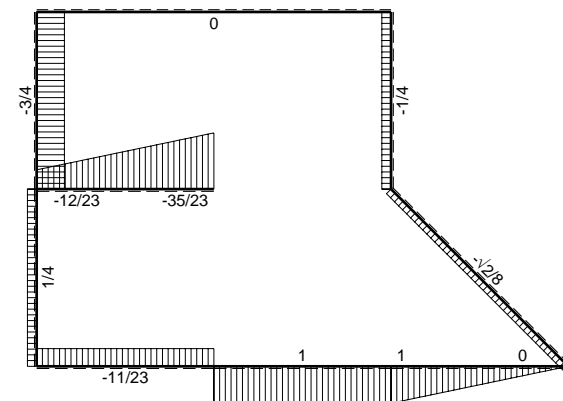
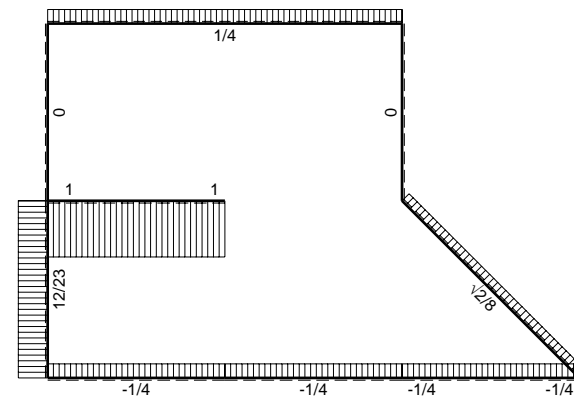
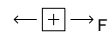
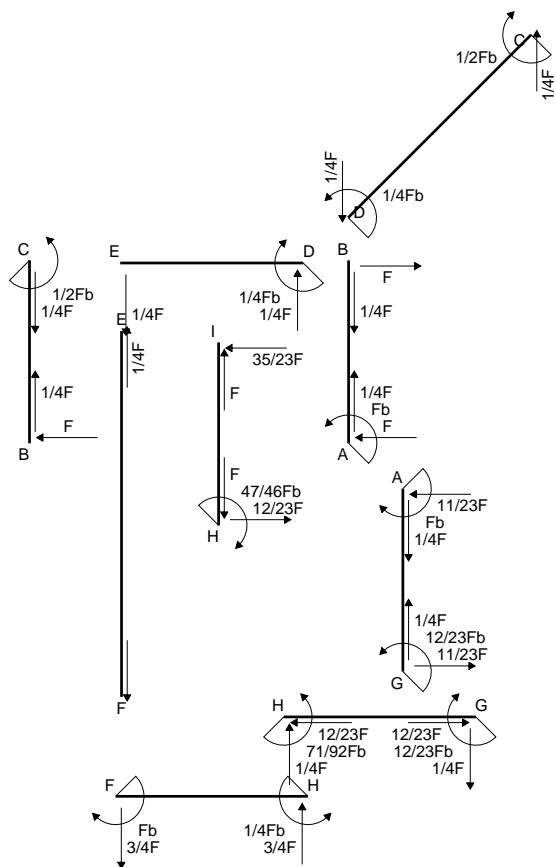
$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

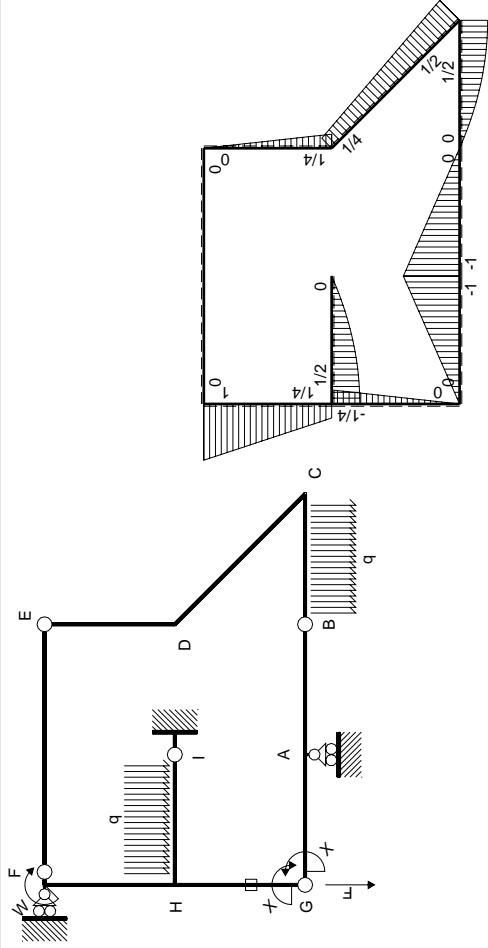
$$L_{IH}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$



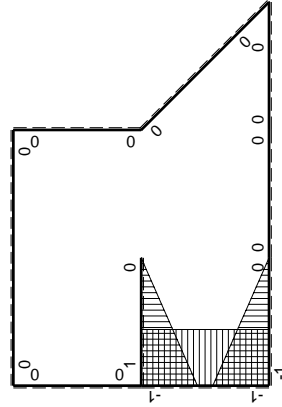
- A = 160. mm²
- J_u = 82754. mm⁴
- J_v = 9072. mm⁴
- J_i = 134. mm⁴
- y_o = 10.6 mm
- y_g = 29.51 mm
- T_y = 1460. N
- M_x = -667950. Nmm
- x_m = 6. mm
- u_m = -12. mm
- v_m = -29.51 mm
- σ_m = -Mv/J_u = -238.2 N/mm²
- x_c = 18. mm
- v_c = -29.51 mm
- σ_c = -Mv/J_u = -238.2 N/mm²
- τ_c = TS'/tJ_u = 22.49 N/mm²
- τ_g = TS'/tJ_u = 22.49 N/mm²
- t_c = 730. mm
- σ_o = √σ²+3τ² = 241.4 N/mm²





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-Fb+Fx	0	0	0	0
BA b	0	Fx	0	0	0	0
BC b	0	$Fx-1/2qx^2$	0	0	0	0
CB b	0	$-1/2Fb+1/2qx^2$	0	0	0	0
CD $\sqrt{2}b$	0	$1/2Fb-\sqrt{2}/8Fx$	0	0	0	0
DE b	0	$1/4Fb-1/4Fx$	0	0	0	0
ED b	0	$-1/4Fx$	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2		
FH b	0	$Fb-3/4Fx$	0	0	0	0
HF b	0	$-1/4Fb-3/4Fx$	0	0	0	0
HI b	$1-x/b$	$1/2Fb-1/2qx^2$	$1/2Fb-1/2Fx-1/2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$5/24Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$-Fx+1/2qx^2$	$Fx^2/b-1/2qx^3/b$	x^2/b^2		
HG b	-1	$-1/4Fb+1/4Fx$	$1/4Fb-1/4Fx$	1	$1/8Fb^2/EJ$	Xb/EJ
GH b	1	$1/4Fx$	$1/4Fx$	1		
HG	elongazione asta $N_{1HG} \epsilon_{HG} L_{HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{0A}+XV_{1A})/k_A$				$-1/2Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$12/23Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[1/2 x^2/b - 1/3 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[1/2 x^2/b - 1/3 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1/2 - 1/2 x/b - 1/2 x^2/b^2 + 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx$$

$$= \left[1/2 x - 1/4 x^2/b - 1/6 x^3/b^2 + 1/8 x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/4 b - 1/6 b + 1/8 b) \cdot Fb \cdot 1/EJ = 5/24 \cdot Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (x^2/b^2 - 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[1/3 x^3/b^2 - 1/8 x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/3 b - 1/8 b) \cdot Fb \cdot 1/EJ = 5/24 \cdot Fb^2/EJ$$

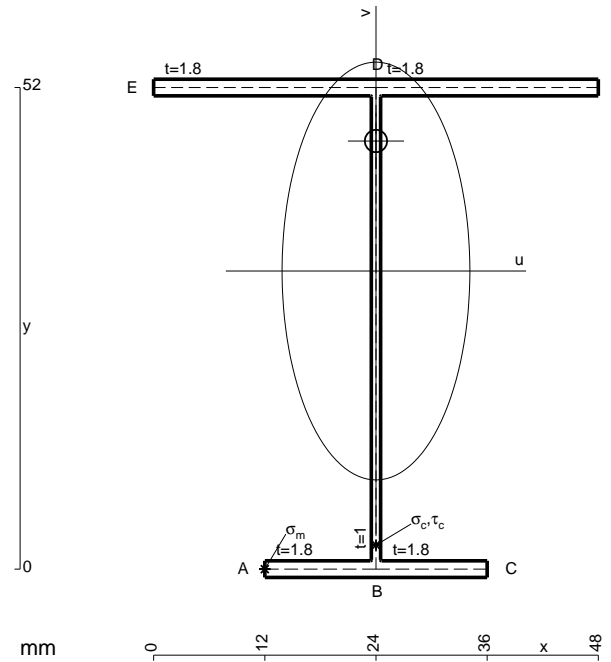
$$L_{HG}^{xo} = \int_0^b (1/4 - 1/4 x/b) \cdot Fb \cdot 1/EJ \, dx - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ$$

$$= \left[1/4 x - 1/8 x^2/b \right]_0^b \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ$$

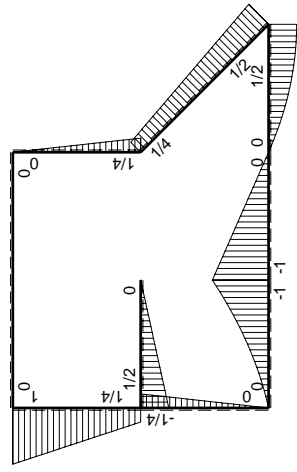
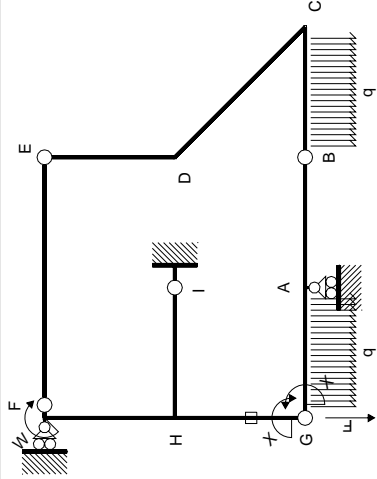
$$= (1/4 b - 1/8 b) \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ = -7/8 \cdot Fb^2/EJ$$

$$L_{GH}^{xo} = \int_0^b (1/4 x/b) \cdot Fb \cdot 1/EJ \, dx - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ = \left[1/8 x^2/b \right]_0^b \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ$$

$$= (1/8 b) \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ = -7/8 \cdot Fb^2/EJ$$

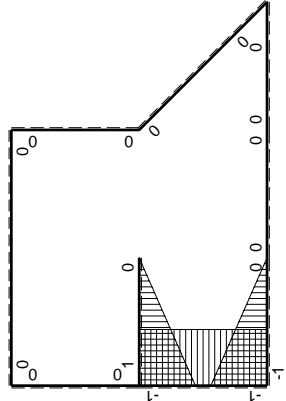


- A = 181.6 mm²
- J_u = 92380. mm⁴
- J_v = 18662. mm⁴
- J_t = 157.3 mm⁴
- y_o = 14.04 mm
- y_g = 32.19 mm
- N = -215. N
- T_y = 860. N
- M_x = -567600. Nmm
- x_m = 12. mm
- u_m = -12. mm
- v_m = -32.19 mm
- σ_m = N/A-Mv/J_u = -198.9 N/mm²
- x_c = 24. mm
- v_c = -32.19 mm
- σ_c = N/A-Mv/J_u = -198.9 N/mm²
- τ_c = TS/tJ_u = 12.94 N/mm²
- τ_g = TS/tJ_u = 12.94 N/mm²
- t_c = 860. mm
- σ_o = √σ²+3τ² = 200.2 N/mm²



Schema di calcolo iperstatico

(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-Fb+Fx	0	0	0	0
BA b	0	Fx	0	0	0	0
BC b	0	Fx-1/2qx ²	0	0	0	0
CB b	0	-1/2Fb+1/2qx ²	0	0	0	0
CD √2b	0	1/2Fb-√2/8Fx	0	0	0	0
DE b	0	1/4Fb-1/4Fx	0	0	0	0
ED b	0	-1/4Fx	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	-1+x/b	-1/2Fx-1/2qx ²	1/2Fx-1/2qx ³ /b	1-2x/b+x ² /b ²	1/8Fb ² /EJ	1/3Xb/EJ
AG b	x/b	Fb-3/2Fx+1/2qx ²	Fx-3/2Fx ² /b+1/2qx ³ /b	x ² /b ²	1/8Fb ² /EJ	1/3Xb/EJ
FH b	0	Fb-3/4Fx	0	0	0	0
HF b	0	-1/4Fb-3/4Fx	0	0	0	0
HI b	1-x/b	1/2Fb-1/2Fx	1/2Fb-Fx+1/2Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
IH b	-x/b	-1/2Fx	1/2Fx ² /b	x ² /b ²	1/8Fb ² /EJ	Xb/EJ
HG b	-1	-1/4Fb+1/4Fx	1/4Fb-1/4Fx	1	1/8Fb ² /EJ	Xb/EJ
GH b	1	1/4Fx	1/4Fx	1	1/8Fb ² /EJ	Xb/EJ
HG	elongazione asta $N_{1HG} = HG \cdot \frac{1}{k_A}$				-Fb ² /EJ	
A	molla nodo $-V_{1A}(V_{0A} + XV_{1A})/k_A$				-5/8Fb ² /EJ	1/4Xb/EJ
	totali				-29/24Fb ² /EJ	23/12Xb/EJ
	iperstatica X=W _{GA}				29/46Fb	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{x_0} = \int_0^b (1/2 x/b - 1/2 x^3/b^3) Fb 1/EJ dx = [1/4 x^2/b - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$

$$L_{AG}^{x_0} = \int_0^b (x/b - 3/2 x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [1/2 x^2/b - 1/2 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$

$$L_{HI}^{x_0} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{IH}^{x_0} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

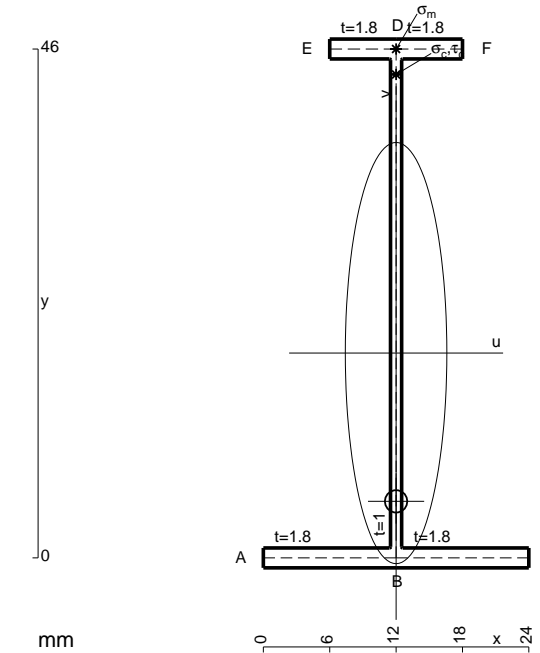
$$L_{HG}^{x_0} = \int_0^b (1/4 - 1/4 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/4 x - 1/8 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

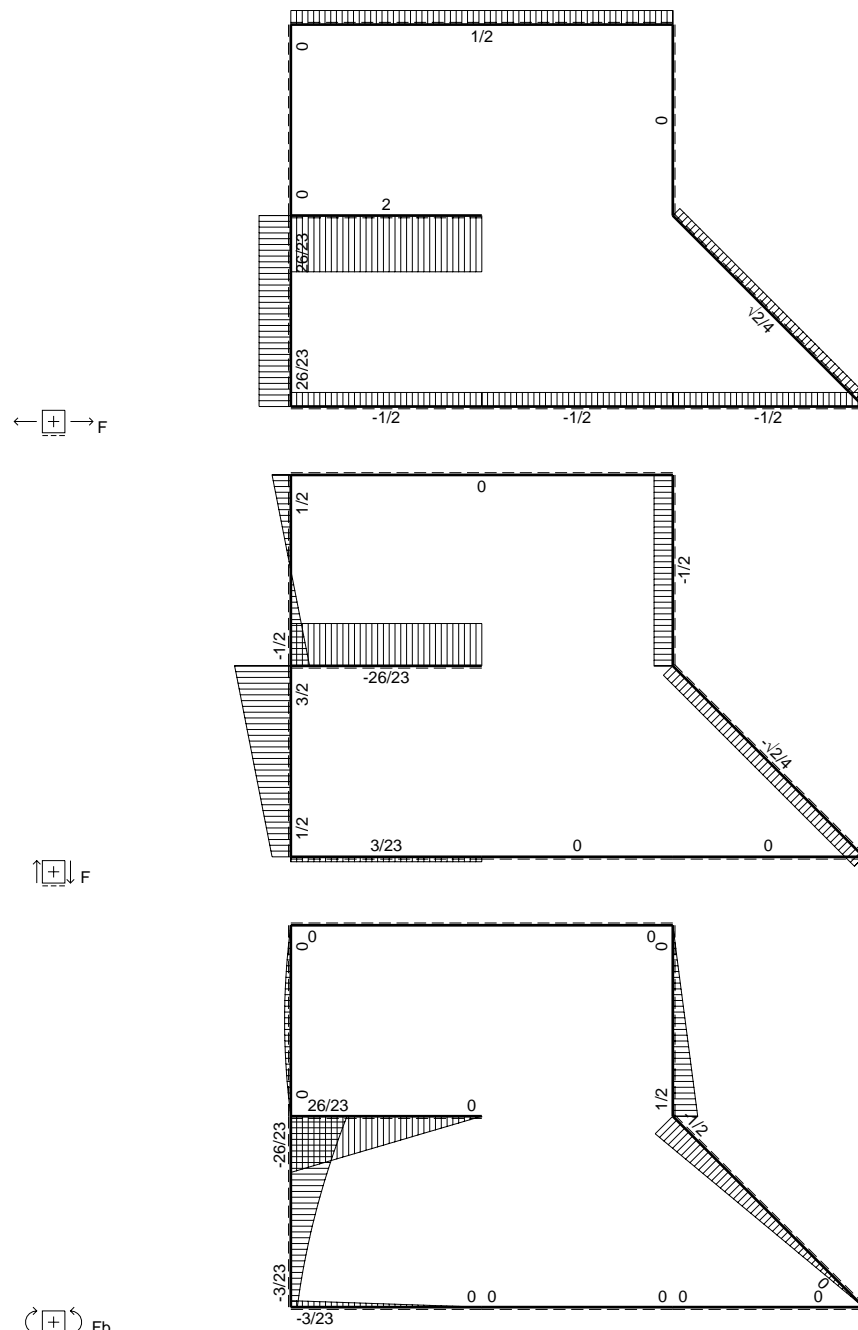
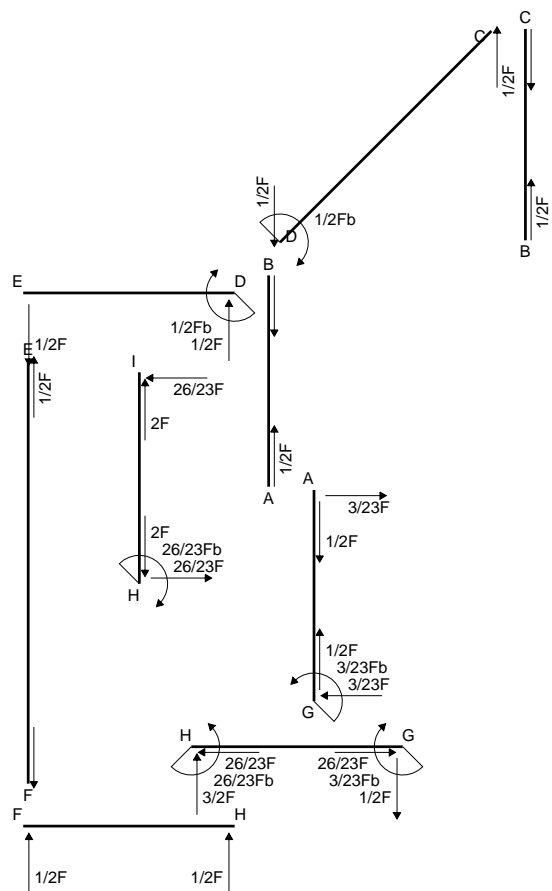
$$= (1/4 b - 1/8 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -7/8 Fb^2/EJ$$

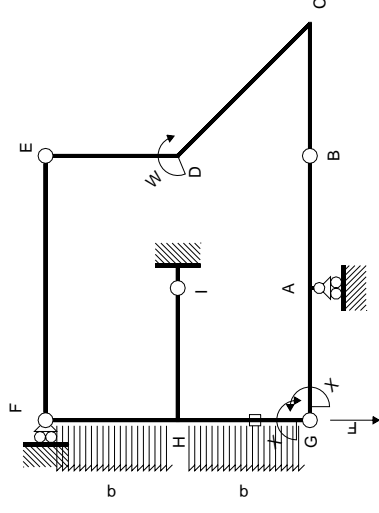
$$L_{GH}^{x_0} = \int_0^b (1/4 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/8 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/8 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -7/8 Fb^2/EJ$$



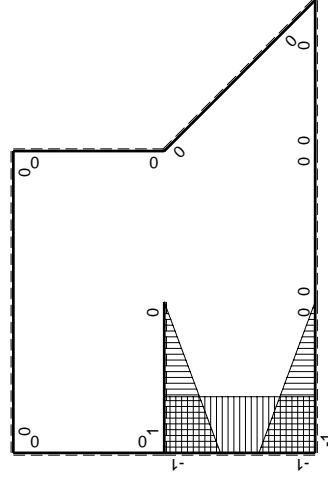
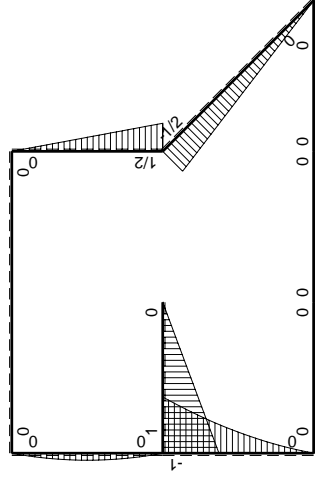
- A = 110.8 mm²
- J_u = 40163. mm⁴
- J_v = 2333. mm⁴
- J_t = 85.32 mm⁴
- y_o = -13.41 mm
- y_g = 18.52 mm
- N = -122.5 N
- T_y = 490. N
- M_x = -303800. Nmm
- x_m = 12. mm
- y_m = 46. mm
- v_m = 27.48 mm
- σ_m = N/A-Mv/J_u = 206.8 N/mm²
- y_c = 2. mm
- u_c = -12. mm
- v_c = -16.52 mm
- σ_c = N/A-Mv/J_u = 206.8 N/mm²
- τ_c = TS¹/tJ_u = 7.243 N/mm²
- τ_g = TS¹/tJ_u = 7.243 N/mm²
- t_c = 490. mm
- σ_o = √σ²+3τ² = 207.2 N/mm²





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	0	0	0	0	0
BA b	0	0	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	$-\sqrt{2}/4Fx$	0	0	0	0
DE b	0	$1/2Fb-1/2Fx$	0	0	0	0
ED b	0	$-1/2Fx$	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
AG b	x/b	0	0	x^2/b^2	0	0
FH b	0	$1/2Fx-1/2qx^2$	0	0	0	0
HF b	0	$-1/2Fx+1/2qx^2$	0	0	0	0
HI b	$1-x/b$	$Fb-Fx$	$Fb-2Fx+Fx^2/b$	$1-2x/b+x^2/b^2$	$1/3Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$-Fx$	Fx^2/b	x^2/b^2	0	0
HG b	-1	$-Fb+3/2Fx-1/2qx^2$	$Fb-3/2Fx+1/2Fx^2/b$	1	0	0
GH b	1	$1/2Fx+1/2qx^2$	$1/2Fx+1/2Fx^2/b$	1	$5/12Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG}^{HG} \rightarrow$					
A	molla nodo $-V_{1A}(V_{GA}+XV_{1A})/k_A$					
	totali					
	iperstatica X=W _{GA}					
	3/23Fb					

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{HI}^{x_0} = \int_0^b (1 - 2x/b + x^2/b^2) Fb 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - b + 1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{IH}^{x_0} = \int_0^b (x^2/b^2) Fb 1/EJ dx = [1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{HG}^{x_0} = \int_0^b (1 - 3/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

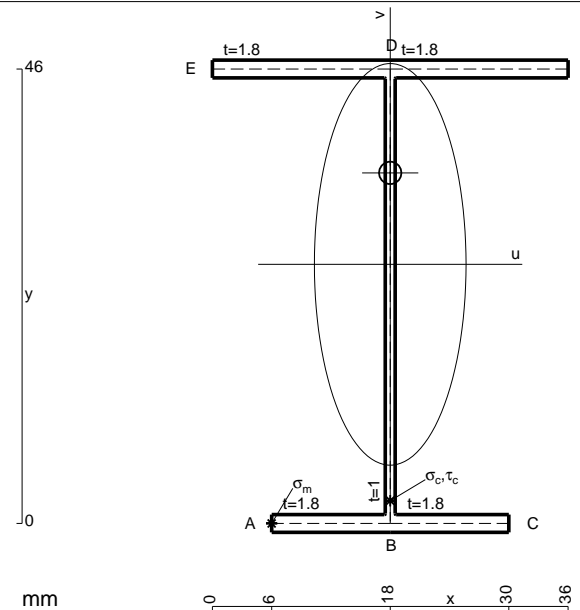
$$= [x - 3/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (b - 3/4 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -7/12 Fb^2/EJ$$

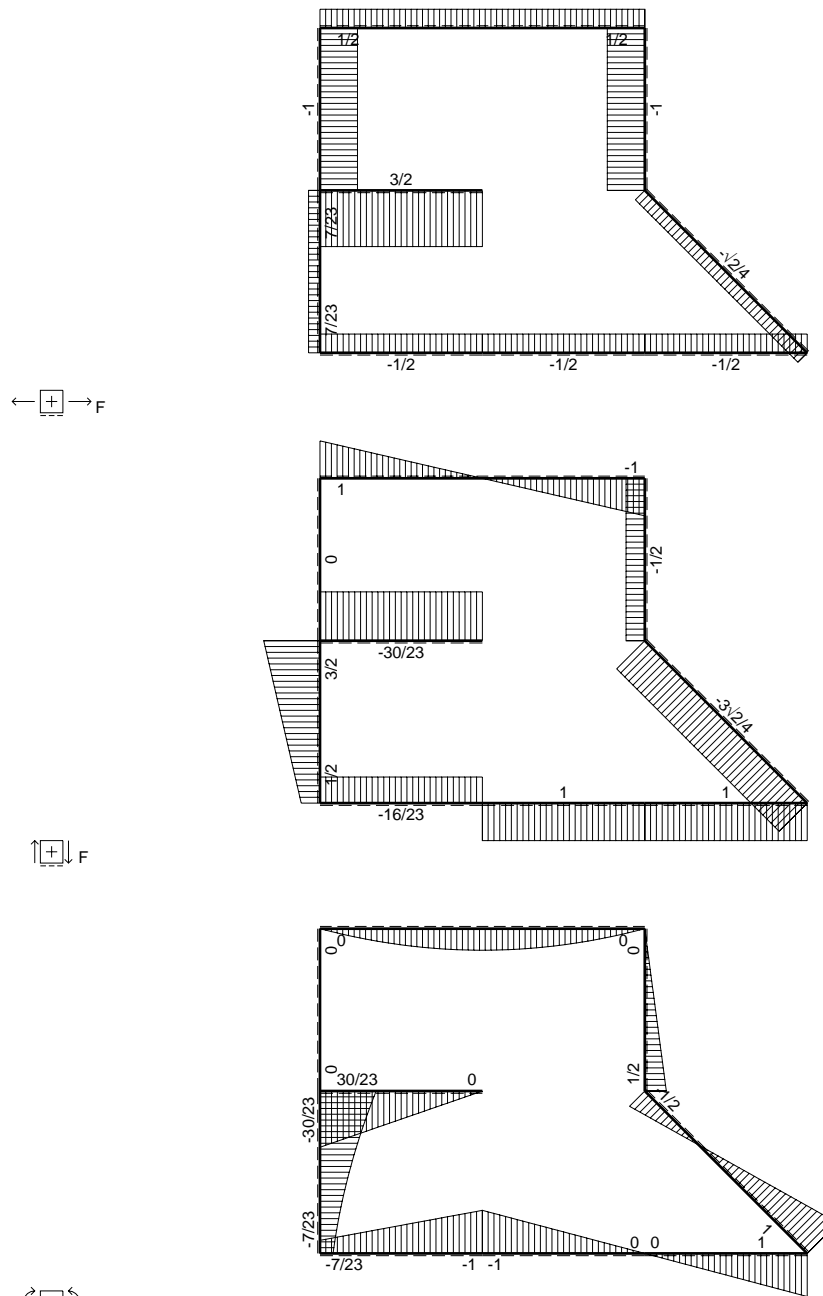
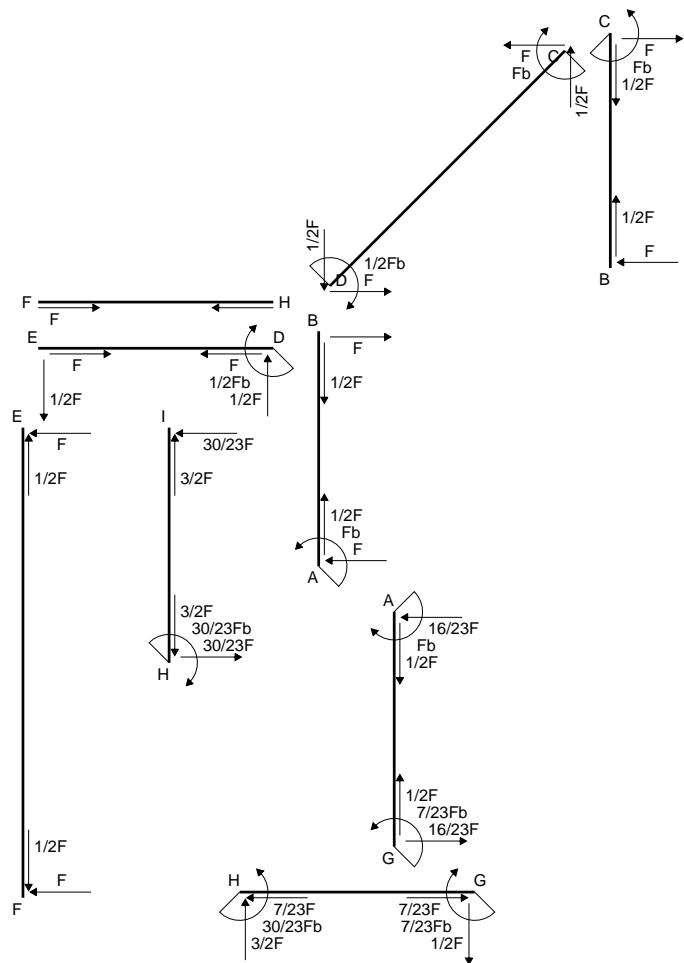
$$L_{GH}^{x_0} = \int_0^b (1/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

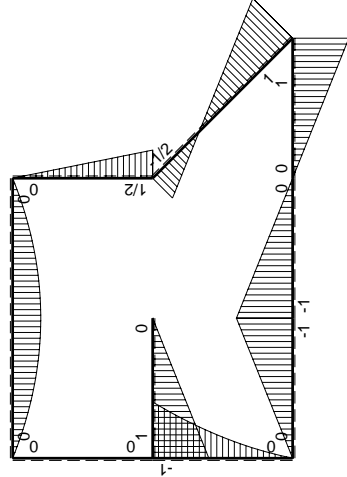
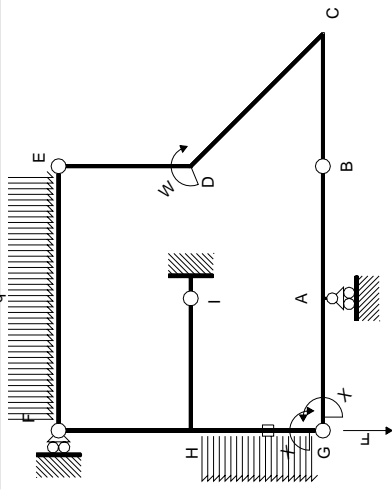
$$= [1/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/4 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -7/12 Fb^2/EJ$$

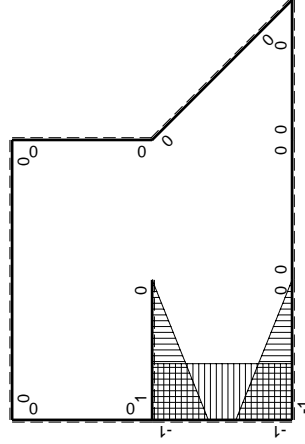


- A = 154. mm²
- J_u = 63641. mm⁴
- J_v = 9072. mm⁴
- J_i = 132. mm⁴
- y_o = 9.26 mm
- y_g = 26.23 mm
- T_y = -805. N
- M_x = 531300. Nmm
- x_m = 6. mm
- u_m = -12. mm
- v_m = -26.23 mm
- σ_m = -Mv/J_u = 218.9 N/mm²
- x_c = 18. mm
- v_c = -26.23 mm
- σ_c = -Mv/J_u = 218.9 N/mm²
- τ_c = TS_v/tJ_u = 14.33 N/mm²
- τ_g = TS_v/tJ_u = 14.33 N/mm²
- t_c = 1610. mm
- σ_o = √σ²+3τ² = 220.3 N/mm²





M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-Fb+Fx	0	0	0	0
BA b	0	Fx	0	0	0	0
BC b	0	Fx	0	0	0	0
CB b	0	-Fb+Fx	0	0	0	0
CD $\sqrt{2}b$	0	Fb-3 $\sqrt{2}/4Fx$	0	0	0	0
DE b	0	1/2Fb-1/2Fx	0	0	0	0
ED b	0	-1/2Fx	0	0	0	0
EF 2b	0	-Fx+1/2qx ²	0	0	0	0
FE 2b	0	Fx-1/2qx ²	0	0	0	0
GA b	-1+x/b	-Fx	Fx-Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
AG b	x/b	Fb-Fx	Fx-Fx ² /b	x ² /b ²	1/3Fb ² /EJ	1/3Xb/EJ
FH b	0	0	0	0	0	0
HF b	0	0	0	0	0	0
HI b	1-x/b	Fb-Fx	Fb-2Fx+Fx ² /b	1-2x/b+x ² /b ²	1/3Fb ² /EJ	1/3Xb/EJ
IH b	-x/b	-Fx	Fx ² /b	x ² /b ²	5/12Fb ² /EJ	Xb/EJ
HG b	-1	-Fb+3/2Fx-1/2qx ²	Fb-3/2Fx+1/2Fx ² /b	1	-Fb ² /EJ	1/4Xb/EJ
GH b	1	1/2Fx+1/2qx ²	1/2Fx+1/2Fx ² /b	1	-7/12Fb ² /EJ	23/12Xb/EJ
HG	elongazione asta $N_{1HG}^{S+HG} \perp HG$					
A	molla nodo $-V_{1A}(V_{GA}+XV_{1A})/k_A$					
	totali					
	iperstatica X=W _{GA}					

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[1/2 x^2/b - 1/3 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[1/2 x^2/b - 1/3 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot Fb \cdot 1/EJ = 1/3 \cdot Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[1/3 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/3 b) \cdot Fb \cdot 1/EJ = 1/3 \cdot Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (1 - 3/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ$$

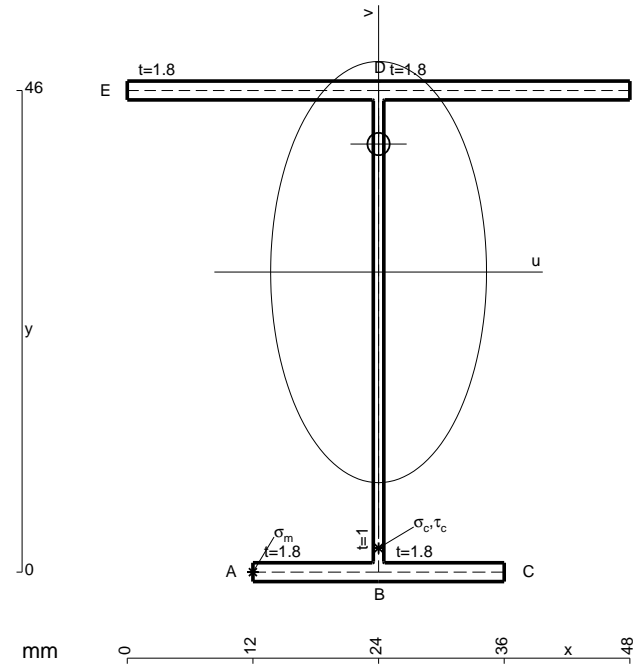
$$= \left[x - 3/4 x^2/b + 1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ$$

$$= (b - 3/4 b + 1/6 b) \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ = -7/12 \cdot Fb^2/EJ$$

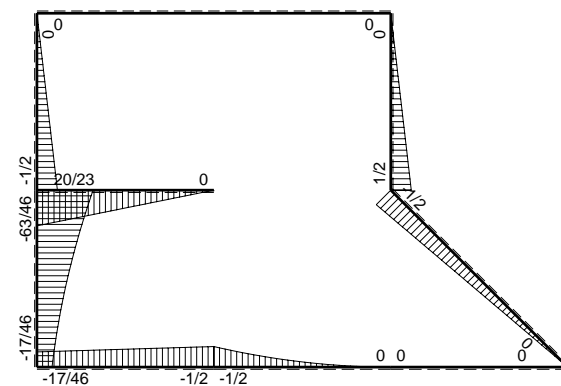
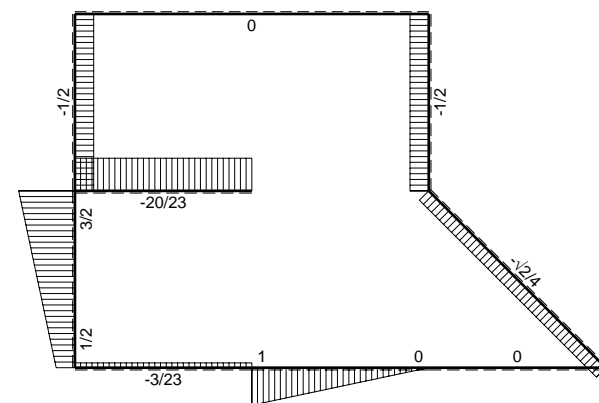
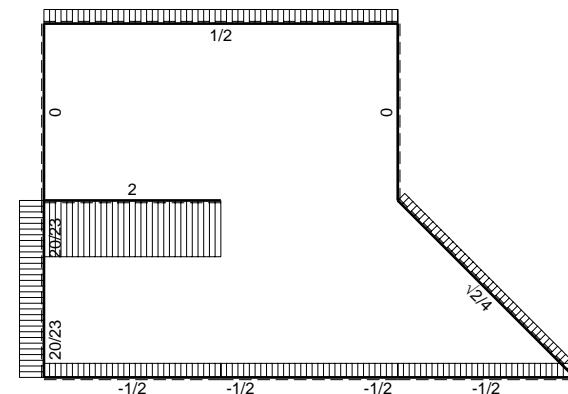
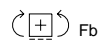
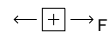
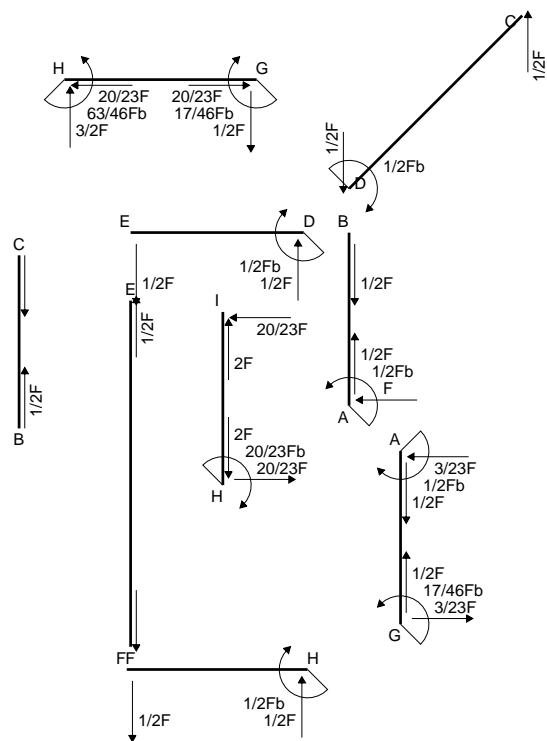
$$L_{GH}^{xo} = \int_0^b (1/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ$$

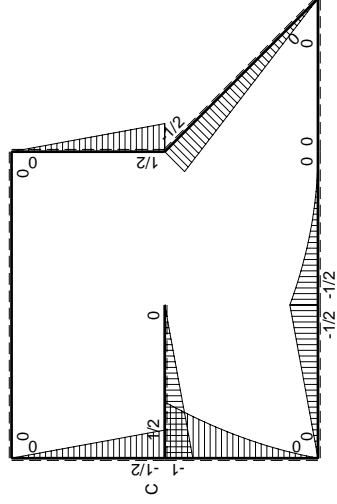
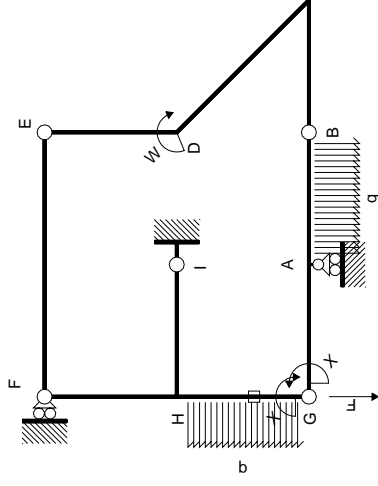
$$= \left[1/4 x^2/b + 1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ$$

$$= (1/4 b + 1/6 b) \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ = -7/12 \cdot Fb^2/EJ$$



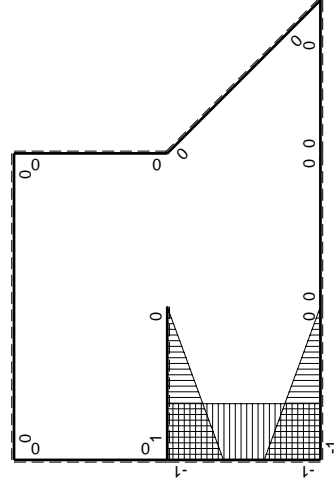
- A = 175.6 mm²
- J_u = 71048. mm⁴
- J_v = 18662. mm⁴
- J_t = 155.3 mm⁴
- y_o = 12.23 mm
- y_g = 28.66 mm
- N = -289.9 N
- T_y = -869.7 N
- M_x = 57400. Nmm
- x_m = 12. mm
- u_m = -12. mm
- v_m = -28.66 mm
- σ_m = N/A - Mv/J_u = 229.9 N/mm²
- x_c = 24. mm
- v_c = -28.66 mm
- σ_c = N/A - Mv/J_u = 229.9 N/mm²
- τ_c = TS/tJ_u = 15.16 N/mm²
- τ_g = TS/tJ_u = 15.16 N/mm²
- t_c = 820. mm
- σ_o = √σ² + 3τ² = 231.4 N/mm²





Schema di calcolo iperstatico

(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$	
AB b	0	$-1/2Fb + Fx - 1/2qx^2$	0	0	0	0	
BA b	0	$1/2qx^2$	0	0	0	0	
BC b	0	0	0	0	0	0	
CB b	0	0	0	0	0	0	
CD $\sqrt{2}b$	0	$-1/2Fx$	0	0	0	0	
DE b	0	$1/2Fb - 1/2Fx$	0	0	0	0	
ED b	0	$-1/2Fx$	0	0	0	0	
EF 2b	0	0	0	0	0	0	
FE 2b	0	0	0	0	0	0	
GA b	$-1+x/b$	$-1/2Fx$	$1/2Fx - 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$	
AG b	x/b	$1/2Fb - 1/2Fx$	$1/2Fx - 1/2Fx^2/b$	x^2/b^2			
FH b	0	$-1/2Fx$	0	0	0	0	
HF b	0	$1/2Fb - 1/2Fx$	0	0	0	0	
HI b	$1-x/b$	$1/2Fb - 1/2Fx$	$1/2Fb - Fx + 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$	
IH b	$-x/b$	$-1/2Fx$	$1/2Fx^2/b$	x^2/b^2			
HG b	-1	$-Fb + 3/2Fx - 1/2qx^2$	$Fb - 3/2Fx + 1/2Fx^2/b$	1	$5/12Fb^2/EJ$	Xb/EJ	
GH b	1	$1/2Fx + 1/2qx^2$	$1/2Fx + 1/2Fx^2/b$	1			
HG	elongazione asta $N_{1HG} = N_{HG} + N_{HG}$						
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$						
	totali						
	iperstatica X=W _{GA}						

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (1 - 3/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

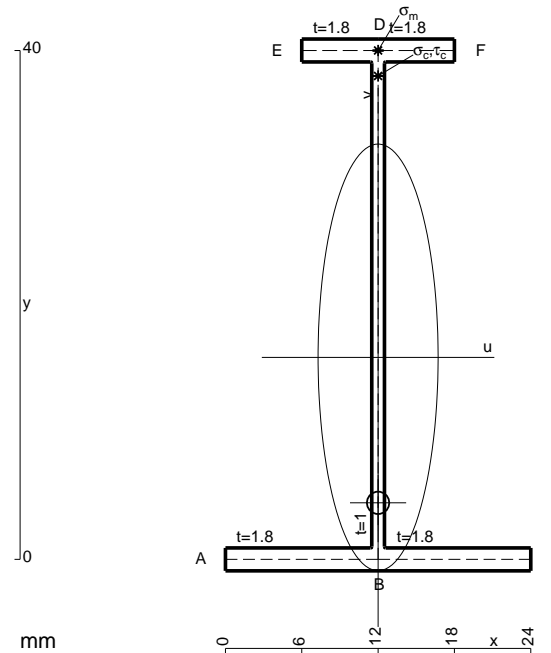
$$= [x - 3/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (b - 3/4 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -7/12 Fb^2/EJ$$

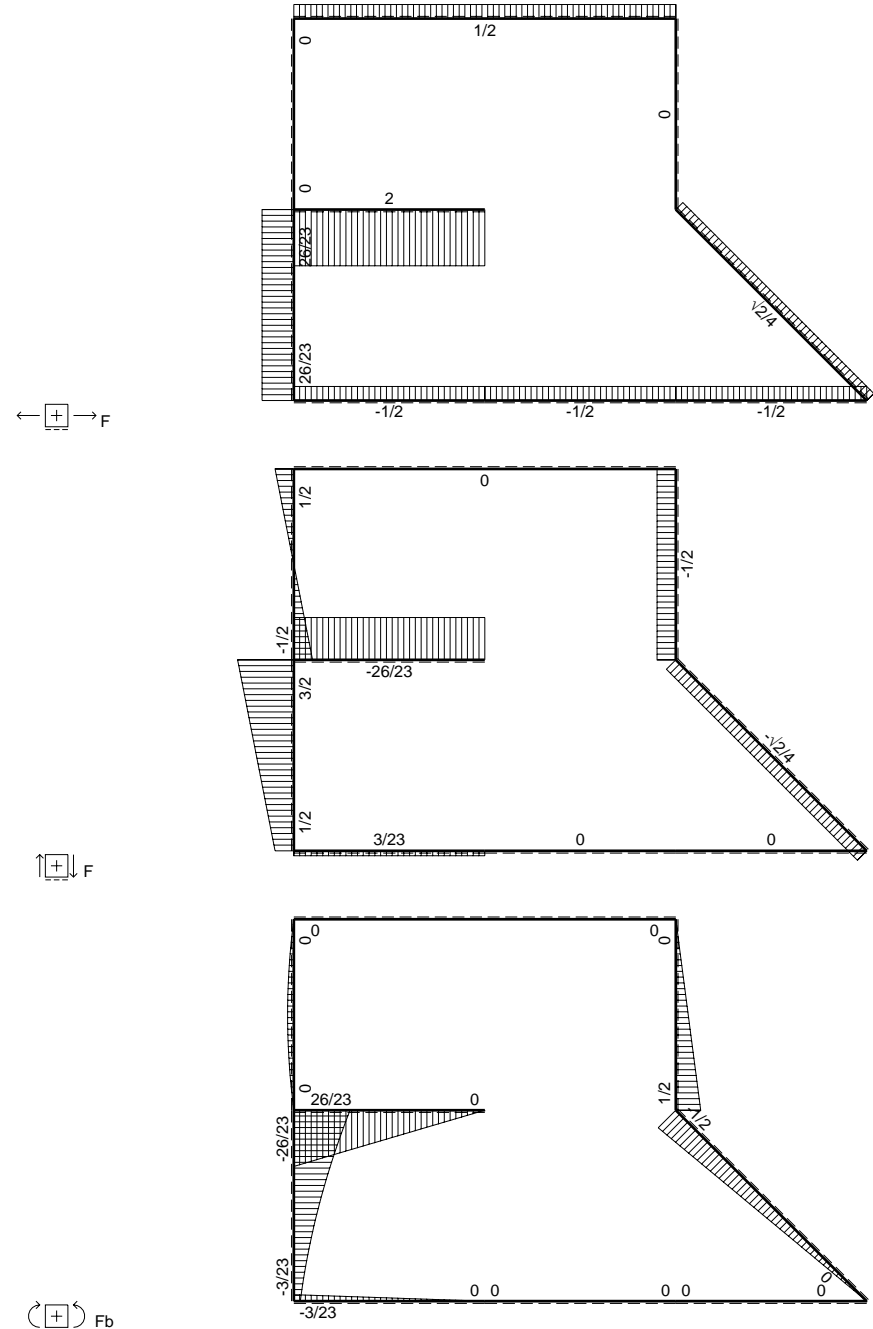
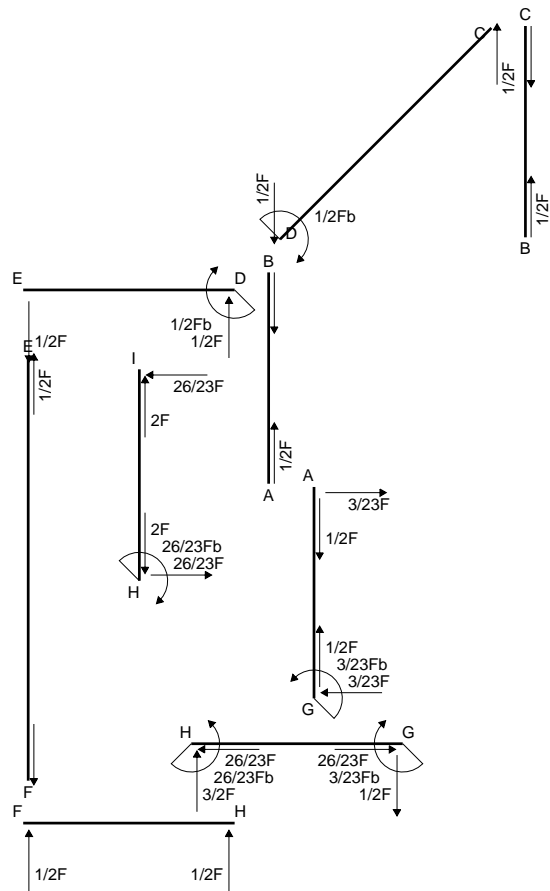
$$L_{GH}^{xo} = \int_0^b (1/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

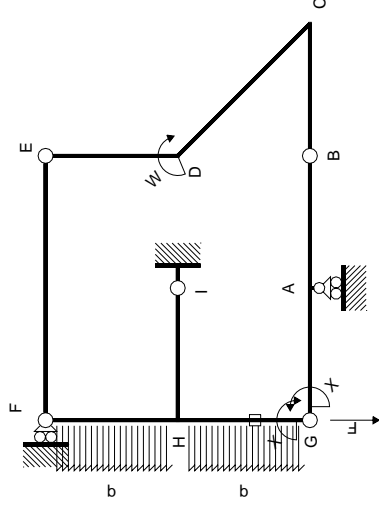
$$= [1/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/4 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -7/12 Fb^2/EJ$$



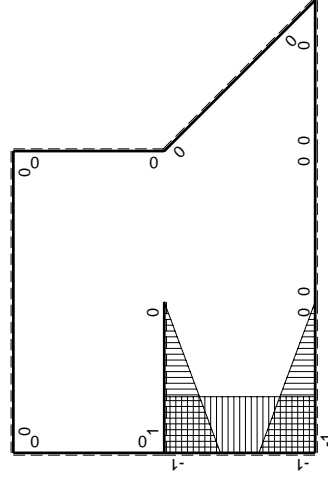
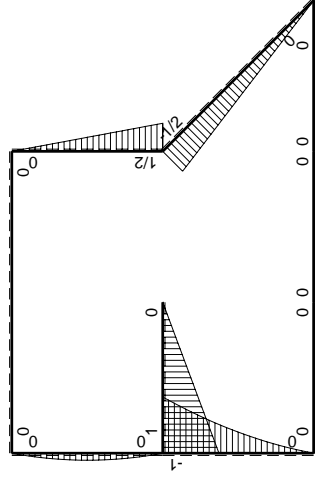
- A = 104.8 mm²
- J_u = 29473. mm⁴
- J_v = 2333. mm⁴
- J_t = 83.32 mm⁴
- y_o = -11.43 mm
- y_g = 15.88 mm
- N = -465. N
- T_y = 930. N
- M_x = -297600. Nmm
- x_m = 12. mm
- y_m = 40. mm
- v_m = 24.12 mm
- σ_m = N/A - Mv/J_u = 239.1 N/mm²
- y_c = 2. mm
- u_c = -12. mm
- v_c = -13.88 mm
- σ_c = N/A - Mv/J_u = 239.1 N/mm²
- τ_c = TS_y/tJ_u = 16.44 N/mm²
- τ_g = TS_y/tJ_u = 16.44 N/mm²
- t_c = 930. mm
- σ_o = √σ² + 3τ² = 240.8 N/mm²





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	0	0	0	0	0
BA b	0	0	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	$-\sqrt{2}/4Fx$	0	0	0	0
DE b	0	$1/2Fb-1/2Fx$	0	0	0	0
ED b	0	$-1/2Fx$	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
AG b	x/b	0	0	x^2/b^2	0	0
FH b	0	$1/2Fx-1/2qx^2$	0	0	0	0
HF b	0	$-1/2Fx+1/2qx^2$	0	0	0	0
HI b	$1-x/b$	$Fb-Fx$	$Fb-2Fx+Fx^2/b$	$1-2x/b+x^2/b^2$	$1/3Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$-Fx$	Fx^2/b	x^2/b^2	0	0
HG b	-1	$-Fb+3/2Fx-1/2qx^2$	$Fb-3/2Fx+1/2Fx^2/b$	1	0	0
GH b	1	$1/2Fx+1/2qx^2$	$1/2Fx+1/2Fx^2/b$	1	$5/12Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG}^{HG} \rightarrow$					
A	molla nodo $-V_{1A}(V_{GA}+XV_{1A})/k_A$					
	totali					
	iperstatica X=W _{GA}					
	3/23Fb					

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{HI}^{x_0} = \int_0^b (1 - 2x/b + x^2/b^2) Fb 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - b + 1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{IH}^{x_0} = \int_0^b (x^2/b^2) Fb 1/EJ dx = [1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{HG}^{x_0} = \int_0^b (1 - 3/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

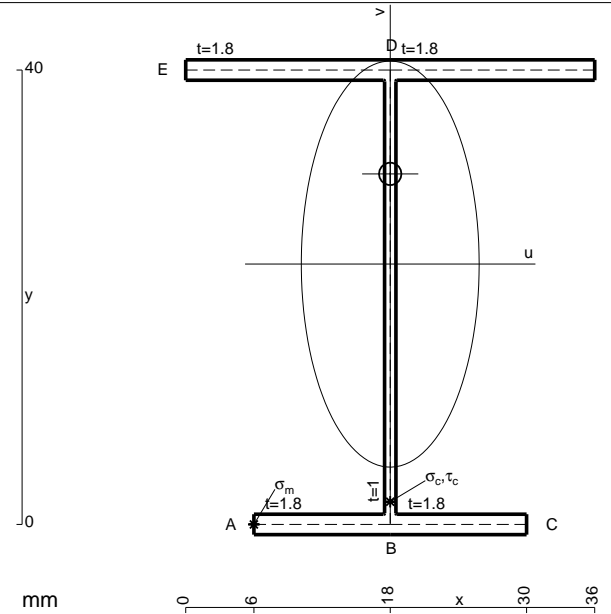
$$= [x - 3/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (b - 3/4 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -7/12 Fb^2/EJ$$

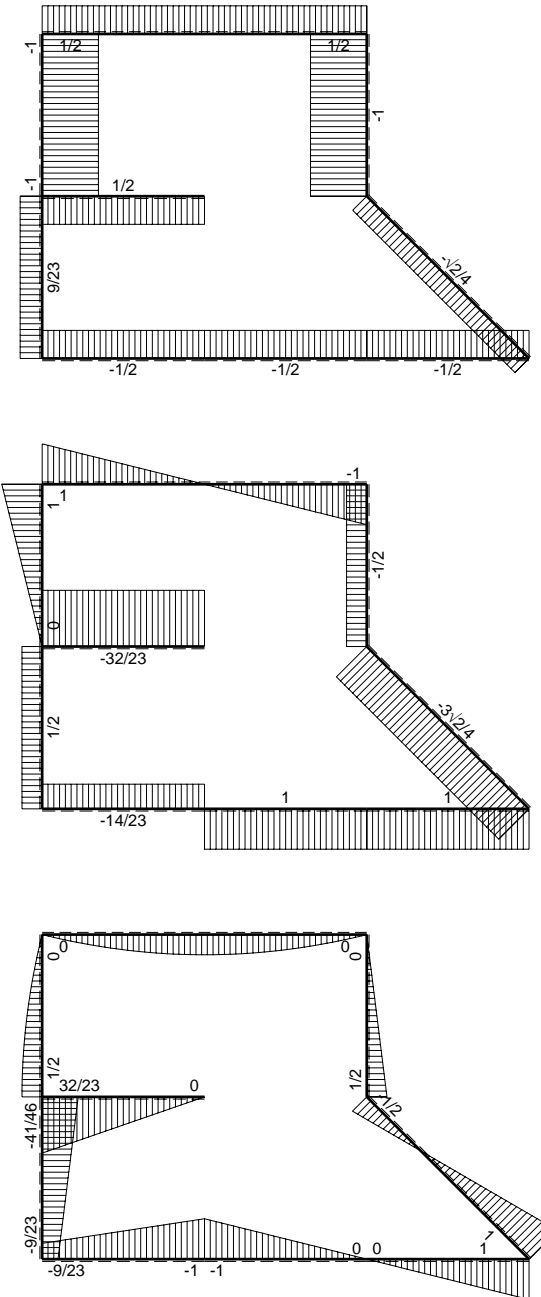
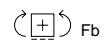
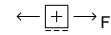
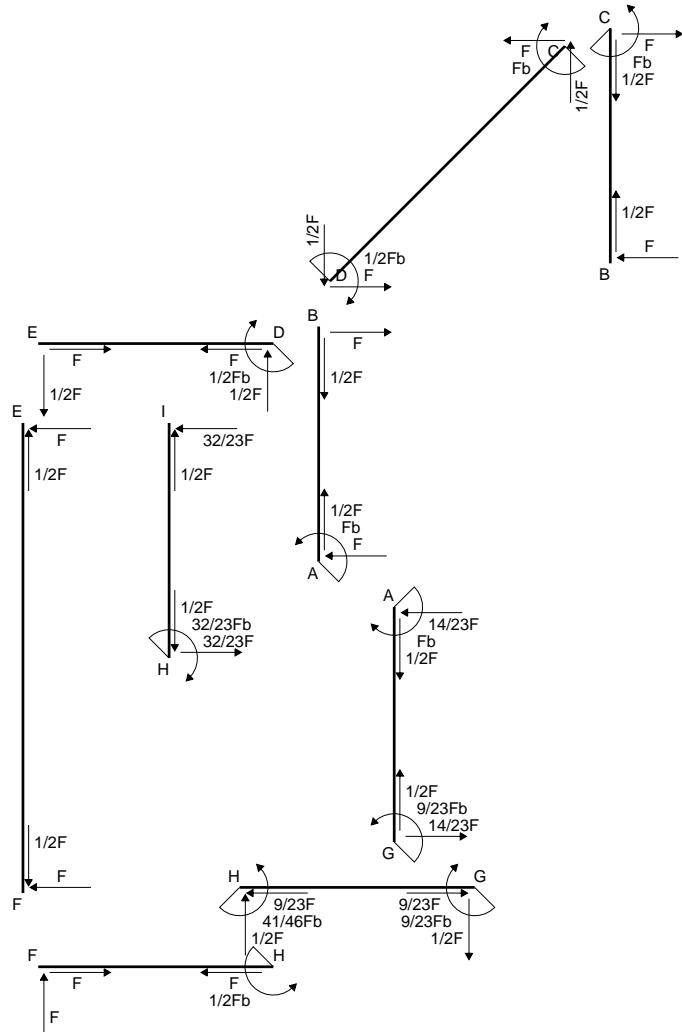
$$L_{GH}^{x_0} = \int_0^b (1/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

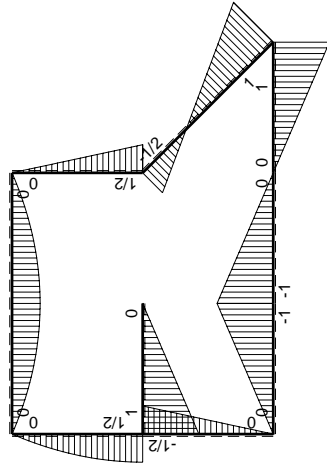
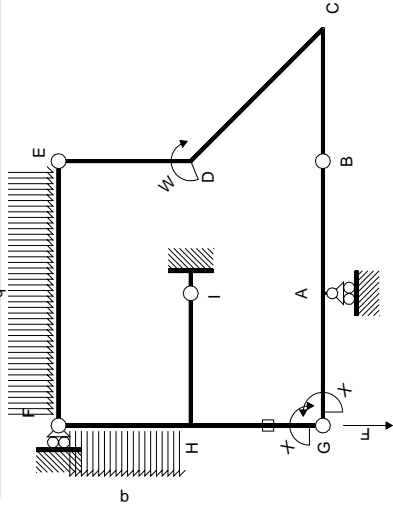
$$= [1/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/4 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -7/12 Fb^2/EJ$$



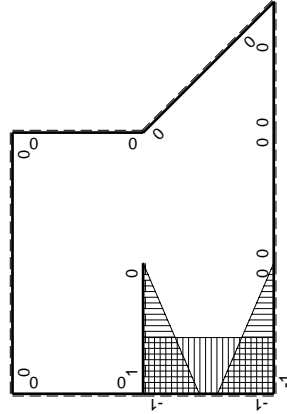
- A = 148. mm²
- J_u = 47272. mm⁴
- J_v = 9072. mm⁴
- J_i = 130. mm⁴
- y_o = 7.938 mm
- y_g = 22.92 mm
- T_y = -1210. N
- M_x = 411400. Nmm
- x_m = 6. mm
- u_m = -12. mm
- v_m = -22.92 mm
- σ_m = -Mv/J_u = 199.5 N/mm²
- x_c = 18. mm
- v_c = -22.92 mm
- σ_c = -Mv/J_u = 199.5 N/mm²
- τ_c = TS'/tJ_u = 25.34 N/mm²
- τ_g = TS'/tJ_u = 25.34 N/mm²
- t_c = 2420. mm
- σ_o = √σ²+3τ² = 204.2 N/mm²





Schema di calcolo iperstatico

$\left[\oplus \right] M_0$ flessione da carichi assegnati



$\left[\oplus \right] M_x$ flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	M _x (x)	M ₀ (x)	M _x M ₀	M _x M ₀	M _x M ₀ /EJ dx	∫ X M _x M ₀ /EJ dx
AB b	0	-Fb+Fx	0	0	0	0
BA b	0	Fx	0	0	0	0
BC b	0	Fx	0	0	0	0
CB b	0	-Fb+Fx	0	0	0	0
CD √2b	0	Fb-3√2/4Fx	0	0	0	0
DE b	0	1/2Fb-1/2Fx	0	0	0	0
ED b	0	-1/2Fx	0	0	0	0
EF 2b	0	-Fx+1/2qx ²	0	0	0	0
FE 2b	0	Fx-1/2qx ²	0	0	0	0
GA b	-1+x/b	-Fx	Fx-Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
AG b	x/b	Fb-Fx	Fx-Fx ² /b	x ² /b ²		
FH b	0	Fx-1/2qx ²	0	0	0	0
HF b	0	-1/2Fb+1/2qx ²	0	0	0	0
HI b	1-x/b	Fb-Fx	Fb-2Fx+Fx ² /b	1-2x/b+x ² /b ²	1/3Fb ² /EJ	1/3Xb/EJ
IH b	-x/b	-Fx	Fx ² /b	x ² /b ²		
HG b	-1	-1/2Fb+1/2Fx	1/2Fb-1/2Fx	1	1/4Fb ² /EJ	Xb/EJ
GH b	1	1/2Fx	1/2Fx	1		
HG	elongazione asta N _{1HG} ^{±HG} ±HG				-Fb ² /EJ	
A	molla nodo -V _{1A} (V _{0A} +XV _{1A})/k _A				-1/2Fb ² /EJ	1/4Xb/EJ
	totali				-3/4Fb ² /EJ	23/12Xb/EJ
	iperstatica X=W _{GA}				9/23Fb	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1 - 2x/b + x^2/b^2) Fb 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - b + 1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (x^2/b^2) Fb 1/EJ dx = [1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

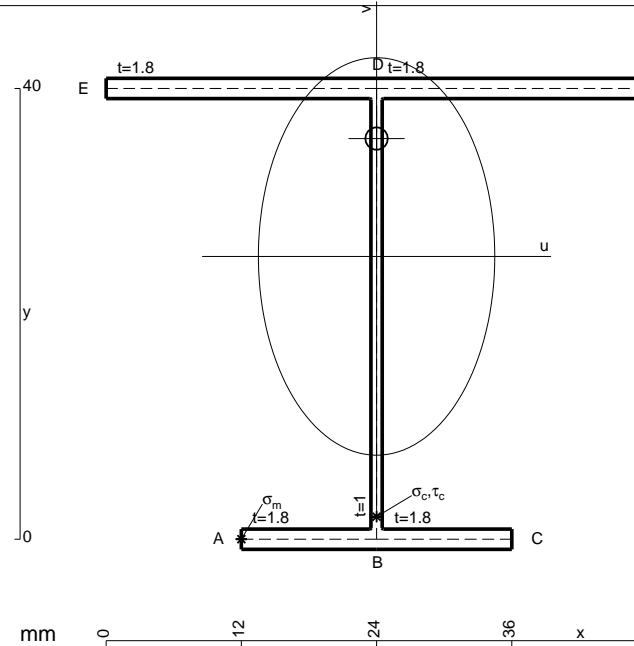
$$L_{HG}^{xo} = \int_0^b (1/2 - 1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/2 x - 1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

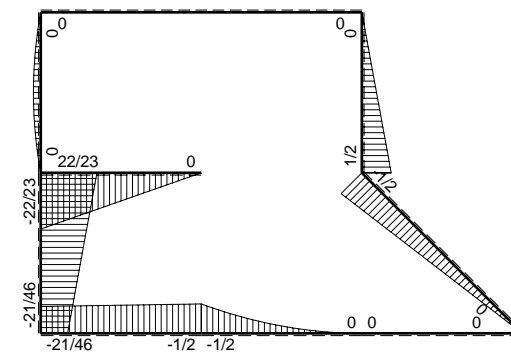
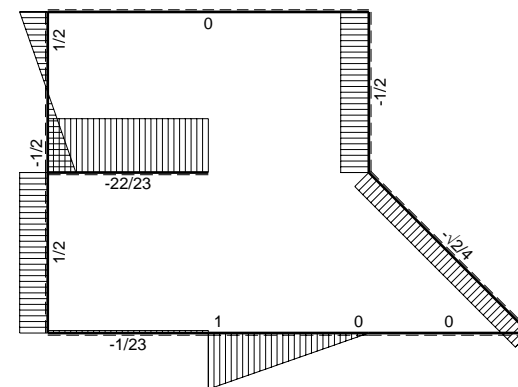
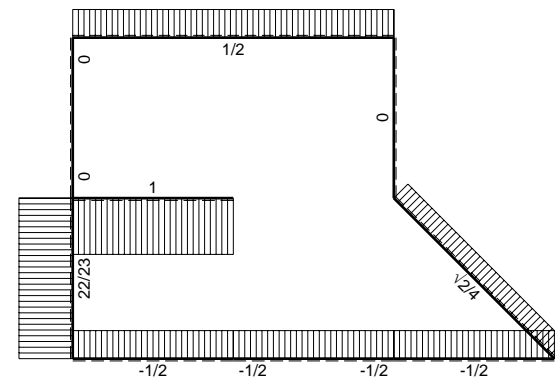
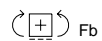
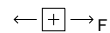
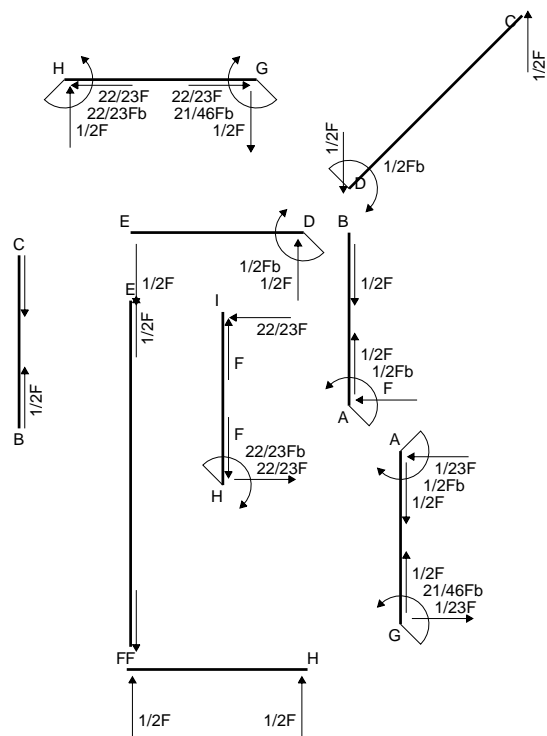
$$= (1/2 b - 1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$

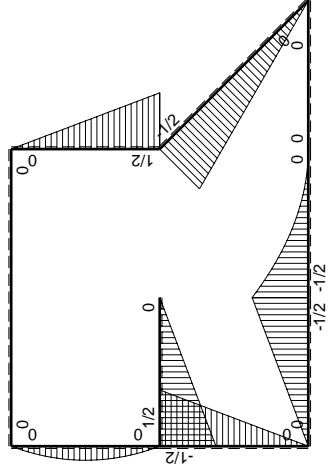
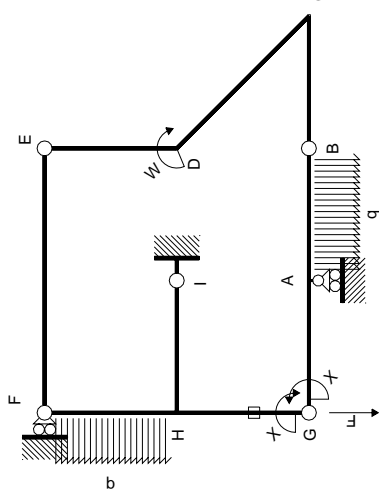
$$L_{GH}^{xo} = \int_0^b (1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$



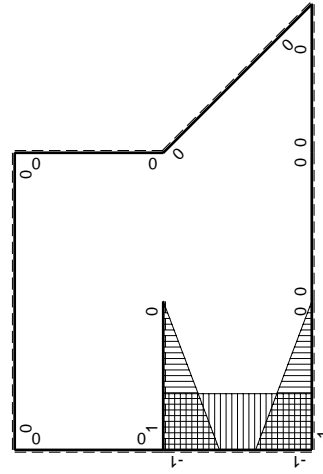
- A = 169.6 mm²
- J_u = 52772. mm⁴
- J_v = 18662. mm⁴
- J_t = 153.3 mm⁴
- y_o = 10.46 mm
- y_g = 25.09 mm
- N = -424.3 N
- T_y = -1273. N
- M_x = 444000. Nmm
- x_m = 12. mm
- u_m = -12. mm
- v_m = -25.09 mm
- σ_m = N/A-Mv/J_u = 208.6 N/mm²
- x_c = 24. mm
- v_c = -25.09 mm
- σ_c = N/A-Mv/J_u = 208.6 N/mm²
- τ_c = TS_v/tJ_u = 26.15 N/mm²
- τ_g = TS_v/tJ_u = 26.15 N/mm²
- t_c = 1200. mm
- σ_o = √σ²+3τ² = 213.5 N/mm²





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$	
AB b	0	$-1/2Fb + Fx - 1/2qx^2$	0	0	0	0	
BA b	0	$1/2qx^2$	0	0	0	0	
BC b	0	0	0	0	0	0	
CB b	0	0	0	0	0	0	
CD $\sqrt{2}b$	0	$-\sqrt{2}/4Fx$	0	0	0	0	
DE b	0	$1/2Fb - 1/2Fx$	0	0	0	0	
ED b	0	$-1/2Fx$	0	0	0	0	
EF 2b	0	0	0	0	0	0	
FE 2b	0	0	0	0	0	0	
GA b	$-1+x/b$	$-1/2Fx$	$1/2Fx - 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$	
AG b	x/b	$1/2Fb - 1/2Fx$	$1/2Fx - 1/2Fx^2/b$	x^2/b^2	$1/12Fb^2/EJ$	$1/3Xb/EJ$	
FH b	0	$1/2Fx - 1/2qx^2$	0	0	0	0	
HF b	0	$-1/2Fx + 1/2qx^2$	0	0	0	0	
HI b	$1-x/b$	$1/2Fb - 1/2Fx$	$1/2Fb - Fx + 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$	
IH b	$-x/b$	$-1/2Fx$	$1/2Fx^2/b$	x^2/b^2	$1/6Fb^2/EJ$	$1/3Xb/EJ$	
HG b	-1	$-1/2Fb + 1/2Fx$	$1/2Fb - 1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ	
GH b	1	$1/2Fx$	$1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ	
HG	elongazione asta $N_{1HG} = N_{HG} - HG$						
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$						
	totali						
	iperstatica X=W _{GA}						

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

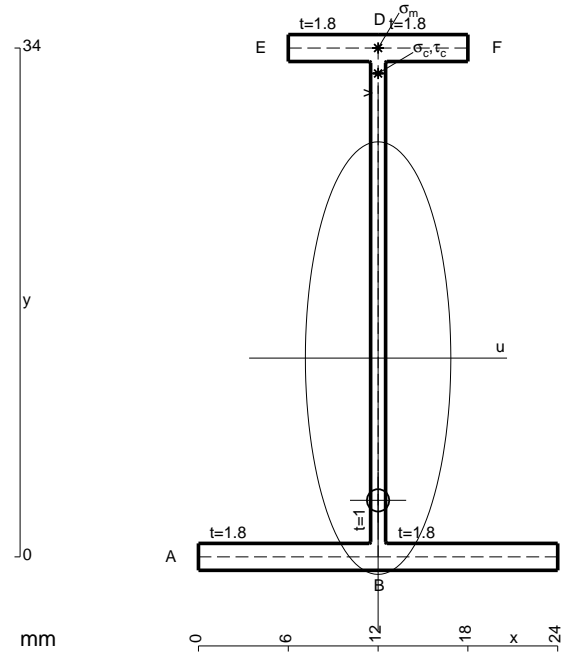
$$L_{HG}^{xo} = \int_0^b (1/2 - 1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/2 x - 1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

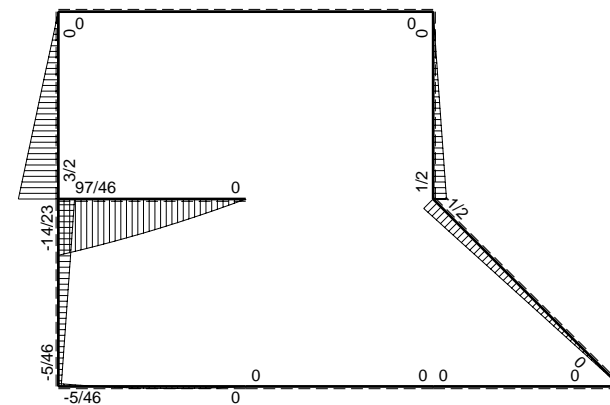
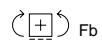
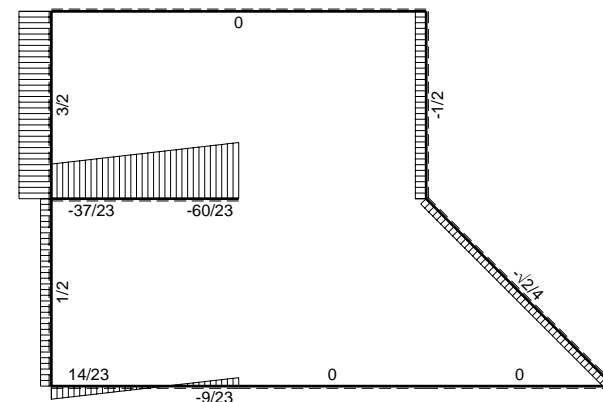
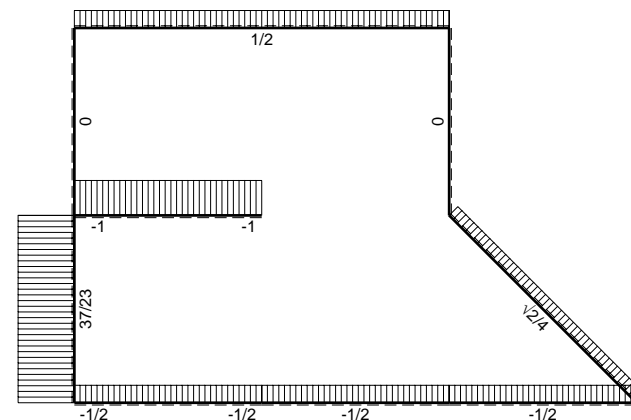
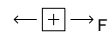
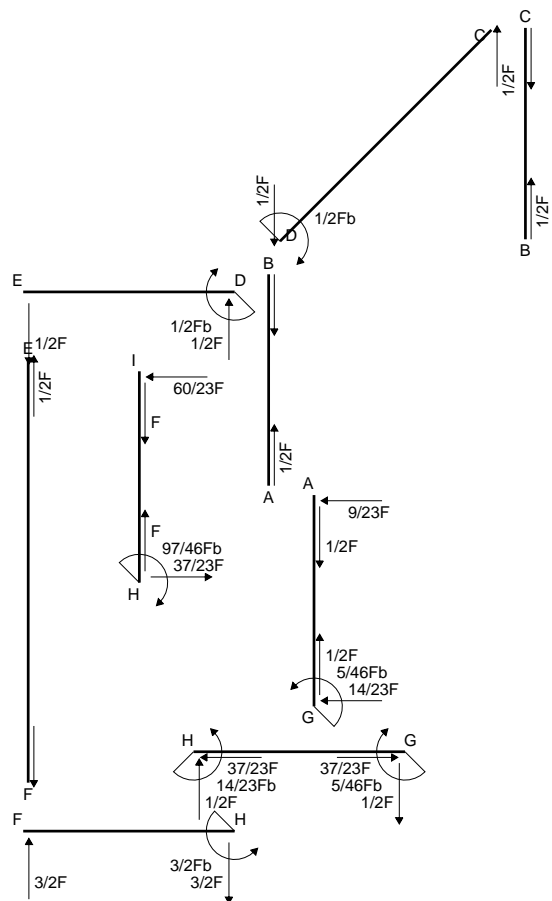
$$= (1/2 b - 1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$

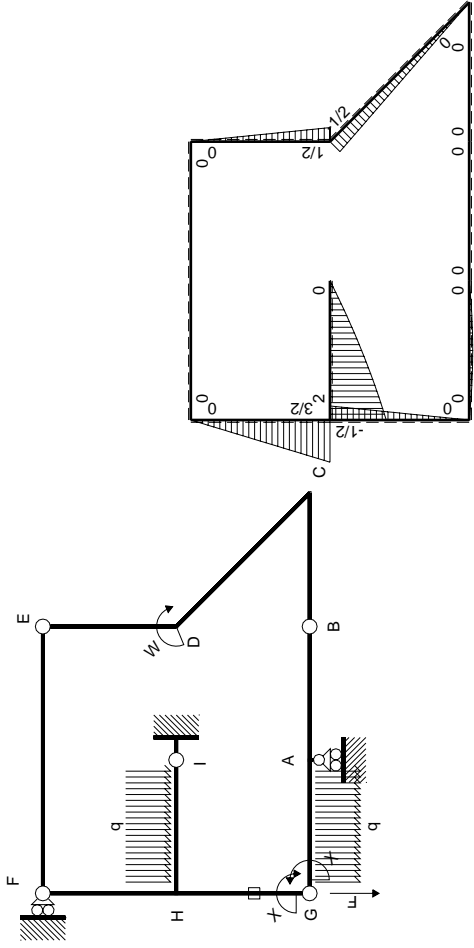
$$L_{GH}^{xo} = \int_0^b (1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$



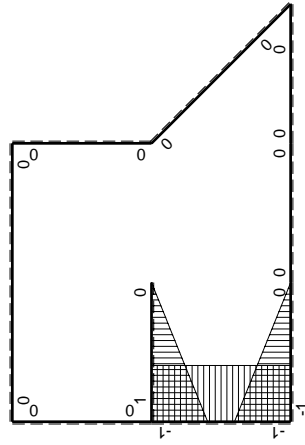
- A = 98.8 mm²
- J_u = 20638. mm⁴
- J_v = 2333. mm⁴
- J_t = 81.32 mm⁴
- y_o = -9.506 mm
- y_g = 13.28 mm
- N = -660. N
- T_y = 1320. N
- M_x = -224400. Nmm
- x_m = 12. mm
- y_m = 34. mm
- v_m = 20.72 mm
- σ_m = N/A-Mv/J_u = 218.6 N/mm²
- y_c = 2. mm
- u_c = -12. mm
- v_c = -11.28 mm
- σ_c = N/A-Mv/J_u = 218.6 N/mm²
- τ_c = TS/tJ_u = 28.62 N/mm²
- τ_g = TS/tJ_u = 28.62 N/mm²
- t_c = 1320. mm
- σ_o = √σ²+3τ² = 224.1 N/mm²





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{GA}$

→	$M_x(x)$	$M_o(x)$	$M_x M_o$	$M_x M_x$	$\int M_x M_o / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	0	0	0	0	0
BA b	0	0	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	$-\sqrt{2}/4Fx$	0	0	0	0
DE b	0	$1/2Fb-1/2Fx$	0	0	0	0
ED b	0	$-1/2Fx$	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$1/2Fx-1/2qx^2$	$-1/2Fx+Fx^2/b-1/2qx^3/b$	$1-2x/b+x^2/b^2$	$-1/24Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$-1/2Fx+1/2qx^2$	$-1/2Fx^2/b+1/2qx^3/b$	x^2/b^2	$-1/24Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$3/2Fx$	0	0	0	0
HF b	0	$-3/2Fb+3/2Fx$	0	0	0	0
HI b	$1-x/b$	$2Fb-3/2Fx-1/2qx^2$	$2Fb-7/2Fx+Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$17/24Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$-5/2Fx+1/2qx^2$	$5/2Fx^2/b-1/2qx^3/b$	x^2/b^2	$17/24Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	$-1/2Fb+1/2Fx$	$1/2Fb-1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
GH b	1	$1/2Fx$	$1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG} \epsilon_{HG} L_{HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{oA}+XV_{1A})/k_A$				$-1/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-5/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$5/46Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (-1/2 x/b + x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [-1/4 x^2/b + 1/3 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (-1/4 b + 1/3 b - 1/8 b) Fb 1/EJ = -1/24 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (-1/2 x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [-1/6 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (-1/6 b + 1/8 b) Fb 1/EJ = -1/24 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (2 - 7/2 x/b + x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [2x - 7/4 x^2/b + 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (2b - 7/4 b + 1/3 b + 1/8 b) Fb 1/EJ = 17/24 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (5/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [5/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (5/6 b - 1/8 b) Fb 1/EJ = 17/24 Fb^2/EJ$$

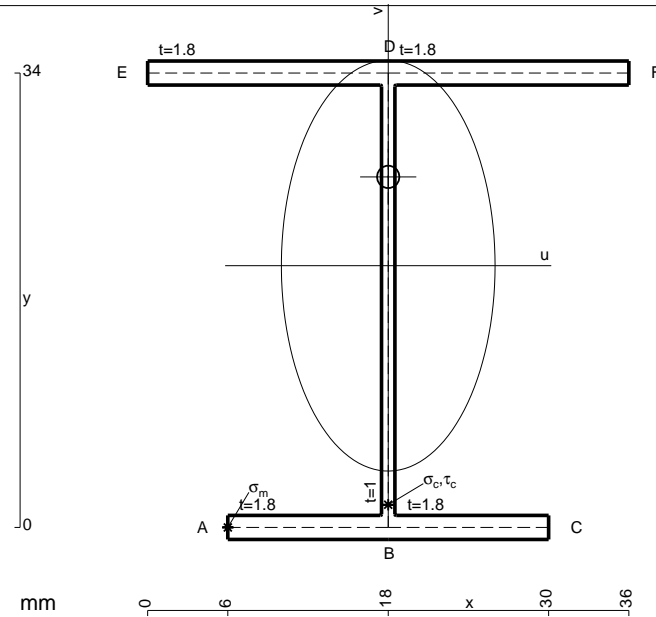
$$L_{HG}^{xo} = \int_0^b (1/2 - 1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/2 x - 1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

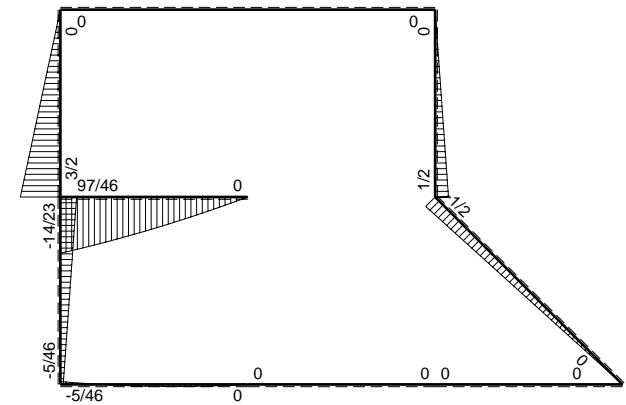
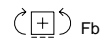
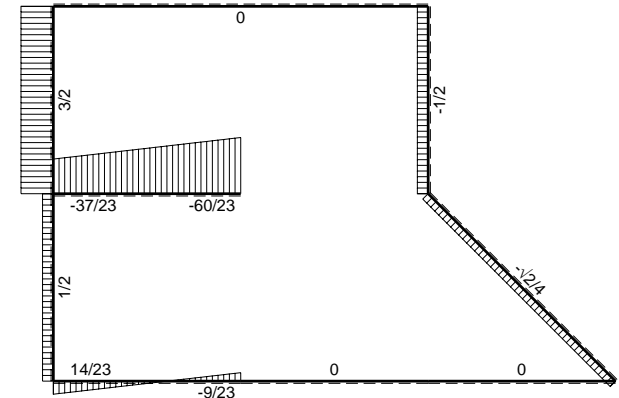
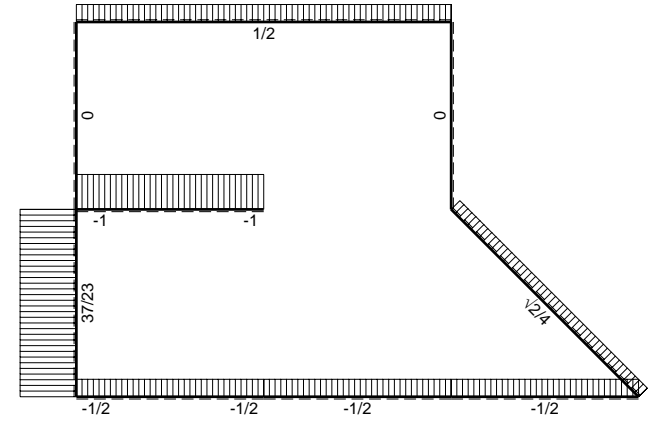
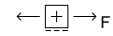
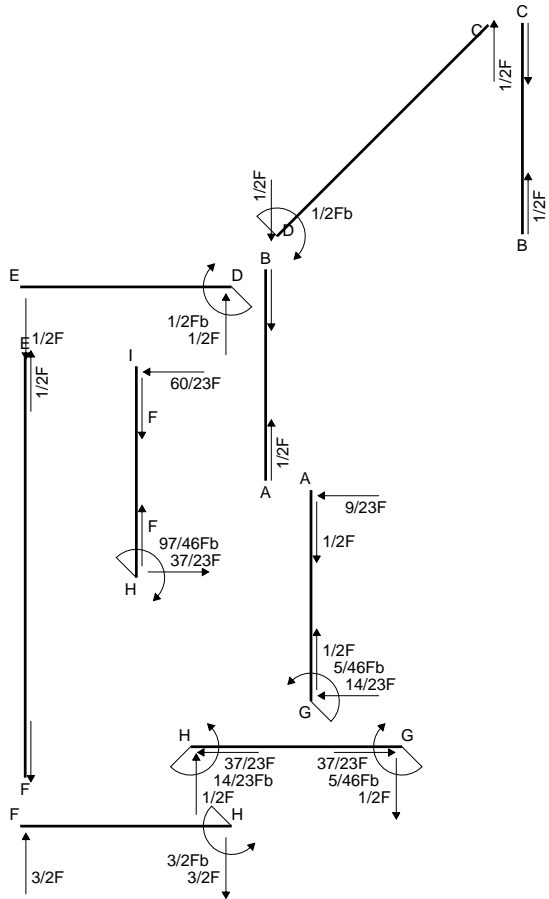
$$= (1/2 b - 1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$

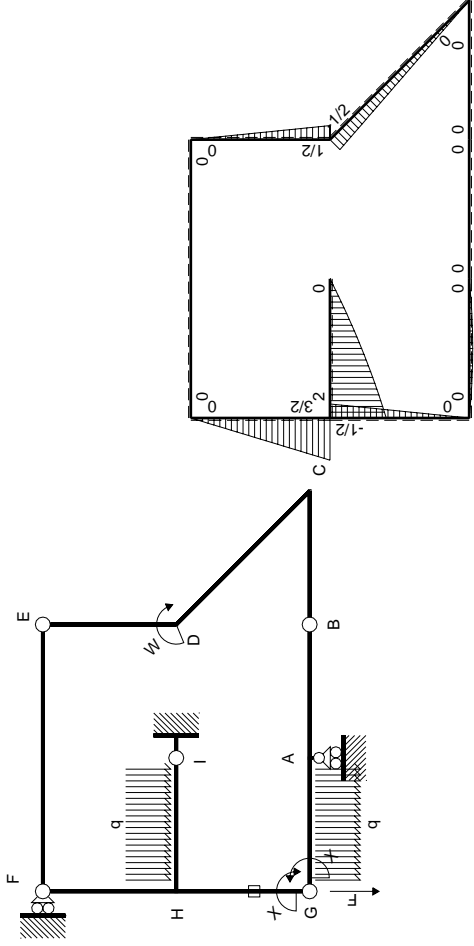
$$L_{GH}^{xo} = \int_0^b (1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$



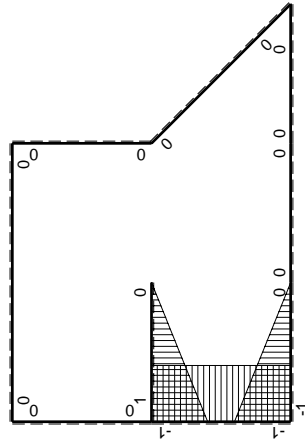
- A = 142. mm²
- J_u = 33538. mm⁴
- J_v = 9072. mm⁴
- J_i = 128. mm⁴
- y_o = 6.643 mm
- y_g = 19.59 mm
- T_y = 1050. N
- M_x = 388500. Nmm
- x_m = 6. mm
- u_m = -12. mm
- v_m = -19.59 mm
- σ_m = -Mv/J_u = 226.9 N/mm²
- x_c = 18. mm
- v_c = -19.59 mm
- σ_c = -Mv/J_u = 226.9 N/mm²
- τ_c = TS_v/tJ_u = 26.49 N/mm²
- τ_g = TS_v/tJ_u = 26.49 N/mm²
- t_c = 700. mm
- σ_o = √σ²+3τ² = 231.5 N/mm²





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{GA}$

→	$M_x(x)$	$M_o(x)$	$M_x M_o$	$M_x M_x$	$\int M_x M_o / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	0	0	0	0	0
BA b	0	0	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	$-\sqrt{2}/4Fx$	0	0	0	0
DE b	0	$1/2Fb-1/2Fx$	0	0	0	0
ED b	0	$-1/2Fx$	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$1/2Fx-1/2qx^2$	$-1/2Fx+Fx^2/b-1/2qx^3/b$	$1-2x/b+x^2/b^2$	$-1/24Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$-1/2Fx+1/2qx^2$	$-1/2Fx^2/b+1/2qx^3/b$	x^2/b^2	$-1/24Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$3/2Fx$	0	0	0	0
HF b	0	$-3/2Fb+3/2Fx$	0	0	0	0
HI b	$1-x/b$	$2Fb-3/2Fx-1/2qx^2$	$2Fb-7/2Fx+Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$17/24Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$-5/2Fx+1/2qx^2$	$5/2Fx^2/b-1/2qx^3/b$	x^2/b^2	$17/24Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	$-1/2Fb+1/2Fx$	$1/2Fb-1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
GH b	1	$1/2Fx$	$1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG} \epsilon_{HG} L_{HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{oA}+XV_{1A})/k_A$				$-1/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-5/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$5/46Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (-1/2 x/b + x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [-1/4 x^2/b + 1/3 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (-1/4 b + 1/3 b - 1/8 b) Fb 1/EJ = -1/24 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (-1/2 x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [-1/6 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (-1/6 b + 1/8 b) Fb 1/EJ = -1/24 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (2 - 7/2 x/b + x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [2x - 7/4 x^2/b + 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (2b - 7/4 b + 1/3 b + 1/8 b) Fb 1/EJ = 17/24 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (5/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [5/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (5/6 b - 1/8 b) Fb 1/EJ = 17/24 Fb^2/EJ$$

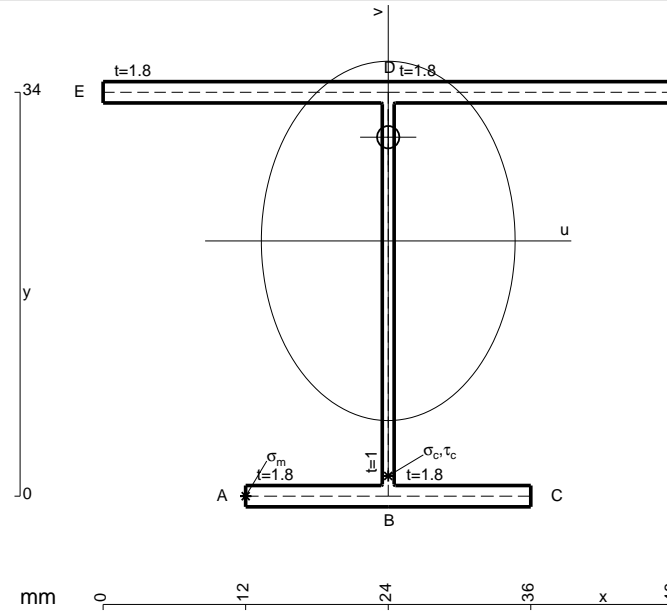
$$L_{HG}^{xo} = \int_0^b (1/2 - 1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/2 x - 1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

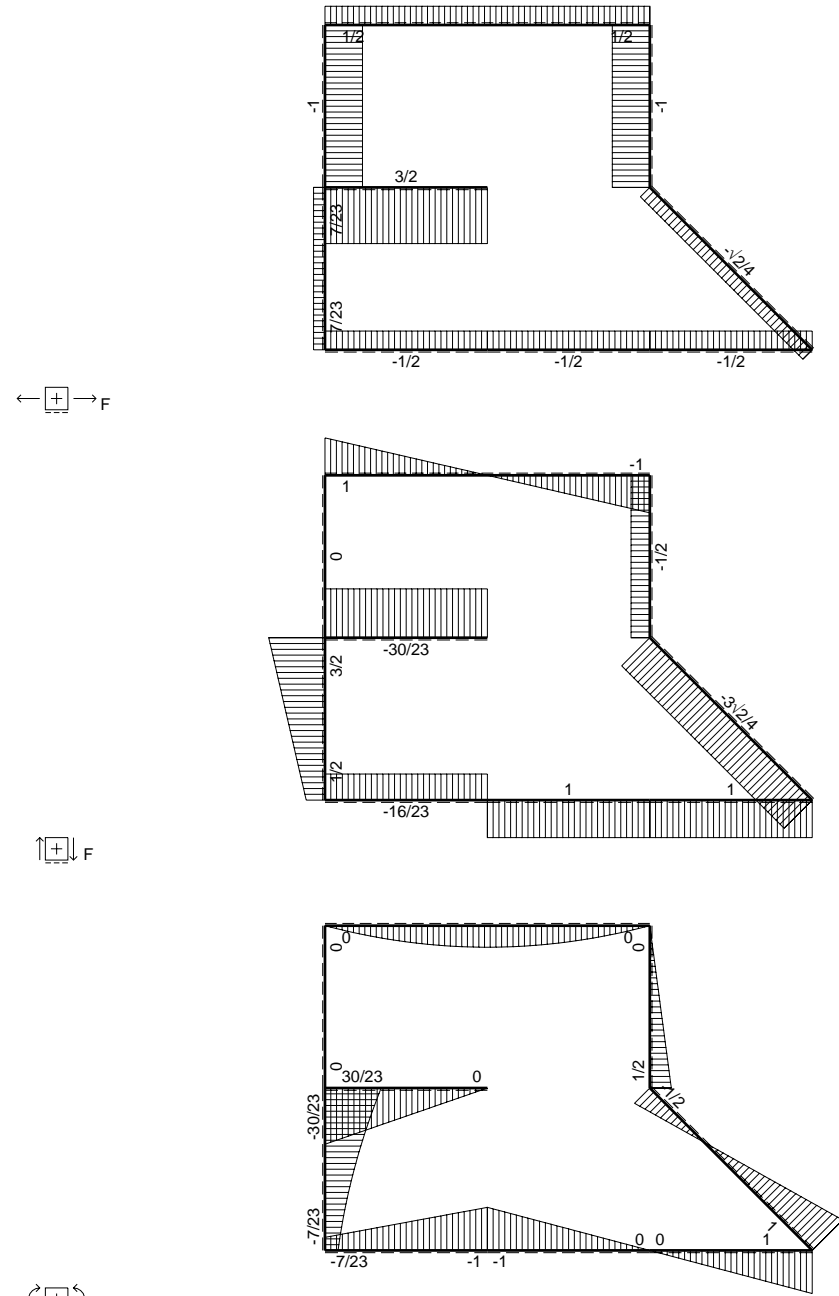
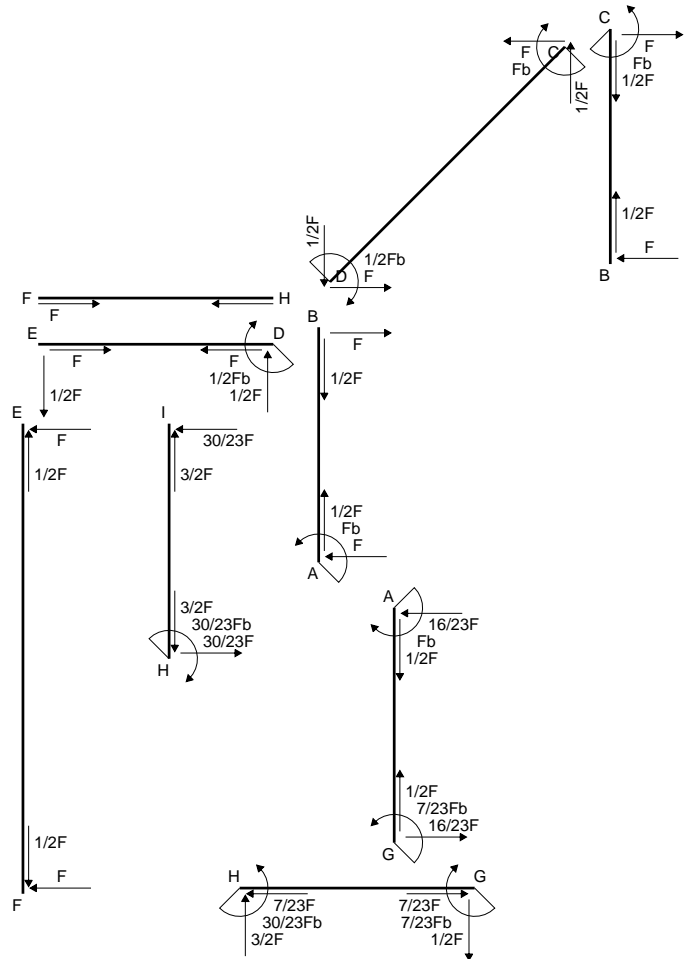
$$= (1/2 b - 1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$

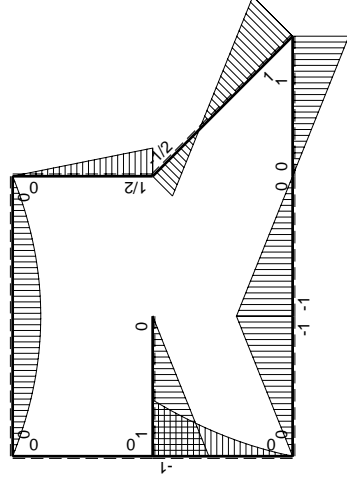
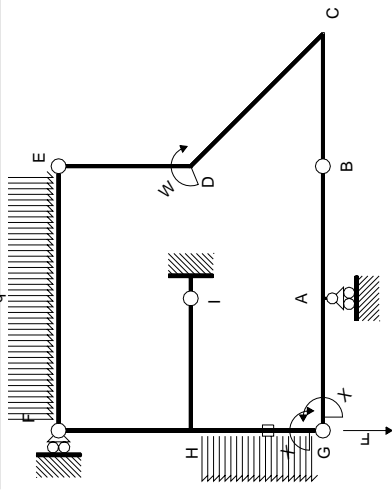
$$L_{GH}^{xo} = \int_0^b (1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$

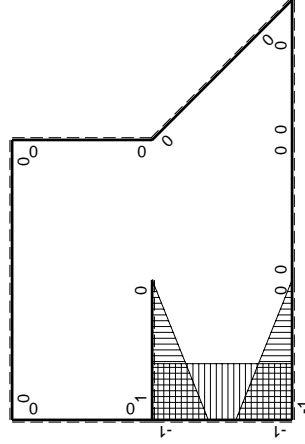


- A = 163.6 mm²
- F J_u = 37433. mm⁴
- J_v = 18662. mm⁴
- J_i = 151.3 mm⁴
- y_o = 8.733 mm
- y_g = 21.49 mm
- T_y = 1035. N
- M_x = 414000. Nmm
- x_m = 12. mm
- u_m = -12. mm
- v_m = -21.49 mm
- σ_m = -Mv/J_u = 237.7 N/mm²
- x_c = 24. mm
- v_c = -21.49 mm
- σ_c = -Mv/J_u = 237.7 N/mm²
- τ_c = TS_i/tJ_u = 25.67 N/mm²
- τ_g = TS_i/tJ_u = 25.67 N/mm²
- t_c = 690. mm
- σ_o = √σ²+3τ² = 241.8 N/mm²





(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-Fb+Fx	0	0	0	0
BA b	0	Fx	0	0	0	0
BC b	0	Fx	0	0	0	0
CB b	0	-Fb+Fx	0	0	0	0
CD $\sqrt{2}b$	0	Fb-3 $\sqrt{2}/4Fx$	0	0	0	0
DE b	0	1/2Fb-1/2Fx	0	0	0	0
ED b	0	-1/2Fx	0	0	0	0
EF 2b	0	-Fx+1/2qx ²	0	0	0	0
FE 2b	0	Fx-1/2qx ²	0	0	0	0
GA b	-1+x/b	-Fx	Fx-Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
AG b	x/b	Fb-Fx	Fx-Fx ² /b	x ² /b ²	1/3Fb ² /EJ	1/3Xb/EJ
FH b	0	0	0	0	0	0
HF b	0	0	0	0	0	0
HI b	1-x/b	Fb-Fx	Fb-2Fx+Fx ² /b	1-2x/b+x ² /b ²	1/3Fb ² /EJ	1/3Xb/EJ
IH b	-x/b	-Fx	Fx ² /b	x ² /b ²	5/12Fb ² /EJ	Xb/EJ
HG b	-1	-Fb+3/2Fx-1/2qx ²	Fb-3/2Fx+1/2Fx ² /b	1	-Fb ² /EJ	1/4Xb/EJ
GH b	1	1/2Fx+1/2qx ²	1/2Fx+1/2Fx ² /b	1	-7/12Fb ² /EJ	23/12Xb/EJ
HG	elongazione asta $N_{1HG}^{S+HG} \perp HG$					
A	molla nodo $-V_{1A}(V_{GA}+XV_{1A})/k_A$					
	totali					
	iperstatica $X=W_{GA}$					

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1 - 2x/b + x^2/b^2) Fb 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - b + 1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (x^2/b^2) Fb 1/EJ dx = [1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (1 - 3/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

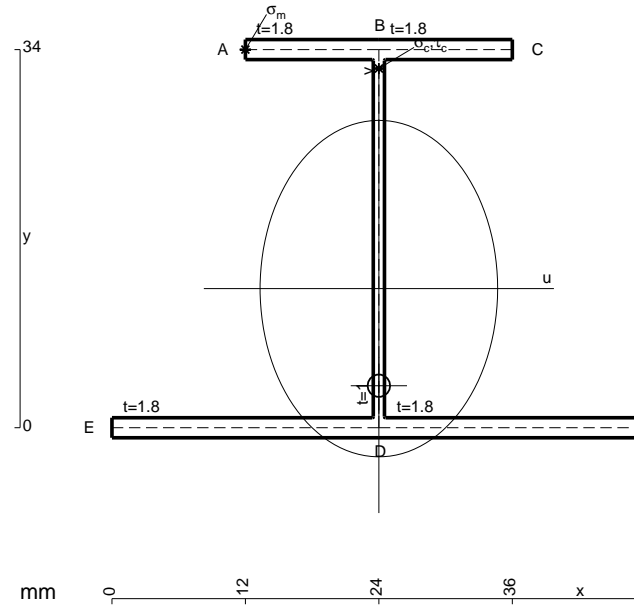
$$= [x - 3/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (b - 3/4 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -7/12 Fb^2/EJ$$

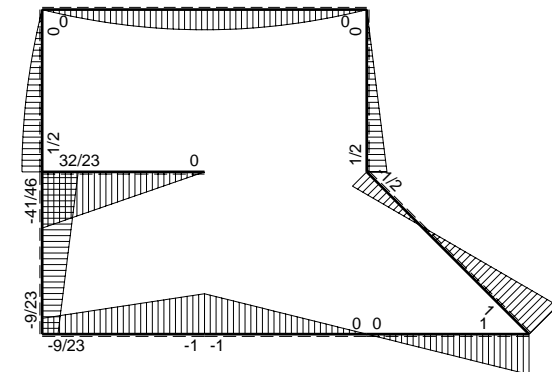
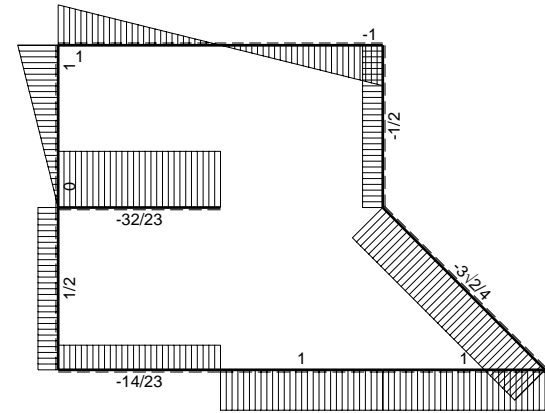
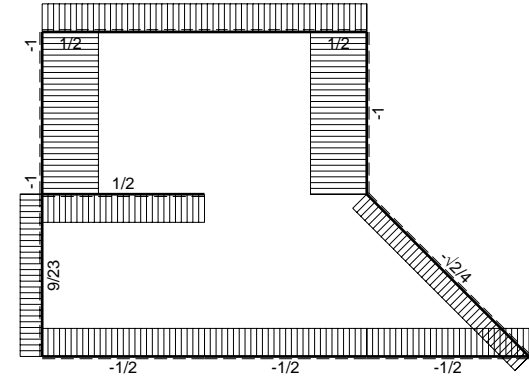
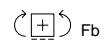
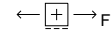
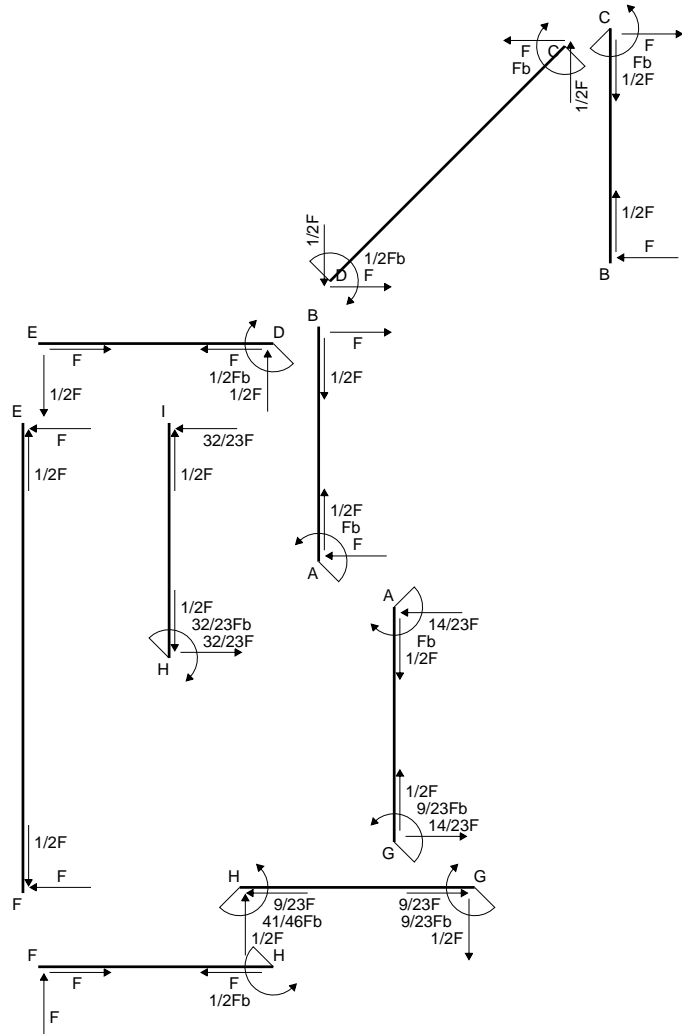
$$L_{GH}^{xo} = \int_0^b (1/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

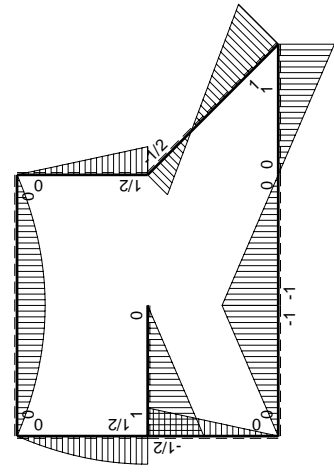
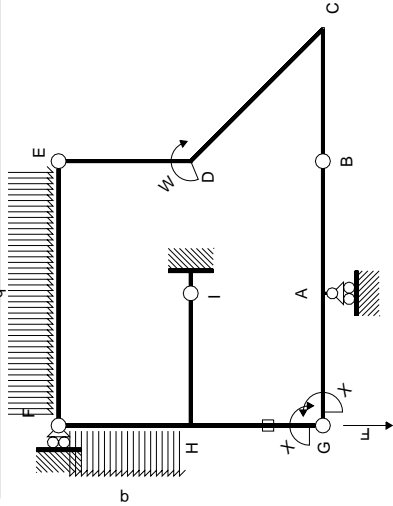
$$= [1/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/4 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -7/12 Fb^2/EJ$$



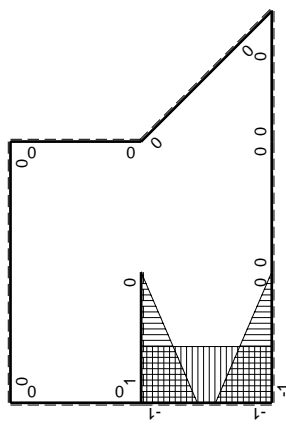
- A = 163.6 mm²
- J_u = 37433. mm⁴
- J_v = 18662. mm⁴
- J_t = 151.3 mm⁴
- y_o = -8.733 mm
- y_g = 12.51 mm
- N = -282.8 N
- T_y = -848.5 N
- M_x = 344000. Nmm
- x_m = 12. mm
- y_m = 34. mm
- u_m = -12. mm
- v_m = 21.49 mm
- σ_m = N/A - Mv/J_u = -199.2 N/mm²
- x_c = 24. mm
- y_c = 34. mm
- v_c = 21.49 mm
- σ_c = N/A - Mv/J_u = -199.2 N/mm²
- τ_c = TS'/tJ_u = 21.04 N/mm²
- τ_g = TS'/tJ_u = 21.04 N/mm²
- t_c = 800. mm
- σ_o = √(σ² + 3τ²) = 202.5 N/mm²





Schema di calcolo iperstatico

(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-Fb+Fx	0	0	0	0
BA b	0	Fx	0	0	0	0
BC b	0	Fx	0	0	0	0
CB b	0	-Fb+Fx	0	0	0	0
CD $\sqrt{2}b$	0	$Fb-3\sqrt{2}/4Fx$	0	0	0	0
DE b	0	$1/2Fb-1/2Fx$	0	0	0	0
ED b	0	-1/2Fx	0	0	0	0
EF 2b	0	$-Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$Fx-1/2qx^2$	0	0	0	0
GA b	-1+x/b	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2		
FH b	0	$Fx-1/2qx^2$	0	0	0	0
HF b	0	$-1/2Fb+1/2qx^2$	0	0	0	0
HI b	1-x/b	Fb-Fx	$Fb-2Fx+Fx^2/b$	$1-2x/b+x^2/b^2$	$1/3Fb^2/EJ$	$1/3Xb/EJ$
IH b	-x/b	-Fx	Fx^2/b	x^2/b^2		
HG b	-1	$-1/2Fb+1/2Fx$	$1/2Fb-1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
GH b	1	1/2Fx	1/2Fx	1		
HG	elongazione asta $N_{1HG} = N_{HG} + N_{HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$				$-1/2Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-3/4Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica X=W _{GA}				9/23Fb	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1 - 2x/b + x^2/b^2) Fb 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - b + 1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (x^2/b^2) Fb 1/EJ dx = [1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

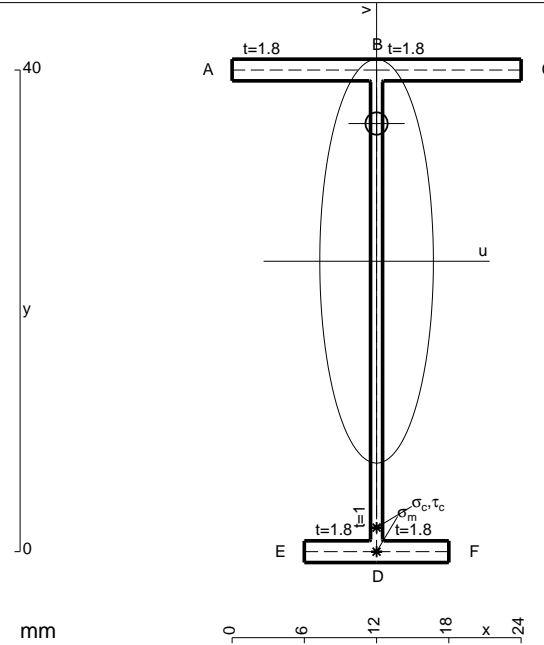
$$L_{HG}^{xo} = \int_0^b (1/2 - 1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/2 x - 1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

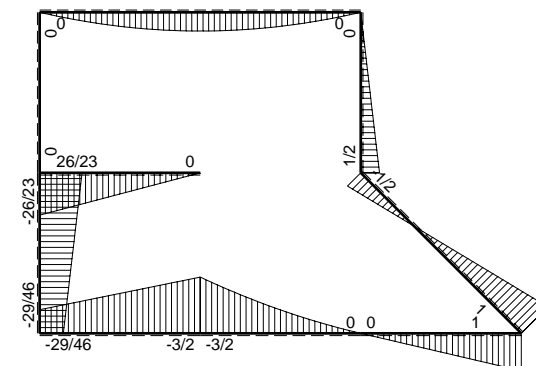
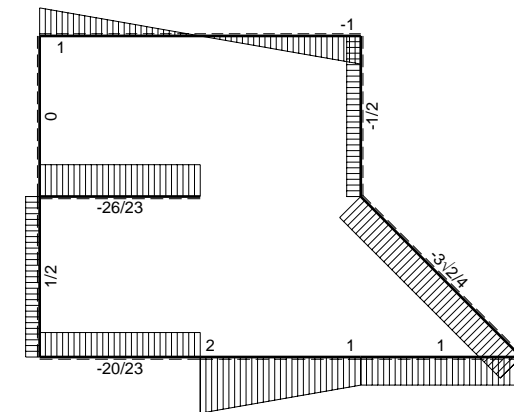
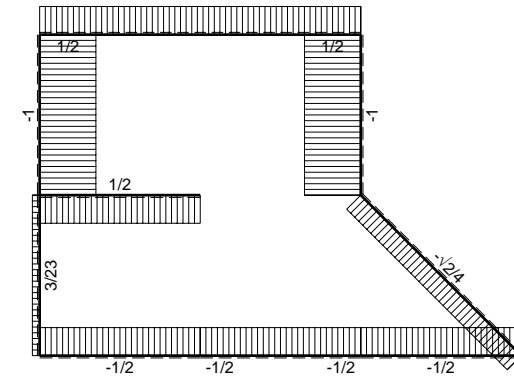
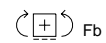
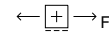
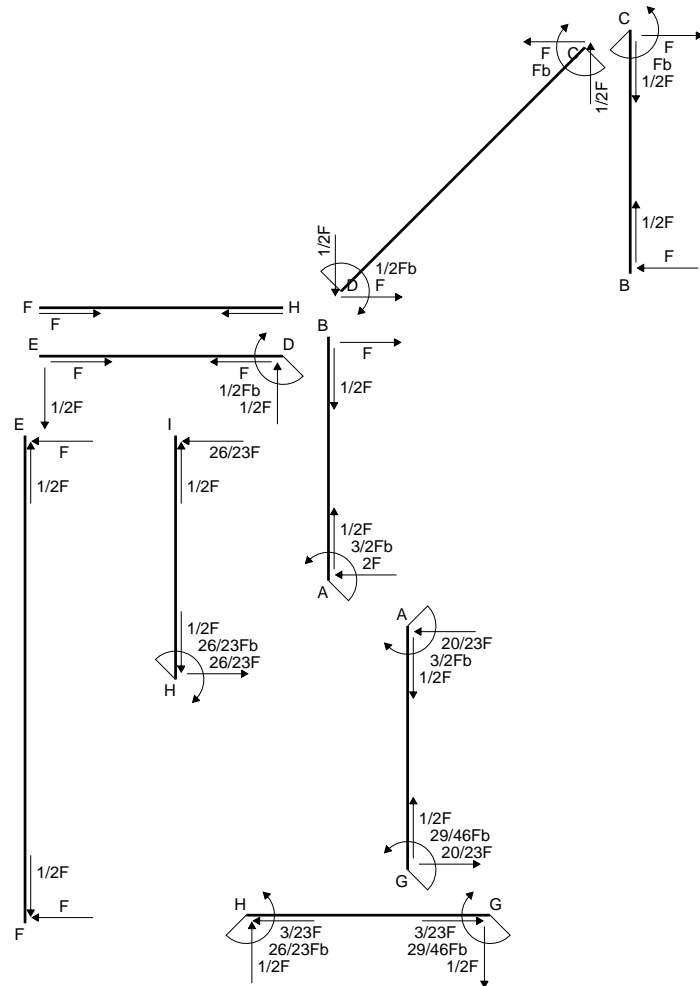
$$= (1/2 b - 1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$

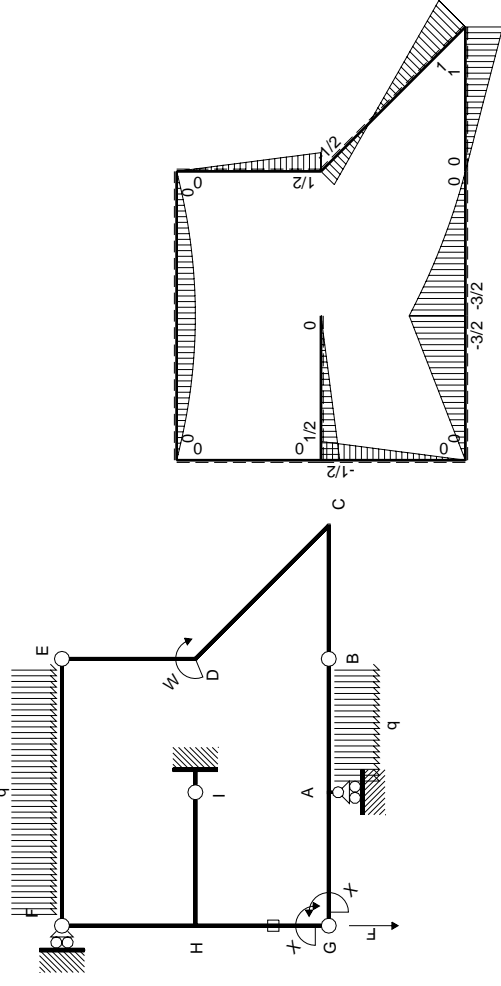
$$L_{GH}^{xo} = \int_0^b (1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$

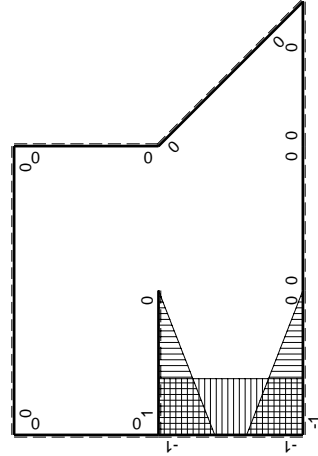


- A = 104.8 mm²
- J_u = 29473. mm⁴
- J_v = 2333. mm⁴
- J_t = 83.32 mm⁴
- y_o = 11.43 mm
- y_g = 24.12 mm
- N = -166.2 N
- T_y = -498.5 N
- M_x = 253800. Nmm
- x_m = 12. mm
- v_m = -24.12 mm
- σ_m = N/A - Mv/J_u = 206.1 N/mm²
- y_c = 3. mm
- u_c = -12. mm
- v_c = -21.12 mm
- σ_c = N/A - Mv/J_u = 206.1 N/mm²
- τ_c = TS_v/tJ_u = 8.813 N/mm²
- τ_g = TS_v/tJ_u = 8.813 N/mm²
- t_c = 470. mm
- σ_o = √σ² + 3τ² = 206.7 N/mm²





(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int M_x M_x / E J dx$	
AB b	0	$-3/2Fb+2Fx-1/2qx^2$	0	0	0	0	
BA b	0	$Fx+1/2qx^2$	0	0	0	0	
BC b	0	Fx	0	0	0	0	
CB b	0	$-Fb+Fx$	0	0	0	0	
CD $\sqrt{2}b$	0	$Fb-3\sqrt{2}/4Fx$	0	0	0	0	
DE b	0	$1/2Fb-1/2Fx$	0	0	0	0	
ED b	0	$-1/2Fx$	0	0	0	0	
EF 2b	0	$-Fx+1/2qx^2$	0	0	0	0	
FE 2b	0	$Fx-1/2qx^2$	0	0	0	0	
GA b	$-1+x/b$	$-3/2Fx$	$3/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/4Fb^2/EJ$	$1/3Xb/EJ$	
AG b	x/b	$3/2Fb-3/2Fx$	$3/2Fx-3/2Fx^2/b$	x^2/b^2	$1/4Fb^2/EJ$	$1/3Xb/EJ$	
FH b	0	0	0	0	0	0	
HF b	0	0	0	0	0	0	
HI b	$1-x/b$	$1/2Fb-1/2Fx$	$1/2Fb-Fx+1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$	
IH b	$-x/b$	$-1/2Fx$	$1/2Fx^2/b$	x^2/b^2	$1/4Fb^2/EJ$	Xb/EJ	
HG b	-1	$-1/2Fb+1/2Fx$	$1/2Fb-1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ	
GH b	1	$1/2Fx$	$1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ	
HG	elongazione asta $N_{1HG}^{HG} \rightarrow HG$						
A	molla nodo $-V_{1A}(V_{GA}+XV_{1A})/k_A$						
totali							
iperstatica $X=W_{GA}$							

Sviluppi di calcolo iperstatica

(\oplus) M_x flessione da iperstatica $X=1$

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

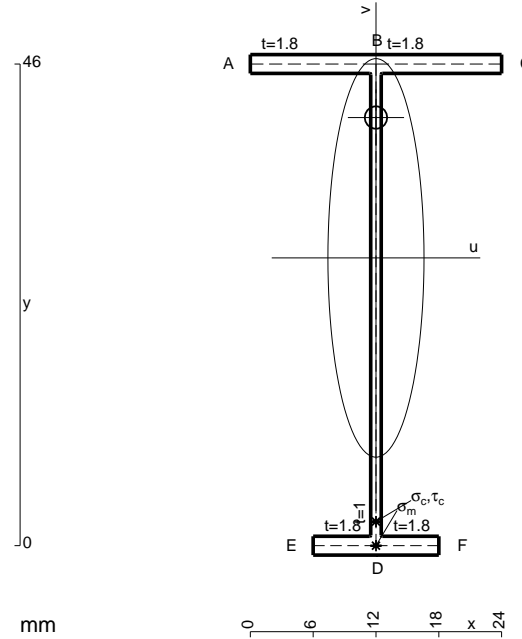
$$L_{HG}^{xo} = \int_0^b (1/2 - 1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/2 x - 1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

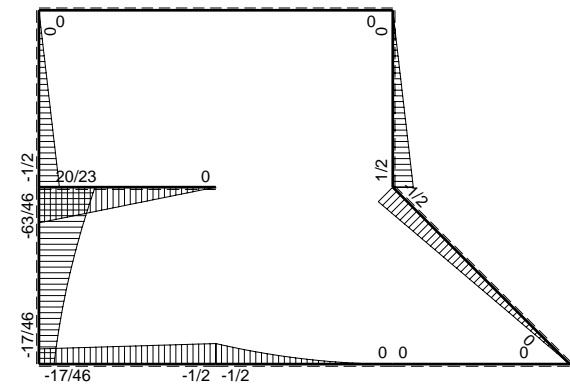
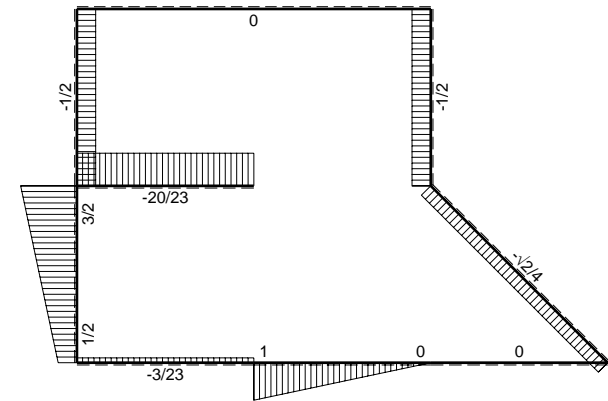
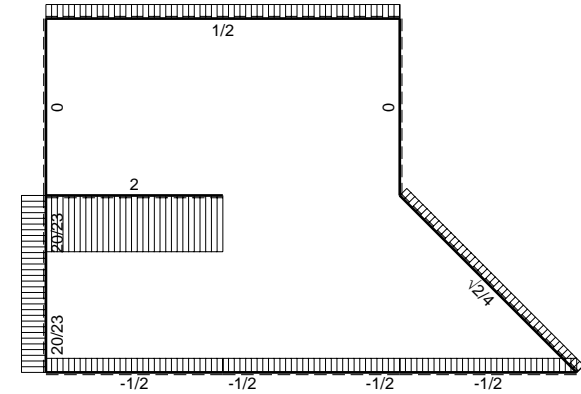
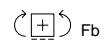
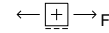
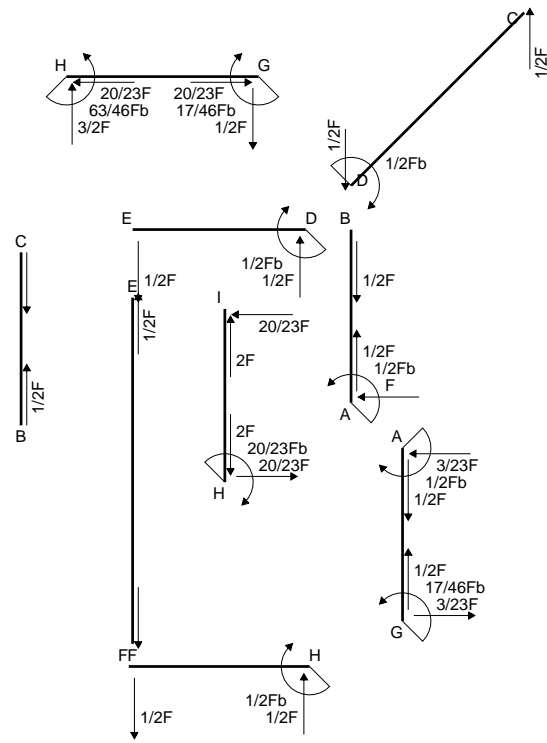
$$= (1/2 b - 1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$

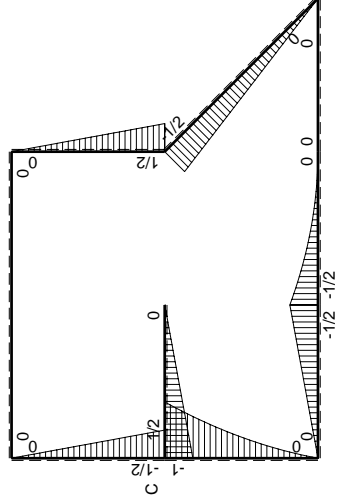
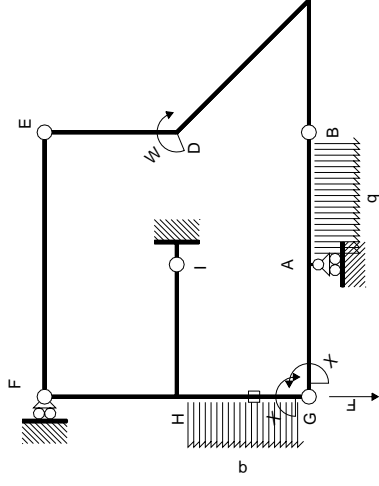
$$L_{GH}^{xo} = \int_0^b (1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$



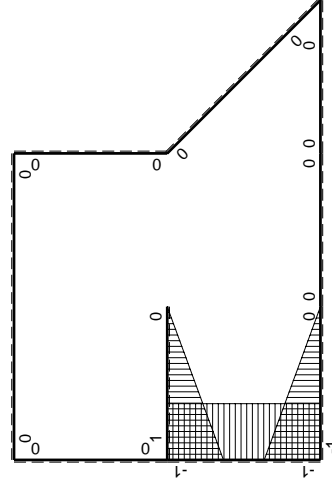
- A = 110.8 mm²
- J_u = 40163. mm⁴
- J_v = 2333. mm⁴
- J_t = 85.32 mm⁴
- y_o = 13.41 mm
- y_g = 27.48 mm
- N = -160. N
- T_y = 640. N
- M_x = -316800. Nmm
- x_m = 12. mm
- v_m = -27.48 mm
- σ_m = N/A-Mv/J_u = -218.2 N/mm²
- y_c = 3. mm
- u_c = -12. mm
- v_c = -24.48 mm
- σ_c = N/A-Mv/J_u = -218.2 N/mm²
- τ_c = TS¹/tJ_u = 9.46 N/mm²
- τ_g = TS¹/tJ_u = 9.46 N/mm²
- t_c = 320. mm
- σ_o = √σ²+3τ² = 218.8 N/mm²





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$	
AB b	0	$-1/2Fb + Fx - 1/2qx^2$	0	0	0	0	
BA b	0	$1/2qx^2$	0	0	0	0	
BC b	0	0	0	0	0	0	
CB b	0	0	0	0	0	0	
CD $\sqrt{2}b$	0	$-1/2Fx$	0	0	0	0	
DE b	0	$1/2Fb - 1/2Fx$	0	0	0	0	
ED b	0	$-1/2Fx$	0	0	0	0	
EF 2b	0	0	0	0	0	0	
FE 2b	0	0	0	0	0	0	
GA b	$-1 + x/b$	$-1/2Fx$	$1/2Fx - 1/2Fx^2/b$	$1 - 2x/b + x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$	
AG b	x/b	$1/2Fb - 1/2Fx$	$1/2Fx - 1/2Fx^2/b$	x^2/b^2	$1/12Fb^2/EJ$	$1/3Xb/EJ$	
FH b	0	$-1/2Fx$	0	0	0	0	
HF b	0	$1/2Fb - 1/2Fx$	0	0	0	0	
HI b	$1 - x/b$	$1/2Fb - 1/2Fx$	$1/2Fb - Fx + 1/2Fx^2/b$	$1 - 2x/b + x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$	
IH b	$-x/b$	$-1/2Fx$	$1/2Fx^2/b$	x^2/b^2	$1/6Fb^2/EJ$	$1/3Xb/EJ$	
HG b	-1	$-Fb + 3/2Fx - 1/2qx^2$	$Fb - 3/2Fx + 1/2Fx^2/b$	1	$5/12Fb^2/EJ$	Xb/EJ	
GH b	1	$1/2Fx + 1/2qx^2$	$1/2Fx + 1/2Fx^2/b$	1	$5/12Fb^2/EJ$	Xb/EJ	
HG	elongazione asta $N_{1HG} = N_{HG} + N_{HG}$						
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$						
	totali						
	iperstatica X=W _{GA}						

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = \left[1/3 x^3/b^2 \right]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = \left[1/3 x^3/b^2 \right]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = \left[x \right]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = \left[x \right]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{x_0} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = \left[1/4 x^2/b - 1/6 x^3/b^2 \right]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{AG}^{x_0} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = \left[1/4 x^2/b - 1/6 x^3/b^2 \right]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{HI}^{x_0} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = \left[1/2 x - 1/2 x^2/b + 1/6 x^3/b^2 \right]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{IH}^{x_0} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = \left[1/6 x^3/b^2 \right]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{HG}^{x_0} = \int_0^b (1 - 3/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

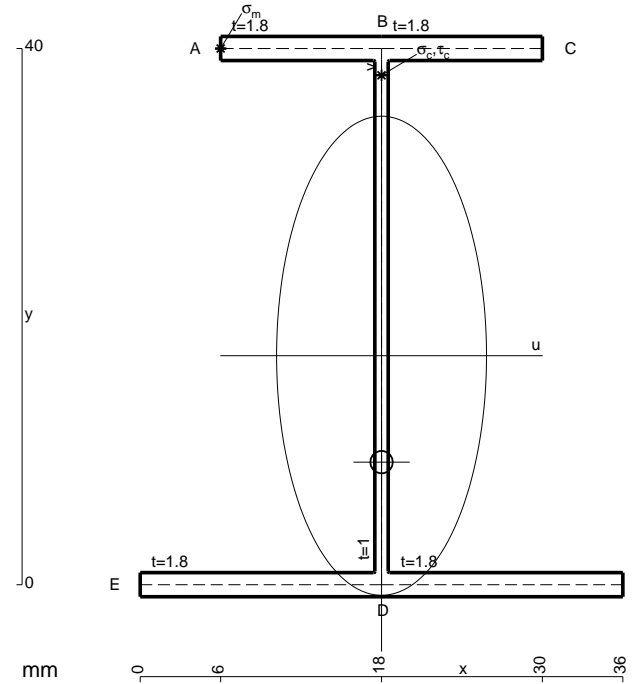
$$= \left[x - 3/4 x^2/b + 1/6 x^3/b^2 \right]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (b - 3/4 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -7/12 Fb^2/EJ$$

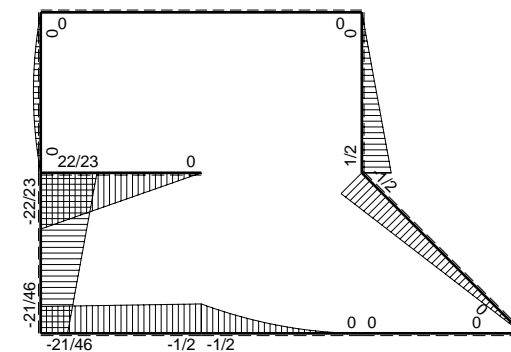
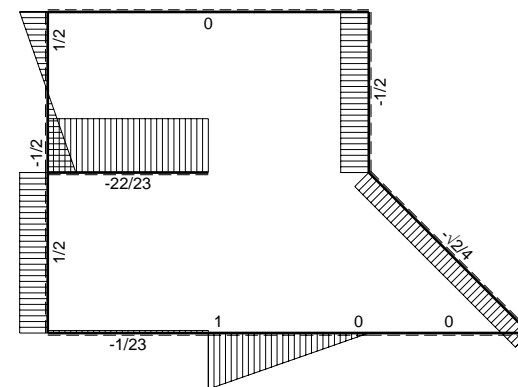
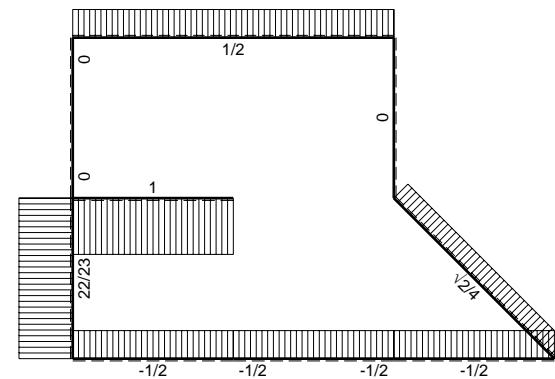
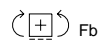
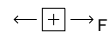
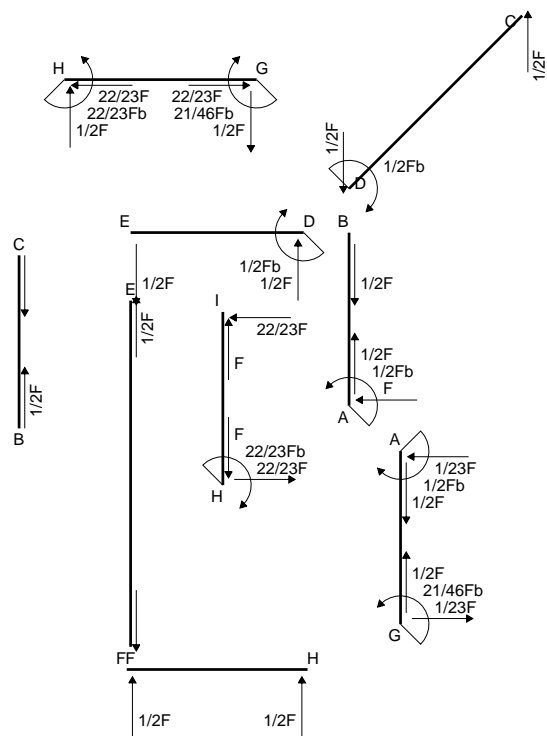
$$L_{GH}^{x_0} = \int_0^b (1/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

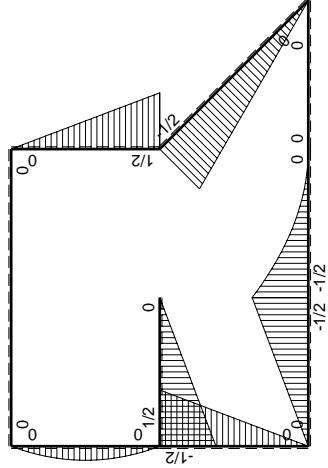
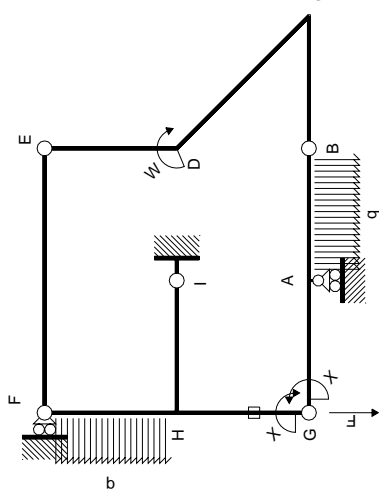
$$= \left[1/4 x^2/b + 1/6 x^3/b^2 \right]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/4 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -7/12 Fb^2/EJ$$



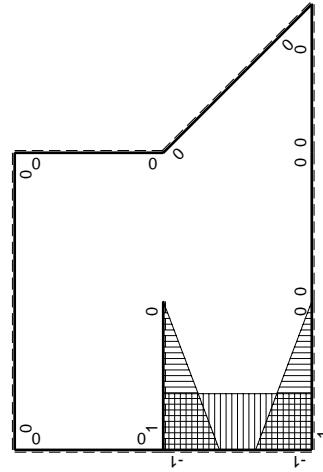
- A = 148. mm²
- J_u = 47272. mm⁴
- J_v = 9072. mm⁴
- J_t = 130. mm⁴
- y_o = -7.938 mm
- y_g = 17.08 mm
- N = -795. N
- T_y = 1590. N
- M_x = -484950. Nmm
- x_m = 6. mm
- y_m = 40. mm
- u_m = -12. mm
- v_m = 22.92 mm
- σ_m = N/A - Mv/J_u = 229.7 N/mm²
- x_c = 18. mm
- y_c = 40. mm
- v_c = 22.92 mm
- σ_c = N/A - Mv/J_u = 229.7 N/mm²
- τ_c = TS/tJ_u = 33.3 N/mm²
- τ_g = TS/tJ_u = 33.3 N/mm²
- t_c = 1590. mm
- σ_o = √σ² + 3τ² = 236.9 N/mm²





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-1/2Fb + Fx - 1/2qx^2$	0	0	0	0
BA b	0	$1/2qx^2$	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	$-\sqrt{2}/4Fx$	0	0	0	0
DE b	0	$1/2Fb - 1/2Fx$	0	0	0	0
ED b	0	$-1/2Fx$	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$-1/2Fx$	$1/2Fx - 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$1/2Fb - 1/2Fx$	$1/2Fx - 1/2Fx^2/b$	x^2/b^2	$1/12Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$1/2Fx - 1/2qx^2$	0	0	0	0
HF b	0	$-1/2Fx + 1/2qx^2$	0	0	0	0
HI b	$1-x/b$	$1/2Fb - 1/2Fx$	$1/2Fb - Fx + 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$-1/2Fx$	$1/2Fx^2/b$	x^2/b^2	$1/6Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	$-1/2Fb + 1/2Fx$	$1/2Fb - 1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
GH b	1	$1/2Fx$	$1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG} = N_{HG} - HG$					
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$					
	totali					
	iperstatica X=W _{GA}					

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

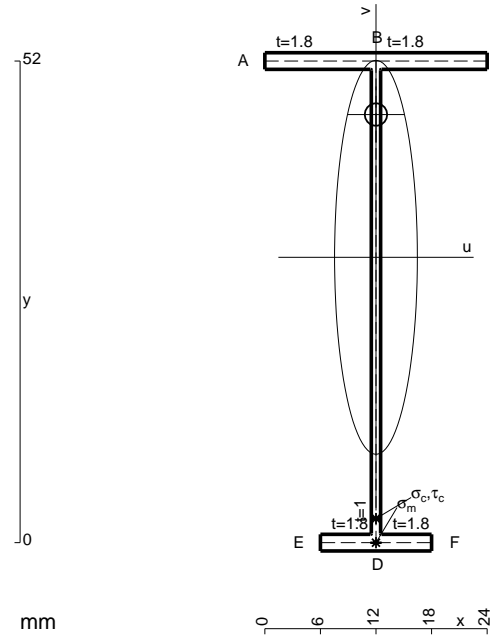
$$L_{HG}^{xo} = \int_0^b (1/2 - 1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/2 x - 1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

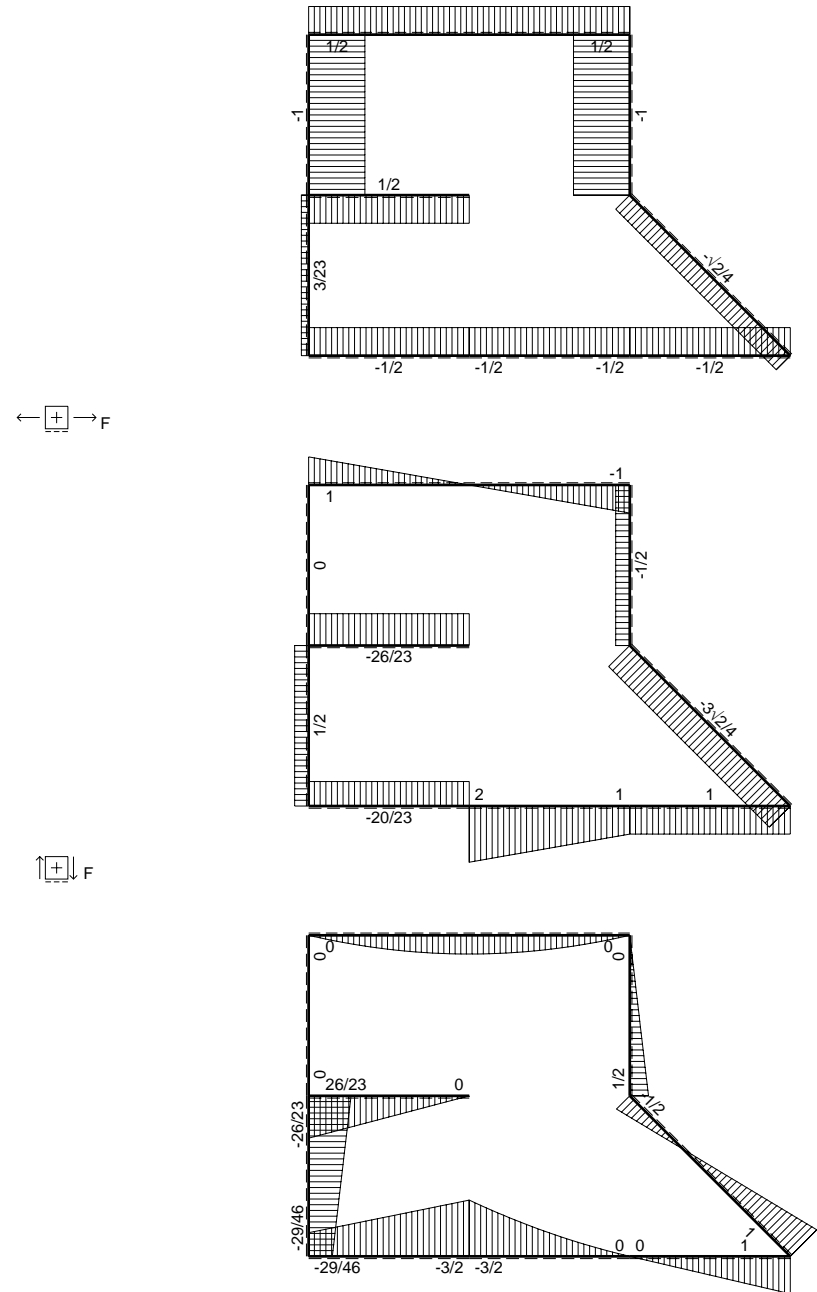
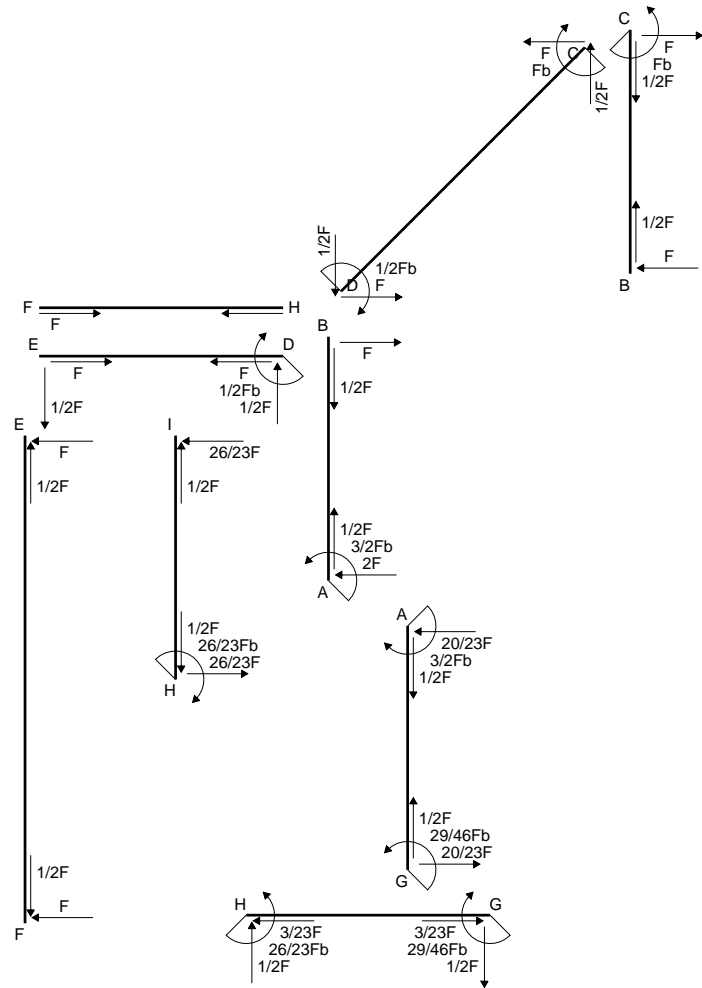
$$= (1/2 b - 1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$

$$L_{GH}^{xo} = \int_0^b (1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

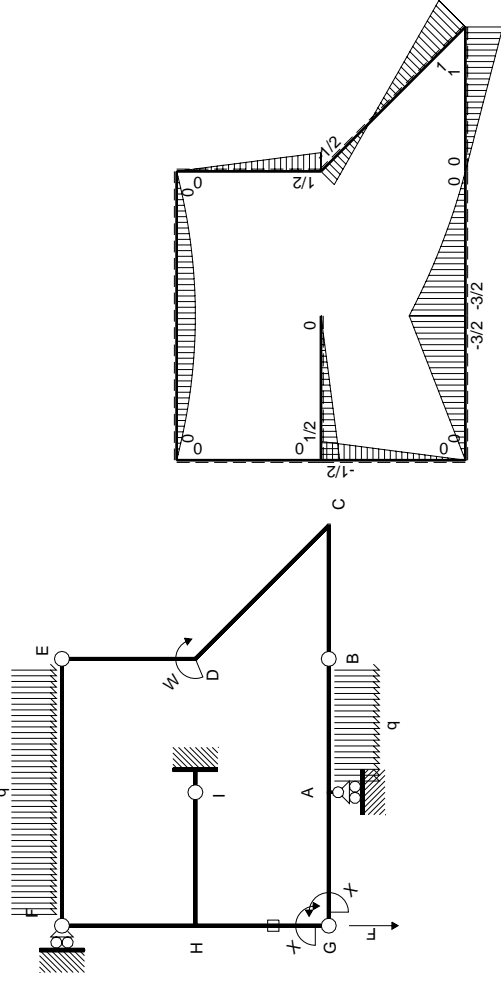
$$= (1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$



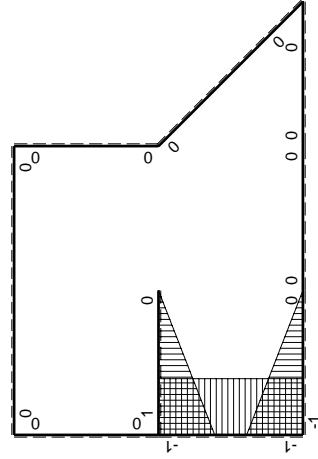
- A = 116.8 mm²
- J_u = 52822. mm⁴
- J_v = 2333. mm⁴
- J_I = 87.32 mm⁴
- y_o = 15.41 mm
- y_g = 30.81 mm
- N = -485. N
- T_y = 970. N
- M_x = -402550. Nmm
- x_m = 12. mm
- v_m = -30.81 mm
- σ_m = N/A - Mv/J_u = -238.9 N/mm²
- y_c = 3. mm
- u_c = -12. mm
- v_c = -27.81 mm
- σ_c = N/A - Mv/J_u = -238.9 N/mm²
- τ_c = TS_v/tJ_u = 12.22 N/mm²
- τ_g = TS_v/tJ_u = 12.22 N/mm²
- t_c = 970. mm
- σ_o = √σ² + 3τ² = 239.9 N/mm²



\oplus F_b



(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int M_x M_x / E J dx$
AB b	0	$-3/2Fb+2Fx-1/2qx^2$	0	0	0	0
BA b	0	$Fx+1/2qx^2$	0	0	0	0
BC b	0	Fx	0	0	0	0
CB b	0	$-Fb+Fx$	0	0	0	0
CD $\sqrt{2}b$	0	$Fb-3\sqrt{2}/4Fx$	0	0	0	0
DE b	0	$1/2Fb-1/2Fx$	0	0	0	0
ED b	0	$-1/2Fx$	0	0	0	0
EF 2b	0	$-Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$Fx-1/2qx^2$	0	0	0	0
GA b	$-1+x/b$	$-3/2Fx$	$3/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/4Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$3/2Fb-3/2Fx$	$3/2Fx-3/2Fx^2/b$	x^2/b^2	$1/4Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	0	0	0	0	0
HF b	0	0	0	0	0	0
HI b	$1-x/b$	$1/2Fb-1/2Fx$	$1/2Fb-Fx+1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$-1/2Fx$	$1/2Fx^2/b$	x^2/b^2	$1/4Fb^2/EJ$	Xb/EJ
HG b	-1	$-1/2Fb+1/2Fx$	$1/2Fb-1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
GH b	1	$1/2Fx$	$1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG}^{HG} \rightarrow HG$					
A	molla nodo $-V_{1A}(V_{0A}+XV_{1A})/k_A$					
totali						
iperstatica $X=W_{GA}$						

Sviluppi di calcolo iperstatica

(\oplus) M_x flessione da iperstatica $X=1$

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{x_0} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{AG}^{x_0} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{HI}^{x_0} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{IH}^{x_0} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

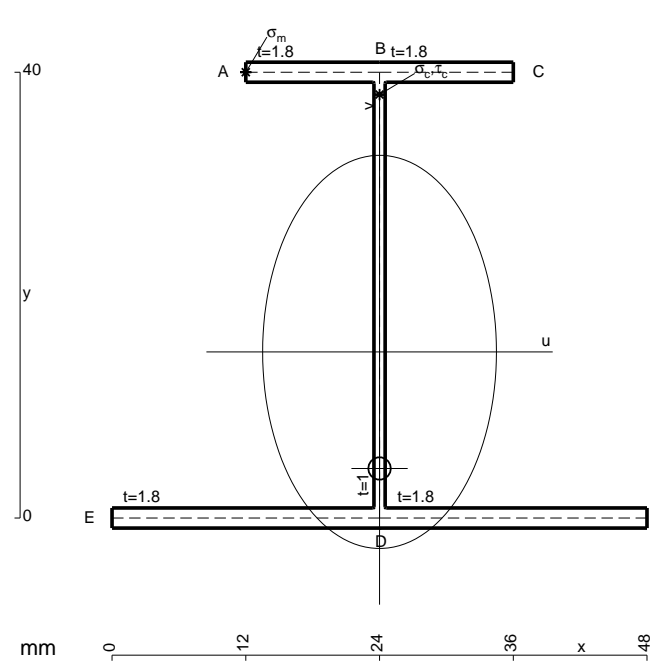
$$L_{HG}^{x_0} = \int_0^b (1/2 - 1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/2 x - 1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

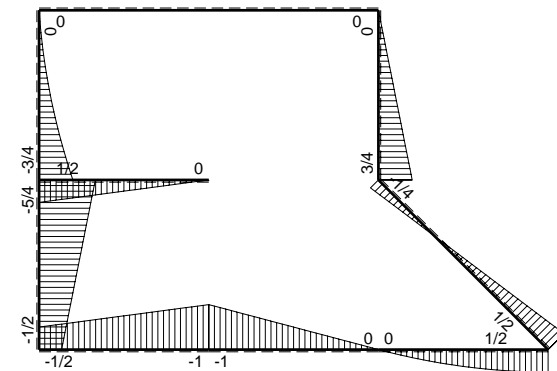
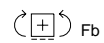
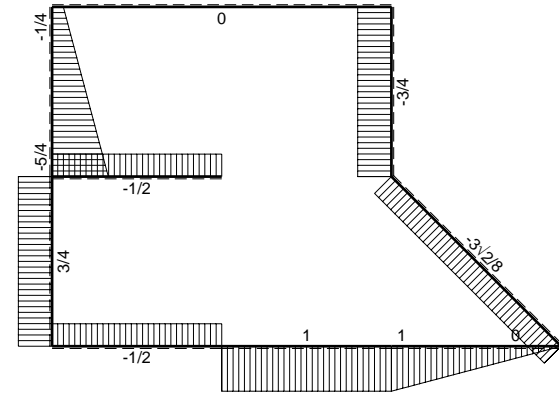
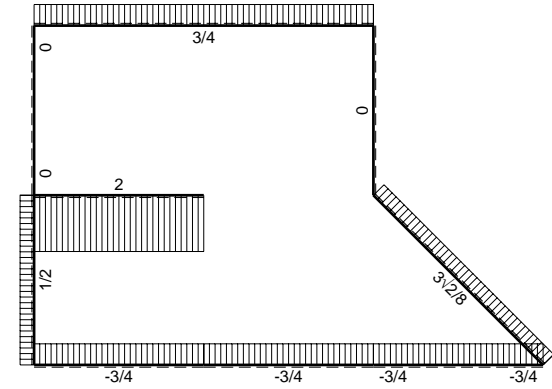
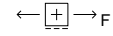
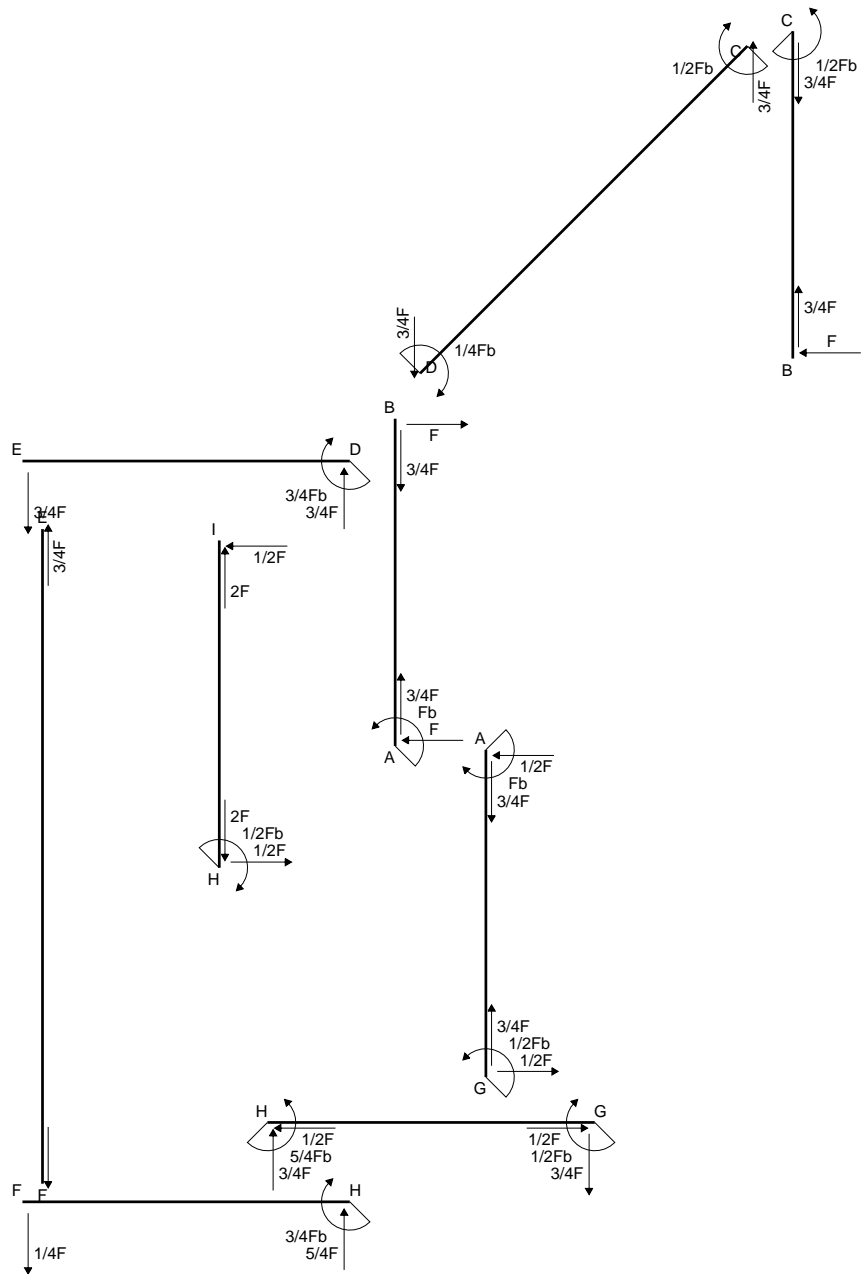
$$= (1/2 b - 1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$

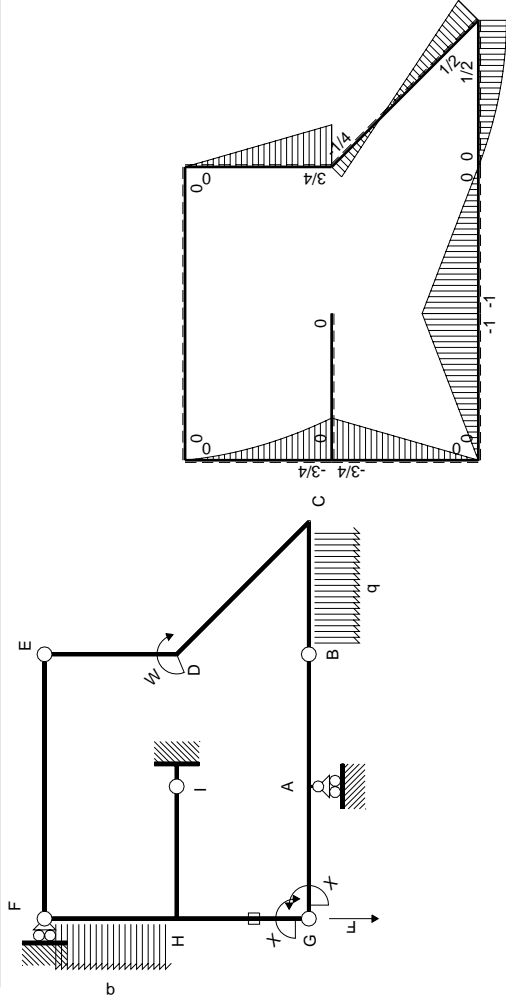
$$L_{GH}^{x_0} = \int_0^b (1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$

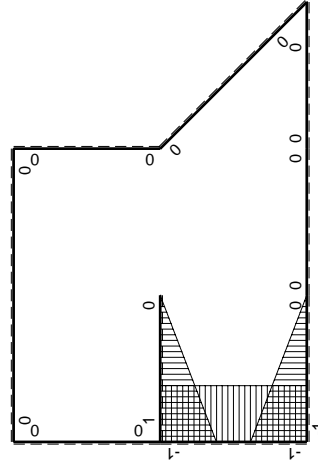


- A = 169.6 mm²
- J_u = 52772. mm⁴
- J_v = 18662. mm⁴
- J_t = 153.3 mm⁴
- y_o = -10.46 mm
- y_g = 14.91 mm
- N = -415. N
- T_y = 1660. N
- M_x = -423300. Nmm
- x_m = 12. mm
- y_m = 40. mm
- u_m = -12. mm
- v_m = 25.09 mm
- σ_m = N/A-Mv/J_u = 198.8 N/mm²
- x_c = 24. mm
- y_c = 40. mm
- v_c = 25.09 mm
- σ_c = N/A-Mv/J_u = 198.8 N/mm²
- τ_c = TS_y/tJ_u = 34.1 N/mm²
- τ_g = TS_y/tJ_u = 34.1 N/mm²
- t_c = 830. mm
- σ_o = √σ²+3τ² = 207.4 N/mm²





(\oplus) M_0 flessione da carichi assegnati



Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-Fb+Fx$	0	0	0	0
BA b	0	Fx	0	0	0	0
BC b	0	$Fx-1/2qx^2$	0	0	0	0
CB b	0	$-1/2Fb+1/2qx^2$	0	0	0	0
CD $\sqrt{2}b$	0	$1/2Fb-3\sqrt{2}/8Fx$	0	0	0	0
DE b	0	$3/4Fb-3/4Fx$	0	0	0	0
ED b	0	$-3/4Fx$	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$-Fx$	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$Fb-Fx$	$Fx-Fx^2/b$	x^2/b^2	$1/6Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$-1/4Fx-1/2qx^2$	0	0	0	0
HF b	0	$3/4Fb-5/4Fx+1/2qx^2$	0	0	0	0
HI b	$1-x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
IH b	$-x/b$	0	0	x^2/b^2	0	$1/3Xb/EJ$
HG b	-1	$-3/4Fb+3/4Fx$	$3/4Fb-3/4Fx$	1	$3/8Fb^2/EJ$	Xb/EJ
GH b	1	$3/4Fx$	$3/4Fx$	1	$3/8Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG^{\pm}HG^{\mp}HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{0A}+XV_{1A})/k_A$				$-1/2Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-23/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$1/2Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{x_0} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{AG}^{x_0} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

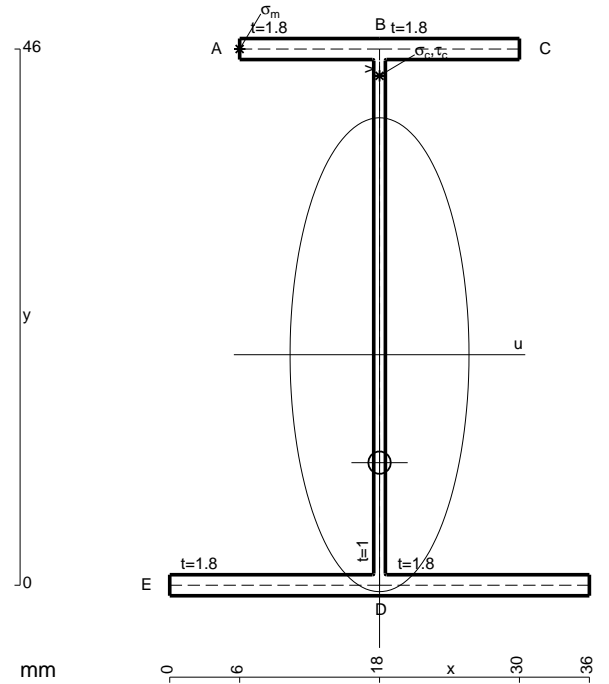
$$L_{HG}^{x_0} = \int_0^b (3/4 - 3/4 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [3/4 x - 3/8 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

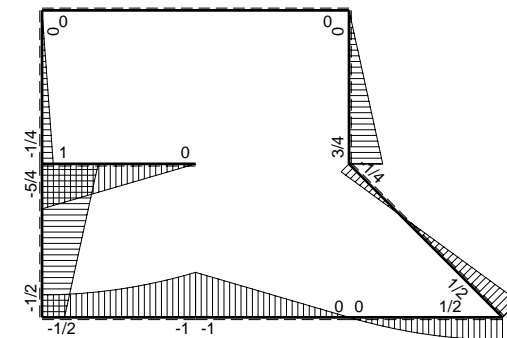
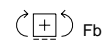
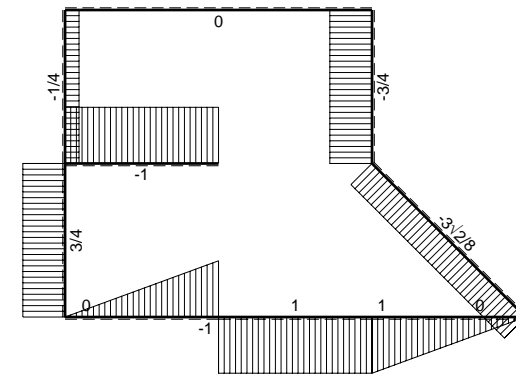
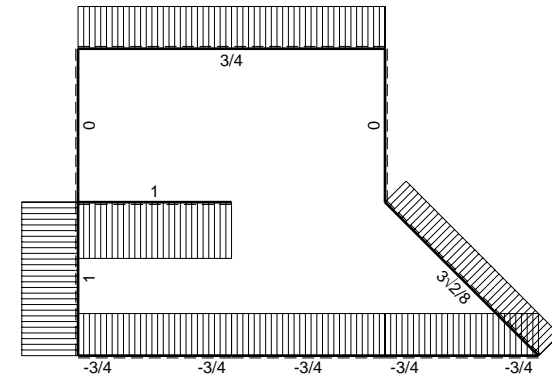
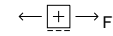
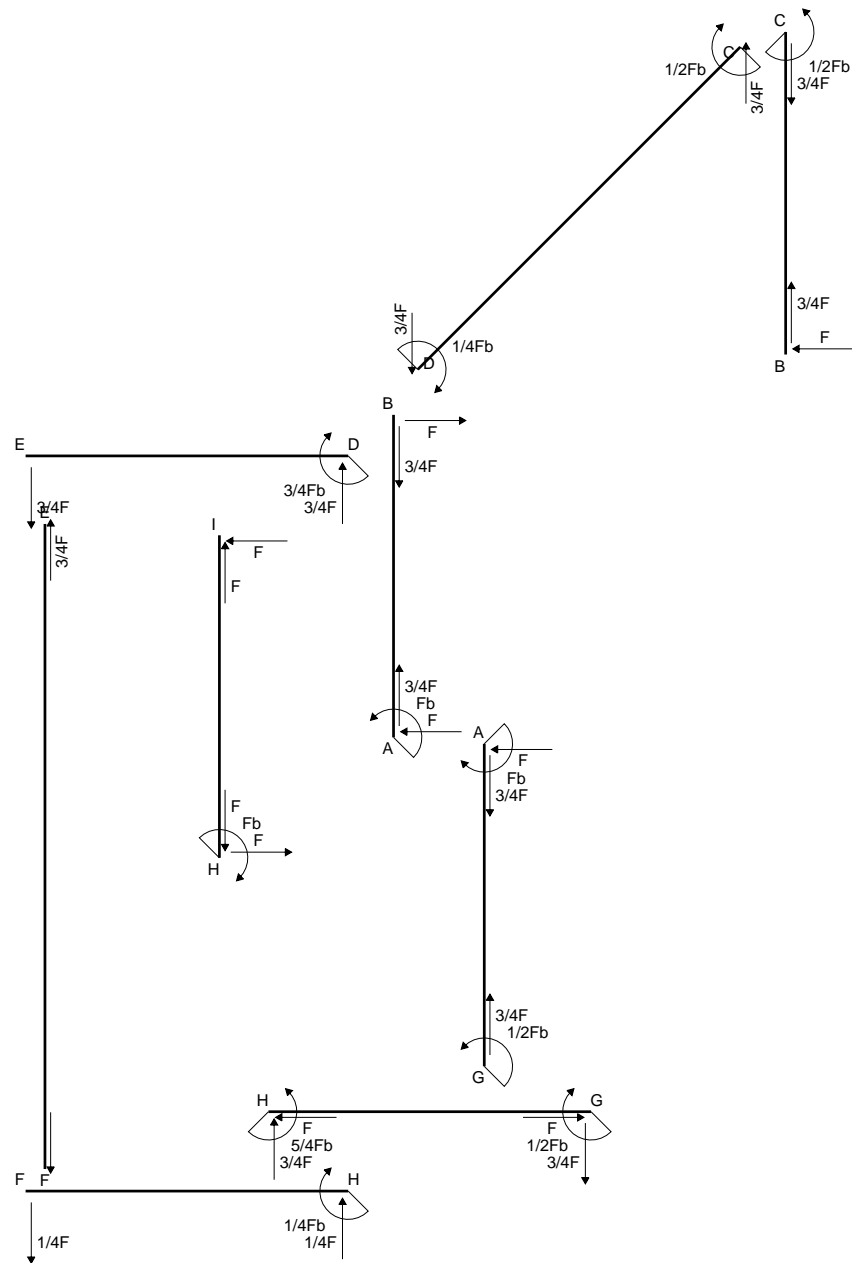
$$= (3/4 b - 3/8 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/8 Fb^2/EJ$$

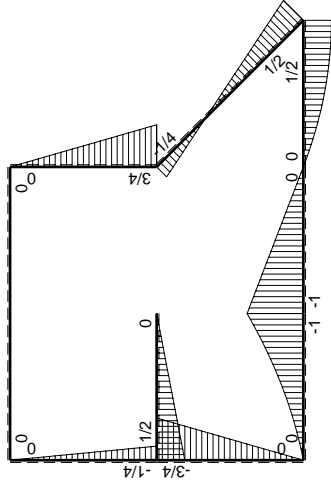
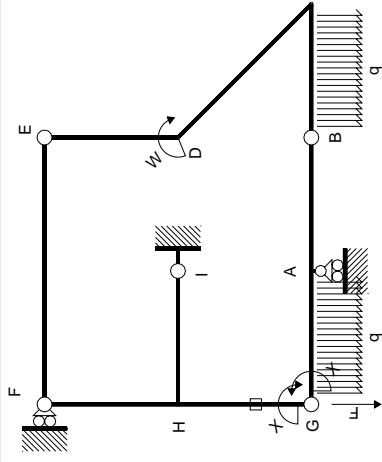
$$L_{GH}^{x_0} = \int_0^b (3/4 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [3/8 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (3/8 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/8 Fb^2/EJ$$

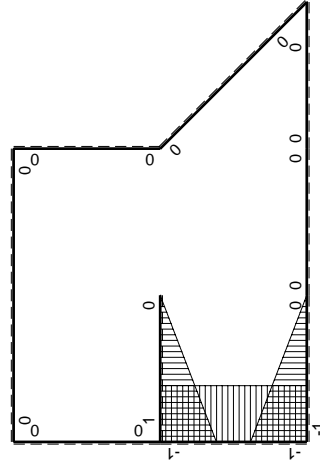


- A = 154. mm²
- J_u = 63641. mm⁴
- J_v = 9072. mm⁴
- J_t = 132. mm⁴
- y_o = -9.26 mm
- y_g = 19.77 mm
- N = -930. N
- T_y = 1240. N
- M_x = -520800. Nmm
- x_m = 6. mm
- y_m = 46. mm
- u_m = -12. mm
- v_m = 26.23 mm
- σ_m = N/A - Mv/J_u = 208.6 N/mm²
- x_c = 18. mm
- y_c = 46. mm
- v_c = 26.23 mm
- σ_c = N/A - Mv/J_u = 208.6 N/mm²
- τ_c = TS_y/tJ_u = 22.08 N/mm²
- τ_g = TS_y/tJ_u = 22.08 N/mm²
- t_c = 1240. mm
- σ_o = √σ² + 3τ² = 212.1 N/mm²





M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-Fb+Fx	0	0	0	0
BA b	0	Fx	0	0	0	0
BC b	0	Fx-1/2qx ²	0	0	0	0
CB b	0	-1/2Fb+1/2qx ²	0	0	0	0
CD 1/2b	0	1/2Fb-3/28Fx	0	0	0	0
DE b	0	3/4Fb-3/4Fx	0	0	0	0
ED b	0	-3/4Fx	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	-1+x/b	-1/2Fx-1/2qx ²	1/2Fx-1/2qx ³ /b	1-2x/b+x ² /b ²	1/8Fb ² /EJ	1/3Xb/EJ
AG b	x/b	Fb-3/2Fx+1/2qx ²	Fx-3/2Fx ² /b+1/2qx ³ /b	x ² /b ²	1/8Fb ² /EJ	1/3Xb/EJ
FH b	0	-1/4Fx	0	0	0	0
HF b	0	1/4Fb-1/4Fx	0	0	0	0
HI b	1-x/b	1/2Fb-1/2Fx	1/2Fb-Fx+1/2Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
IH b	-x/b	-1/2Fx	1/2Fx ² /b	x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
HG b	-1	-3/4Fb+3/4Fx	3/4Fb-3/4Fx	1	3/8Fb ² /EJ	Xb/EJ
GH b	1	3/4Fx	3/4Fx	1	3/8Fb ² /EJ	Xb/EJ
HG	elongazione asta $N_{1HG}^{\pm HG}$				-Fb ² /EJ	
A	molla nodo $-V_{1A}(V_{GA}+XV_{1A})/k_A$				-5/8Fb ² /EJ	1/4Xb/EJ
	totali				-23/24Fb ² /EJ	23/12Xb/EJ
	iperstatica $X=W_{GA}$				1/2Fb	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (1/2 x/b - 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[1/4 x^2/b - 1/8 x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b - 1/8 b) \cdot Fb \cdot 1/EJ = 1/8 \cdot Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (x/b - 3/2 x^2/b^2 + 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[1/2 x^2/b - 1/2 x^3/b^2 + 1/8 x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/2 b + 1/8 b) \cdot Fb \cdot 1/EJ = 1/8 \cdot Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[1/2 x - 1/2 x^2/b + 1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/6 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

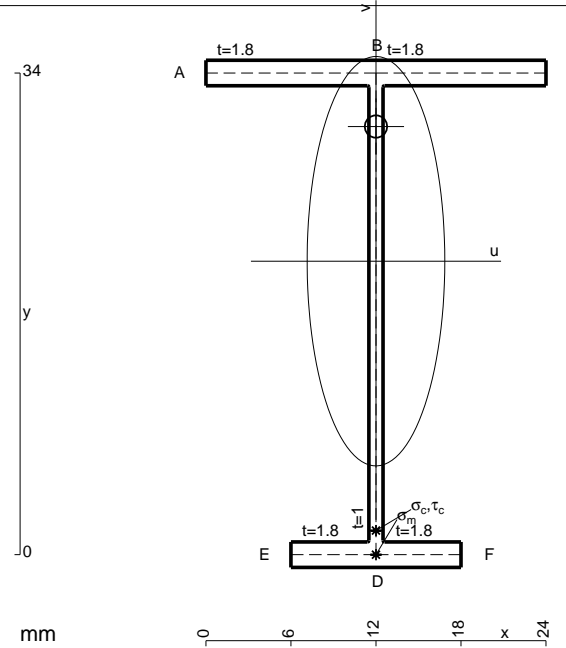
$$L_{HG}^{xo} = \int_0^b (3/4 - 3/4 x/b) \cdot Fb \cdot 1/EJ \, dx - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ$$

$$= \left[3/4 x - 3/8 x^2/b \right]_0^b \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ$$

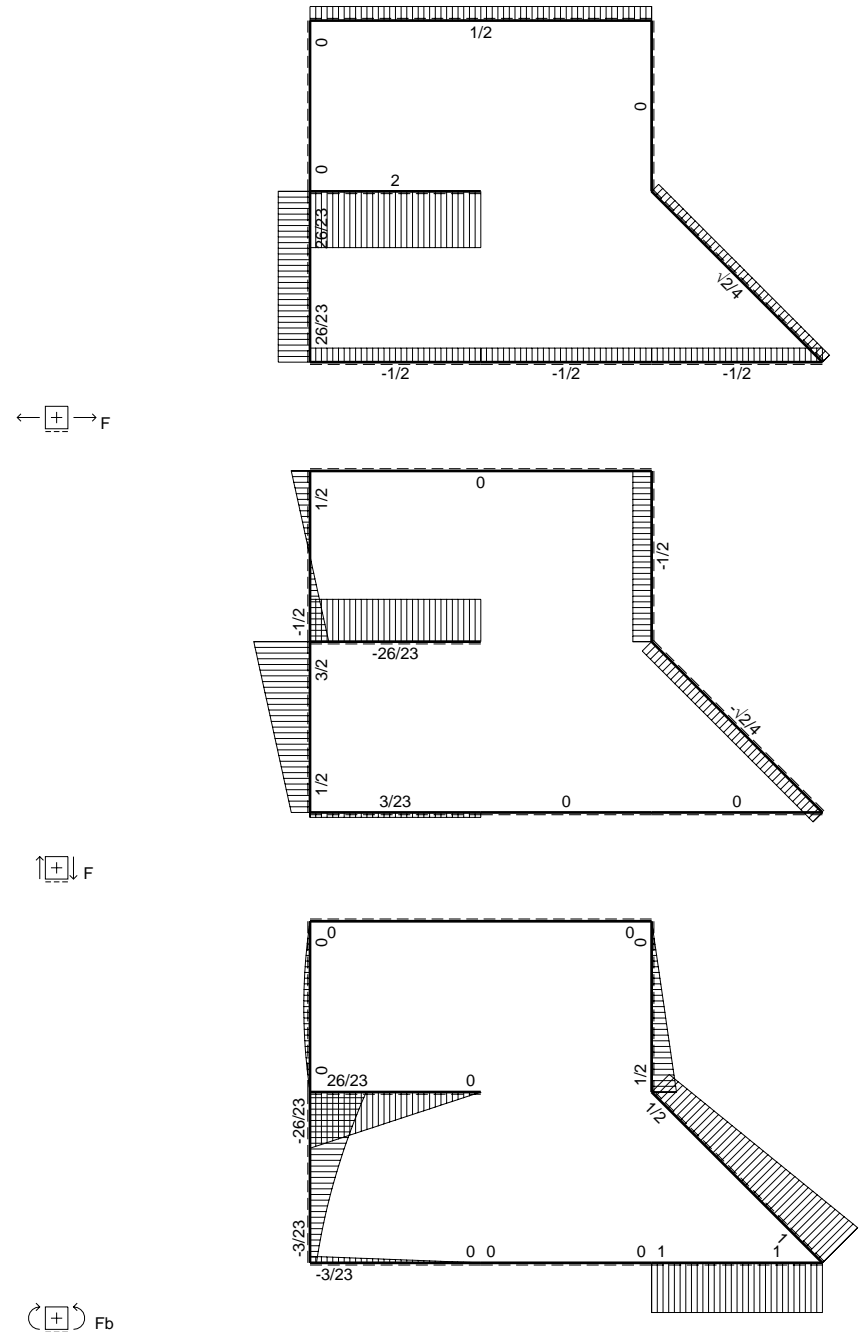
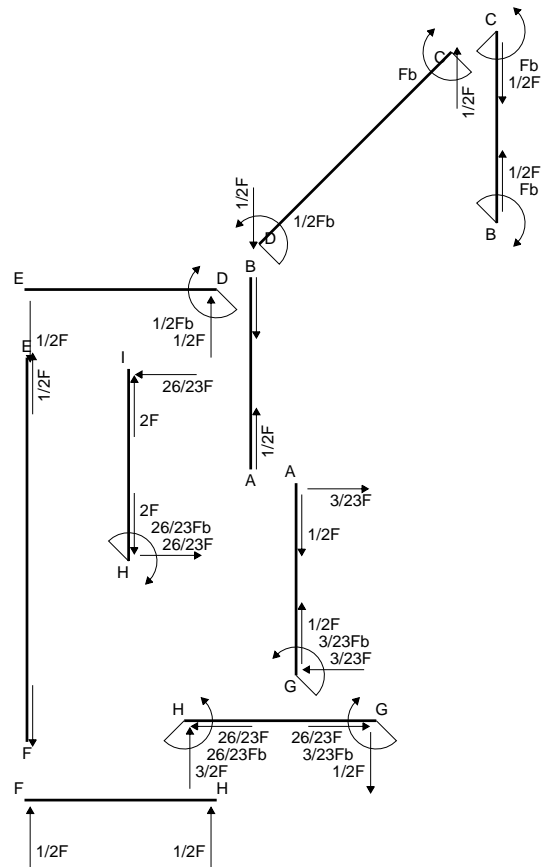
$$= (3/4 b - 3/8 b) \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ = -5/8 \cdot Fb^2/EJ$$

$$L_{GH}^{xo} = \int_0^b (3/4 x/b) \cdot Fb \cdot 1/EJ \, dx - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ = \left[3/8 x^2/b \right]_0^b \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ$$

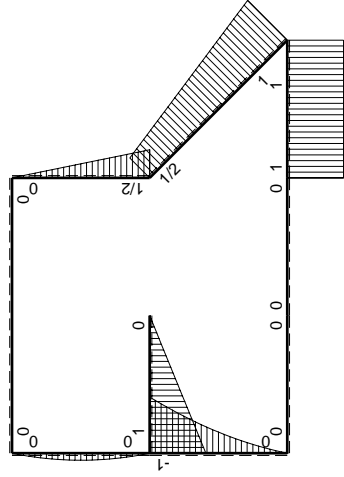
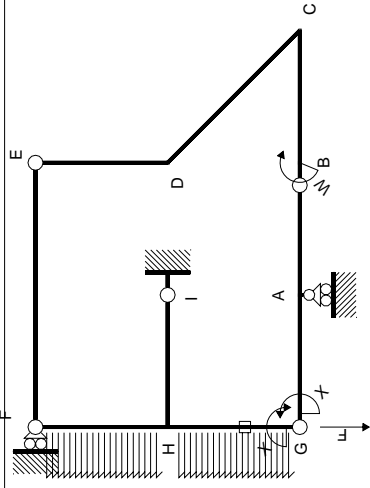
$$= (3/8 b) \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ = -5/8 \cdot Fb^2/EJ$$



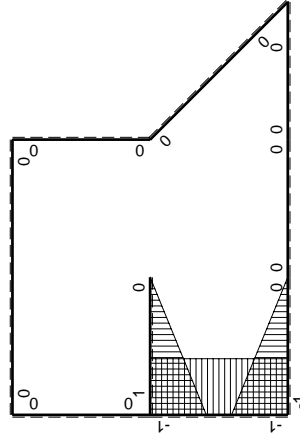
- A = 98.8 mm²
- J_u = 20638. mm⁴
- J_v = 2333. mm⁴
- J_I = 81.32 mm⁴
- y_o = 9.506 mm
- y_g = 20.72 mm
- N = -472.5 N
- T_y = 630. N
- M_x = -214200. Nmm
- x_m = 12. mm
- v_m = -20.72 mm
- σ_m = N/A-Mv/J_u = -219.8 N/mm²
- y_c = 3. mm
- u_c = -12. mm
- v_c = -17.72 mm
- σ_c = N/A-Mv/J_u = -219.8 N/mm²
- τ_c = TS'/tJ_u = 13.66 N/mm²
- τ_g = TS'/tJ_u = 13.66 N/mm²
- t_c = 630. mm
- σ_o = √σ²+3τ² = 221.1 N/mm²



⊕ F_b



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	0	0	0	0	0
BA b	0	0	0	0	0	0
BC b	0	Fb	0	0	0	0
CB b	0	-Fb	0	0	0	0
CD $\sqrt{2}b$	0	$Fb\sqrt{2}/4Fx$	0	0	0	0
DE b	0	$1/2Fb-1/2Fx$	0	0	0	0
ED b	0	$-1/2Fx$	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
AG b	x/b	0	0	x^2/b^2	0	0
FH b	0	$1/2Fx-1/2qx^2$	0	0	0	0
HF b	0	$-1/2Fx+1/2qx^2$	0	0	0	0
HI b	$1-x/b$	Fb-Fx	$Fb-2Fx+Fx^2/b$	$1-2x/b+x^2/b^2$	$1/3Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	-Fx	Fx^2/b	x^2/b^2	$5/12Fb^2/EJ$	Xb/EJ
HG b	-1	$-Fb+3/2Fx-1/2qx^2$	$Fb-3/2Fx+1/2Fx^2/b$	1		
GH b	1	$1/2Fx+1/2qx^2$	$1/2Fx+1/2Fx^2/b$	1		
HG	elongazione asta $N_{1HG}^{HG} \pm HG$					
A	molla nodo $-V_{1A}(V_{GA}+XV_{1A})/k_A$					
	totali					
	iperstatica X=W _{GA}					

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{HI}^{x_0} = \int_0^b (1 - 2x/b + x^2/b^2) Fb 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - b + 1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{IH}^{x_0} = \int_0^b (x^2/b^2) Fb 1/EJ dx = [1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{HG}^{x_0} = \int_0^b (1 - 3/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

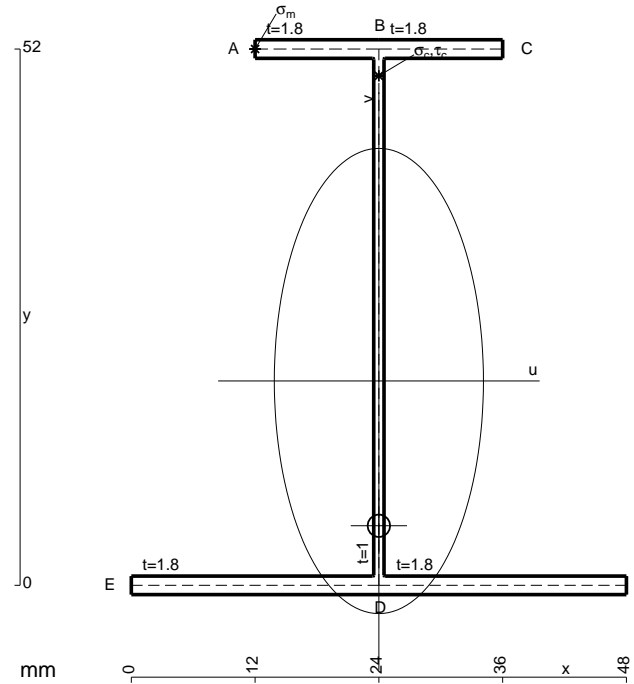
$$= [x - 3/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (b - 3/4 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -7/12 Fb^2/EJ$$

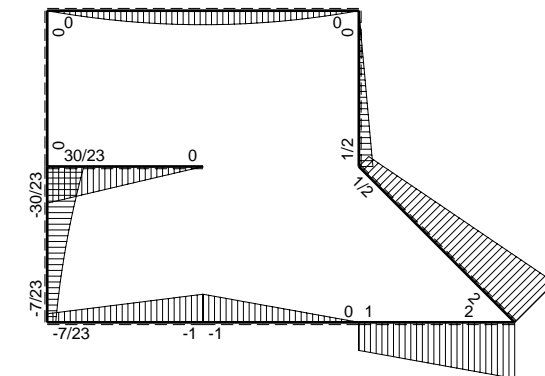
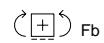
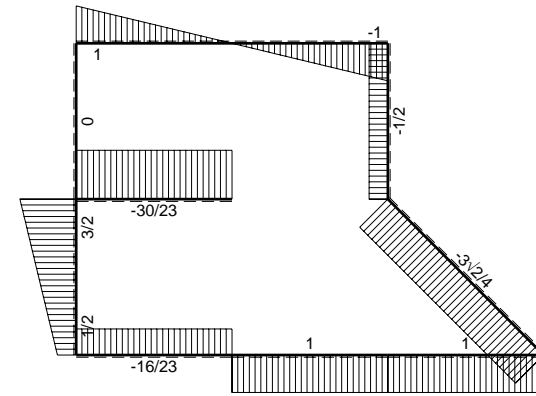
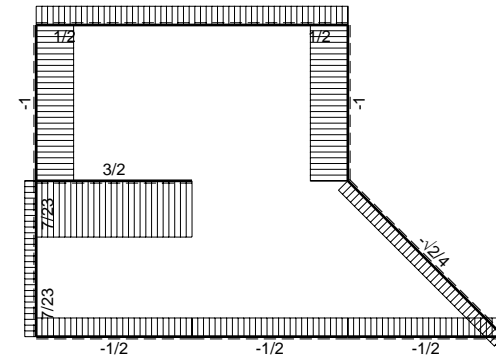
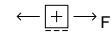
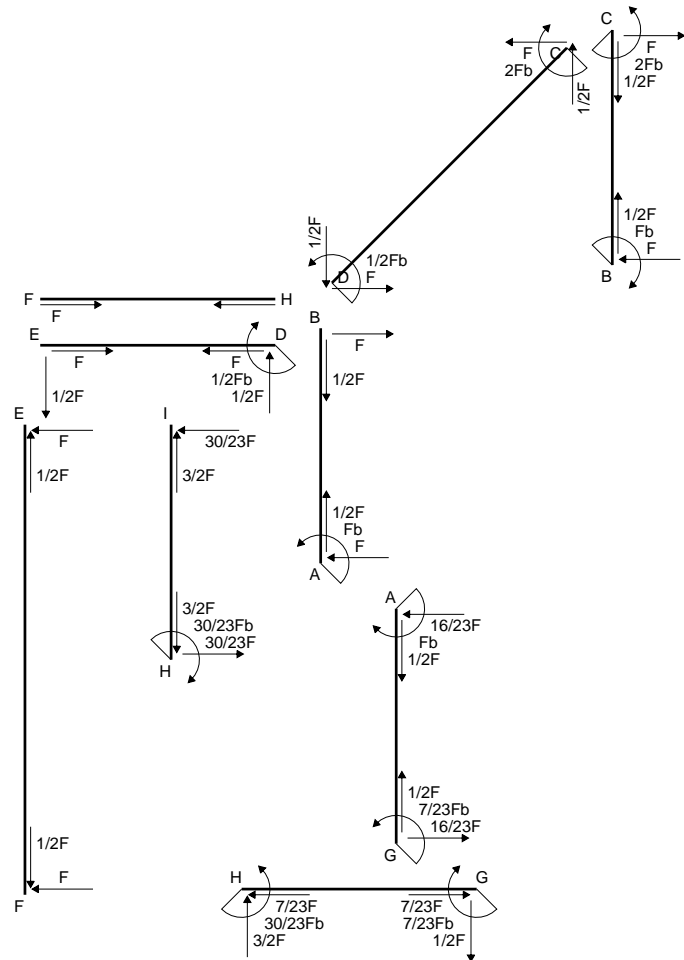
$$L_{GH}^{x_0} = \int_0^b (1/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

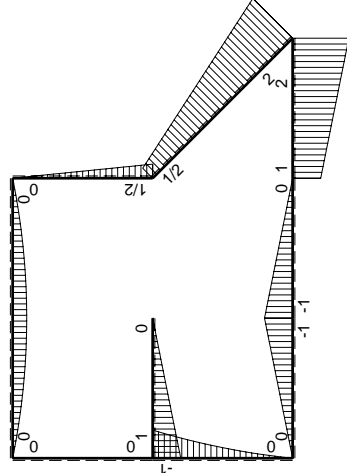
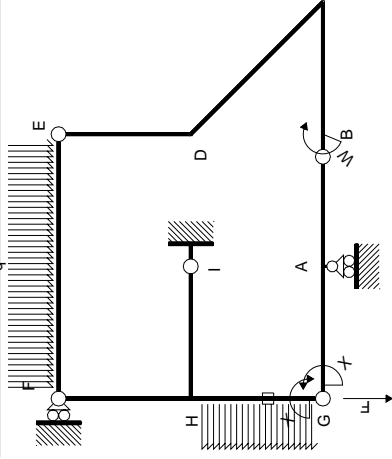
$$= [1/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/4 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -7/12 Fb^2/EJ$$

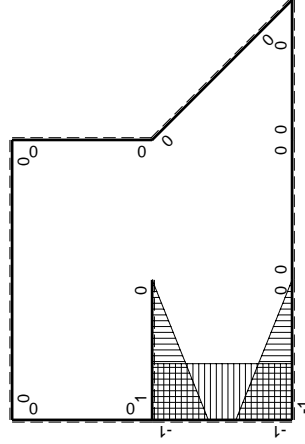


- A = 181.6 mm²
- J_u = 92380. mm⁴
- J_v = 18662. mm⁴
- J_I = 157.3 mm⁴
- y_o = -14.04 mm
- y_g = 19.82 mm
- N = 410.1 N
- T_y = -410.1 N
- M_x = 661200. Nmm
- x_m = 12. mm
- y_m = 52. mm
- u_m = -12. mm
- v_m = 32.19 mm
- σ_m = N/A-Mv/J_u = -228.1 N/mm²
- x_c = 24. mm
- y_c = 52. mm
- v_c = 32.19 mm
- σ_c = N/A-Mv/J_u = -228.1 N/mm²
- τ_c = TS/tJ_u = 6.173 N/mm²
- τ_g = TS/tJ_u = 6.173 N/mm²
- t_c = 1160. mm
- σ_o = √σ²+3τ² = 228.4 N/mm²





(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$	
AB b	0	-Fb+Fx	0	0	0	0	
BA b	0	Fx	0	0	0	0	
BC b	0	Fb+Fx	0	0	0	0	
CB b	0	-2Fb+Fx	0	0	0	0	
CD $\sqrt{2}b$	0	$2Fb-3\sqrt{2}/4Fx$	0	0	0	0	
DE b	0	$1/2Fb-1/2Fx$	0	0	0	0	
ED b	0	-1/2Fx	0	0	0	0	
EF 2b	0	$-Fx+1/2qx^2$	0	0	0	0	
FE 2b	0	$Fx-1/2qx^2$	0	0	0	0	
GA b	-1+x/b	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$	
AG b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2	$1/6Fb^2/EJ$	$1/3Xb/EJ$	
FH b	0	0	0	0	0	0	
HF b	0	0	0	0	0	0	
HI b	1-x/b	Fb-Fx	$Fb-2Fx+Fx^2/b$	$1-2x/b+x^2/b^2$	$1/3Fb^2/EJ$	$1/3Xb/EJ$	
IH b	-x/b	-Fx	Fx^2/b	x^2/b^2	$1/3Fb^2/EJ$	$1/3Xb/EJ$	
HG b	-1	$-Fb+3/2Fx-1/2qx^2$	$Fb-3/2Fx+1/2Fx^2/b$	1	$5/12Fb^2/EJ$	Xb/EJ	
GH b	1	$1/2Fx+1/2qx^2$	$1/2Fx+1/2Fx^2/b$	1	$5/12Fb^2/EJ$	Xb/EJ	
HG	elongazione asta $N_{1HG^{\pm HG}} \pm HG$						
A	molla nodo $-V_{1A}(V_{GA}+XV_{1A})/k_A$						
	totali						
	iperstatica $X=W_{GA}$						

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1 - 2x/b + x^2/b^2) Fb 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - b + 1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (x^2/b^2) Fb 1/EJ dx = [1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (1 - 3/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

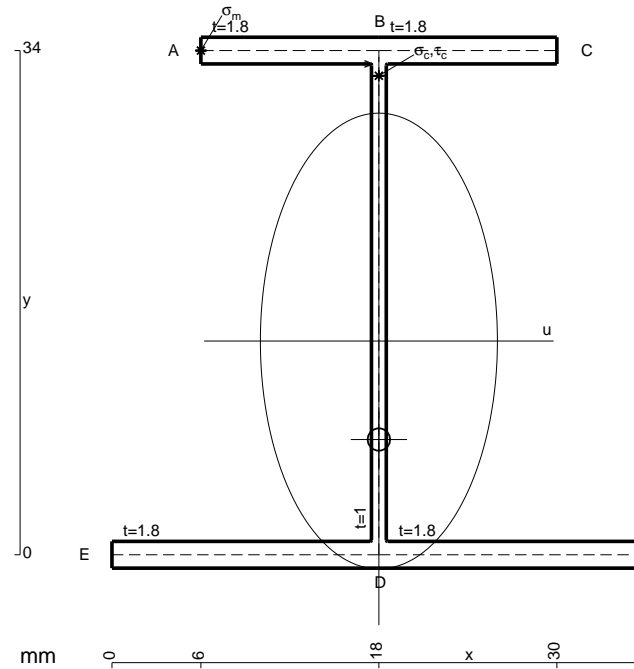
$$= [x - 3/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (b - 3/4 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -7/12 Fb^2/EJ$$

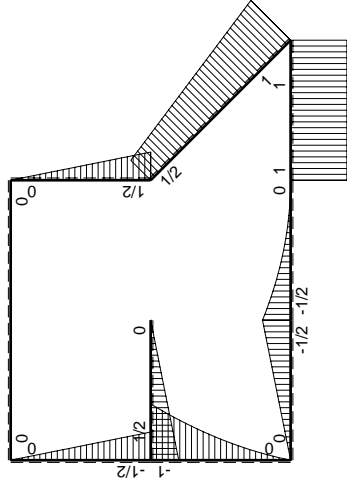
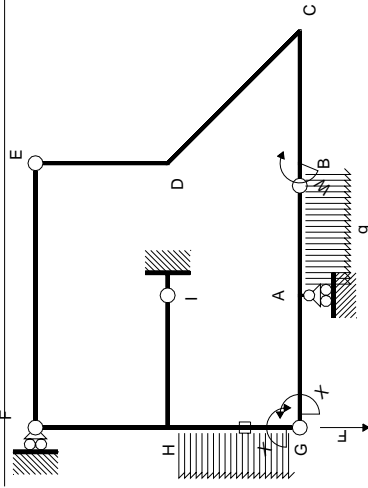
$$L_{GH}^{xo} = \int_0^b (1/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

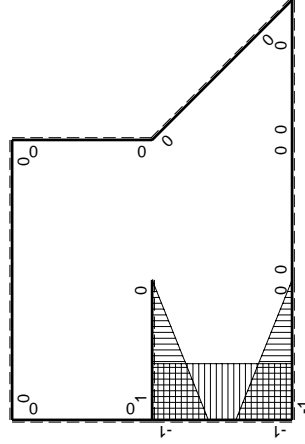
$$= (1/4 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -7/12 Fb^2/EJ$$



- A = 142. mm²
- J_u = 33538. mm⁴
- J_v = 9072. mm⁴
- J_t = 128. mm⁴
- y_o = -6.643 mm
- y_g = 14.41 mm
- N = -180.3 N
- T_y = -540.9 N
- M_x = 408000. Nmm
- x_m = 6. mm
- y_m = 34. mm
- u_m = -12. mm
- v_m = 19.59 mm
- σ_m = N/A - Mv/J_u = -239.5 N/mm²
- x_c = 18. mm
- y_c = 34. mm
- v_c = 19.59 mm
- σ_c = N/A - Mv/J_u = -239.5 N/mm²
- τ_c = TS_t/tJ_u = 13.65 N/mm²
- τ_g = TS_t/tJ_u = 13.65 N/mm²
- t_c = 510. mm
- σ_o = √(σ² + 3τ²) = 240.7 N/mm²



M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-1/2Fb + Fx - 1/2qx^2$	0	0	0	0
BA b	0	$1/2qx^2$	0	0	0	0
BC b	0	Fb	0	0	0	0
CB b	0	-Fb	0	0	0	0
CD $\sqrt{2}b$	0	$Fb - \sqrt{2}/4Fx$	0	0	0	0
DE b	0	$1/2Fb - 1/2Fx$	0	0	0	0
ED b	0	$-1/2Fx$	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$-1/2Fx$	$1/2Fx - 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$1/2Fb - 1/2Fx$	$1/2Fx - 1/2Fx^2/b$	x^2/b^2	$1/12Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$-1/2Fx$	0	0	0	0
HF b	0	$1/2Fb - 1/2Fx$	0	0	0	0
HI b	$1-x/b$	$1/2Fb - 1/2Fx$	$1/2Fb - Fx + 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$-1/2Fx$	$1/2Fx^2/b$	x^2/b^2	$1/12Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	$-Fb + 3/2Fx - 1/2qx^2$	$Fb - 3/2Fx + 1/2Fx^2/b$	1	$5/12Fb^2/EJ$	Xb/EJ
GH b	1	$1/2Fx + 1/2qx^2$	$1/2Fx + 1/2Fx^2/b$	1	$5/12Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG^{\pm}HG^{\mp}HG}$					
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$					
	totali					
	iperstatica $X=W_{GA}$					
	17/46Fb					

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[1/4 x^2/b - 1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/12 \cdot Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[1/4 x^2/b - 1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/4 b - 1/6 b) \cdot Fb \cdot 1/EJ = 1/12 \cdot Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[1/2 x - 1/2 x^2/b + 1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/6 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (1 - 3/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ$$

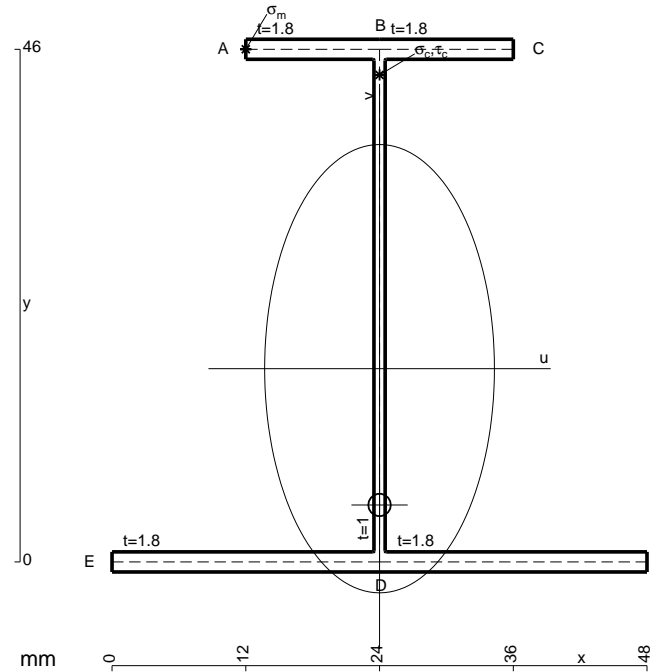
$$= \left[x - 3/4 x^2/b + 1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ$$

$$= (b - 3/4 b + 1/6 b) \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ = -7/12 \cdot Fb^2/EJ$$

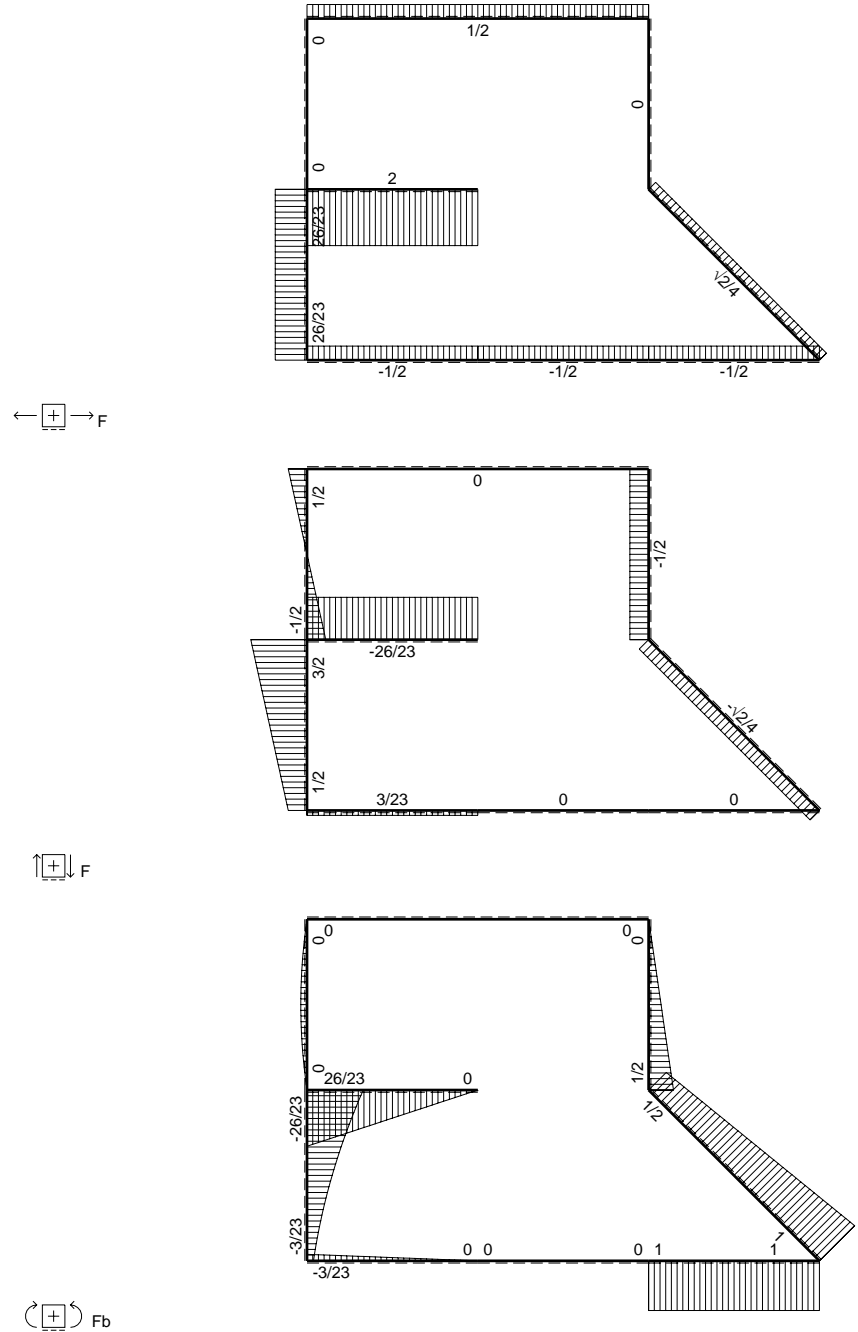
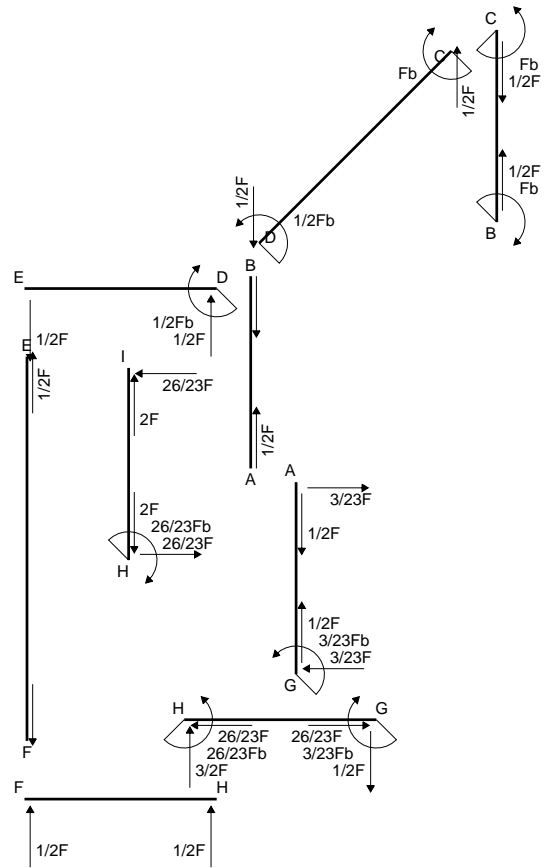
$$L_{GH}^{xo} = \int_0^b (1/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ$$

$$= \left[1/4 x^2/b + 1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ$$

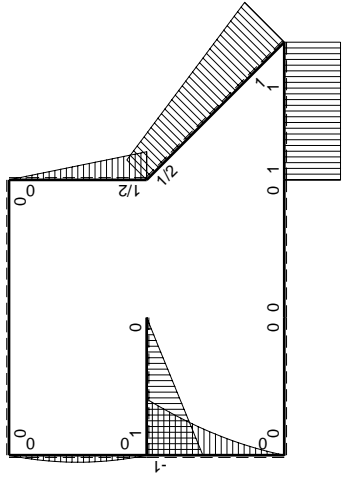
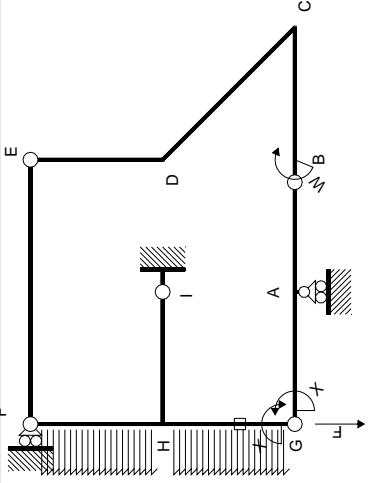
$$= (1/4 b + 1/6 b) \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ = -7/12 \cdot Fb^2/EJ$$



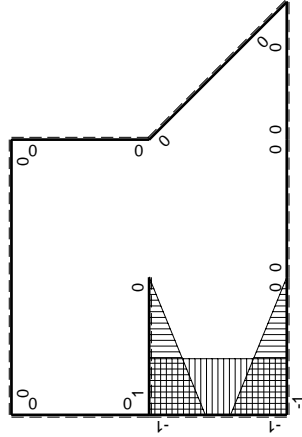
- A = 175.6 mm²
- J_u = 71048. mm⁴
- J_v = 18662. mm⁴
- J_t = 155.3 mm⁴
- y_o = -12.23 mm
- y_g = 17.34 mm
- N = -875. N
- T_y = 1750. N
- M_x = -507500. Nmm
- x_m = 12. mm
- y_m = 46. mm
- u_m = -12. mm
- v_m = 28.66 mm
- σ_m = N/A - Mv/J_u = 199.7 N/mm²
- x_c = 24. mm
- y_c = 46. mm
- v_c = 28.66 mm
- σ_c = N/A - Mv/J_u = 199.7 N/mm²
- τ_c = TS/tJ_u = 30.49 N/mm²
- τ_g = TS/tJ_u = 30.49 N/mm²
- t_c = 1750. mm
- σ_o = √(σ² + 3τ²) = 206.6 N/mm²



\oplus F_b



M_x flessione da carichi assegnati



Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	0	0	0	0	0
BA b	0	0	0	0	0	0
BC b	0	Fb	0	0	0	0
CB b	0	-Fb	0	0	0	0
CD $\sqrt{2}b$	0	$Fb\sqrt{2}/4Fx$	0	0	0	0
DE b	0	$1/2Fb-1/2Fx$	0	0	0	0
ED b	0	$-1/2Fx$	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
AG b	x/b	0	0	x^2/b^2	0	0
FH b	0	$1/2Fx-1/2qx^2$	0	0	0	0
HF b	0	$-1/2Fx+1/2qx^2$	0	0	0	0
HI b	$1-x/b$	$Fb-Fx$	$Fb-2Fx+Fx^2/b$	$1-2x/b+x^2/b^2$	$1/3Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$-Fx$	Fx^2/b	x^2/b^2	$1/3Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	$-Fb+3/2Fx-1/2qx^2$	$Fb-3/2Fx+1/2Fx^2/b$	1	$5/12Fb^2/EJ$	Xb/EJ
GH b	1	$1/2Fx+1/2qx^2$	$1/2Fx+1/2Fx^2/b$	1	$5/12Fb^2/EJ$	Xb/EJ
HG	elongazione asta N_{1HG}^{HG-HG}					
A	molla nodo $-V_{1A}(V_{0A}+XV_{1A})/k_A$					
	totali					
	iperstatica $X=W_{GA}$					
					$-Fb^2/EJ$	$1/4Xb/EJ$
					$-1/4Fb^2/EJ$	$23/12Xb/EJ$
					$3/23Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{HI}^{x_0} = \int_0^b (1 - 2x/b + x^2/b^2) Fb 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - b + 1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{IH}^{x_0} = \int_0^b (x^2/b^2) Fb 1/EJ dx = [1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{HG}^{x_0} = \int_0^b (1 - 3/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

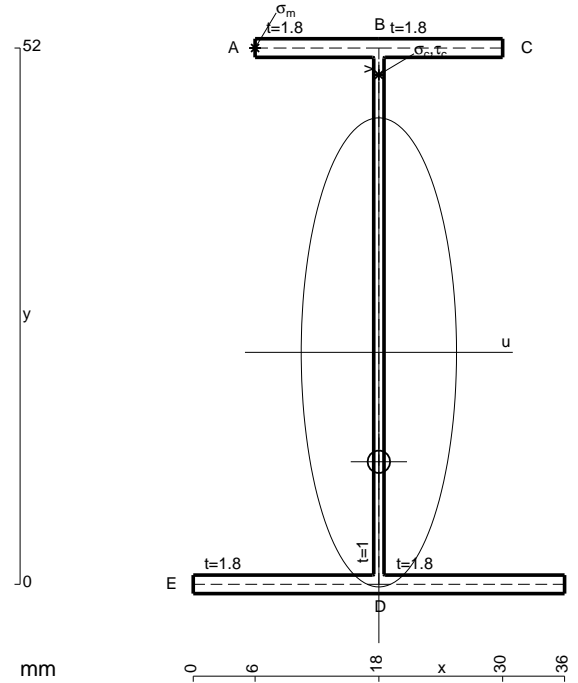
$$= [x - 3/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (b - 3/4 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -7/12 Fb^2/EJ$$

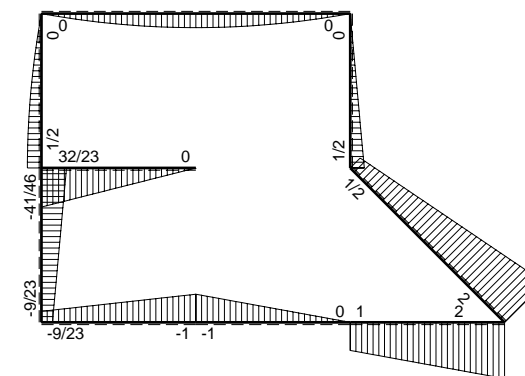
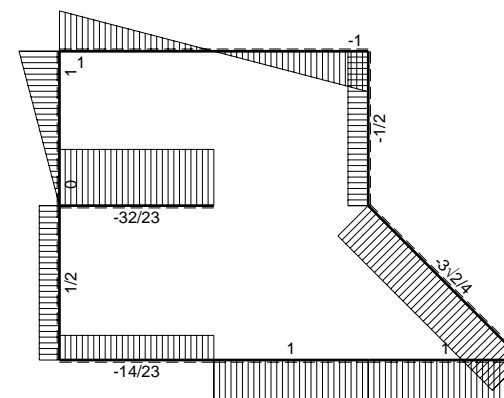
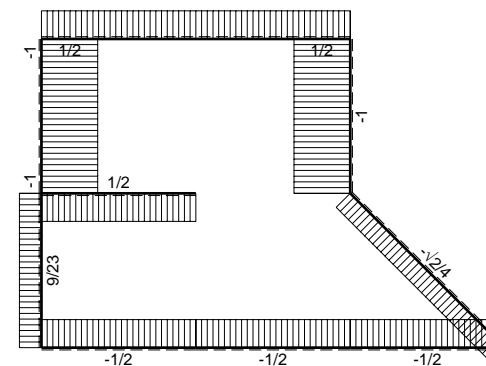
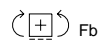
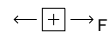
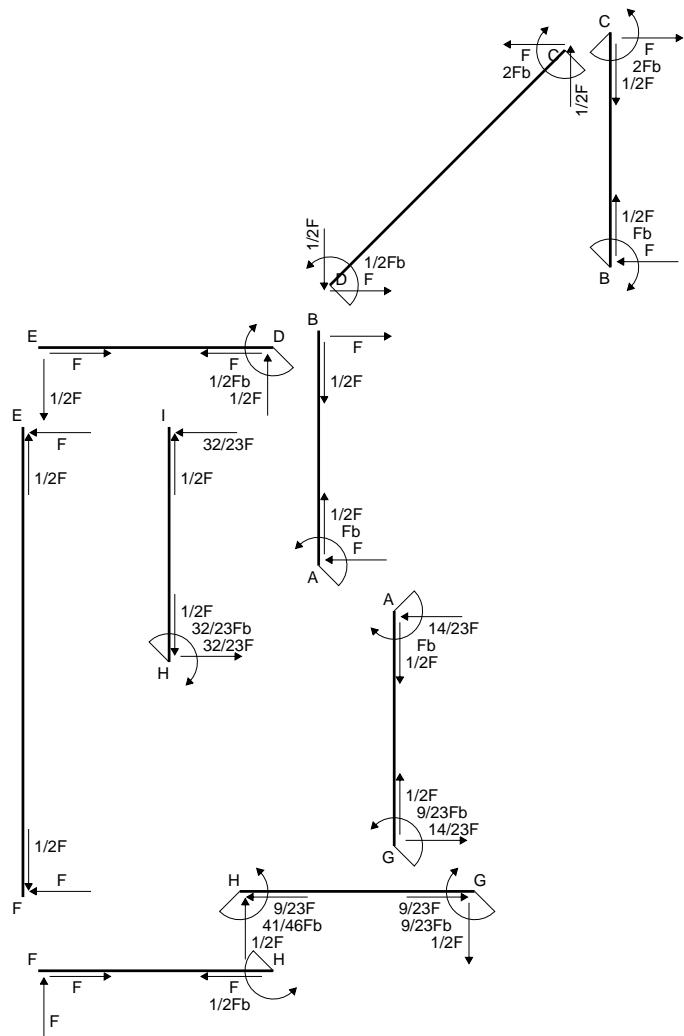
$$L_{GH}^{x_0} = \int_0^b (1/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

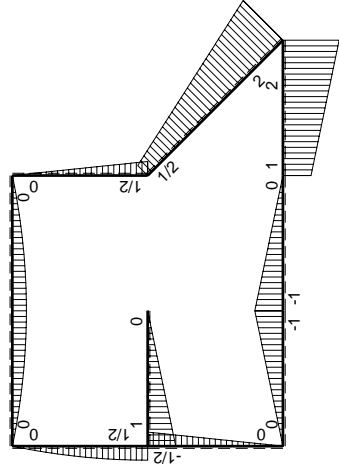
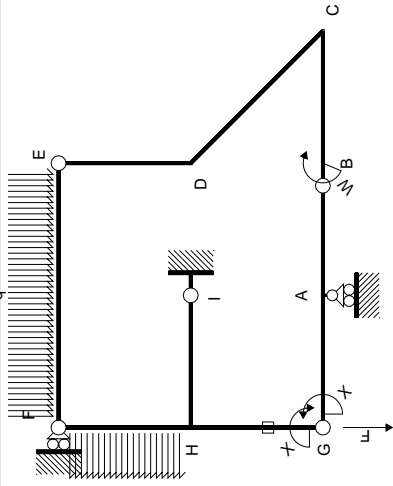
$$= [1/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/4 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -7/12 Fb^2/EJ$$

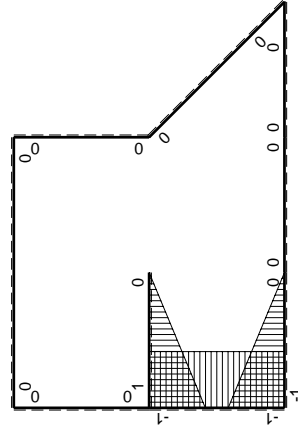


- A = 160. mm²
- J_u = 82754. mm⁴
- J_v = 9072. mm⁴
- J_i = 134. mm⁴
- y_o = -10.6 mm
- y_g = 22.49 mm
- N = 297. N
- T_y = -297. N
- M_x = 588000. Nmm
- x_m = 6. mm
- y_m = 52. mm
- u_m = -12. mm
- v_m = 29.51 mm
- σ_m = N/A-Mv/J_u = -207.8 N/mm²
- x_c = 18. mm
- y_c = 52. mm
- v_c = 29.51 mm
- σ_c = N/A-Mv/J_u = -207.8 N/mm²
- τ_c = TS_y/tJ_u = 4.575 N/mm²
- τ_g = TS_y/tJ_u = 4.575 N/mm²
- t_c = 840. mm
- σ_o = √σ²+3τ² = 208. N/mm²





(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-Fb+Fx	0	0	0	0
BA b	0	Fx	0	0	0	0
BC b	0	Fb+Fx	0	0	0	0
CB b	0	-2Fb+Fx	0	0	0	0
CD $\sqrt{2}b$	0	$2Fb-3\sqrt{2}/4Fx$	0	0	0	0
DE b	0	$1/2Fb-1/2Fx$	0	0	0	0
ED b	0	-1/2Fx	0	0	0	0
EF 2b	0	$-Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$Fx-1/2qx^2$	0	0	0	0
GA b	-1+x/b	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2		
FH b	0	$Fx-1/2qx^2$	0	0	0	0
HF b	0	$-1/2Fb+1/2qx^2$	0	0	0	0
HI b	1-x/b	Fb-Fx	$Fb-2Fx+Fx^2/b$	$1-2x/b+x^2/b^2$	$1/3Fb^2/EJ$	$1/3Xb/EJ$
IH b	-x/b	-Fx	Fx^2/b	x^2/b^2		
HG b	-1	$-1/2Fb+1/2Fx$	$1/2Fb-1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
GH b	1	$1/2Fx$	$1/2Fx$	1		
HG	elongazione asta $N_{1HG} = N_{HG} + H_{HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$				$-1/2Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-3/4Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$9/23Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1 - 2x/b + x^2/b^2) Fb 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - b + 1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (x^2/b^2) Fb 1/EJ dx = [1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

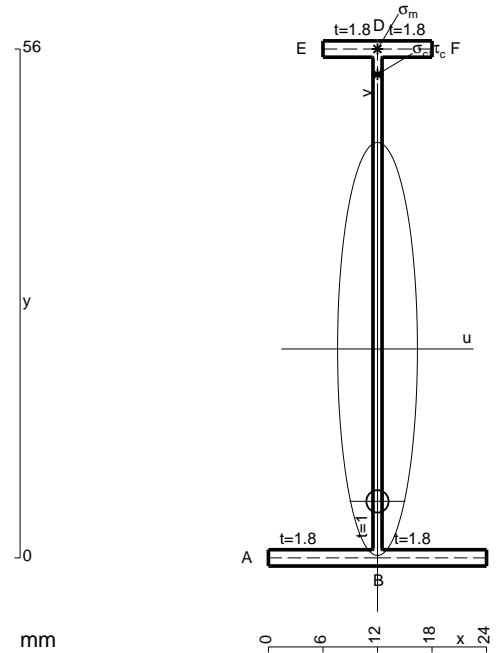
$$L_{HG}^{xo} = \int_0^b (1/2 - 1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/2 x - 1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

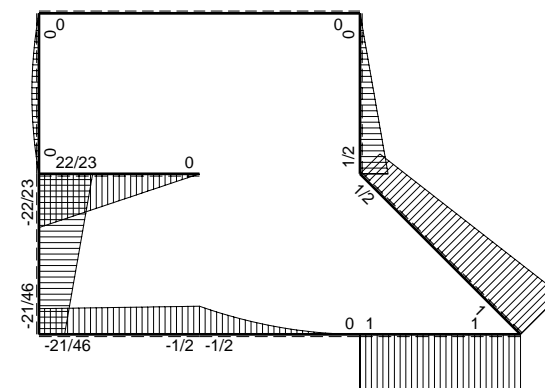
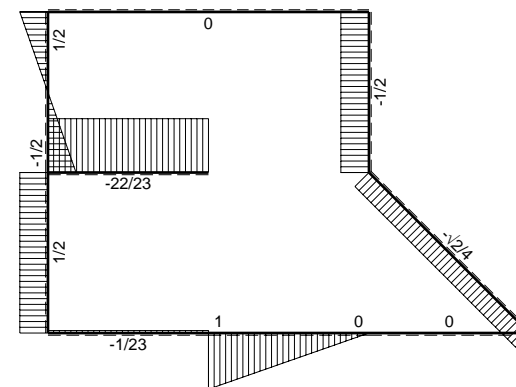
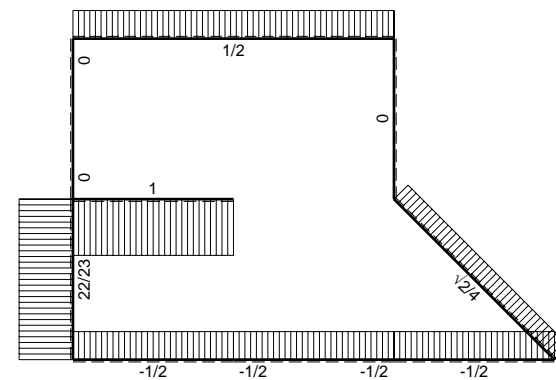
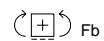
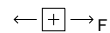
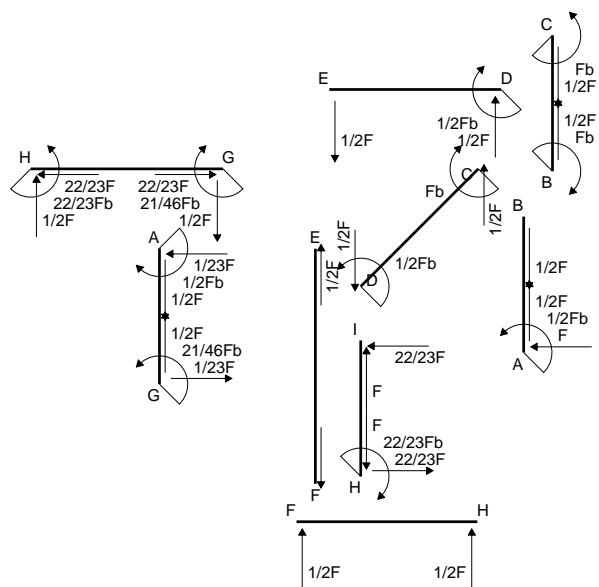
$$= (1/2 b - 1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$

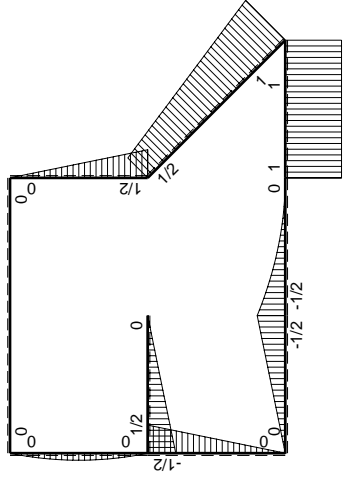
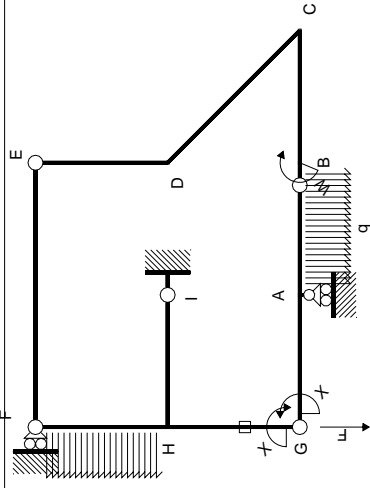
$$L_{GH}^{xo} = \int_0^b (1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$

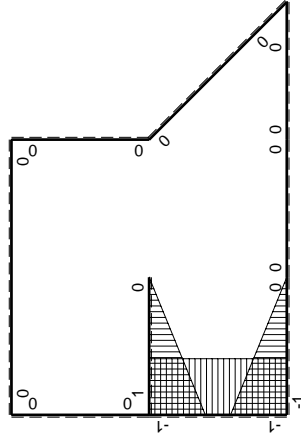


- A = 120.8 mm²
- J_u = 62410. mm⁴
- J_v = 2333. mm⁴
- J_I = 88.65 mm⁴
- y_o = -16.77 mm
- y_g = 22.99 mm
- N = -88.39 N
- T_y = -265.2 N
- M_x = 405000. Nmm
- x_m = 12. mm
- y_m = 56. mm
- v_m = 33.01 mm
- σ_m = N/A - Mv/J_u = -214.9 N/mm²
- y_c = 2. mm
- u_c = -12. mm
- v_c = -20.99 mm
- σ_c = N/A - Mv/J_u = -214.9 N/mm²
- τ_c = TS/tJ_u = 3.029 N/mm²
- τ_g = TS/tJ_u = 3.029 N/mm²
- t_c = 250. mm
- σ_o = √σ² + 3τ² = 215. N/mm²





M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-1/2Fb + Fx - 1/2qx^2$	0	0	0	0
BA b	0	$1/2qx^2$	0	0	0	0
BC b	0	Fb	0	0	0	0
CB b	0	-Fb	0	0	0	0
CD $\sqrt{2}b$	0	$Fb\sqrt{2}/4Fx$	0	0	0	0
DE b	0	$1/2Fb - 1/2Fx$	0	0	0	0
ED b	0	$-1/2Fx$	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$-1/2Fx$	$1/2Fx - 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$1/2Fb - 1/2Fx$	$1/2Fx - 1/2Fx^2/b$	x^2/b^2	$1/12Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$1/2Fx - 1/2qx^2$	0	0	0	0
HF b	0	$-1/2Fx + 1/2qx^2$	0	0	0	0
HI b	$1-x/b$	$1/2Fb - 1/2Fx$	$1/2Fb - Fx + 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$-1/2Fx$	$1/2Fx^2/b$	x^2/b^2	$1/4Fb^2/EJ$	Xb/EJ
HG b	-1	$-1/2Fb + 1/2Fx$	$1/2Fb - 1/2Fx$	1	$-Fb^2/EJ$	
GH b	1	$1/2Fx$	$1/2Fx$	1	$-3/8Fb^2/EJ$	$1/4Xb/EJ$
HG	elongazione asta $N_{1HG+HG-HG}$					
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$					
	totali				$-7/8Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$21/46Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

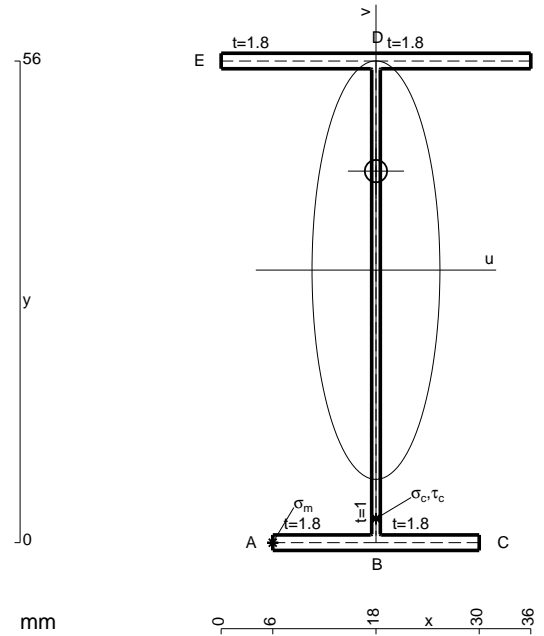
$$L_{HG}^{xo} = \int_0^b (1/2 - 1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/2 x - 1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

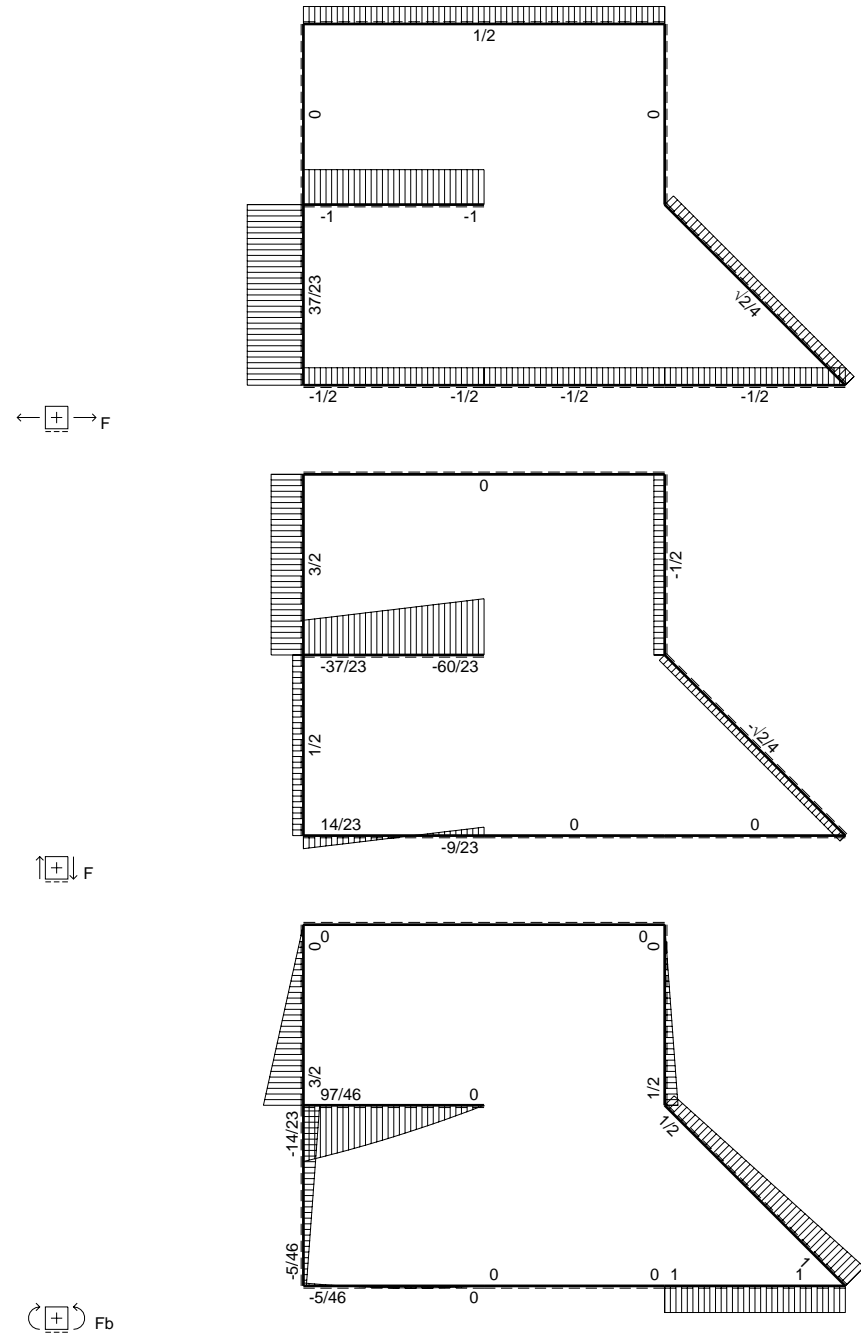
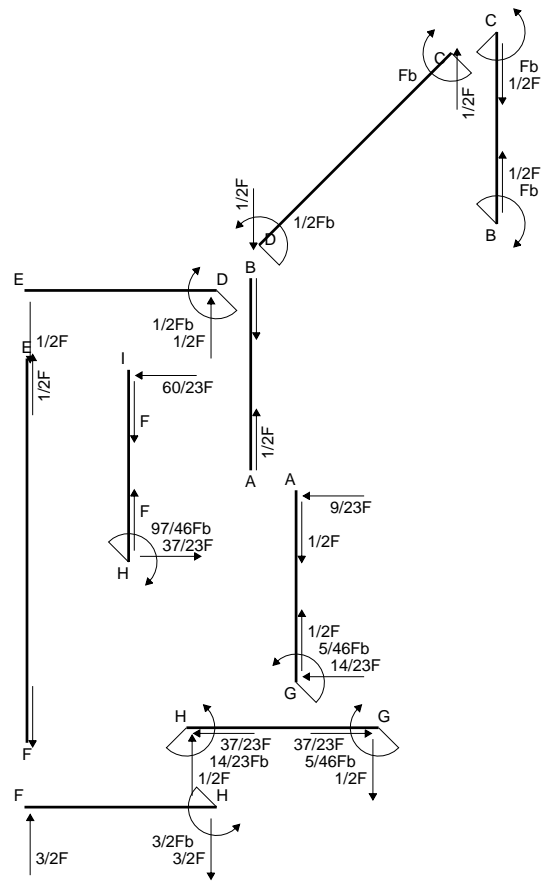
$$= (1/2 b - 1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$

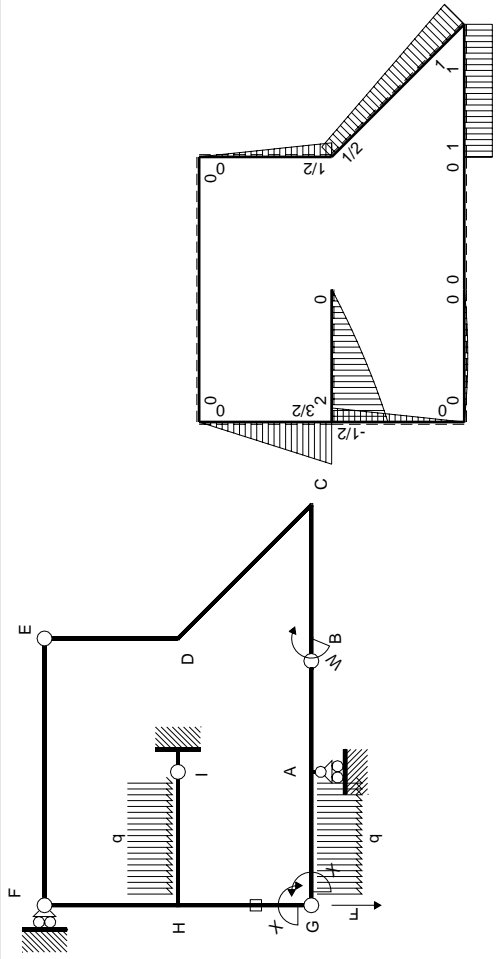
$$L_{GH}^{xo} = \int_0^b (1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$



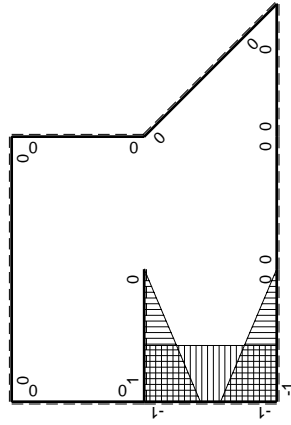
- A = 164. mm²
- J_u = 97076. mm⁴
- J_v = 9072. mm⁴
- J_I = 135.3 mm⁴
- y_o = 11.51 mm
- y_g = 31.69 mm
- N = -800. N
- T_y = 1600. N
- M_x = -688000. Nmm
- x_m = 6. mm
- u_m = -12. mm
- v_m = -31.69 mm
- σ_m = N/A-Mv/J_u = -229.5 N/mm²
- x_c = 18. mm
- v_c = -31.69 mm
- σ_c = N/A-Mv/J_u = -229.5 N/mm²
- τ_c = TS'/tJ_u = 22.56 N/mm²
- τ_g = TS'/tJ_u = 22.56 N/mm²
- t_c = 1600. mm
- σ_o = √σ²+3τ² = 232.8 N/mm²





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

→	$M_x(x)$	$M_o(x)$	$M_x M_o$	$M_x M_x$	$\int M_x M_o / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	0	0	0	0	0
BA b	0	0	0	0	0	0
BC b	0	Fb	0	0	0	0
CB b	0	-Fb	0	0	0	0
CD $\sqrt{2}b$	0	$Fb - \sqrt{2}/4Fx$	0	0	0	0
DE b	0	$1/2Fb - 1/2Fx$	0	0	0	0
ED b	0	$-1/2Fx$	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$1/2Fx - 1/2qx^2$	$-1/2Fx + Fx^2/b - 1/2qx^3/b$	$1-2x/b+x^2/b^2$	$-1/24Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$-1/2Fx + 1/2qx^2$	$-1/2Fx^2/b + 1/2qx^3/b$	x^2/b^2	$-1/24Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$3/2Fx$	0	0	0	0
HF b	0	$-3/2Fb + 3/2Fx$	0	0	0	0
HI b	$1-x/b$	$2Fb - 3/2Fx - 1/2qx^2$	$2Fb - 7/2Fx + Fx^2/b + 1/2qx^3/b$	$1-2x/b+x^2/b^2$	$17/24Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$-5/2Fx + 1/2qx^2$	$5/2Fx^2/b - 1/2qx^3/b$	x^2/b^2	$17/24Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	$-1/2Fb + 1/2Fx$	$1/2Fb - 1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
GH b	1	$1/2Fx$	$1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG} \epsilon_{HG} L_{HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{oA} + XV_{1A})/k_A$				$-1/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-5/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$5/46Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (-1/2 x/b + x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [-1/4 x^2/b + 1/3 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (-1/4 b + 1/3 b - 1/8 b) Fb 1/EJ = -1/24 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (-1/2 x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [-1/6 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (-1/6 b + 1/8 b) Fb 1/EJ = -1/24 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (2 - 7/2 x/b + x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [2x - 7/4 x^2/b + 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (2b - 7/4 b + 1/3 b + 1/8 b) Fb 1/EJ = 17/24 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (5/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [5/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (5/6 b - 1/8 b) Fb 1/EJ = 17/24 Fb^2/EJ$$

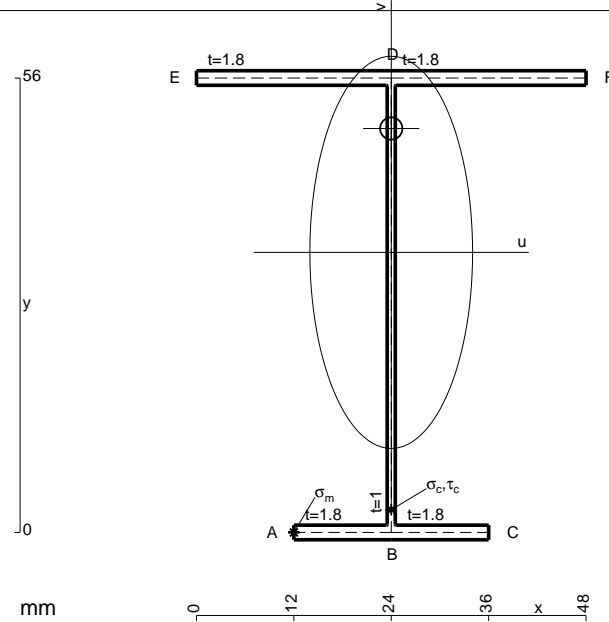
$$L_{HG}^{xo} = \int_0^b (1/2 - 1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/2 x - 1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

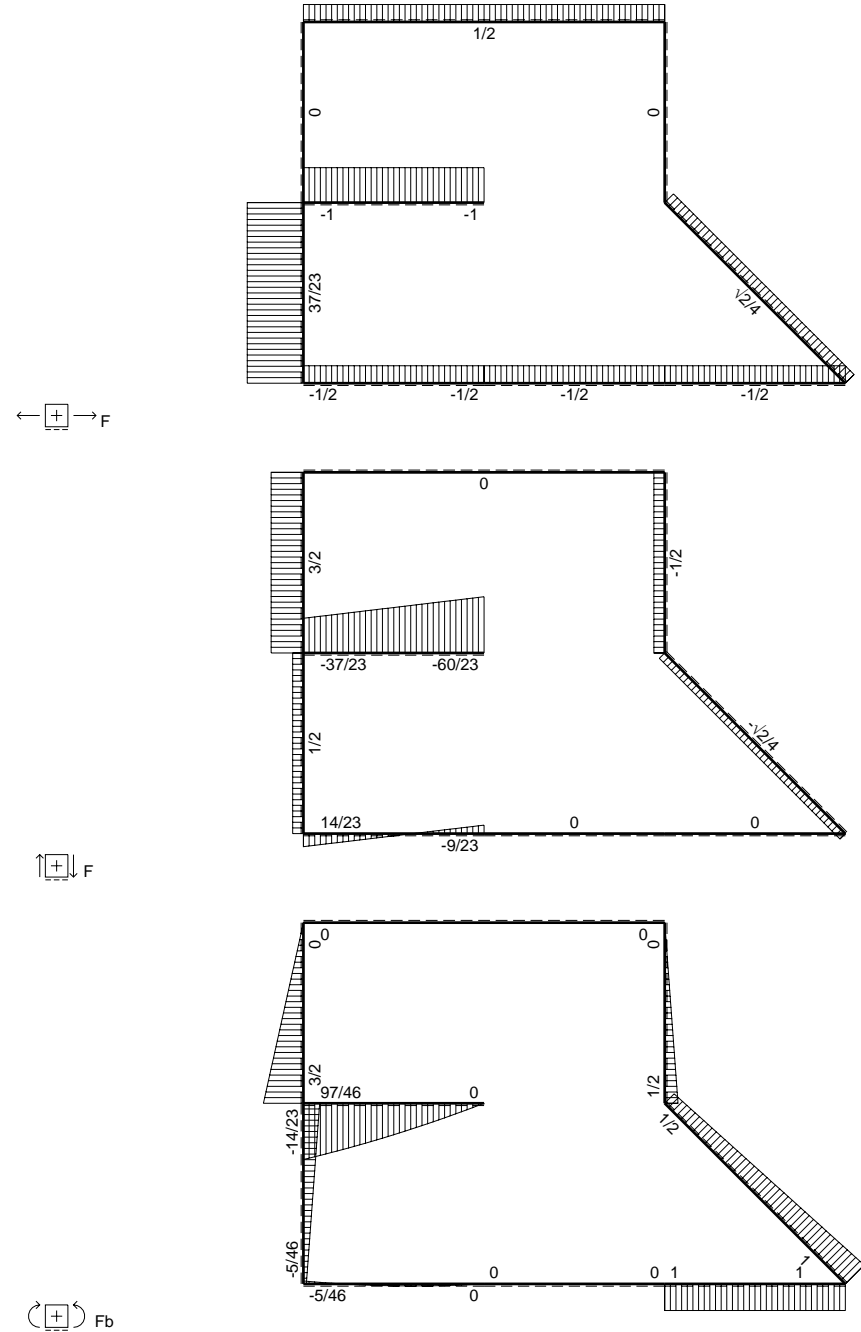
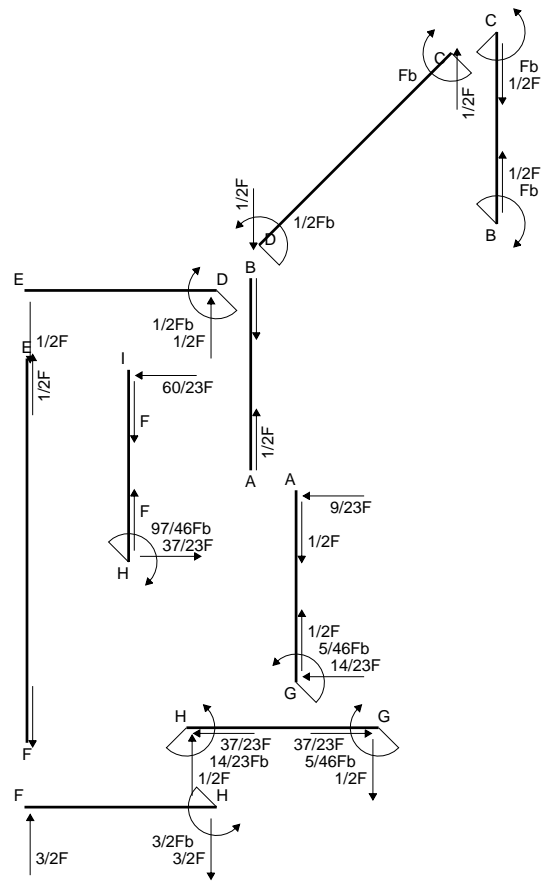
$$= (1/2 b - 1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$

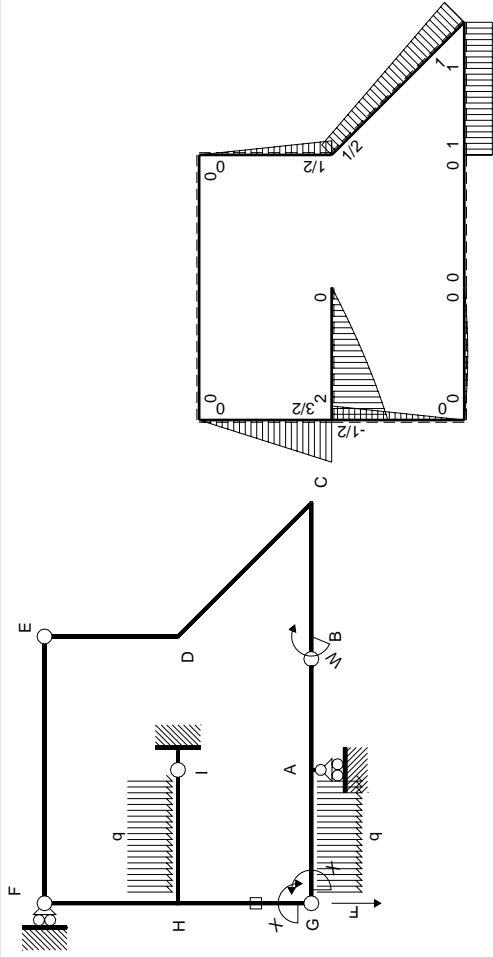
$$L_{GH}^{xo} = \int_0^b (1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$



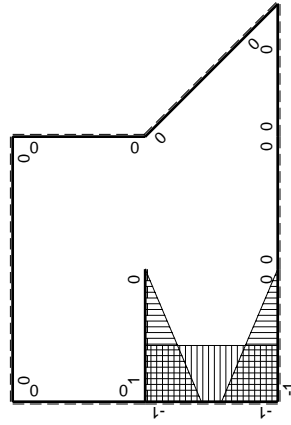
- A = 185.6 mm²
- J_u = 108358. mm⁴
- J_v = 18662. mm⁴
- J_t = 158.6 mm⁴
- y_o = 15.26 mm
- y_g = 34.52 mm
- T_y = 825. N
- M_x = 750750. Nmm
- x_m = 12. mm
- u_m = -12. mm
- v_m = -34.52 mm
- σ_m = -Mv/J_u = 239.1 N/mm²
- x_c = 24. mm
- v_c = -34.52 mm
- σ_c = -Mv/J_u = 239.1 N/mm²
- τ_c = TS^t/tJ_u = 11.35 N/mm²
- τ_g = TS^t/tJ_u = 11.35 N/mm²
- t_c = 550. mm
- σ_o = √σ²+3τ² = 240. N/mm²





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

→	$M_x(x)$	$M_o(x)$	$M_x M_o$	$M_x M_x$	$\int M_x M_o / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	0	0	0	0	0
BA b	0	0	0	0	0	0
BC b	0	Fb	0	0	0	0
CB b	0	-Fb	0	0	0	0
CD $\sqrt{2}b$	0	$Fb - \sqrt{2}/4Fx$	0	0	0	0
DE b	0	$1/2Fb - 1/2Fx$	0	0	0	0
ED b	0	$-1/2Fx$	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$1/2Fx - 1/2qx^2$	$-1/2Fx + Fx^2/b - 1/2qx^3/b$	$1-2x/b+x^2/b^2$	$-1/24Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$-1/2Fx + 1/2qx^2$	$-1/2Fx^2/b + 1/2qx^3/b$	x^2/b^2	$-1/24Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$3/2Fx$	0	0	0	0
HF b	0	$-3/2Fb + 3/2Fx$	0	0	0	0
HI b	$1-x/b$	$2Fb - 3/2Fx - 1/2qx^2$	$2Fb - 7/2Fx + Fx^2/b + 1/2qx^3/b$	$1-2x/b+x^2/b^2$	$17/24Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$-5/2Fx + 1/2qx^2$	$5/2Fx^2/b - 1/2qx^3/b$	x^2/b^2	$17/24Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	$-1/2Fb + 1/2Fx$	$1/2Fb - 1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
GH b	1	$1/2Fx$	$1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG} \epsilon_{HG} L_{HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{oA} + XV_{1A})/k_A$				$-1/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-5/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$5/46Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (-1/2 x/b + x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [-1/4 x^2/b + 1/3 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (-1/4 b + 1/3 b - 1/8 b) Fb 1/EJ = -1/24 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (-1/2 x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [-1/6 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (-1/6 b + 1/8 b) Fb 1/EJ = -1/24 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (2 - 7/2 x/b + x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [2x - 7/4 x^2/b + 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (2b - 7/4 b + 1/3 b + 1/8 b) Fb 1/EJ = 17/24 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (5/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [5/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (5/6 b - 1/8 b) Fb 1/EJ = 17/24 Fb^2/EJ$$

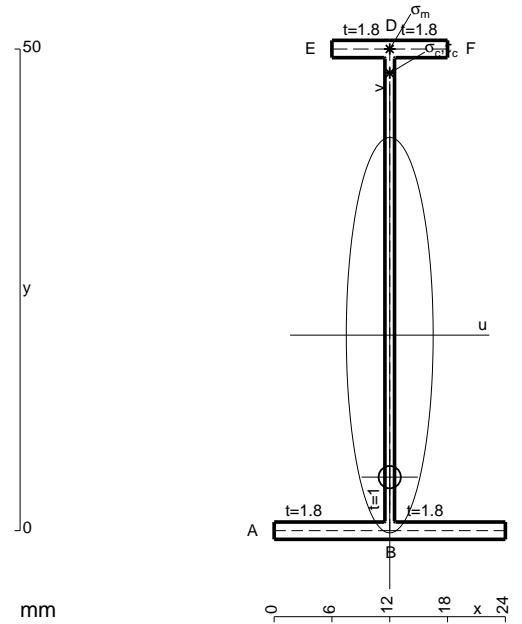
$$L_{HG}^{xo} = \int_0^b (1/2 - 1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/2 x - 1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

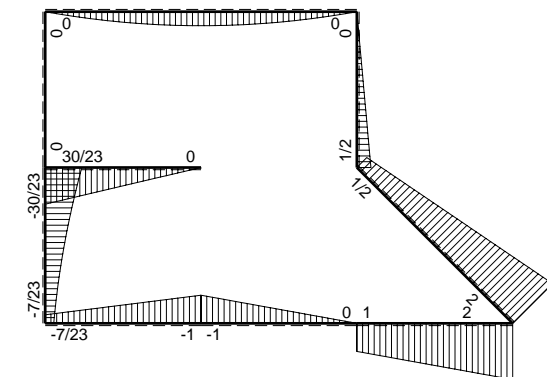
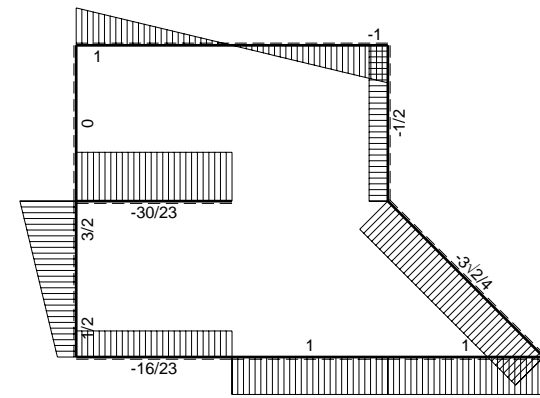
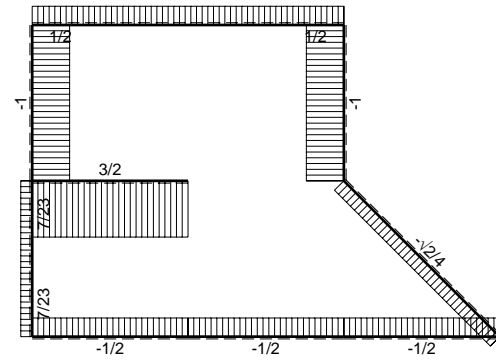
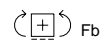
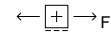
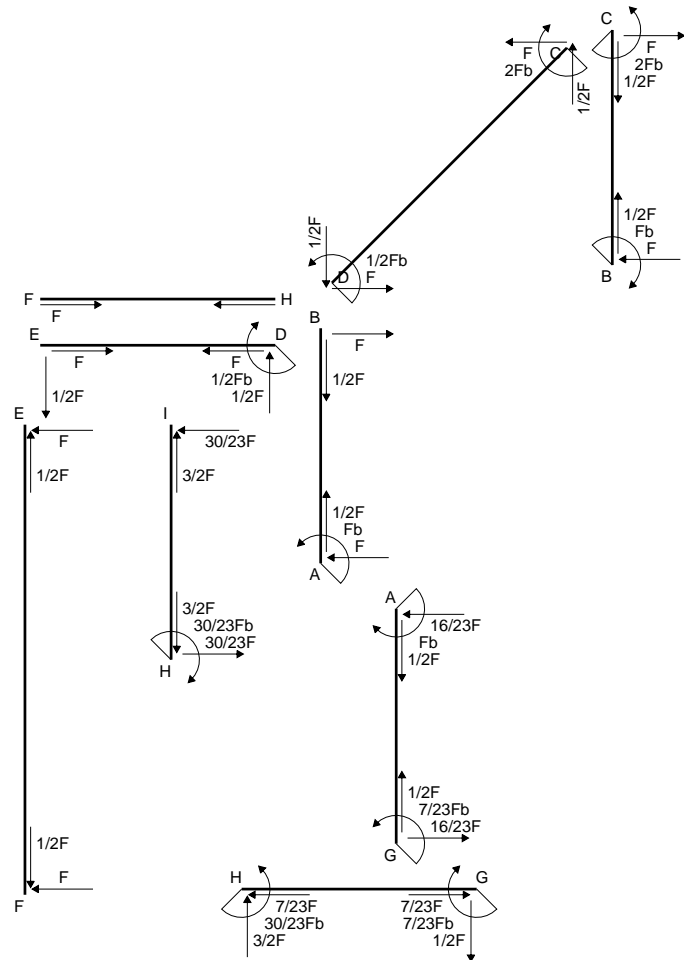
$$= (1/2 b - 1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$

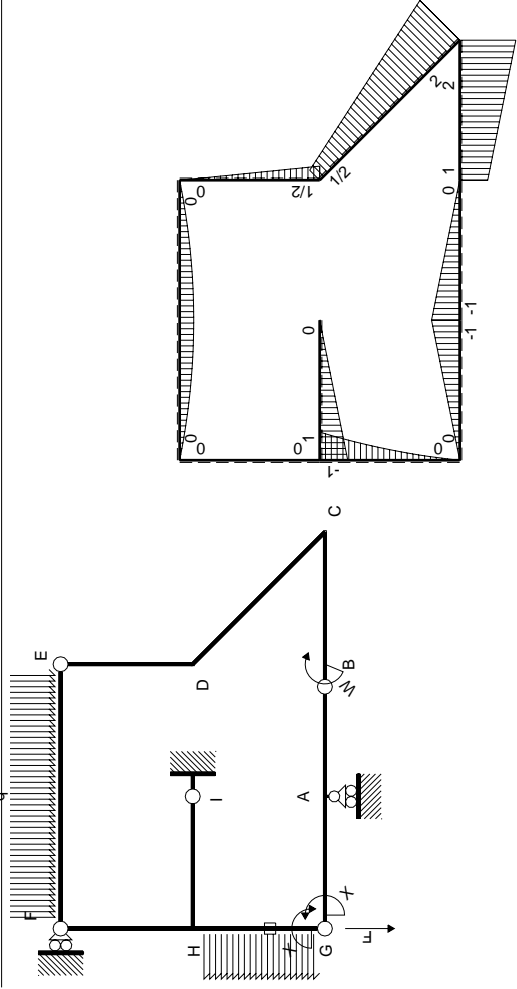
$$L_{GH}^{xo} = \int_0^b (1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$

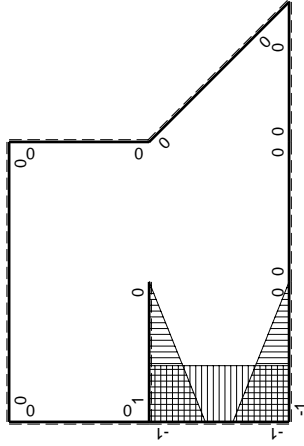


- A = 114.8 mm²
- J_u = 48377. mm⁴
- J_v = 2333. mm⁴
- J_i = 86.65 mm⁴
- y_o = -14.74 mm
- y_g = 20.3 mm
- T_y = 750. N
- M_x = 322500. Nmm
- x_m = 12. mm
- y_m = 50. mm
- v_m = 29.7 mm
- σ_m = -Mv/J_u = -198. N/mm²
- y_c = 2. mm
- u_c = -12. mm
- v_c = -18.3 mm
- σ_c = -Mv/J_u = -198. N/mm²
- τ_c = TS_i/tJ_u = 9.947 N/mm²
- τ_g = TS_i/tJ_u = 9.947 N/mm²
- t_c = 500. mm
- σ_o = √σ²+3τ² = 198.8 N/mm²





M₀ flessione da carichi assegnati



Quadro contributi PLV per iperstatica X=W_{GA}

→	M _x (x)	M ₀ (x)	M _x M ₀	M _x M ₀	M _x M _x	∫M _x M ₀ /EJdx	∫M _x M _x /EJdx
AB b	0	-Fb+Fx	0	0	0	0	0
BA b	0	Fx	0	0	0	0	0
BC b	0	Fb+Fx	0	0	0	0	0
CB b	0	-2Fb+Fx	0	0	0	0	0
CD √2b	0	2Fb-3√2/4Fx	0	0	0	0	0
DE b	0	1/2Fb-1/2Fx	0	0	0	0	0
ED b	0	-1/2Fx	0	0	0	0	0
EF 2b	0	-Fx+1/2qx ²	0	0	0	0	0
FE 2b	0	Fx-1/2qx ²	0	0	0	0	0
GA b	-1+x/b	-Fx	Fx-Fx ² /b	Fx-Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
AG b	x/b	Fb-Fx	Fb-Fx ² /b	Fb-Fx ² /b	x ² /b ²	1/3Fb ² /EJ	1/3Xb/EJ
FH b	0	0	0	0	0	0	0
HF b	0	0	0	0	0	0	0
HI b	1-x/b	Fb-Fx	Fb-2Fx+Fx ² /b	Fb-2Fx+Fx ² /b	1-2x/b+x ² /b ²	1/3Fb ² /EJ	1/3Xb/EJ
IH b	-x/b	-Fx	Fx ² /b	Fx ² /b	x ² /b ²	1/3Fb ² /EJ	1/3Xb/EJ
HG b	-1	-Fb+3/2Fx-1/2qx ²	Fb-3/2Fx+1/2Fx ² /b	Fb-3/2Fx+1/2Fx ² /b	1	5/12Fb ² /EJ	Xb/EJ
GH b	1	1/2Fx+1/2qx ²	1/2Fx+1/2Fx ² /b	1/2Fx+1/2Fx ² /b	1	5/12Fb ² /EJ	Xb/EJ
HG	elongazione asta N _{1HG⁵HG-HG}					-Fb ² /EJ	
A	molla nodo -V _{1A} (V _{GA} +XV _{1A})/k _A					-1/2Fb ² /EJ	1/4Xb/EJ
	totali					-7/12Fb ² /EJ	23/12Xb/EJ
	iperstatica X=W _{GA}					7/23Fb	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1 - 2x/b + x^2/b^2) Fb 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - b + 1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (x^2/b^2) Fb 1/EJ dx = [1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (1 - 3/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

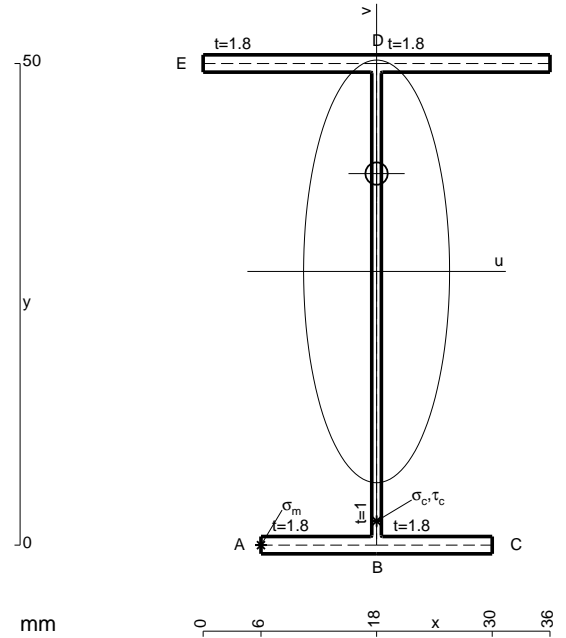
$$= [x - 3/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (b - 3/4 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -7/12 Fb^2/EJ$$

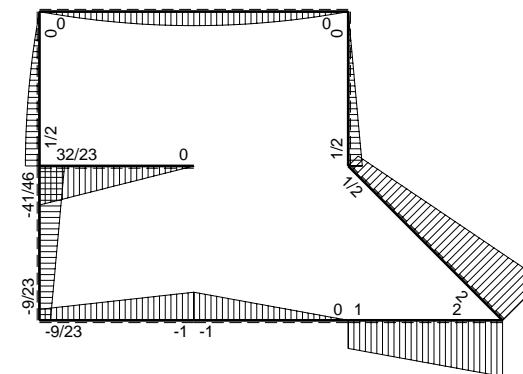
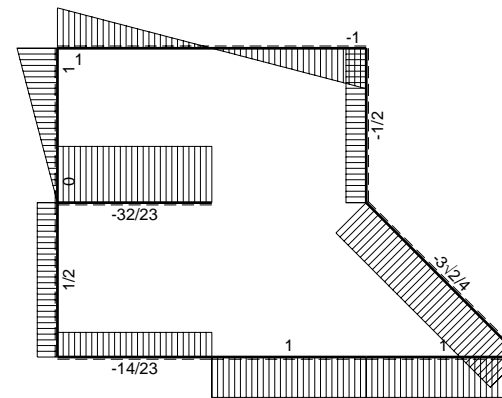
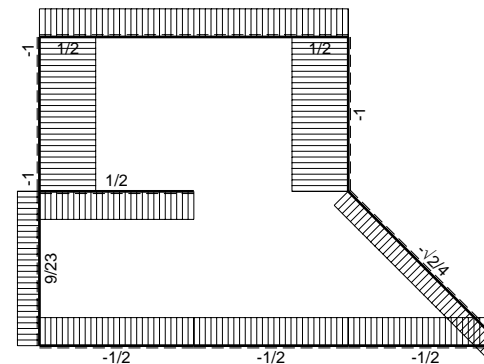
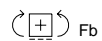
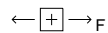
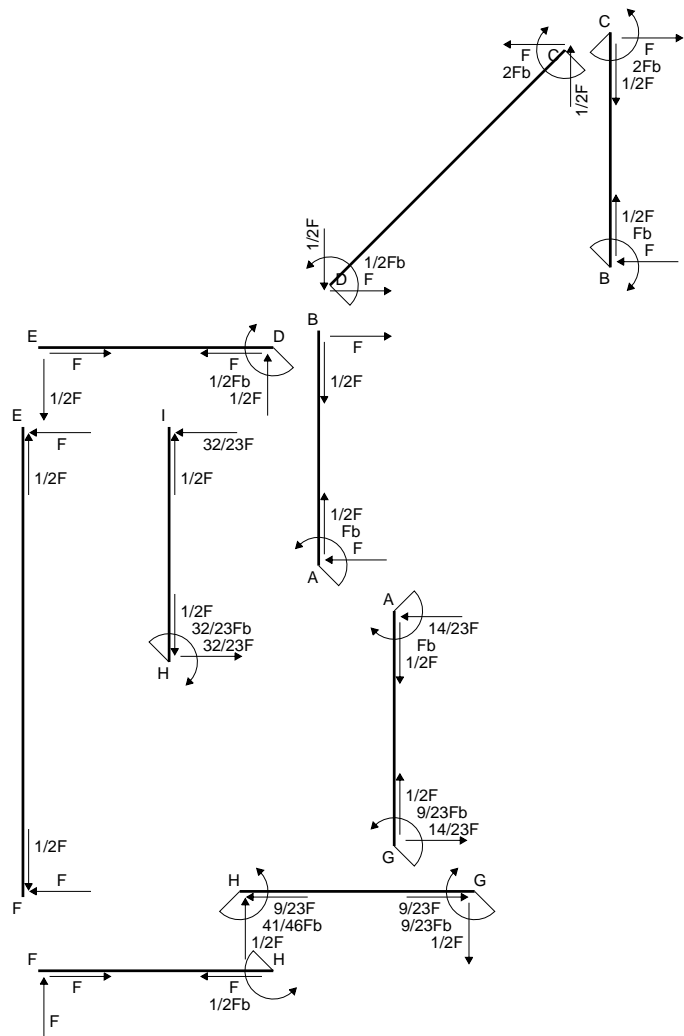
$$L_{GH}^{xo} = \int_0^b (1/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

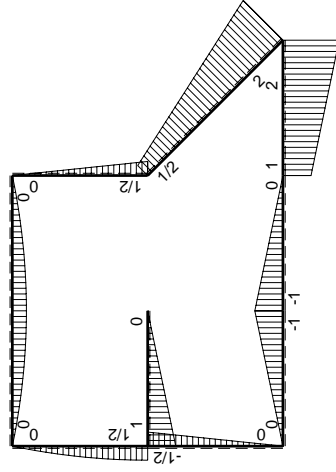
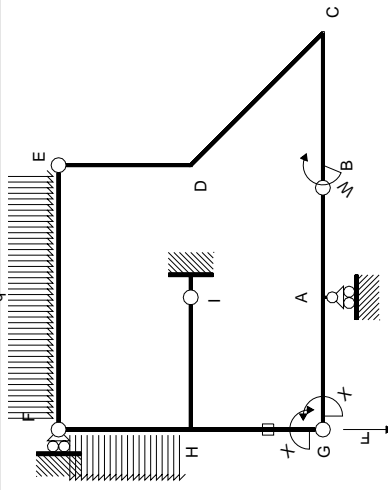
$$= [1/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/4 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -7/12 Fb^2/EJ$$

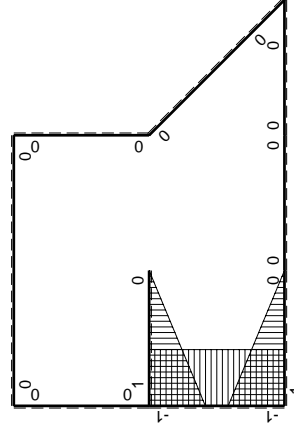


- A = 158. mm²
- J_u = 76071. mm⁴
- J_v = 9072. mm⁴
- J_t = 133.3 mm⁴
- y_o = 10.15 mm
- y_g = 28.42 mm
- N = -212.1 N
- T_y = -636.4 N
- M_x = 564000. Nmm
- x_m = 6. mm
- u_m = -12. mm
- v_m = -28.42 mm
- σ_m = N/A-Mv/J_u = 209.4 N/mm²
- x_c = 18. mm
- v_c = -28.42 mm
- σ_c = N/A-Mv/J_u = 209.4 N/mm²
- τ_c = TS_t/tJ_u = 10.27 N/mm²
- τ_g = TS_t/tJ_u = 10.27 N/mm²
- t_c = 600. mm
- σ_o = √σ²+3τ² = 210.1 N/mm²





(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-Fb+Fx	0	0	0	0
BA b	0	Fx	0	0	0	0
BC b	0	Fb+Fx	0	0	0	0
CB b	0	-2Fb+Fx	0	0	0	0
CD $\sqrt{2}b$	0	$2Fb-3\sqrt{2}/4Fx$	0	0	0	0
DE b	0	$1/2Fb-1/2Fx$	0	0	0	0
ED b	0	-1/2Fx	0	0	0	0
EF 2b	0	$-Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$Fx-1/2qx^2$	0	0	0	0
GA b	-1+x/b	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2		
FH b	0	$Fx-1/2qx^2$	0	0	0	0
HF b	0	$-1/2Fb+1/2qx^2$	0	0	0	0
HI b	1-x/b	Fb-Fx	$Fb-2Fx+Fx^2/b$	$1-2x/b+x^2/b^2$	$1/3Fb^2/EJ$	$1/3Xb/EJ$
IH b	-x/b	-Fx	Fx^2/b	x^2/b^2		
HG b	-1	$-1/2Fb+1/2Fx$	$1/2Fb-1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
GH b	1	$1/2Fx$	$1/2Fx$	1		
HG	elongazione asta N_{1HG}^{HG}				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{GA}+XV_{1A})/k_A$				$-1/2Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-3/4Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$9/23Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1 - 2x/b + x^2/b^2) Fb 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - b + 1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (x^2/b^2) Fb 1/EJ dx = [1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

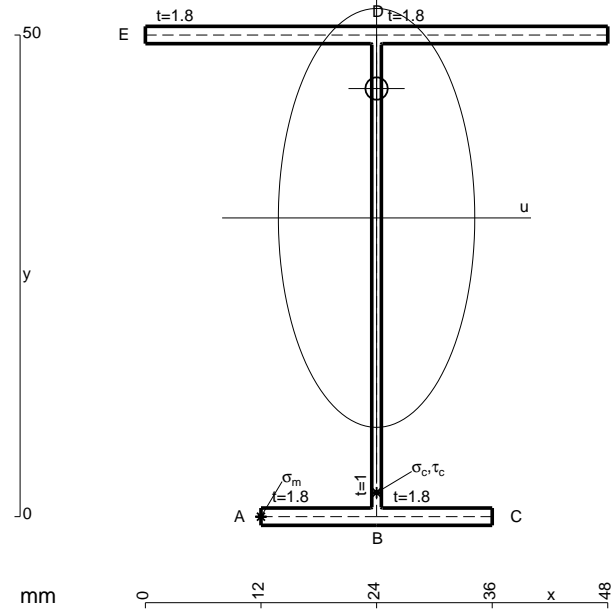
$$L_{HG}^{xo} = \int_0^b (1/2 - 1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/2 x - 1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

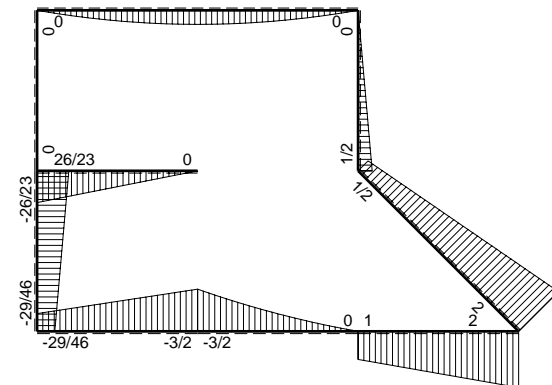
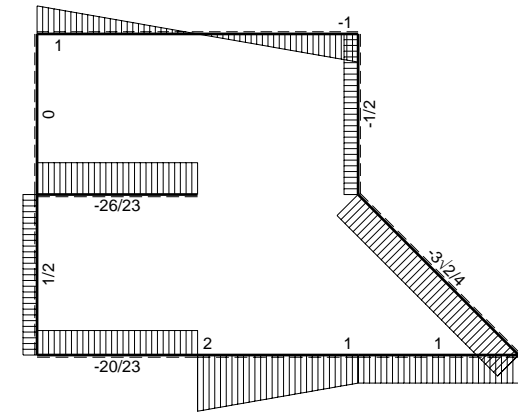
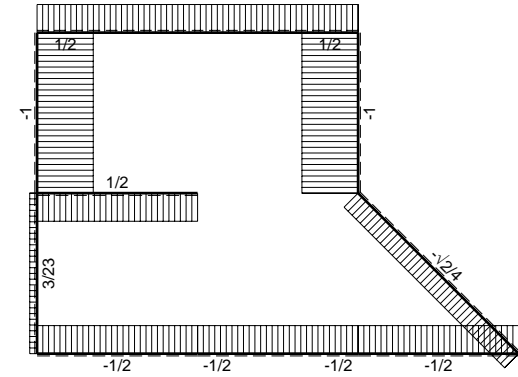
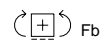
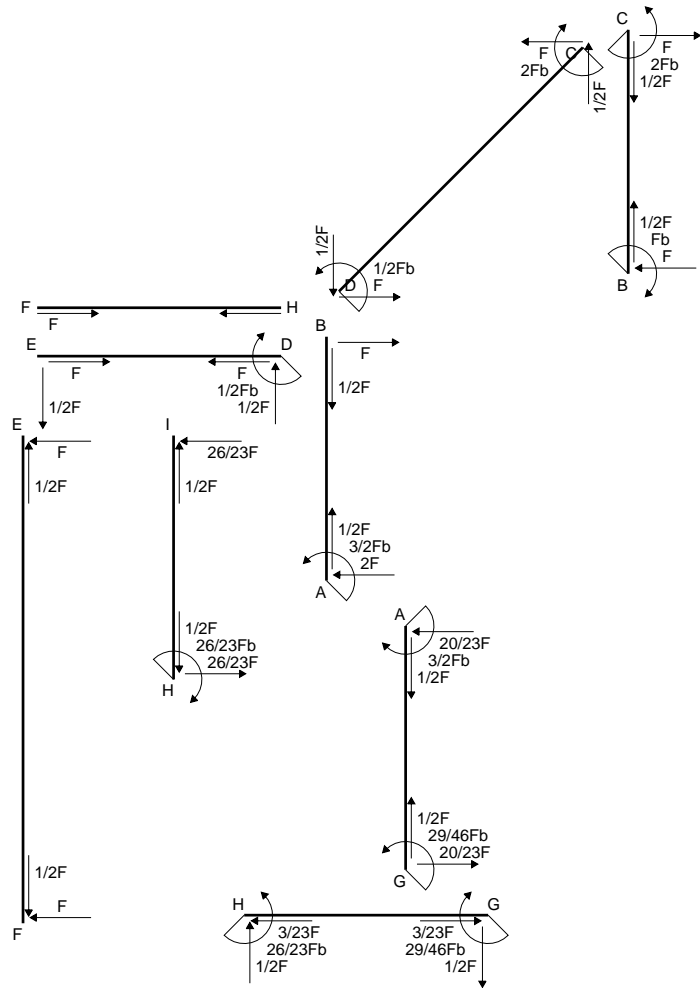
$$= (1/2 b - 1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$

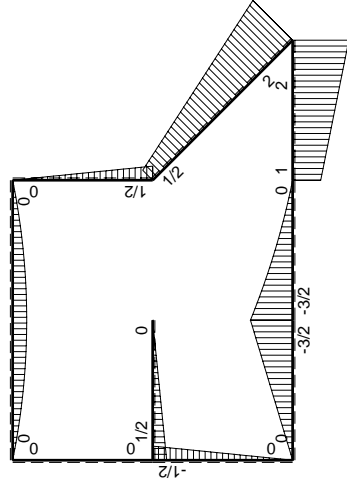
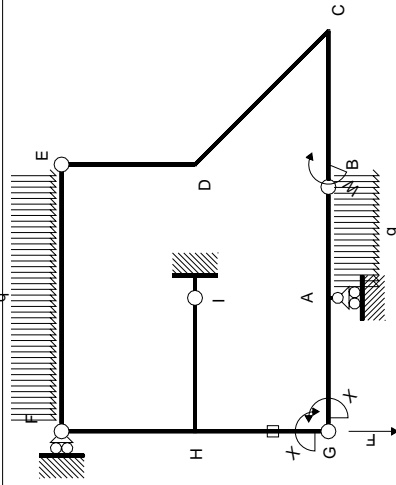
$$L_{GH}^{xo} = \int_0^b (1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$

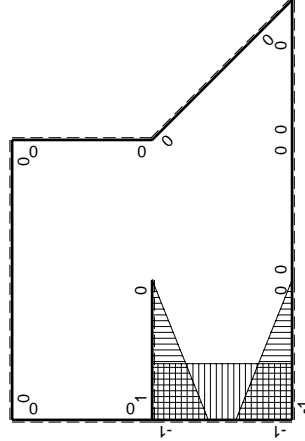


- A = 179.6 mm²
- J_u = 84922. mm⁴
- J_v = 18662. mm⁴
- J_t = 156.6 mm⁴
- y_o = 13.43 mm
- y_g = 31.01 mm
- N = -208.6 N
- T_y = -625.8 N
- M_x = 601800. Nmm
- x_m = 12. mm
- u_m = -12. mm
- v_m = -31.01 mm
- σ_m = N/A-Mv/J_u = 218.6 N/mm²
- x_c = 24. mm
- v_c = -31.01 mm
- σ_c = N/A-Mv/J_u = 218.6 N/mm²
- τ_c = TS_v/tJ_u = 9.873 N/mm²
- τ_g = TS_v/tJ_u = 9.873 N/mm²
- t_c = 590. mm
- σ_o = √σ²+3τ² = 219.3 N/mm²





(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int M_x M_x / E J dx$
AB b	0	$-3/2Fb+2Fx-1/2qx^2$	0	0	0	0
BA b	0	$Fx+1/2qx^2$	0	0	0	0
BC b	0	$Fb+Fx$	0	0	0	0
CB b	0	$-2Fb+Fx$	0	0	0	0
CD $\sqrt{2}b$	0	$2Fb-3\sqrt{2}/4Fx$	0	0	0	0
DE b	0	$1/2Fb-1/2Fx$	0	0	0	0
ED b	0	$-1/2Fx$	0	0	0	0
EF 2b	0	$-Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$Fx-1/2qx^2$	0	0	0	0
GA b	$-1+x/b$	$-3/2Fx$	$3/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/4Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$3/2Fb-3/2Fx$	$3/2Fx-3/2Fx^2/b$	x^2/b^2	$1/4Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	0	0	0	0	0
HF b	0	0	0	0	0	0
HI b	$1-x/b$	$1/2Fb-1/2Fx$	$1/2Fb-Fx+1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$-1/2Fx$	$1/2Fx^2/b$	x^2/b^2	$1/4Fb^2/EJ$	Xb/EJ
HG b	-1	$-1/2Fb+1/2Fx$	$1/2Fb-1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
GH b	1	$1/2Fx$	$1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG}^{HG} \rightarrow HG$					
A	molla nodo $-V_{1A}(V_{GA}+XV_{1A})/k_A$					
	totali					
	iperstatica $X=W_{GA}$					
	29/46Fb					

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

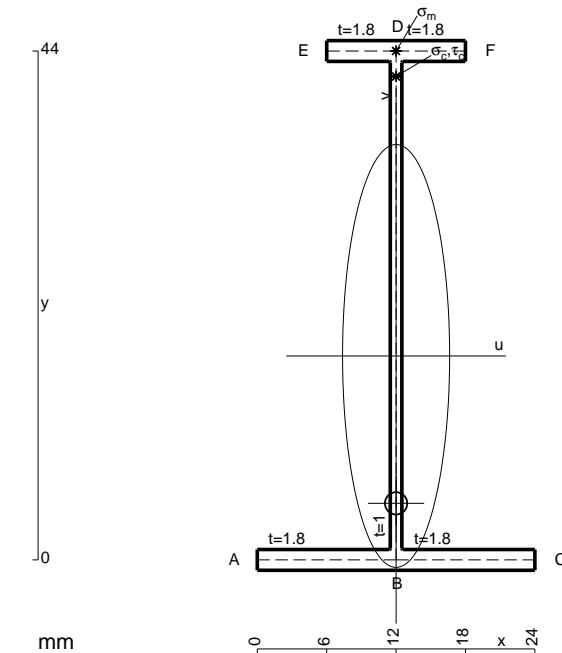
$$L_{HG}^{xo} = \int_0^b (1/2 - 1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/2 x - 1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

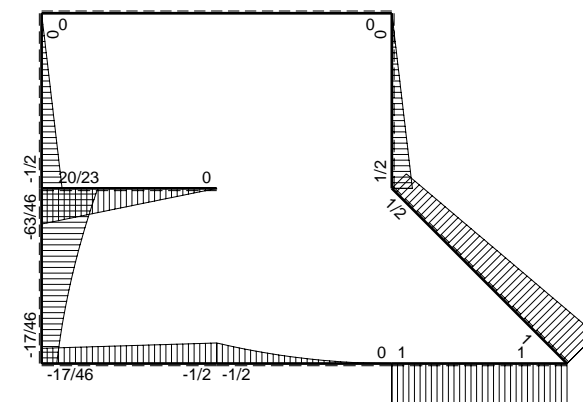
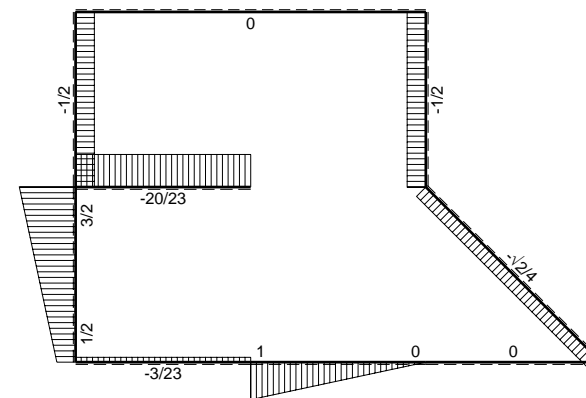
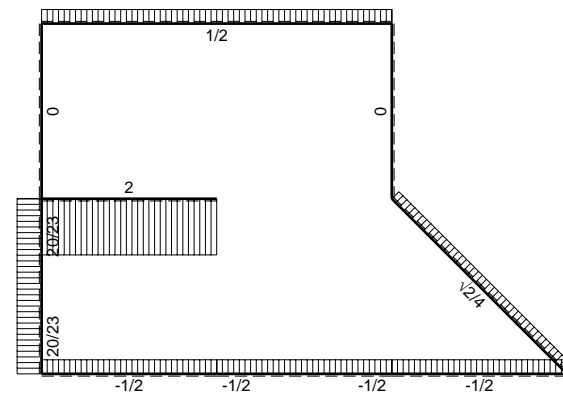
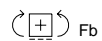
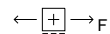
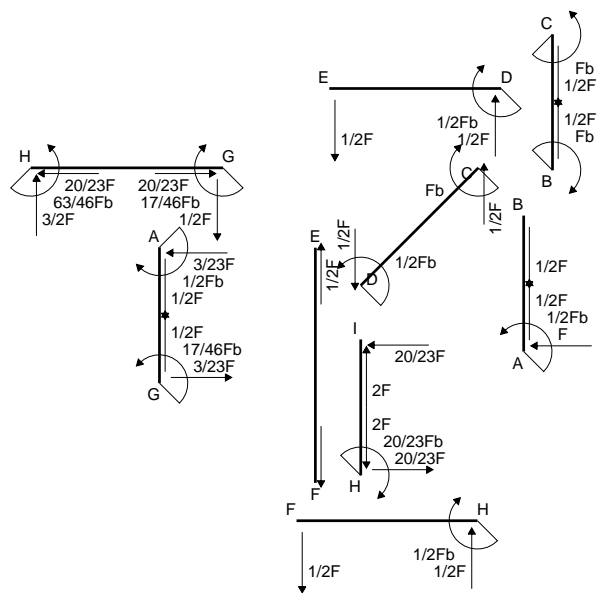
$$= (1/2 b - 1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$

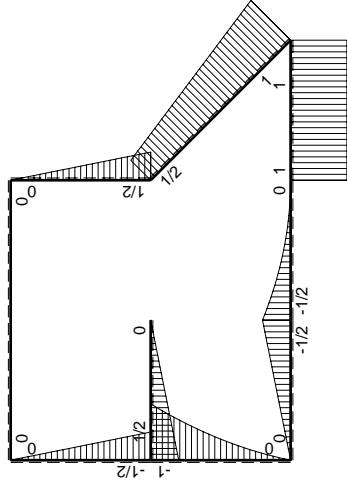
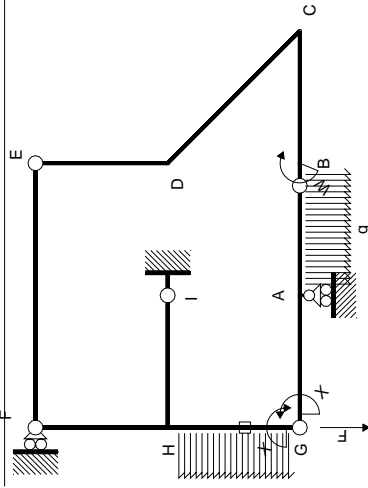
$$L_{GH}^{xo} = \int_0^b (1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$

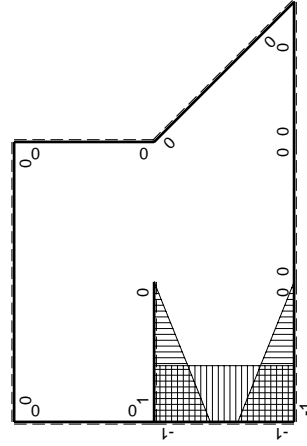


- A = 108.8 mm²
- J_u = 36386. mm⁴
- J_v = 2333. mm⁴
- J_t = 84.65 mm⁴
- y_o = -12.74 mm
- y_g = 17.63 mm
- N = -215. N
- T_y = 860. N
- M_x = -316050. Nmm
- x_m = 12. mm
- y_m = 44. mm
- v_m = 26.37 mm
- σ_m = N/A-Mv/J_u = 227.1 N/mm²
- y_c = 2. mm
- u_c = -12. mm
- v_c = -15.63 mm
- σ_c = N/A-Mv/J_u = 227.1 N/mm²
- τ_c = TS/tJ_u = 13.46 N/mm²
- τ_g = TS/tJ_u = 13.46 N/mm²
- t_c = 430. mm
- σ_o = √σ²+3τ² = 228.2 N/mm²





(\oplus) M_x flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-1/2Fb + Fx - 1/2qx^2$	0	0	0	0
BA b	0	$1/2qx^2$	0	0	0	0
BC b	0	Fb	0	0	0	0
CB b	0	-Fb	0	0	0	0
CD $\sqrt{2}b$	0	$Fb - \sqrt{2}/4Fx$	0	0	0	0
DE b	0	$1/2Fb - 1/2Fx$	0	0	0	0
ED b	0	$-1/2Fx$	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$-1/2Fx$	$1/2Fx - 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$1/2Fb - 1/2Fx$	$1/2Fx - 1/2Fx^2/b$	x^2/b^2	$1/12Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$-1/2Fx$	0	0	0	0
HF b	0	$1/2Fb - 1/2Fx$	0	0	0	0
HI b	$1-x/b$	$1/2Fb - 1/2Fx$	$1/2Fb - Fx + 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$-1/2Fx$	$1/2Fx^2/b$	x^2/b^2	$5/12Fb^2/EJ$	Xb/EJ
HG b	-1	$-Fb + 3/2Fx - 1/2qx^2$	$Fb - 3/2Fx + 1/2Fx^2/b$	1	$-Fb^2/EJ$	
GH b	1	$1/2Fx + 1/2qx^2$	$1/2Fx + 1/2Fx^2/b$	1	$-3/8Fb^2/EJ$	$1/4Xb/EJ$
HG	elongazione asta $N_{1HG^{\pm}HG^{\pm}HG}$					
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$					
	totali					
	iperstatica $X=W_{GA}$					
	17/46Fb					

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (1 - 3/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

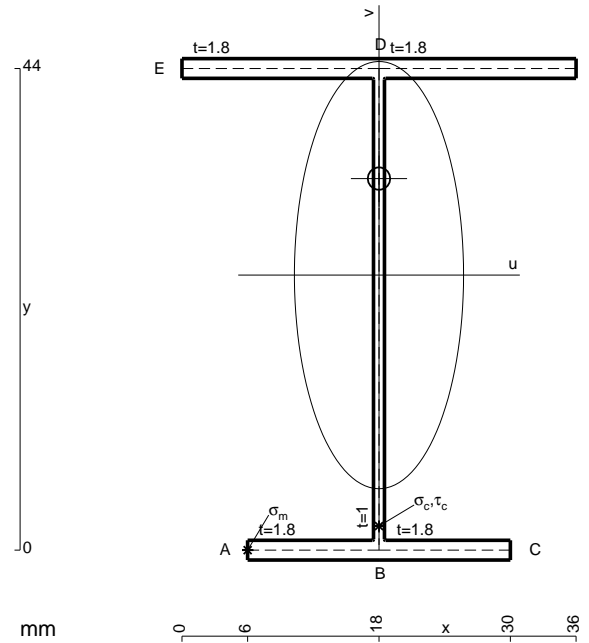
$$= [x - 3/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (b - 3/4 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -7/12 Fb^2/EJ$$

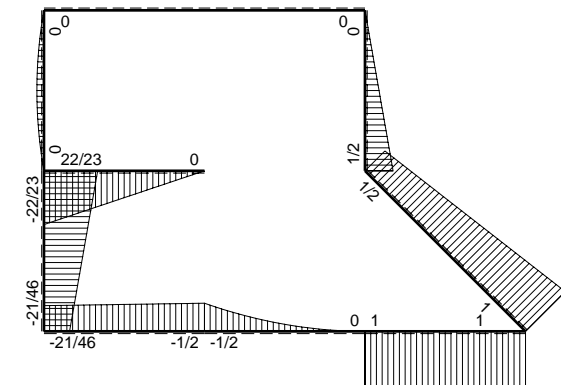
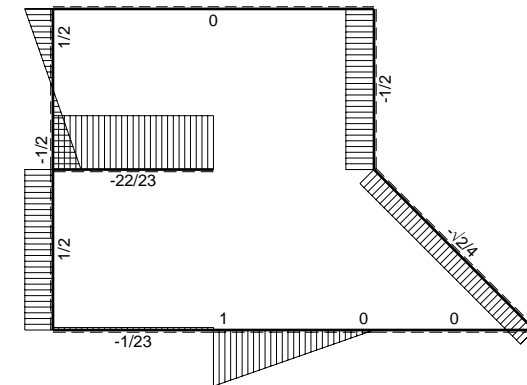
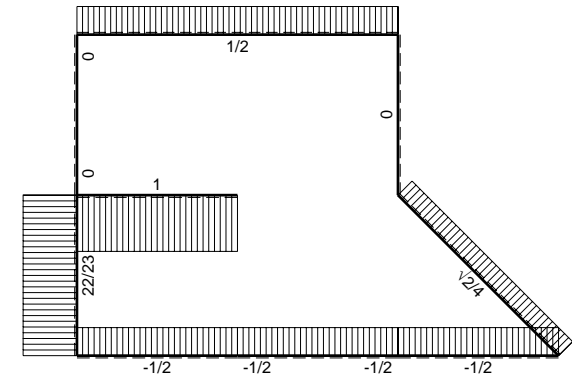
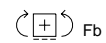
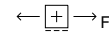
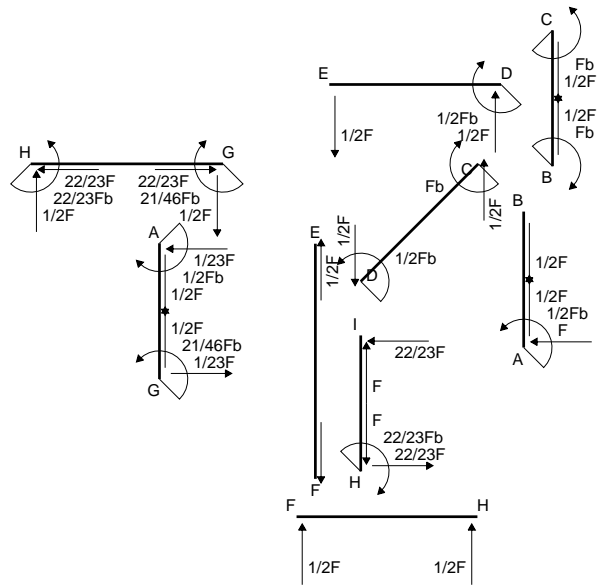
$$L_{GH}^{xo} = \int_0^b (1/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

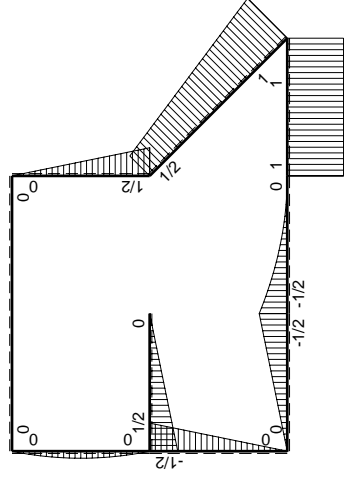
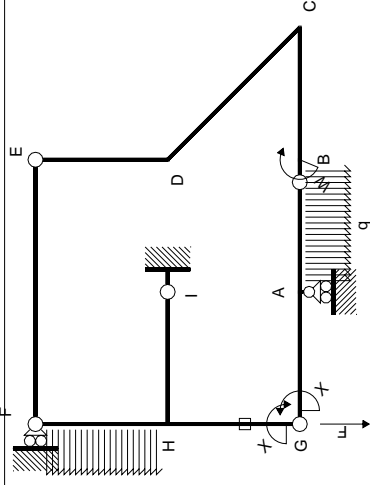
$$= [1/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/4 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -7/12 Fb^2/EJ$$

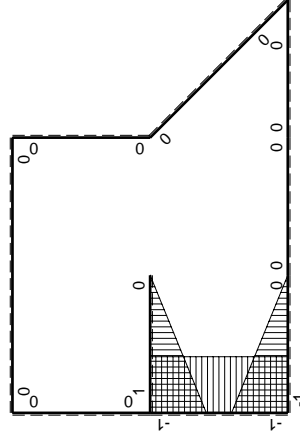


- A = 152. mm²
- J_u = 57885. mm⁴
- J_v = 9072. mm⁴
- J_t = 131.3 mm⁴
- y_o = 8.817 mm
- y_g = 25.13 mm
- N = -1010. N
- T_y = 2020. N
- M_x = -535300. Nmm
- x_m = 6. mm
- u_m = -12. mm
- v_m = -25.13 mm
- σ_m = N/A - Mv/J_u = -239. N/mm²
- x_c = 18. mm
- v_c = -25.13 mm
- σ_c = N/A - Mv/J_u = -239. N/mm²
- τ_c = TS'/tJ_u = 37.88 N/mm²
- τ_g = TS'/tJ_u = 37.88 N/mm²
- t_c = 2020. mm
- σ_o = √(σ² + 3τ²) = 247.8 N/mm²





M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contribuiti PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-1/2Fb + Fx - 1/2qx^2$	0	0	0	0
BA b	0	$1/2qx^2$	0	0	0	0
BC b	0	Fb	0	0	0	0
CB b	0	-Fb	0	0	0	0
CD $\sqrt{2}b$	0	$Fb - \sqrt{2}/4Fx$	0	0	0	0
DE b	0	$1/2Fb - 1/2Fx$	0	0	0	0
ED b	0	$-1/2Fx$	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$-1/2Fx$	$1/2Fx - 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$1/2Fb - 1/2Fx$	$1/2Fx - 1/2Fx^2/b$	x^2/b^2	$1/12Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$1/2Fx - 1/2qx^2$	0	0	0	0
HF b	0	$-1/2Fx + 1/2qx^2$	0	0	0	0
HI b	$1-x/b$	$1/2Fb - 1/2Fx$	$1/2Fb - Fx + 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$-1/2Fx$	$1/2Fx^2/b$	x^2/b^2	$1/4Fb^2/EJ$	Xb/EJ
HG b	-1	$-1/2Fb + 1/2Fx$	$1/2Fb - 1/2Fx$	1	$-Fb^2/EJ$	
GH b	1	$1/2Fx$	$1/2Fx$	1	$-3/8Fb^2/EJ$	$1/4Xb/EJ$
HG	elongazione asta $N_{1HG^{\pm HG}} \pm HG$					
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$					
	totali					
	iperstatica $X=W_{GA}$					
	21/46Fb					

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

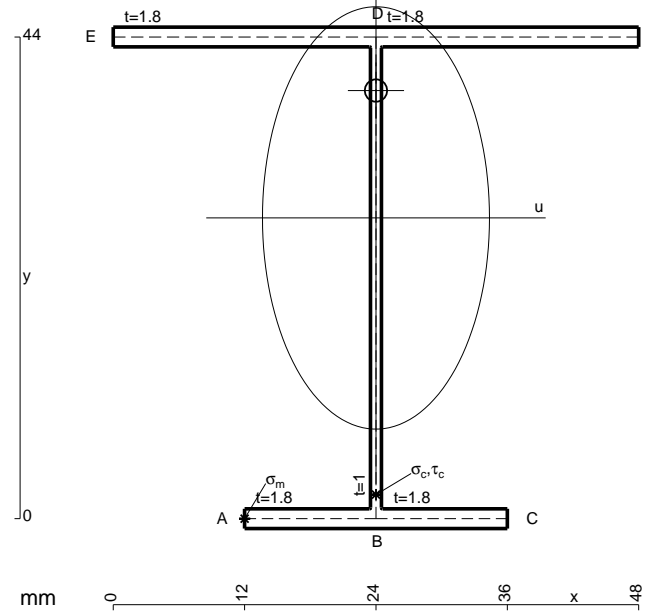
$$L_{HG}^{xo} = \int_0^b (1/2 - 1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/2 x - 1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

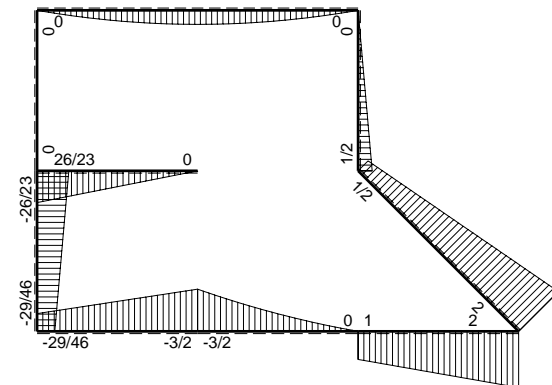
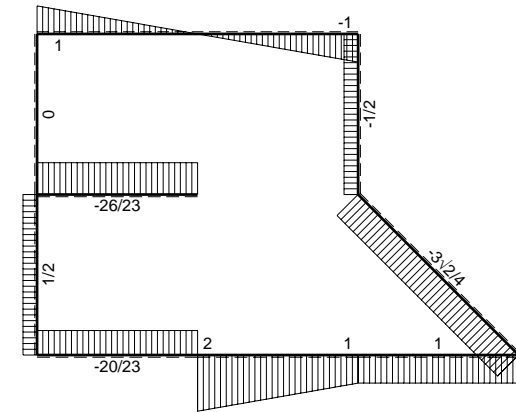
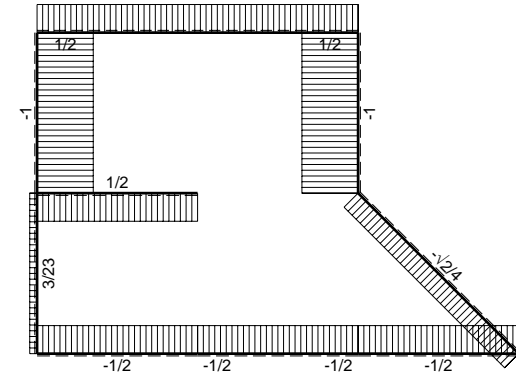
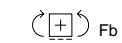
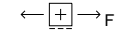
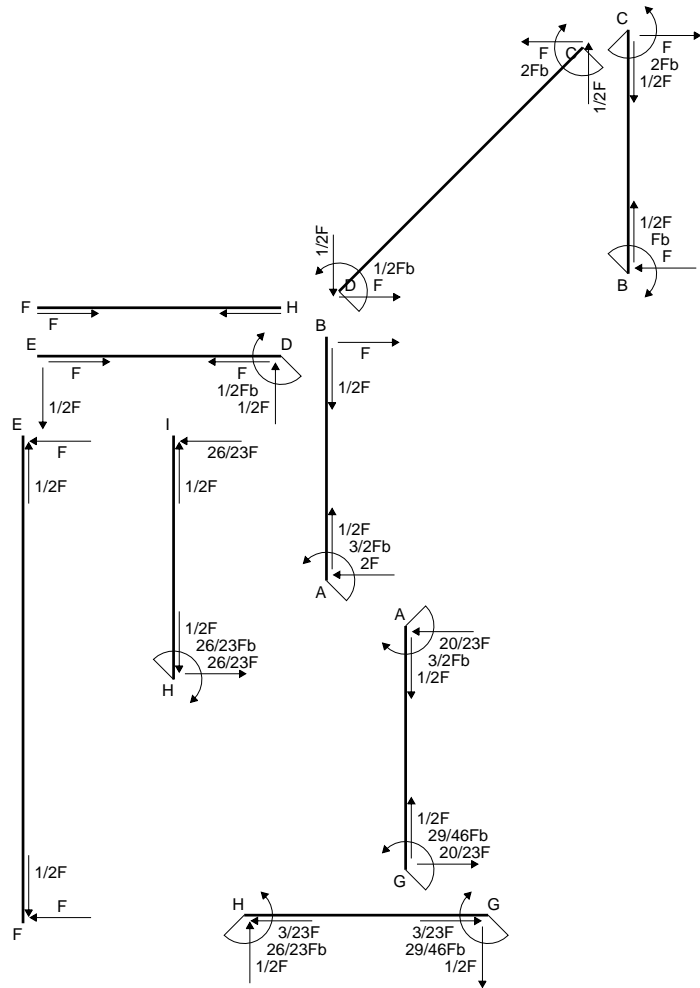
$$= (1/2 b - 1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$

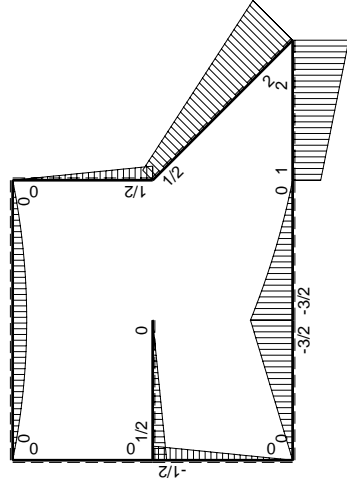
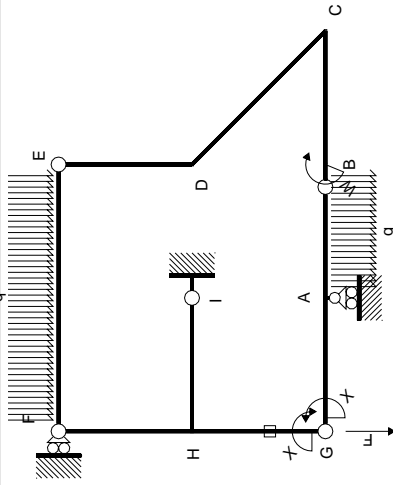
$$L_{GH}^{xo} = \int_0^b (1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$

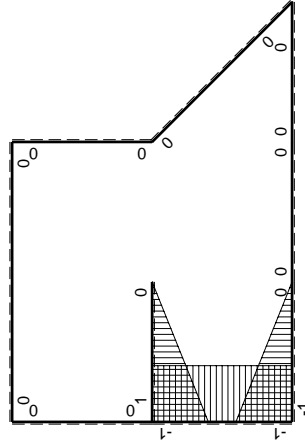


- A = 173.6 mm²
- J_u = 64622. mm⁴
- J_v = 18662. mm⁴
- J_t = 154.6 mm⁴
- y_o = 11.64 mm
- y_g = 27.47 mm
- N = -805. N
- T_y = 1610. N
- M_x = -458850. Nmm
- x_m = 12. mm
- u_m = -12. mm
- v_m = -27.47 mm
- σ_m = N/A-Mv/J_u = -199.7 N/mm²
- x_c = 24. mm
- v_c = -27.47 mm
- σ_c = N/A-Mv/J_u = -199.7 N/mm²
- τ_c = TS_t/J_u = 29.57 N/mm²
- τ_g = TS_t/J_u = 29.57 N/mm²
- t_c = 1610. mm
- σ_o = √σ²+3τ² = 206.2 N/mm²





(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int M_x M_x / E J dx$	
AB b	0	$-3/2Fb+2Fx-1/2qx^2$	0	0	0	0	
BA b	0	$Fx+1/2qx^2$	0	0	0	0	
BC b	0	$Fb+Fx$	0	0	0	0	
CB b	0	$-2Fb+Fx$	0	0	0	0	
CD $\sqrt{2}b$	0	$2Fb-3\sqrt{2}/4Fx$	0	0	0	0	
DE b	0	$1/2Fb-1/2Fx$	0	0	0	0	
ED b	0	$-1/2Fx$	0	0	0	0	
EF 2b	0	$-Fx+1/2qx^2$	0	0	0	0	
FE 2b	0	$Fx-1/2qx^2$	0	0	0	0	
GA b	$-1+x/b$	$-3/2Fx$	$3/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/4Fb^2/EJ$	$1/3Xb/EJ$	
AG b	x/b	$3/2Fb-3/2Fx$	$3/2Fx-3/2Fx^2/b$	x^2/b^2	$1/4Fb^2/EJ$	$1/3Xb/EJ$	
FH b	0	0	0	0	0	0	
HF b	0	0	0	0	0	0	
HI b	$1-x/b$	$1/2Fb-1/2Fx$	$1/2Fb-Fx+1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$	
IH b	$-x/b$	$-1/2Fx$	$1/2Fx^2/b$	x^2/b^2	$1/4Fb^2/EJ$	Xb/EJ	
HG b	-1	$-1/2Fb+1/2Fx$	$1/2Fb-1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ	
GH b	1	$1/2Fx$	$1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ	
HG	elongazione asta $N_{1HG}^{HG} \rightarrow HG$						
A	molla nodo $-V_{1A}(V_{GA}+XV_{1A})/k_A$						
totali						$-29/24Fb^2/EJ$	$23/12Xb/EJ$
iperstatica $X=W_{GA}$						$29/46Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

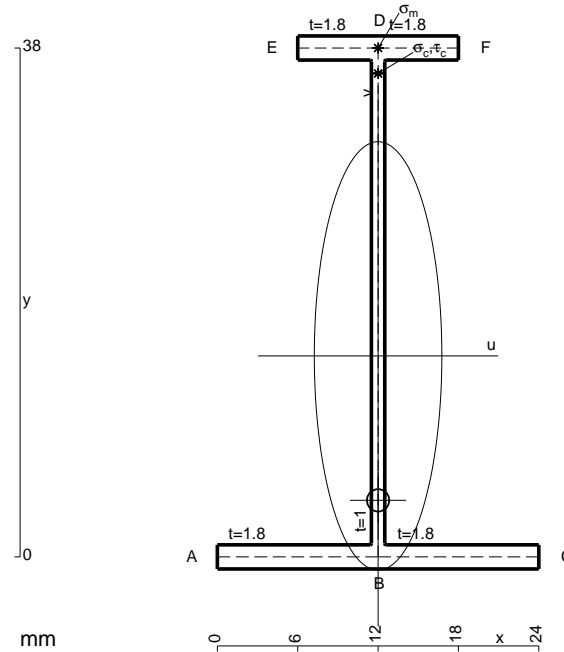
$$L_{HG}^{xo} = \int_0^b (1/2 - 1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/2 x - 1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

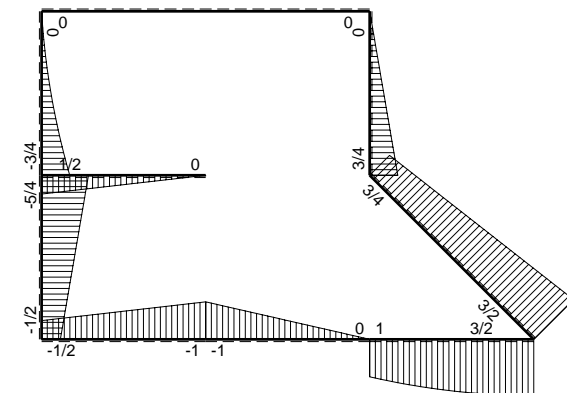
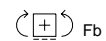
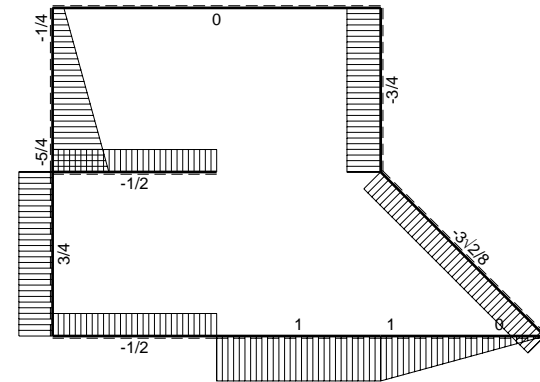
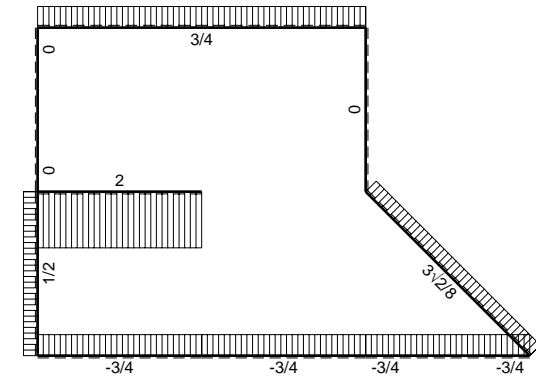
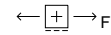
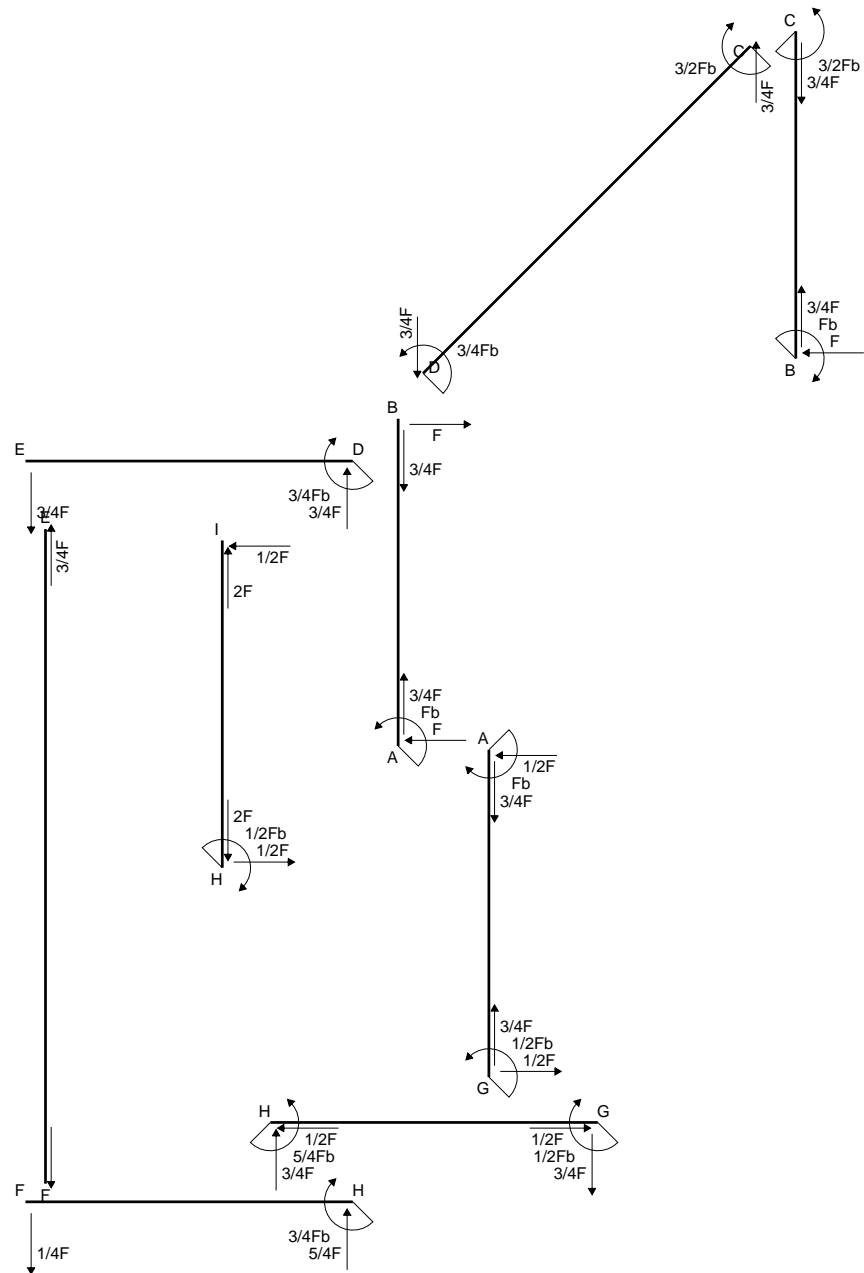
$$= (1/2 b - 1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$

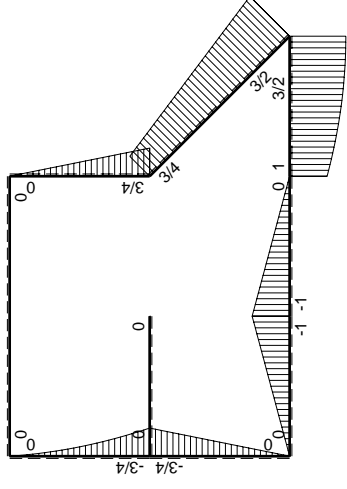
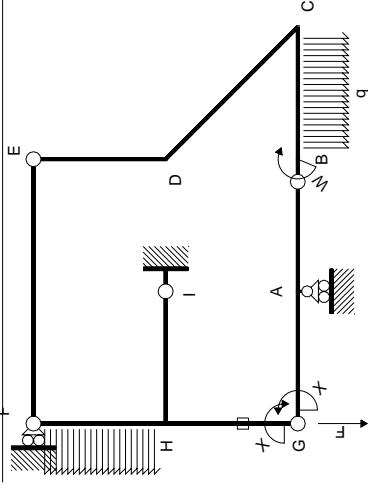
$$L_{GH}^{xo} = \int_0^b (1/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -3/4 Fb^2/EJ$$

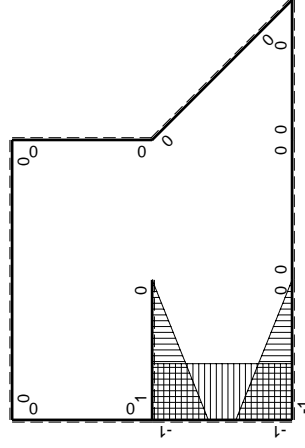


- A = 102.8 mm²
- J_u = 26327. mm⁴
- J_v = 2333. mm⁴
- J_t = 82.65 mm⁴
- y_o = -10.79 mm
- y_g = 15.01 mm
- N = -155. N
- T_y = 620. N
- M_x = -237150. Nmm
- x_m = 12. mm
- y_m = 38. mm
- v_m = 22.99 mm
- σ_m = N/A-Mv/J_u = 205.6 N/mm²
- y_c = 2. mm
- u_c = -12. mm
- v_c = -13.01 mm
- σ_c = N/A-Mv/J_u = 205.6 N/mm²
- τ_c = TS/tJ_u = 11.7 N/mm²
- τ_g = TS/tJ_u = 11.7 N/mm²
- t_c = 310. mm
- σ_o = √σ²+3τ² = 206.6 N/mm²





(+) M_0 flessione da carichi assegnati



Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-Fb+Fx	0	0	0	0
BA b	0	Fx	0	0	0	0
BC b	0	Fb+Fx-1/2qx ²	0	0	0	0
CB b	0	-3/2Fb+1/2qx ²	0	0	0	0
CD $\sqrt{2}b$	0	3/2Fb-3 $\sqrt{2}$ /8Fx	0	0	0	0
DE b	0	3/4Fb-3/4Fx	0	0	0	0
ED b	0	-3/4Fx	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	-1+x/b	-Fx	Fx-Fx ² /b	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	Fb-Fx	Fx-Fx ² /b	x^2/b^2	$1/6Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	-1/4Fx-1/2qx ²	0	0	0	0
HF b	0	3/4Fb-5/4Fx+1/2qx ²	0	0	0	0
HI b	1-x/b	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
IH b	-x/b	0	0	x^2/b^2	0	$1/3Xb/EJ$
HG b	-1	-3/4Fb+3/4Fx	3/4Fb-3/4Fx	1	3/8Fb ² /EJ	Xb/EJ
GH b	1	3/4Fx	3/4Fx	1	3/8Fb ² /EJ	Xb/EJ
HG	elongazione asta N_{1HG}^{HG-HG}				-Fb ² /EJ	
A	molla nodo $-V_{1A}(V_{GA}+XV_{1A})/k_A$				-1/2Fb ² /EJ	1/4Xb/EJ
	totali				-23/24Fb ² /EJ	23/12Xb/EJ
	iperstatica $X=W_{GA}$				1/2Fb	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{x_0} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{AG}^{x_0} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

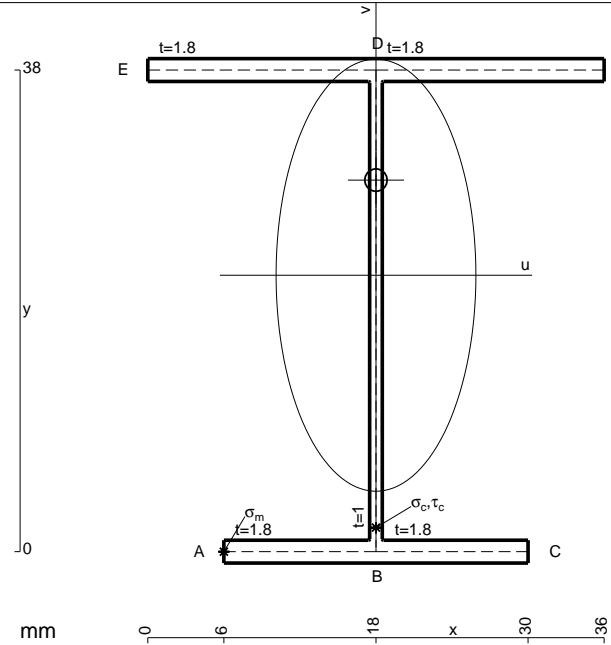
$$L_{HG}^{x_0} = \int_0^b (3/4 - 3/4 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [3/4 x - 3/8 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

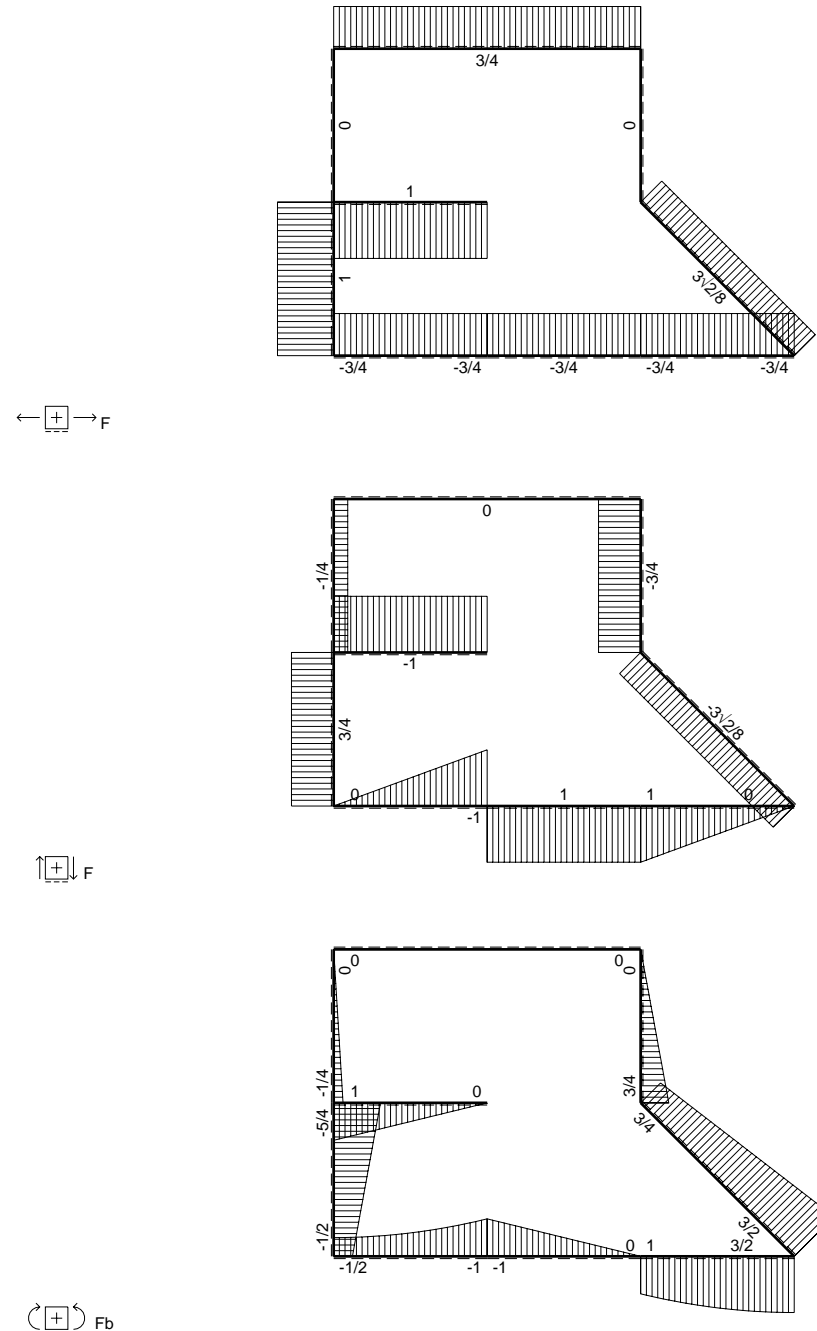
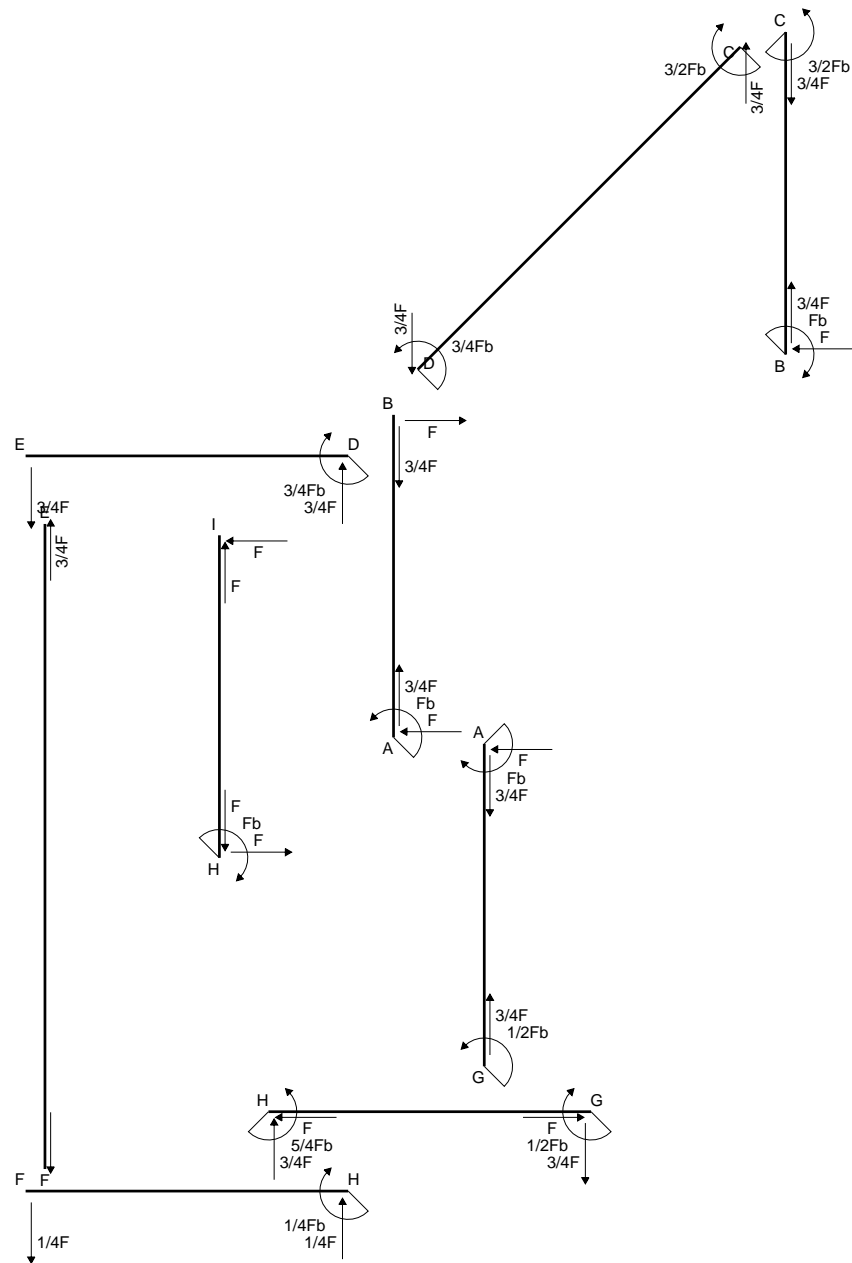
$$= (3/4 b - 3/8 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/8 Fb^2/EJ$$

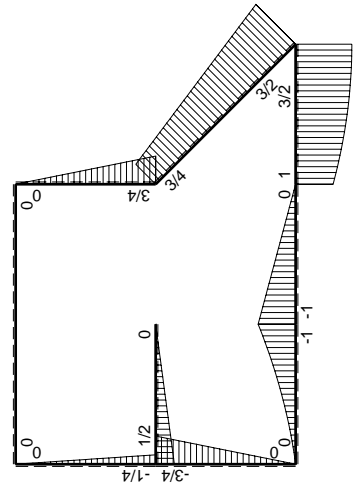
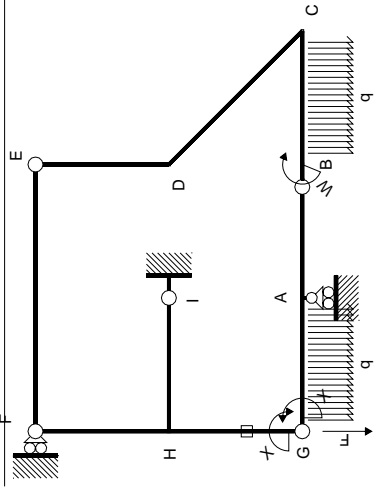
$$L_{GH}^{x_0} = \int_0^b (3/4 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [3/8 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (3/8 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/8 Fb^2/EJ$$

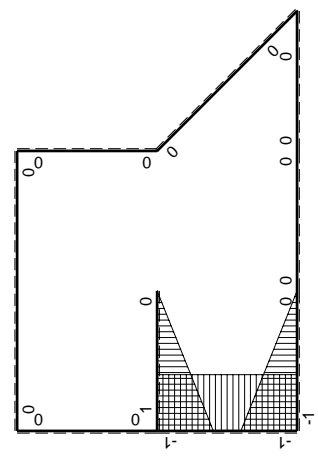


- A = 146. mm²
- J_u = 42407. mm⁴
- J_v = 9072. mm⁴
- J_t = 129.3 mm⁴
- y_o = 7.503 mm
- y_g = 21.81 mm
- N = -577.5 N
- T_y = 770. N
- M_x = -415800. Nmm
- x_m = 6. mm
- u_m = -12. mm
- v_m = -21.81 mm
- σ_m = N/A-Mv/J_u = -217.8 N/mm²
- x_c = 18. mm
- v_c = -21.81 mm
- σ_c = N/A-Mv/J_u = -217.8 N/mm²
- τ_c = TS'/tJ_u = 17.11 N/mm²
- τ_g = TS'/tJ_u = 17.11 N/mm²
- t_c = 770. mm
- σ_o = √σ²+3τ² = 219.8 N/mm²





(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-Fb+Fx	0	0	0	0
BA b	0	Fx	0	0	0	0
BC b	0	Fb+Fx-1/2qx ²	0	0	0	0
CB b	0	-3/2Fb+1/2qx ²	0	0	0	0
CD $\sqrt{2}b$	0	3/2Fb-3 $\sqrt{2}$ 8Fx	0	0	0	0
DE b	0	3/4Fb-3/4Fx	0	0	0	0
ED b	0	-3/4Fx	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	-1+x/b	-1/2Fx-1/2qx ²	1/2Fx-1/2qx ³ /b	1-2x/b+x ² /b ²	1/8Fb ² /EJ	1/3Xb/EJ
AG b	x/b	Fb-3/2Fx+1/2qx ²	Fx-3/2Fx ² /b+1/2qx ³ /b	x ² /b ²	1/8Fb ² /EJ	1/3Xb/EJ
FH b	0	-1/4Fx	0	0	0	0
HF b	0	1/4Fb-1/4Fx	0	0	0	0
HI b	1-x/b	1/2Fb-1/2Fx	1/2Fb-Fx+1/2Fx ² /b	1-2x/b+x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
IH b	-x/b	-1/2Fx	1/2Fx ² /b	x ² /b ²	1/6Fb ² /EJ	1/3Xb/EJ
HG b	-1	-3/4Fb+3/4Fx	3/4Fb-3/4Fx	1	3/8Fb ² /EJ	Xb/EJ
GH b	1	3/4Fx	3/4Fx	1	3/8Fb ² /EJ	Xb/EJ
HG	elongazione asta N_{1HG}^{HG}				-Fb ² /EJ	
A	molla nodo $-V_{1A}(V_{0A}+XV_{1A})/k_A$				-5/8Fb ² /EJ	1/4Xb/EJ
	totali				-23/24Fb ² /EJ	23/12Xb/EJ
	iperstatica $X=W_{GA}$				1/2Fb	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (1/2 x/b - 1/2 x^3/b^3) Fb 1/EJ dx = [1/4 x^2/b - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (x/b - 3/2 x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [1/2 x^2/b - 1/2 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/8 b) Fb 1/EJ = 1/8 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1/2 - x/b + 1/2 x^2/b^2) Fb 1/EJ dx = [1/2 x - 1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/2 b + 1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (1/2 x^2/b^2) Fb 1/EJ dx = [1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/6 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

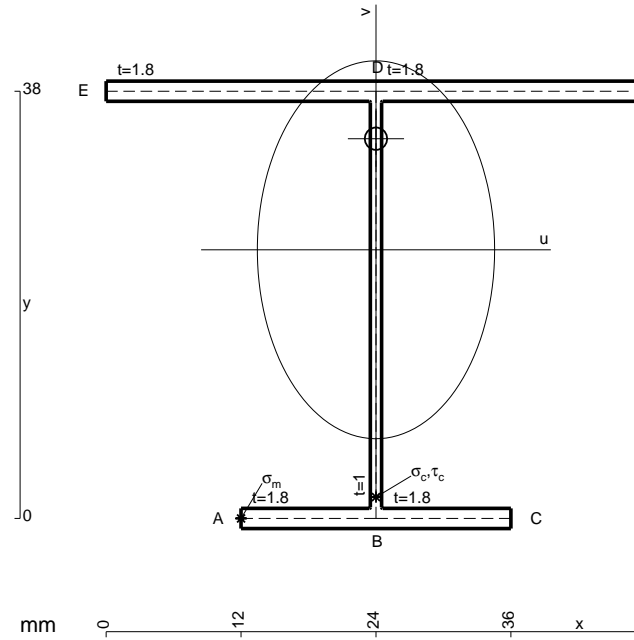
$$L_{HG}^{xo} = \int_0^b (3/4 - 3/4 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [3/4 x - 3/8 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

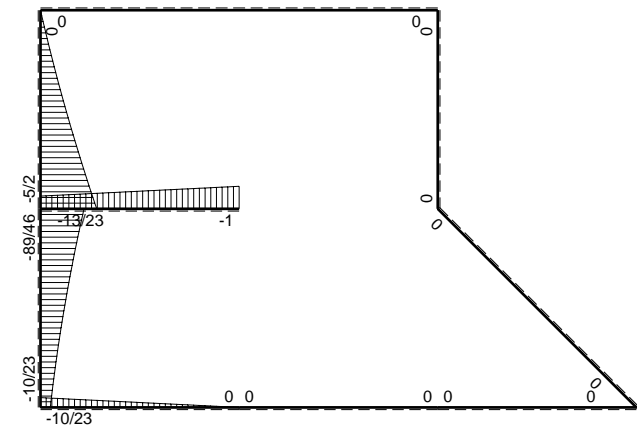
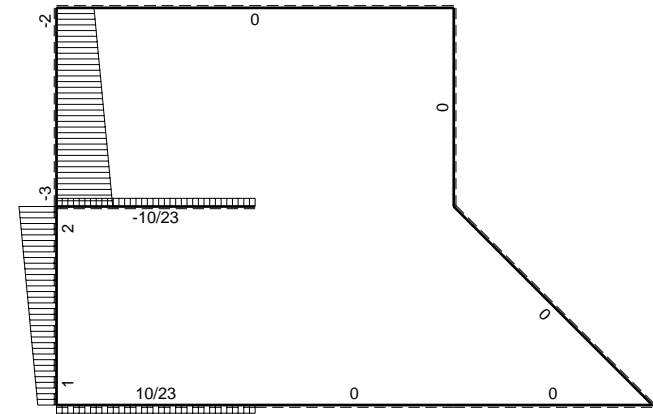
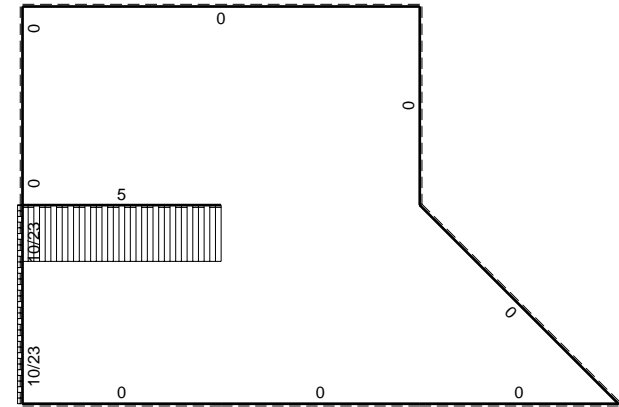
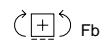
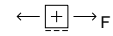
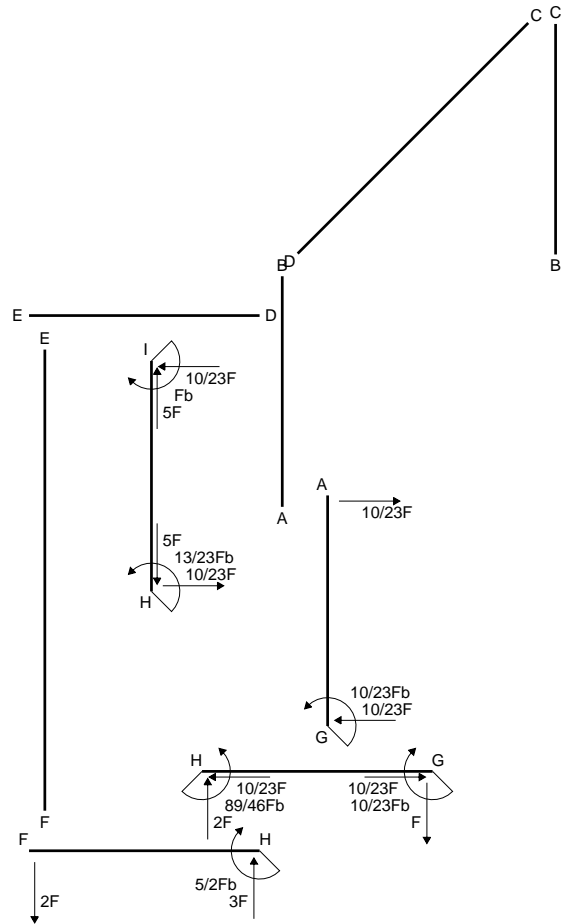
$$= (3/4 b - 3/8 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/8 Fb^2/EJ$$

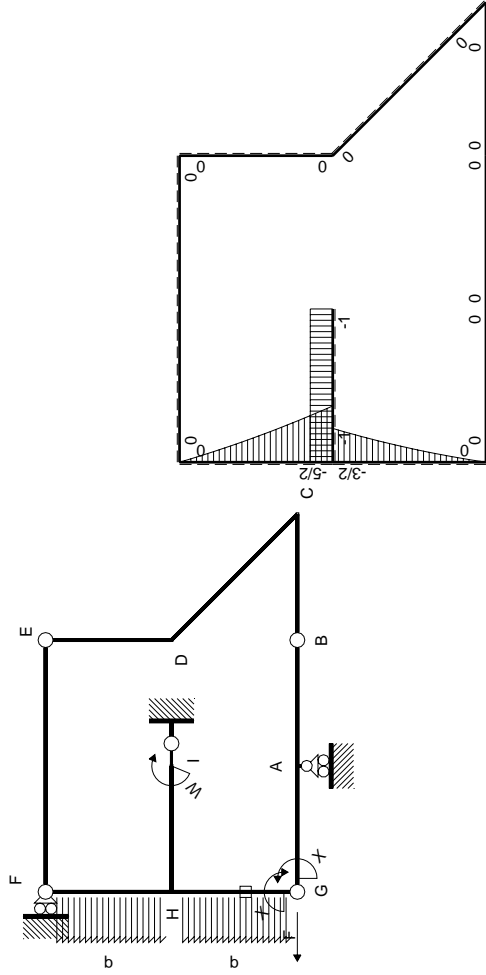
$$L_{GH}^{xo} = \int_0^b (3/4 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [3/8 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (3/8 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -5/8 Fb^2/EJ$$



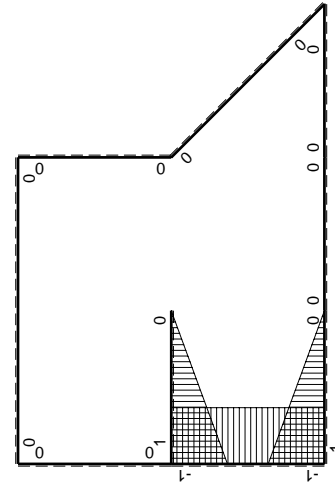
- A = 167.6 mm²
- J_u = 47339. mm⁴
- J_v = 18662. mm⁴
- J_t = 152.6 mm⁴
- y_o = 9.88 mm
- y_g = 23.9 mm
- N = -585. N
- T_y = 780. N
- M_x = -444600. Nmm
- x_m = 12. mm
- u_m = -12. mm
- v_m = -23.9 mm
- σ_m = N/A-Mv/J_u = -227.9 N/mm²
- x_c = 24. mm
- v_c = -23.9 mm
- σ_c = N/A-Mv/J_u = -227.9 N/mm²
- τ_c = TS_t/J_u = 17.01 N/mm²
- τ_g = TS_t/J_u = 17.01 N/mm²
- t_c = 780. mm
- σ_o = √σ²+3τ² = 229.8 N/mm²





Schema di calcolo iperstatico

(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	0	0	0	0	0
BA b	0	0	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	0	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
AG b	x/b	0	0	x^2/b^2	0	
FH b	0	$-2Fx-1/2qx^2$	0	0	0	0
HF b	0	$5/2Fb-3Fx+1/2qx^2$	0	0	0	0
HI b	$1-x/b$	-Fb	-Fb+Fx	$1-2x/b+x^2/b^2$	$-1/2Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	Fb	-Fx	x^2/b^2		
HG b	-1	$-3/2Fb+2Fx-1/2qx^2$	$3/2Fb-2Fx+1/2Fx^2/b$	1	$2/3Fb^2/EJ$	Xb/EJ
GH b	1	$Fx+1/2qx^2$	$Fx+1/2Fx^2/b$	1		
HG	elongazione asta $N_{1HG}^{HG} - N_{HG}^{HG}$					
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$					
	totali					
	iperstatica $X=W_{GA}$					
					$-5/6Fb^2/EJ$	$23/12Xb/EJ$
					$10/23Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = \left[1/3 x^3/b^2 \right]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = \left[1/3 x^3/b^2 \right]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = \left[x \right]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = \left[x \right]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{HI}^{xo} = \int_0^b (-1 + x/b) Fb 1/EJ dx = \left[-x + 1/2 x^2/b \right]_0^b Fb 1/EJ$$

$$= (-b + 1/2 b) Fb 1/EJ = -1/2 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (-x/b) Fb 1/EJ dx = \left[-1/2 x^2/b \right]_0^b Fb 1/EJ$$

$$= (-1/2 b) Fb 1/EJ = -1/2 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (3/2 - 2x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 \quad (-1) \quad (-1) \quad Fb^2/EJ$$

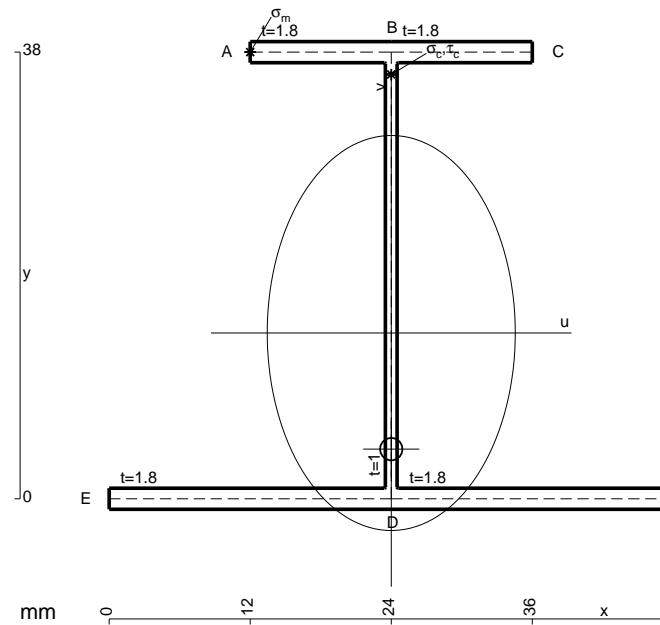
$$= \left[3/2 x - x^2/b + 1/6 x^3/b^2 \right]_0^b Fb 1/EJ - 1 \quad (-1) \quad (-1) \quad Fb^2/EJ$$

$$= (3/2 b - b + 1/6 b) Fb 1/EJ - 1 \quad (-1) \quad (-1) \quad Fb^2/EJ = -1/3 Fb^2/EJ$$

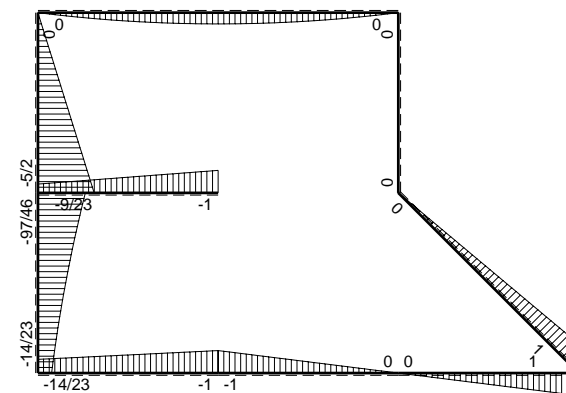
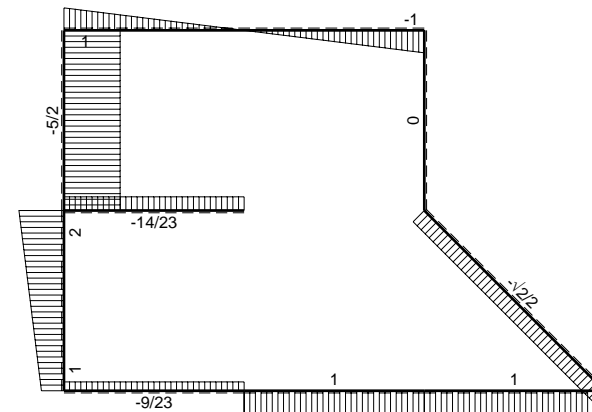
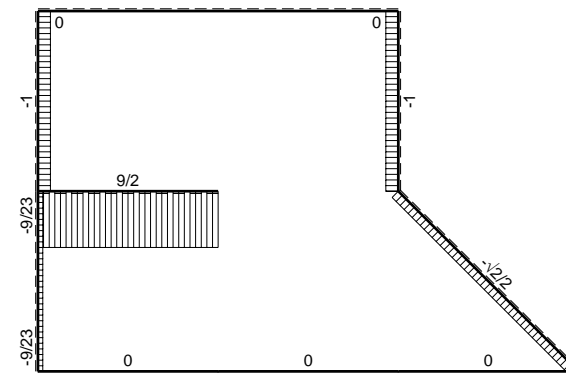
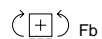
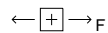
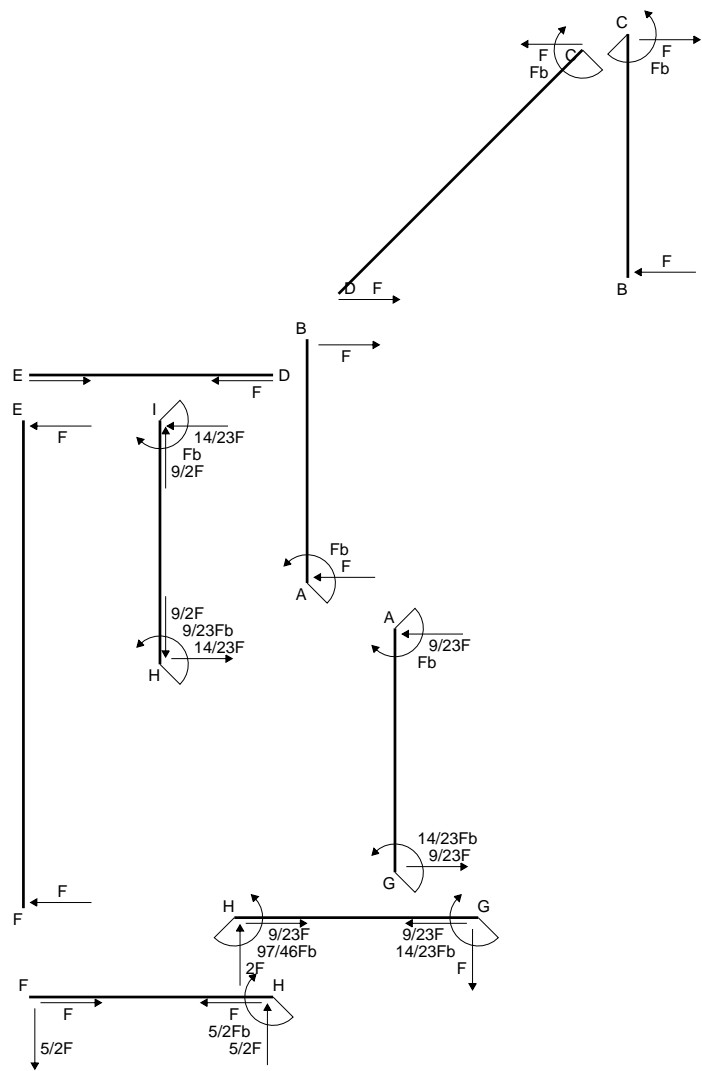
$$L_{GH}^{xo} = \int_0^b (x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 \quad (-1) \quad (-1) \quad Fb^2/EJ$$

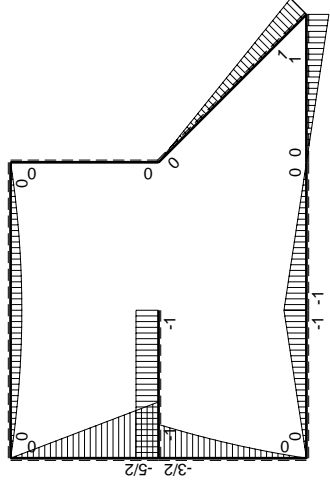
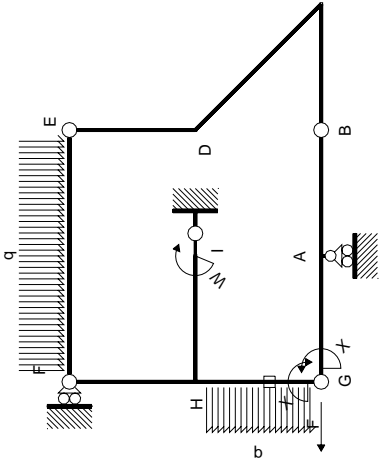
$$= \left[1/2 x^2/b + 1/6 x^3/b^2 \right]_0^b Fb 1/EJ - 1 \quad (-1) \quad (-1) \quad Fb^2/EJ$$

$$= (1/2 b + 1/6 b) Fb 1/EJ - 1 \quad (-1) \quad (-1) \quad Fb^2/EJ = -1/3 Fb^2/EJ$$

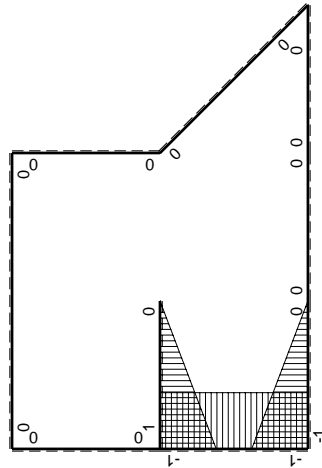


- A = 167.6 mm²
- J_u = 47339. mm⁴
- J_v = 18662. mm⁴
- J_i = 152.6 mm⁴
- y_o = -9.88 mm
- y_g = 14.1 mm
- T_y = -930. N
- M_x = -465000. Nmm
- x_m = 12. mm
- y_m = 38. mm
- u_m = -12. mm
- v_m = 23.9 mm
- σ_m = -M_y/J_u = 234.7 N/mm²
- x_c = 24. mm
- y_c = 38. mm
- v_c = 23.9 mm
- σ_c = -M_y/J_u = 234.7 N/mm²
- τ_c = T_S/t_{J_u} = 20.28 N/mm²
- τ_g = T_S/t_{J_u} = 20.28 N/mm²
- t_c = 310. mm
- σ_o = √σ²+3τ² = 237.4 N/mm²





(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-Fb+Fx	0	0	0	0
BA b	0	Fx	0	0	0	0
BC b	0	Fx	0	0	0	0
CB b	0	-Fb+Fx	0	0	0	0
CD $\sqrt{2}b$	0	Fb- $\sqrt{2}/2Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	-Fx+ $1/2qx^2$	0	0	0	0
FE 2b	0	Fx- $1/2qx^2$	0	0	0	0
GA b	-1+x/b	-Fx	Fx-Fx $^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	Fb-Fx	Fx-Fx $^2/b$	x^2/b^2	$1/6Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	-5/2Fx	0	0	0	0
HF b	0	5/2Fb-5/2Fx	0	0	0	0
HI b	1-x/b	-Fb	-Fb+Fx	$1-2x/b+x^2/b^2$	$-1/2Fb^2/EJ$	$1/3Xb/EJ$
IH b	-x/b	Fb	-Fx	x^2/b^2	$-1/2Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	-3/2Fb+2Fx- $1/2qx^2$	$3/2Fb-2Fx+1/2Fx^2/b$	1	$2/3Fb^2/EJ$	Xb/EJ
GH b	1	Fx+ $1/2qx^2$	Fx+ $1/2Fx^2/b$	1	$2/3Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG}^{HG} \rightarrow HG$					
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$					
	totali					
	iperstatica $X=W_{GA}$					

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (-1 + x/b) Fb 1/EJ dx = [-x + 1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (-b + 1/2 b) Fb 1/EJ = -1/2 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (-x/b) Fb 1/EJ dx = [-1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (-1/2 b) Fb 1/EJ = -1/2 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (3/2 - 2x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

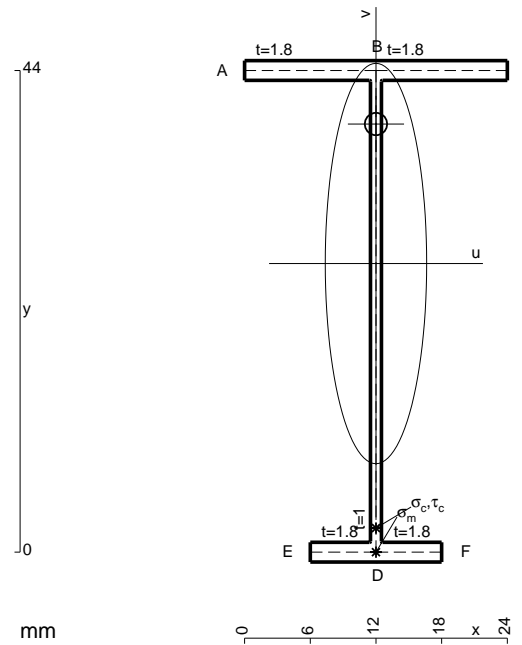
$$= [3/2 x - x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (3/2 b - b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/3 Fb^2/EJ$$

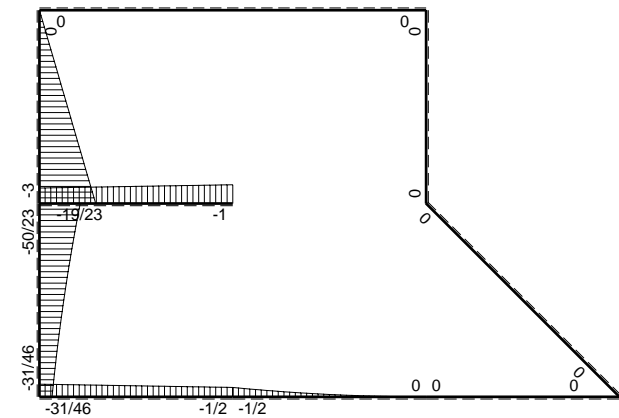
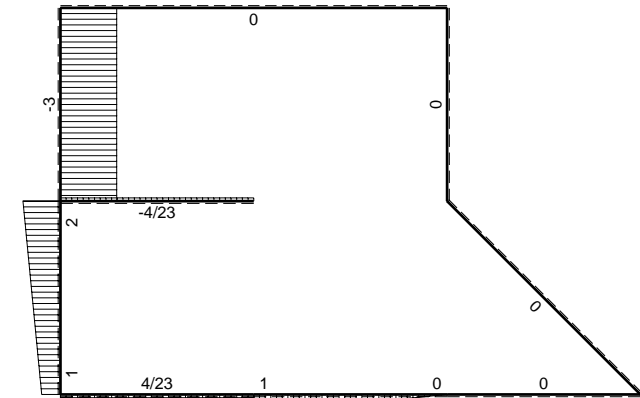
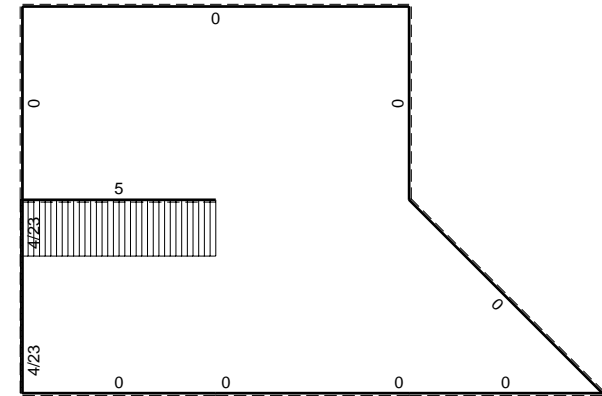
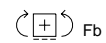
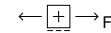
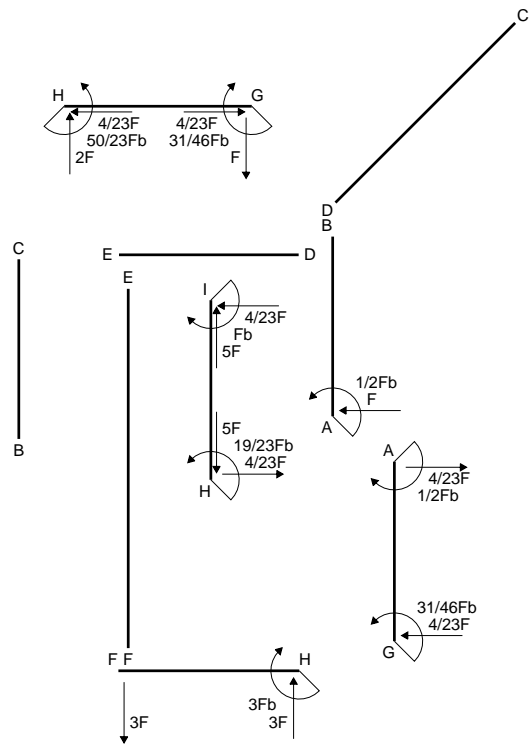
$$L_{GH}^{xo} = \int_0^b (x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

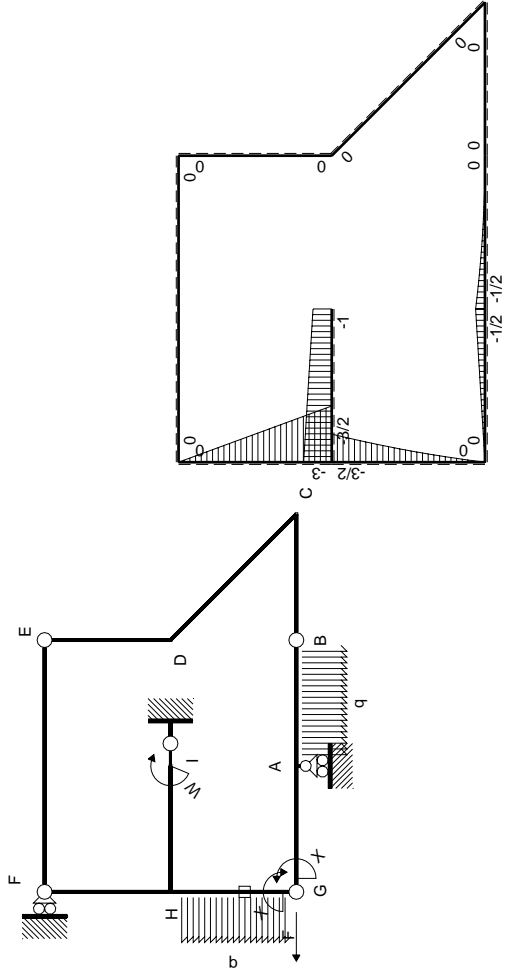
$$= [1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/3 Fb^2/EJ$$



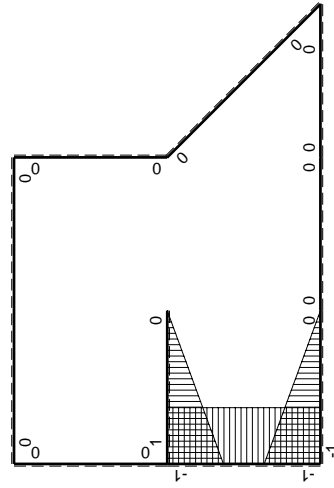
- A = 108.8 mm²
- J_u = 36386. mm⁴
- J_v = 2333. mm⁴
- J_t = 84.65 mm⁴
- y_o = 12.74 mm
- y_g = 26.37 mm
- N = -280. N
- T_y = -700. N
- M_x = -266000. Nmm
- x_m = 12. mm
- v_m = -26.37 mm
- σ_m = N/A - M_v/J_u = -195.3 N/mm²
- y_c = 3. mm
- u_c = -12. mm
- v_c = -23.37 mm
- σ_c = N/A - M_v/J_u = -195.3 N/mm²
- τ_c = T_s/t_u = 10.96 N/mm²
- τ_g = T_s/t_u = 10.96 N/mm²
- t_c = 280. mm
- σ_o = √σ² + 3τ² = 196.3 N/mm²





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-1/2Fb + Fx - 1/2qx^2$	0	0	0	0
BA b	0	$1/2qx^2$	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	0	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$-1/2Fx$	$1/2Fx - 1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$1/2Fb - 1/2Fx$	$1/2Fx - 1/2Fx^2/b$	x^2/b^2	$1/12Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$-3Fx$	0	0	0	0
HF b	0	$3Fb - 3Fx$	0	0	0	0
HI b	$1-x/b$	$-3/2Fb + 1/2Fx$	$-3/2Fb + 2Fx - 1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$-2/3Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$Fb + 1/2Fx$	$-Fx - 1/2Fx^2/b$	x^2/b^2	$-2/3Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	$-3/2Fb + 2Fx - 1/2qx^2$	$3/2Fb - 2Fx + 1/2Fx^2/b$	1	$2/3Fb^2/EJ$	Xb/EJ
GH b	1	$Fx + 1/2qx^2$	$Fx + 1/2Fx^2/b$	1	$2/3Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG} = N_{HG} - HG$					
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$					
	totali					
	iperstatica X=W _{GA}					

Sviluppi di calcolo iperstatico

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (-3/2 + 2x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [-3/2 x + x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-3/2 b + b - 1/6 b) Fb 1/EJ = -2/3 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (-x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b - 1/6 b) Fb 1/EJ = -2/3 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (3/2 - 2x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

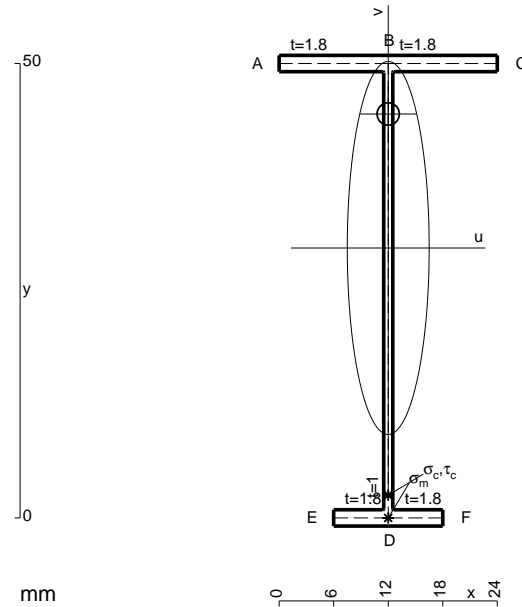
$$= [3/2 x - x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (3/2 b - b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/3 Fb^2/EJ$$

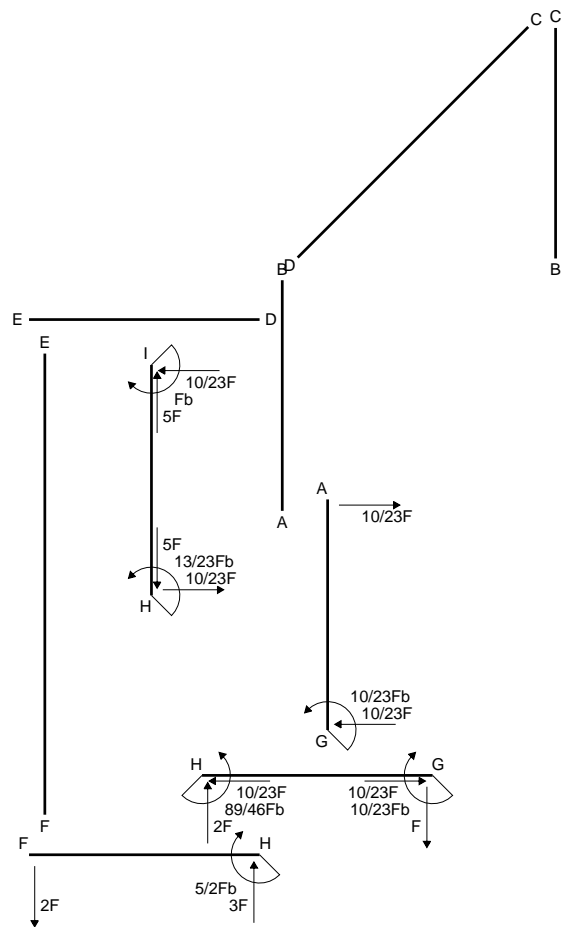
$$L_{GH}^{xo} = \int_0^b (x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

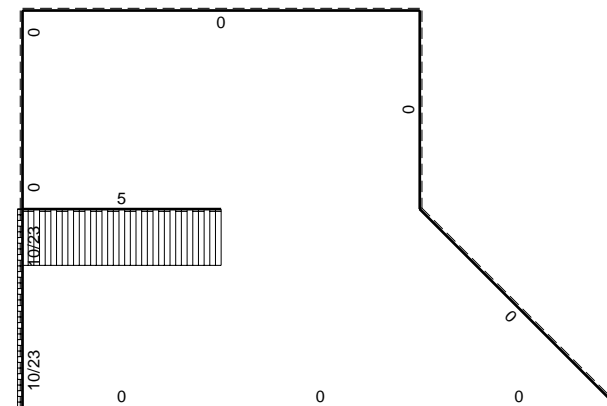
$$= (1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/3 Fb^2/EJ$$



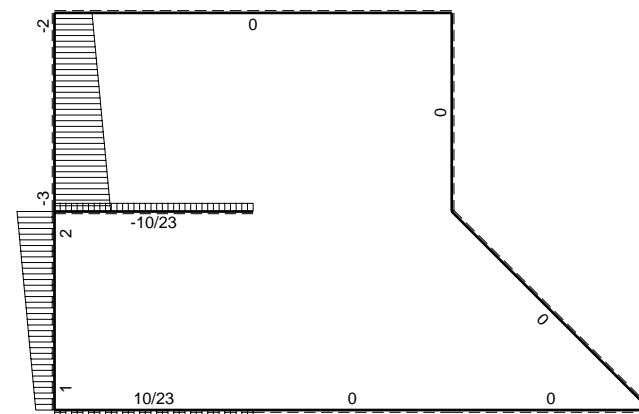
- A = 114.8 mm²
- J_u = 48377. mm⁴
- J_v = 2333. mm⁴
- J_t = 86.65 mm⁴
- y_o = 14.74 mm
- y_g = 29.7 mm
- T_y = -720. N
- M_x = -338400. Nmm
- x_m = 12. mm
- v_m = -29.7 mm
- σ_m = -Mv/J_u = -207.8 N/mm²
- y_c = 3. mm
- u_c = -12. mm
- v_c = -26.7 mm
- σ_c = -Mv/J_u = -207.8 N/mm²
- τ_c = TS_y/tJ_u = 9.549 N/mm²
- τ_g = TS_y/tJ_u = 9.549 N/mm²
- t_c = 240. mm
- σ_o = √σ²+3τ² = 208.4 N/mm²



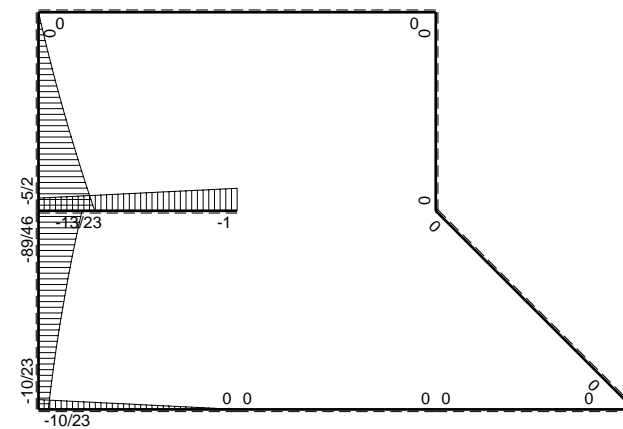
← ⊕ → F

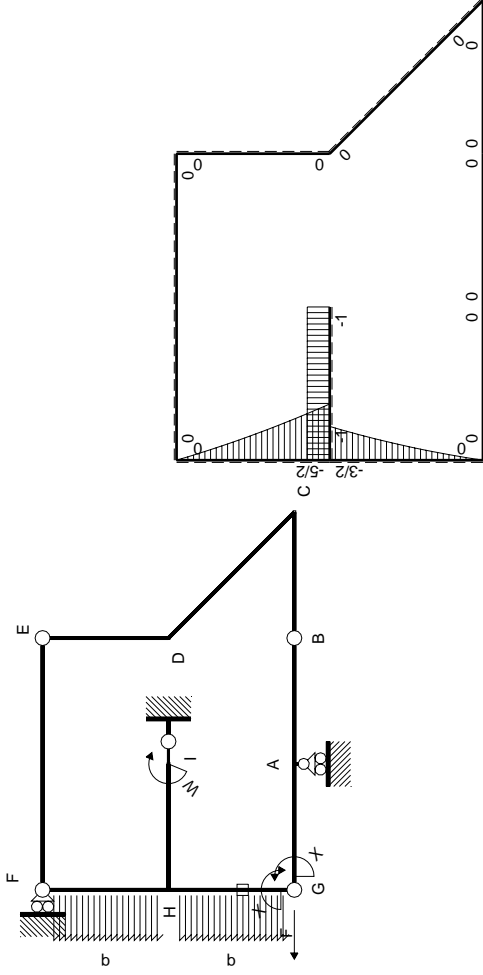


↑ ⊕ ↓ F



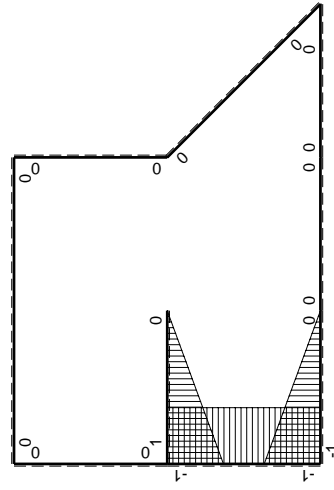
⊕ ⊖ Fb





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$	
AB b	0	0	0	0	0	0	
BA b	0	0	0	0	0	0	
BC b	0	0	0	0	0	0	
CB b	0	0	0	0	0	0	
CD $\sqrt{2}b$	0	0	0	0	0	0	
DE b	0	0	0	0	0	0	
ED b	0	0	0	0	0	0	
EF 2b	0	0	0	0	0	0	
FE 2b	0	0	0	0	0	0	
GA b	$-1+x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$	
AG b	x/b	0	0	x^2/b^2	0		
FH b	0	$-2Fx-1/2qx^2$	0	0	0	0	
HF b	0	$5/2Fb-3Fx+1/2qx^2$	0	0	0	0	
HI b	$1-x/b$	-Fb	-Fb+Fx	$1-2x/b+x^2/b^2$	$-1/2Fb^2/EJ$	$1/3Xb/EJ$	
IH b	$-x/b$	Fb	-Fx	x^2/b^2			
HG b	-1	$-3/2Fb+2Fx-1/2qx^2$	$3/2Fb-2Fx+1/2Fx^2/b$	1	$2/3Fb^2/EJ$	Xb/EJ	
GH b	1	$Fx+1/2qx^2$	$Fx+1/2Fx^2/b$	1			
HG	elongazione asta $N_{1HG}^{HG} - N_{1HG}^{HG}$						
A	molla nodo $-V_{1A}(V_{0A} + XV_{1A})/k_A$						
	totali						
	iperstatica X=W _{GA}						
					$-5/6Fb^2/EJ$	$23/12Xb/EJ$	
					$10/23Fb$		

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = \left[1/3 x^3/b^2 \right]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = \left[1/3 x^3/b^2 \right]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = \left[x \right]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = \left[x \right]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{HI}^{xo} = \int_0^b (-1 + x/b) Fb 1/EJ dx = \left[-x + 1/2 x^2/b \right]_0^b Fb 1/EJ$$

$$= (-b + 1/2 b) Fb 1/EJ = -1/2 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (-x/b) Fb 1/EJ dx = \left[-1/2 x^2/b \right]_0^b Fb 1/EJ$$

$$= (-1/2 b) Fb 1/EJ = -1/2 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (3/2 - 2x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 \quad (-1) \quad (-1) \quad Fb^2/EJ$$

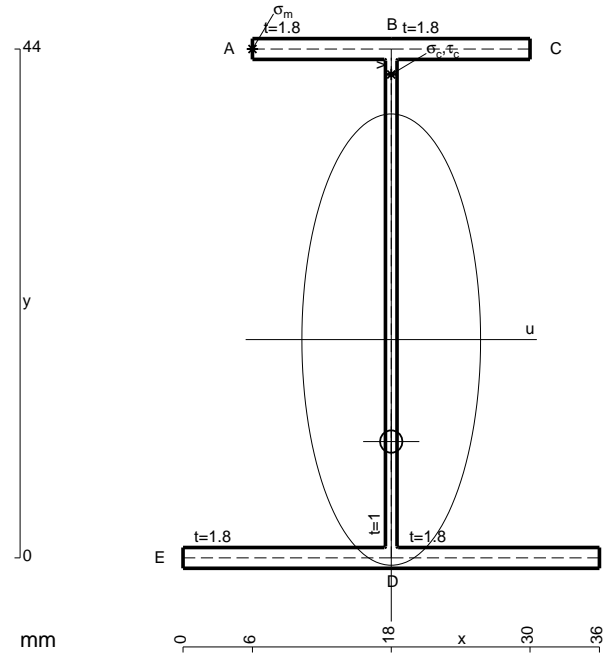
$$= \left[3/2 x - x^2/b + 1/6 x^3/b^2 \right]_0^b Fb 1/EJ - 1 \quad (-1) \quad (-1) \quad Fb^2/EJ$$

$$= (3/2 b - b + 1/6 b) Fb 1/EJ - 1 \quad (-1) \quad (-1) \quad Fb^2/EJ = -1/3 Fb^2/EJ$$

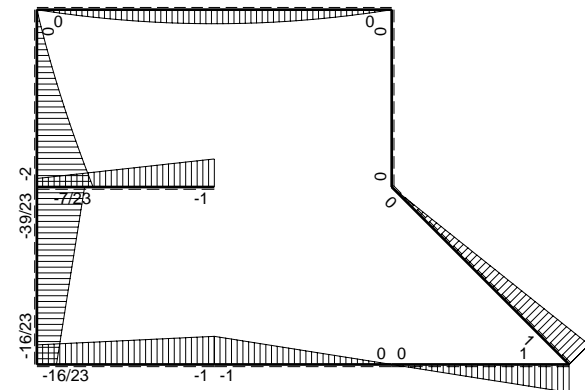
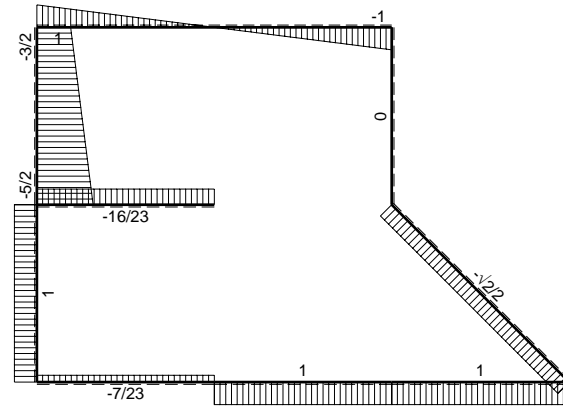
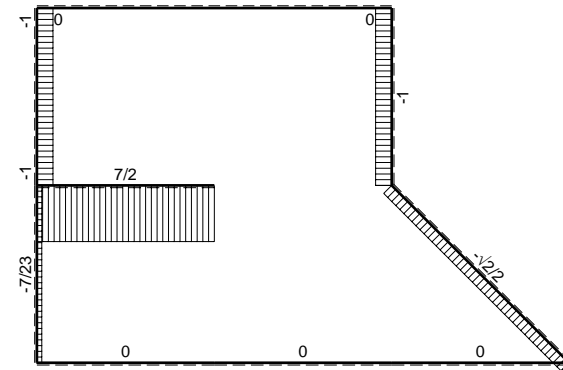
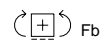
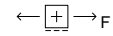
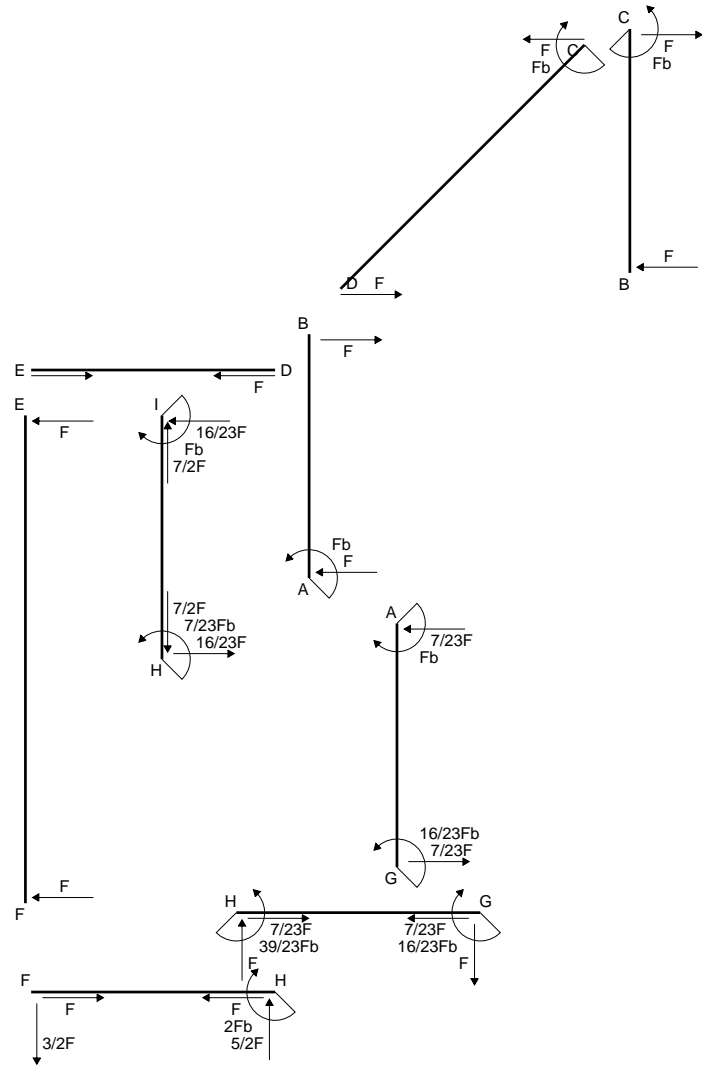
$$L_{GH}^{xo} = \int_0^b (x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 \quad (-1) \quad (-1) \quad Fb^2/EJ$$

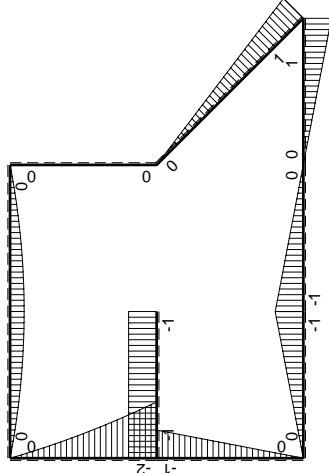
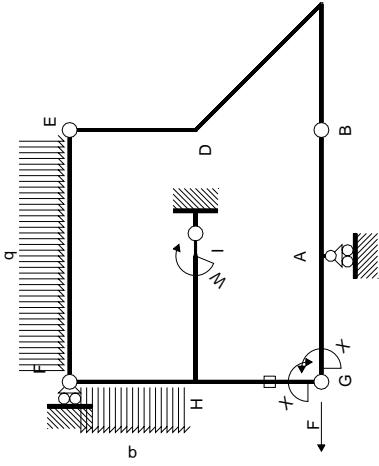
$$= \left[1/2 x^2/b + 1/6 x^3/b^2 \right]_0^b Fb 1/EJ - 1 \quad (-1) \quad (-1) \quad Fb^2/EJ$$

$$= (1/2 b + 1/6 b) Fb 1/EJ - 1 \quad (-1) \quad (-1) \quad Fb^2/EJ = -1/3 Fb^2/EJ$$

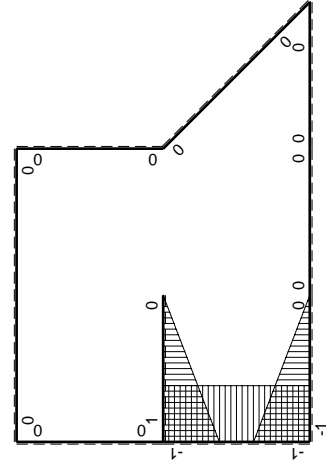


- A = 152. mm²
- J_u = 57885. mm⁴
- J_v = 9072. mm⁴
- J_i = 131.3 mm⁴
- y_o = -8.817 mm
- y_g = 18.87 mm
- T_y = -1350. N
- M_x = -506250. Nmm
- x_m = 6. mm
- y_m = 44. mm
- u_m = -12. mm
- v_m = 25.13 mm
- σ_m = -Mv/J_u = 219.7 N/mm²
- x_c = 18. mm
- y_c = 44. mm
- v_c = 25.13 mm
- σ_c = -Mv/J_u = 219.7 N/mm²
- τ_c = TS'/tJ_u = 25.32 N/mm²
- τ_g = TS'/tJ_u = 25.32 N/mm²
- t_c = 450. mm
- σ_o = √σ²+3τ² = 224.1 N/mm²





(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-Fb+Fx	0	0	0	0
BA b	0	Fx	0	0	0	0
BC b	0	Fx	0	0	0	0
CB b	0	-Fb+Fx	0	0	0	0
CD $\sqrt{2}b$	0	$Fb-\sqrt{2}/2Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	$-Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$Fx-1/2qx^2$	0	0	0	0
GA b	$-1+x/b$	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2	$1/6Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$-3/2Fx-1/2qx^2$	0	0	0	0
HF b	0	$2Fb-5/2Fx+1/2qx^2$	0	0	0	0
HI b	$1-x/b$	-Fb	$-Fb+Fx$	$1-2x/b+x^2/b^2$	$-1/2Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	Fb	-Fx	x^2/b^2	$-1/2Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	-Fb+Fx	Fb-Fx	1	$1/2Fb^2/EJ$	Xb/EJ
GH b	1	Fx	Fx	1	$1/2Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG^{\pm}HG^{\pm}HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{0A}+XV_{1A})/k_A$				$-1/2Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-4/3Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$16/23Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (-1 + x/b) Fb 1/EJ dx = [-x + 1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (-b + 1/2 b) Fb 1/EJ = -1/2 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (-x/b) Fb 1/EJ dx = [-1/2 x^2/b]_0^b Fb 1/EJ$$

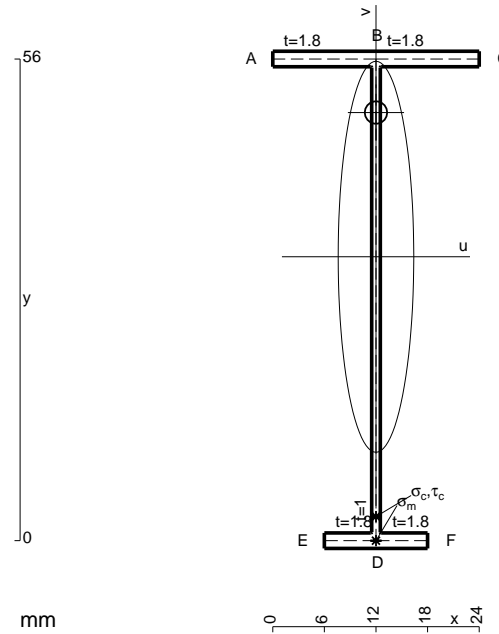
$$= (-1/2 b) Fb 1/EJ = -1/2 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [x - 1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

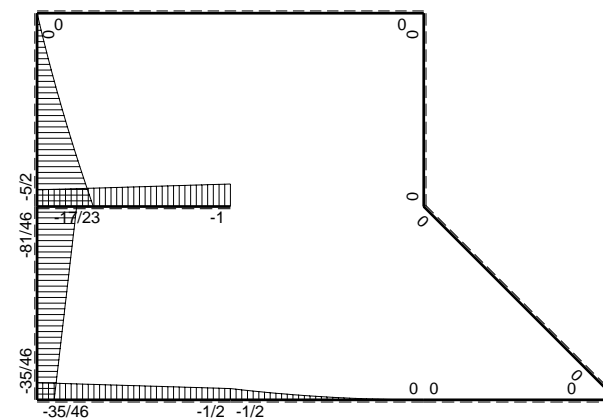
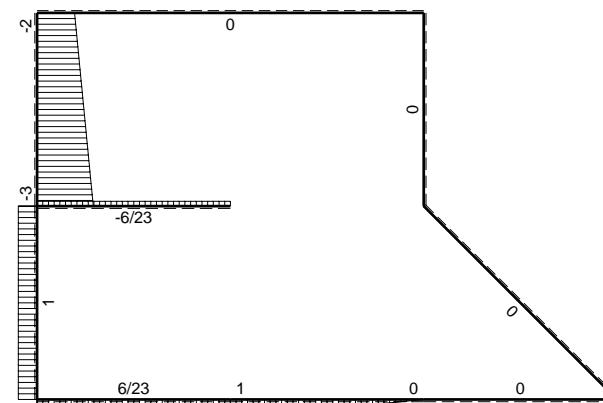
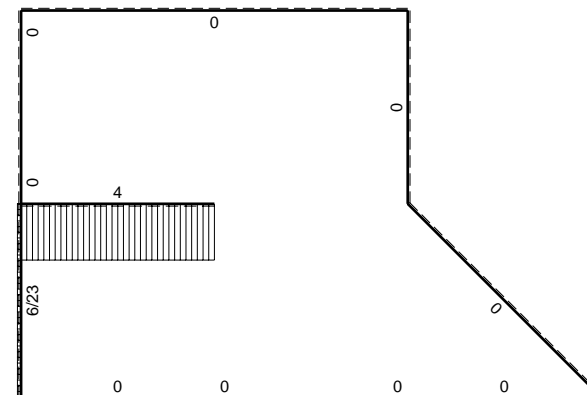
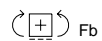
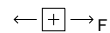
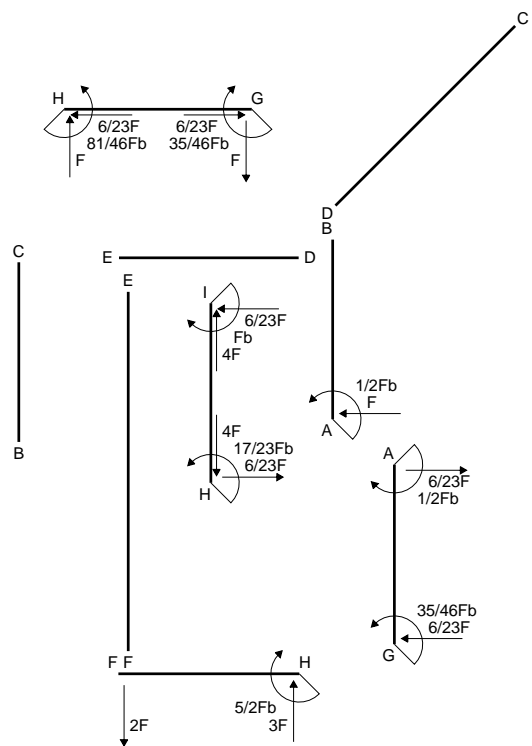
$$= (b - 1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$

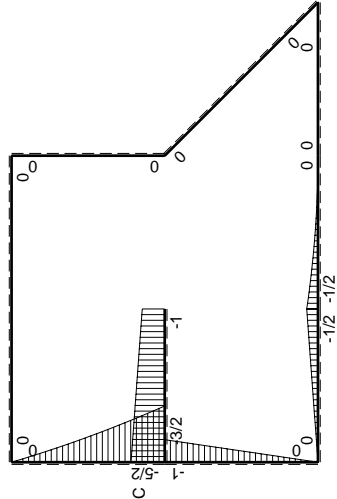
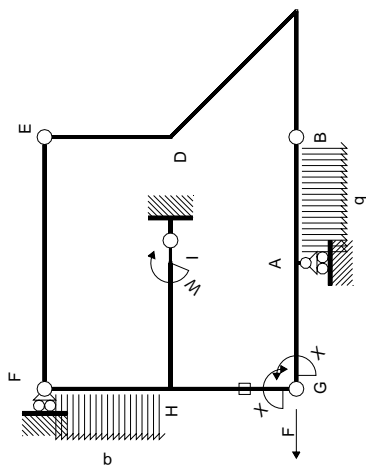
$$L_{GH}^{xo} = \int_0^b (x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$



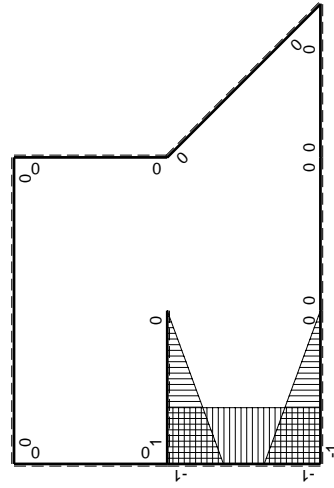
- A = 120.8 mm²
- J_u = 62410. mm⁴
- J_v = 2333. mm⁴
- J_t = 88.65 mm⁴
- y_o = 16.77 mm
- y_g = 33.01 mm
- N = -340. N
- T_y = -850. N
- M_x = -421600. Nmm
- x_m = 12. mm
- v_m = -33.01 mm
- σ_m = N/A - Mv/J_u = -225.8 N/mm²
- y_c = 3. mm
- u_c = -12. mm
- v_c = -30.01 mm
- σ_c = N/A - Mv/J_u = -225.8 N/mm²
- τ_c = TS_v/tJ_u = 9.71 N/mm²
- τ_g = TS_v/tJ_u = 9.71 N/mm²
- t_c = 340. mm
- σ_o = √σ² + 3τ² = 226.4 N/mm²





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-1/2Fb + Fx - 1/2qx^2$	0	0	0	0
BA b	0	$1/2qx^2$	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	0	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$-1/2Fx$	$1/2Fx - 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$1/2Fb - 1/2Fx$	$1/2Fx - 1/2Fx^2/b$	x^2/b^2		
FH b	0	$-2Fx - 1/2qx^2$	0	0	0	0
HF b	0	$5/2Fb - 3Fx + 1/2qx^2$	0	0	0	0
HI b	$1-x/b$	$-3/2Fb + 1/2Fx$	$-3/2Fb + 2Fx - 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$-2/3Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$Fb + 1/2Fx$	$-Fx - 1/2Fx^2/b$	x^2/b^2		
HG b	-1	$-Fb + Fx$	$Fb - Fx$	1	$1/2Fb^2/EJ$	Xb/EJ
GH b	1	Fx	Fx	1		
HG	elongazione asta $N_{1HG} = N_{HG} - HG$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$				$-3/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-35/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica X=W _{GA}				$35/46Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (-3/2 + 2x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [-3/2 x + x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-3/2 b + b - 1/6 b) Fb 1/EJ = -2/3 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (-x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

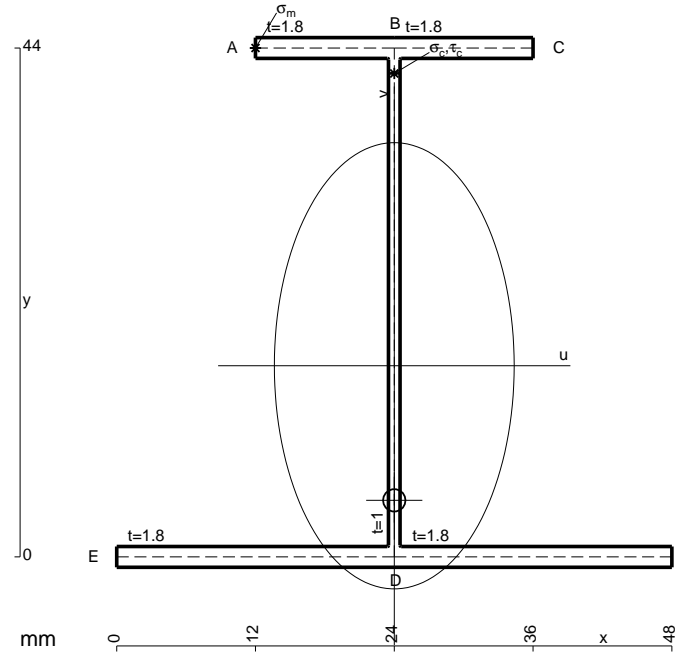
$$= (-1/2 b - 1/6 b) Fb 1/EJ = -2/3 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [x - 1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

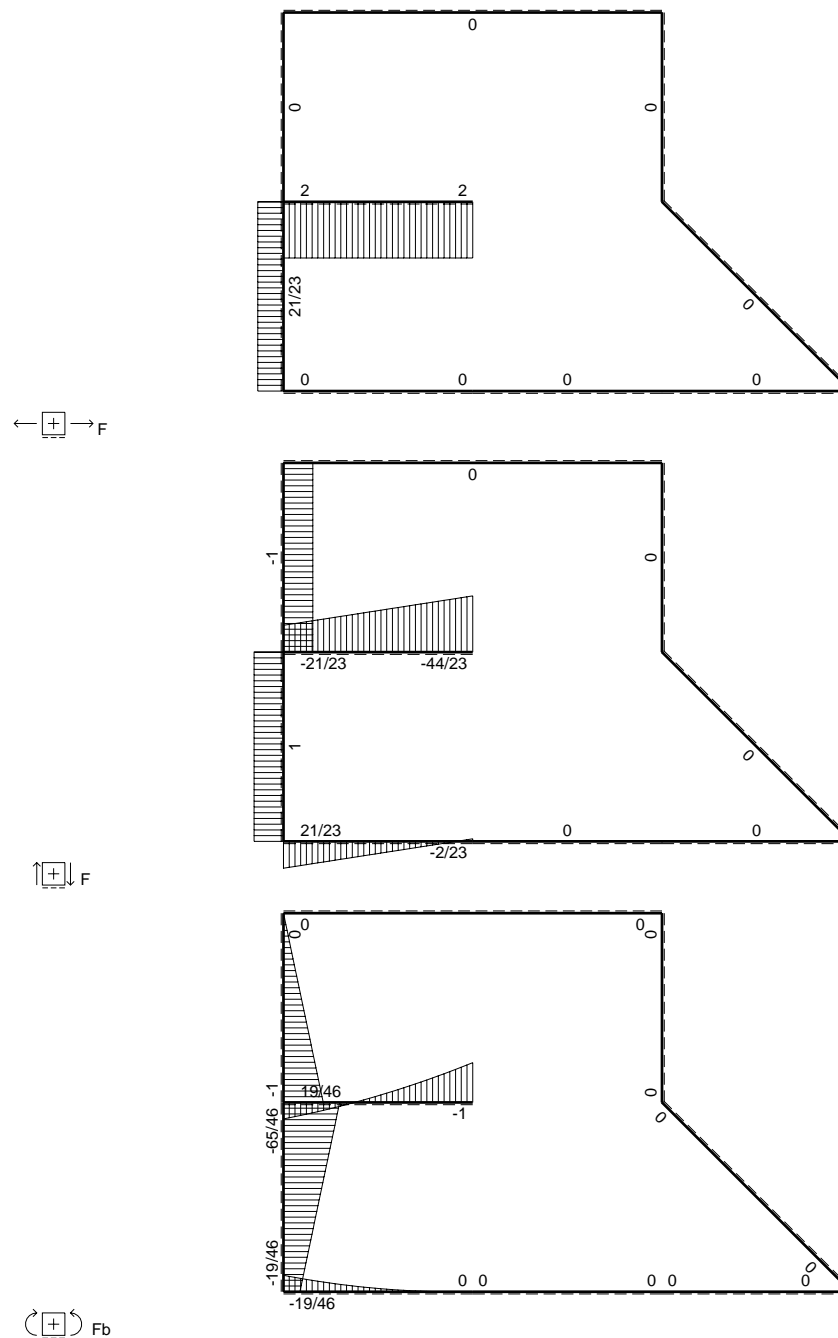
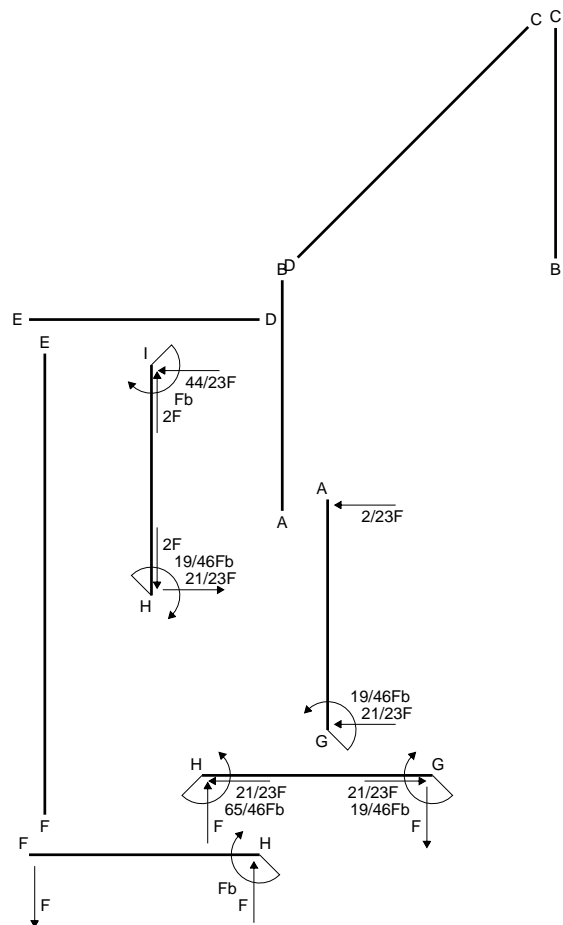
$$= (b - 1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$

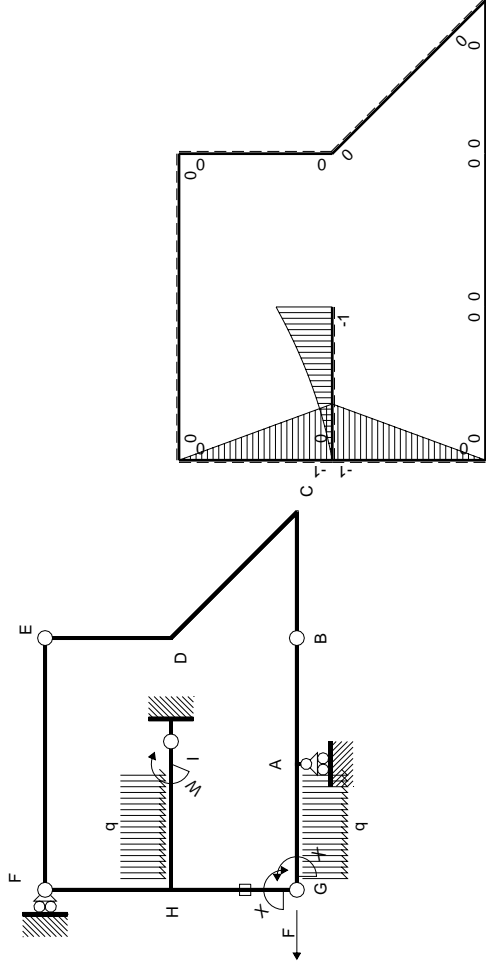
$$L_{GH}^{xo} = \int_0^b (x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$



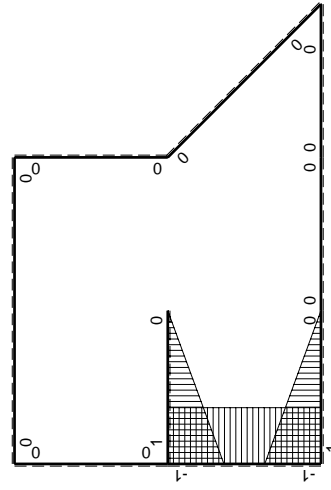
- A = 173.6 mm²
- J_u = 64622. mm⁴
- J_v = 18662. mm⁴
- J_t = 154.6 mm⁴
- y_o = -11.64 mm
- y_g = 16.53 mm
- T_y = -1260. N
- M_x = -556500. Nmm
- x_m = 12. mm
- y_m = 44. mm
- u_m = -12. mm
- v_m = 27.47 mm
- σ_m = -Mv/J_u = 236.6 N/mm²
- x_c = 24. mm
- y_c = 44. mm
- v_c = 27.47 mm
- σ_c = -Mv/J_u = 236.6 N/mm²
- τ_c = TS/tJ_u = 23.14 N/mm²
- τ_g = TS/tJ_u = 23.14 N/mm²
- t_c = 420. mm
- σ_o = √σ²+3τ² = 240. N/mm²





Schema di calcolo iperstatico

(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	0	0	0	0	0
BA b	0	0	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	0	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$1/2Fx-1/2qx^2$	$-1/2Fx+F^2/b-1/2qx^3/b$	$1-2x/b+x^2/b^2$	$-1/24Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$-1/2Fx+1/2qx^2$	$-1/2Fx^2/b+1/2qx^3/b$	x^2/b^2	$-1/24Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	-Fx	0	0	0	0
HF b	0	Fb-Fx	0	0	0	0
HI b	$1-x/b$	$-1/2Fx-1/2qx^2$	$-1/2Fx+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$-1/8Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$Fb-3/2Fx+1/2qx^2$	$-Fx+3/2Fx^2/b-1/2qx^3/b$	x^2/b^2	$-1/8Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	-Fb-Fx	Fb-Fx	1	$1/2Fb^2/EJ$	Xb/EJ
GH b	1	Fx	Fx	1	$1/2Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG^{\pm}HG^{\pm}HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{GA}+XV_{1A})/k_A$				$-1/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-19/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica X=W _{GA}				19/46Fb	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (-1/2 x/b + x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [-1/4 x^2/b + 1/3 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (-1/4 b + 1/3 b - 1/8 b) Fb 1/EJ = -1/24 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (-1/2 x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [-1/6 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (-1/6 b + 1/8 b) Fb 1/EJ = -1/24 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (-1/2 x/b + 1/2 x^3/b^3) Fb 1/EJ dx = [-1/4 x^2/b + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (-1/4 b + 1/8 b) Fb 1/EJ = -1/8 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (-x/b + 3/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [-1/2 x^2/b + 1/2 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

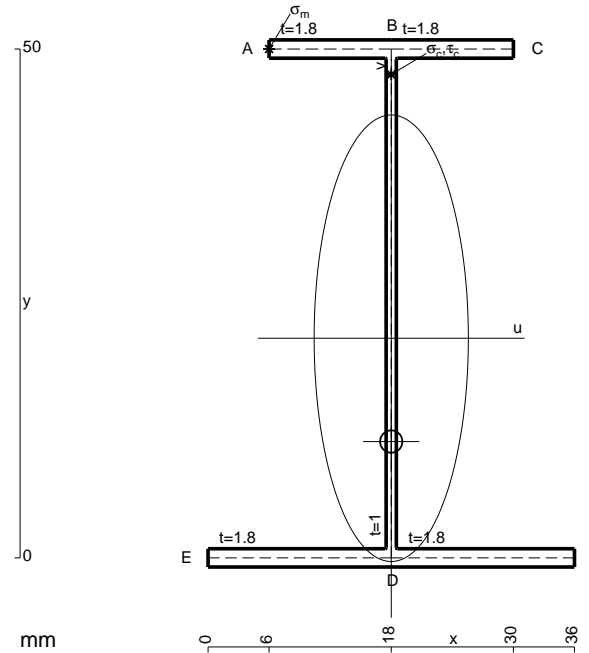
$$= (-1/2 b + 1/2 b - 1/8 b) Fb 1/EJ = -1/8 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [x - 1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

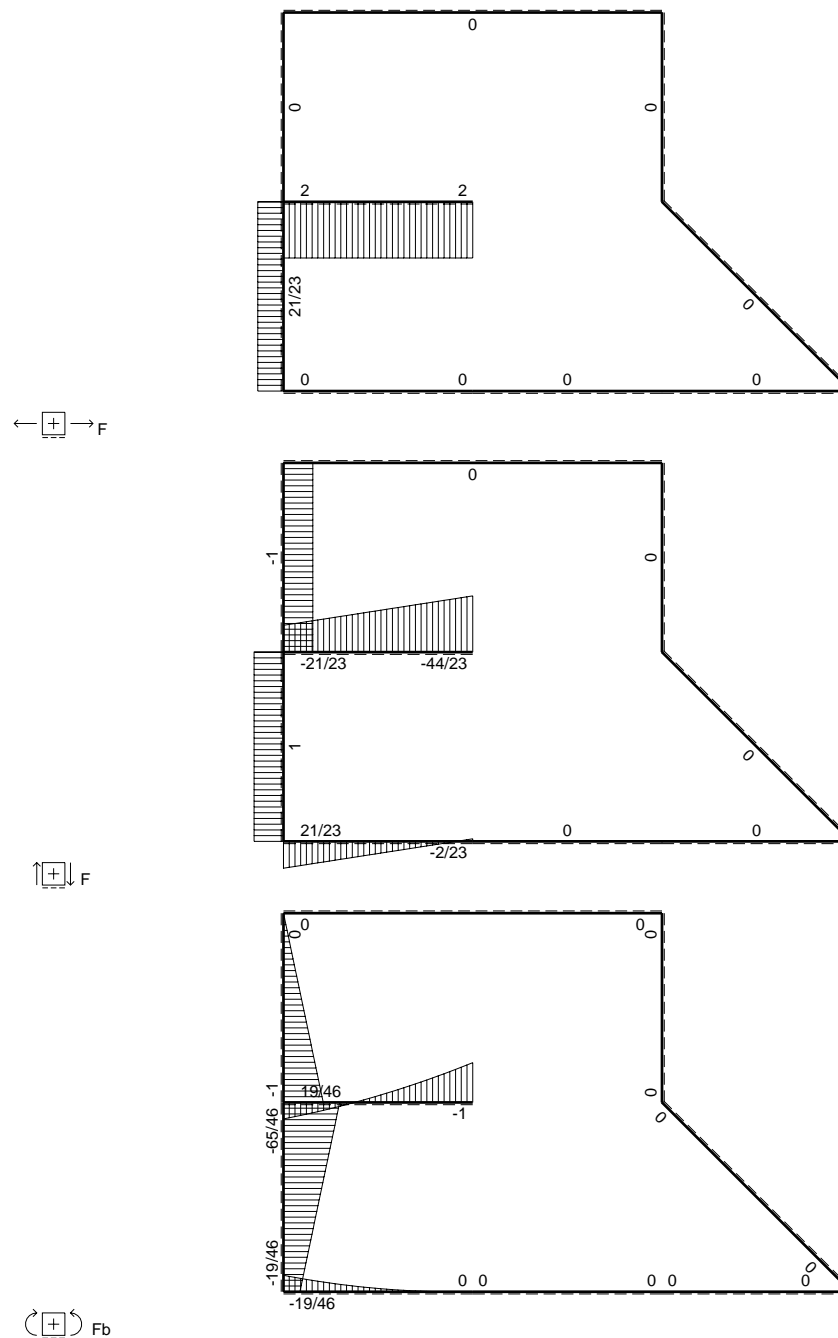
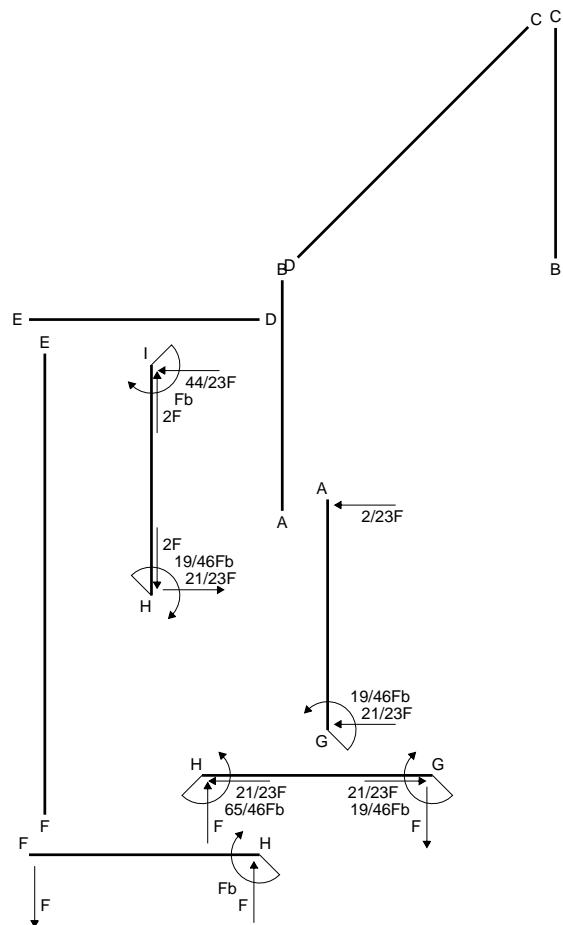
$$= (b - 1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$

$$L_{GH}^{xo} = \int_0^b (x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

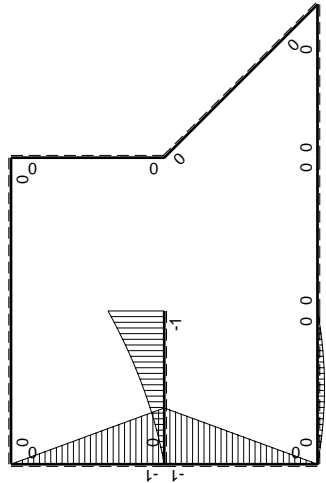
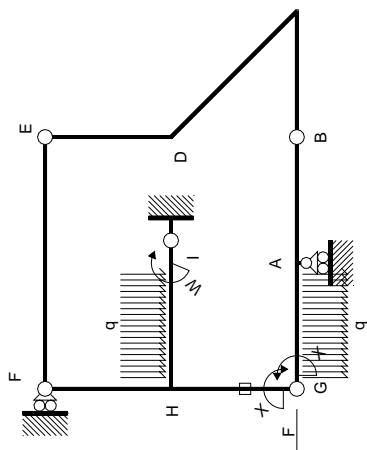
$$= (1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$



- A = 158. mm²
- J_u = 76071. mm⁴
- J_v = 9072. mm⁴
- J_i = 133.3 mm⁴
- y_o = -10.15 mm
- y_g = 21.58 mm
- T_y = -830. N
- M_x = -531200. Nmm
- x_m = 6. mm
- y_m = 50. mm
- u_m = -12. mm
- v_m = 28.42 mm
- σ_m = -M_y/J_u = 198.4 N/mm²
- x_c = 18. mm
- y_c = 50. mm
- v_c = 28.42 mm
- σ_c = -M_y/J_u = 198.4 N/mm²
- τ_c = T_S/tJ_u = 13.39 N/mm²
- τ_g = T_S/tJ_u = 13.39 N/mm²
- t_c = 830. mm
- σ_o = √(σ²+3τ²) = 199.8 N/mm²

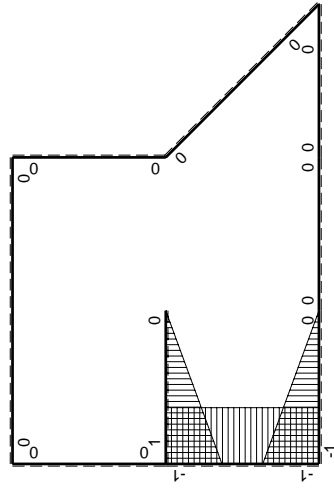


\oplus F_b



Schema di calcolo iperstatico

(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	0	0	0	0	0
BA b	0	0	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	0	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$1/2Fx-1/2qx^2$	$-1/2Fx+F^2/b-1/2qx^3/b$	$1-2x/b+x^2/b^2$	$-1/24Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$-1/2Fx+1/2qx^2$	$-1/2Fx^2/b+1/2qx^3/b$	x^2/b^2	$-1/24Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	-Fx	0	0	0	0
HF b	0	Fb-Fx	0	0	0	0
HI b	$1-x/b$	$-1/2Fx-1/2qx^2$	$-1/2Fx+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$-1/8Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$Fb-3/2Fx+1/2qx^2$	$-Fx+3/2Fx^2/b-1/2qx^3/b$	x^2/b^2	$-1/8Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	-Fb+Fx	Fb-Fx	1	$1/2Fb^2/EJ$	Xb/EJ
GH b	1	Fx	Fx	1	$1/2Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG^{\pm}HG^{\pm}HG}$					
A	molla nodo $-V_{1A}(V_{GA}+XV_{1A})/k_A$					
	totali					
	iperstatica X=W _{GA}					
	19/46Fb					

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (-1/2 x/b + x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [-1/4 x^2/b + 1/3 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (-1/4 b + 1/3 b - 1/8 b) Fb 1/EJ = -1/24 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (-1/2 x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [-1/6 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (-1/6 b + 1/8 b) Fb 1/EJ = -1/24 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (-1/2 x/b + 1/2 x^3/b^3) Fb 1/EJ dx = [-1/4 x^2/b + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (-1/4 b + 1/8 b) Fb 1/EJ = -1/8 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (-x/b + 3/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [-1/2 x^2/b + 1/2 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

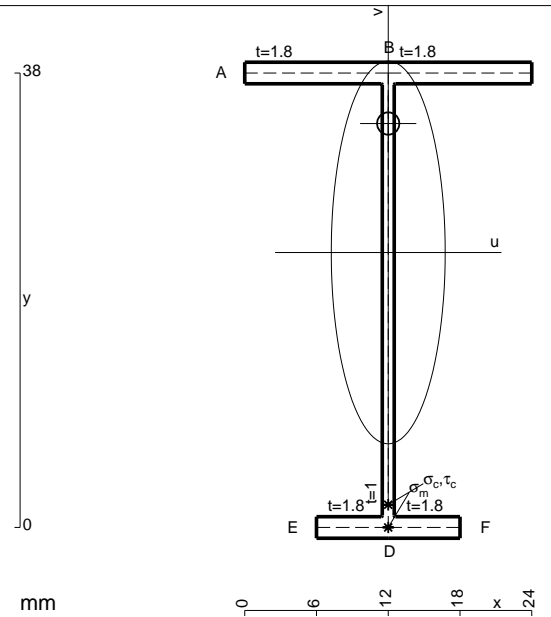
$$= (-1/2 b + 1/2 b - 1/8 b) Fb 1/EJ = -1/8 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [x - 1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

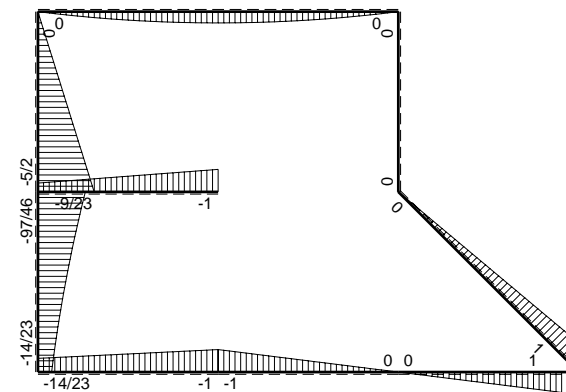
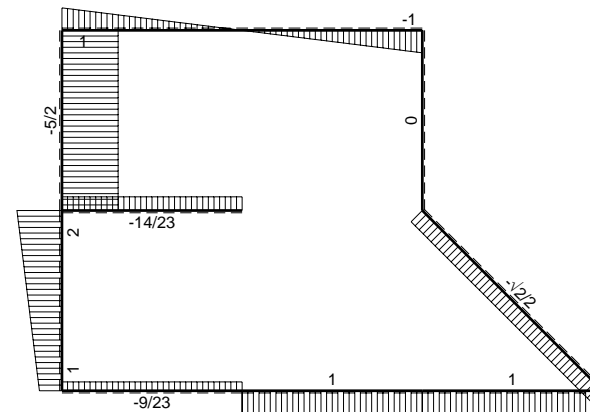
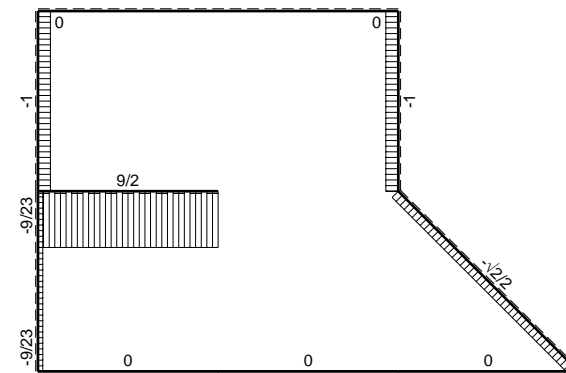
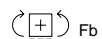
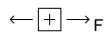
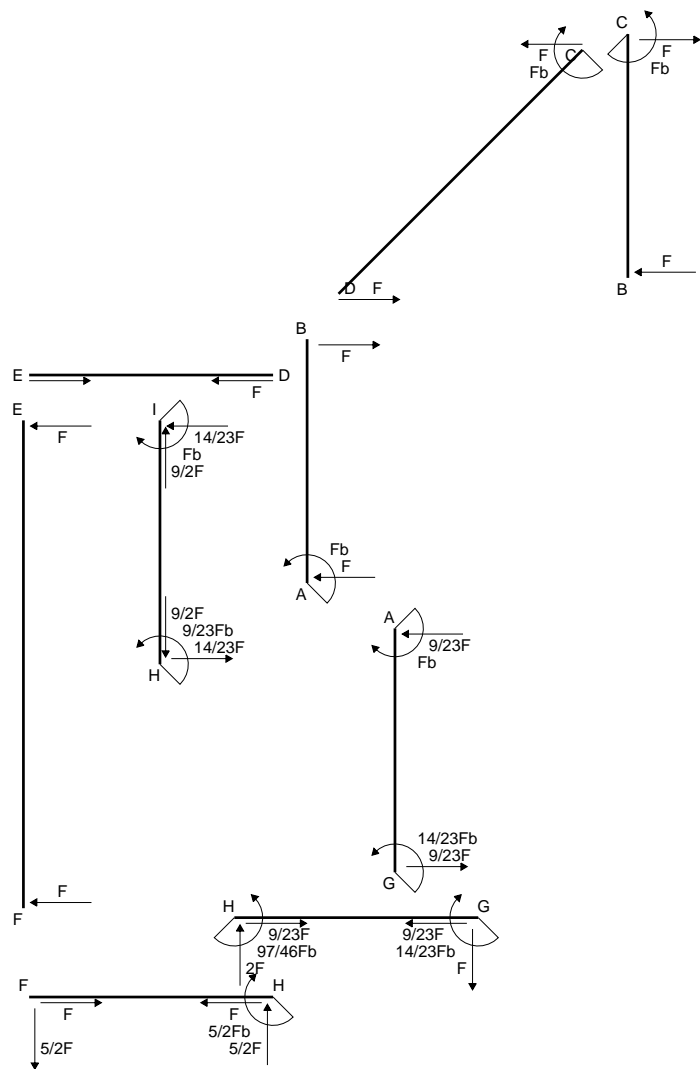
$$= (b - 1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$

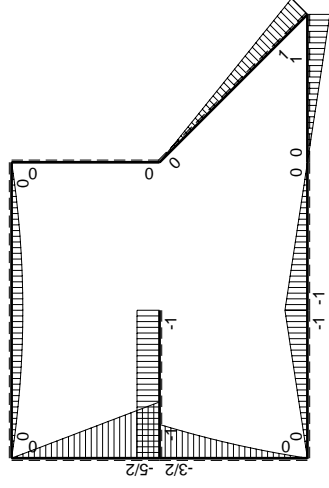
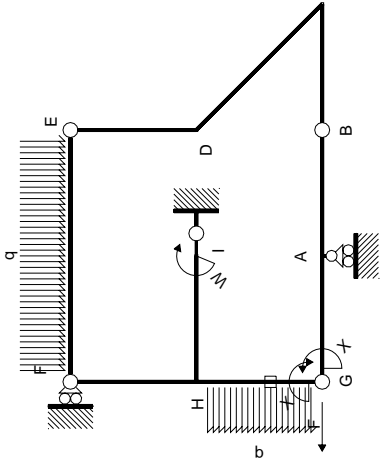
$$L_{GH}^{xo} = \int_0^b (x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$

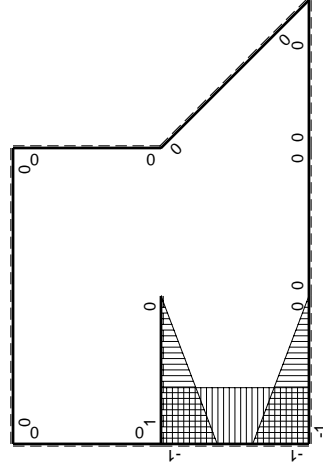


- A = 102.8 mm²
- J_u = 26327. mm⁴
- J_v = 2333. mm⁴
- J_i = 82.65 mm⁴
- y_o = 10.79 mm
- y_g = 22.99 mm
- T_y = -470. N
- M_x = -239700. Nmm
- x_m = 12. mm
- v_m = -22.99 mm
- σ_m = -Mv/J_u = -209.3 N/mm²
- y_c = 3. mm
- u_c = -12. mm
- v_c = -19.99 mm
- σ_c = -Mv/J_u = -209.3 N/mm²
- τ_c = TS_i/tJ_u = 8.866 N/mm²
- τ_g = TS_i/tJ_u = 8.866 N/mm²
- t_c = 470. mm
- σ_o = √σ²+3τ² = 209.9 N/mm²





M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-Fb+Fx	0	0	0	0
BA b	0	Fx	0	0	0	0
BC b	0	Fx	0	0	0	0
CB b	0	-Fb+Fx	0	0	0	0
CD $\sqrt{2}b$	0	Fb- $\sqrt{2}/2Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	-Fx+ $1/2qx^2$	0	0	0	0
FE 2b	0	Fx- $1/2qx^2$	0	0	0	0
GA b	-1+x/b	-Fx	Fx-Fx $^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	Fb-Fx	Fx-Fx $^2/b$	x^2/b^2	$1/6Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	-5/2Fx	0	0	0	0
HF b	0	5/2Fb-5/2Fx	0	0	0	0
HI b	1-x/b	-Fb	-Fb+Fx	$1-2x/b+x^2/b^2$	$-1/2Fb^2/EJ$	$1/3Xb/EJ$
IH b	-x/b	Fb	-Fx	x^2/b^2	$-1/2Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	-3/2Fb+2Fx- $1/2qx^2$	$3/2Fb-2Fx+1/2Fx^2/b$	1	$2/3Fb^2/EJ$	Xb/EJ
GH b	1	Fx+ $1/2qx^2$	Fx+ $1/2Fx^2/b$	1	$2/3Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG^+HG^-HG}$				-Fb $^2/EJ$	
A	molla nodo $-V_{1A}(V_{GA}+XV_{1A})/k_A$				-1/2Fb $^2/EJ$	1/4Xb/EJ
	totali				-7/6Fb $^2/EJ$	23/12Xb/EJ
	iperstatica $X=W_{GA}$				14/23Fb	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (-1 + x/b) Fb 1/EJ dx = [-x + 1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (-b + 1/2 b) Fb 1/EJ = -1/2 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (-x/b) Fb 1/EJ dx = [-1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (-1/2 b) Fb 1/EJ = -1/2 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (3/2 - 2x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

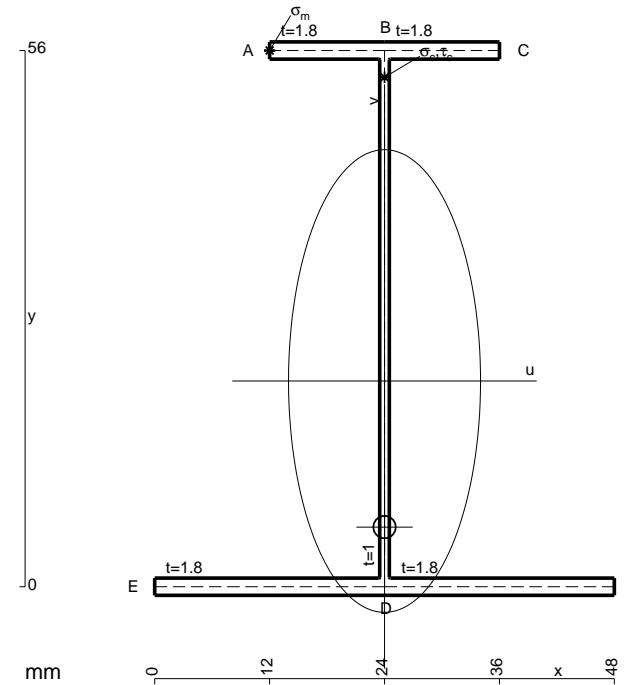
$$= [3/2 x - x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (3/2 b - b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/3 Fb^2/EJ$$

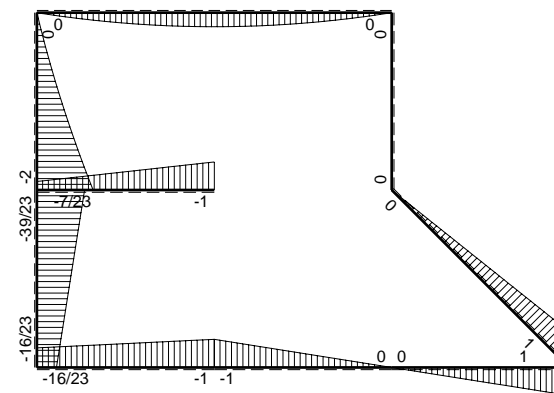
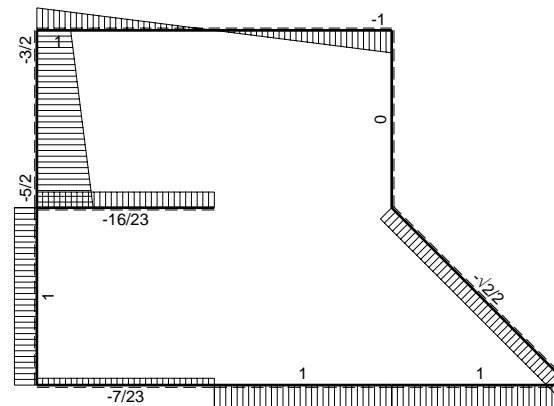
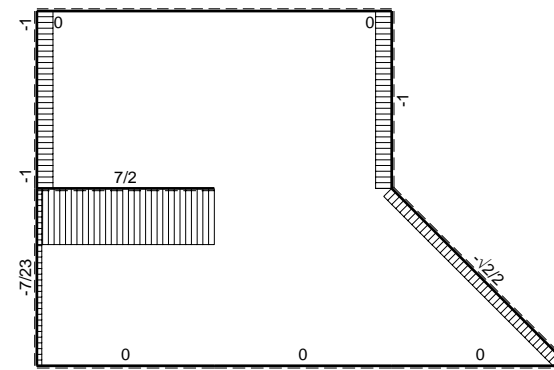
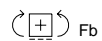
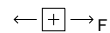
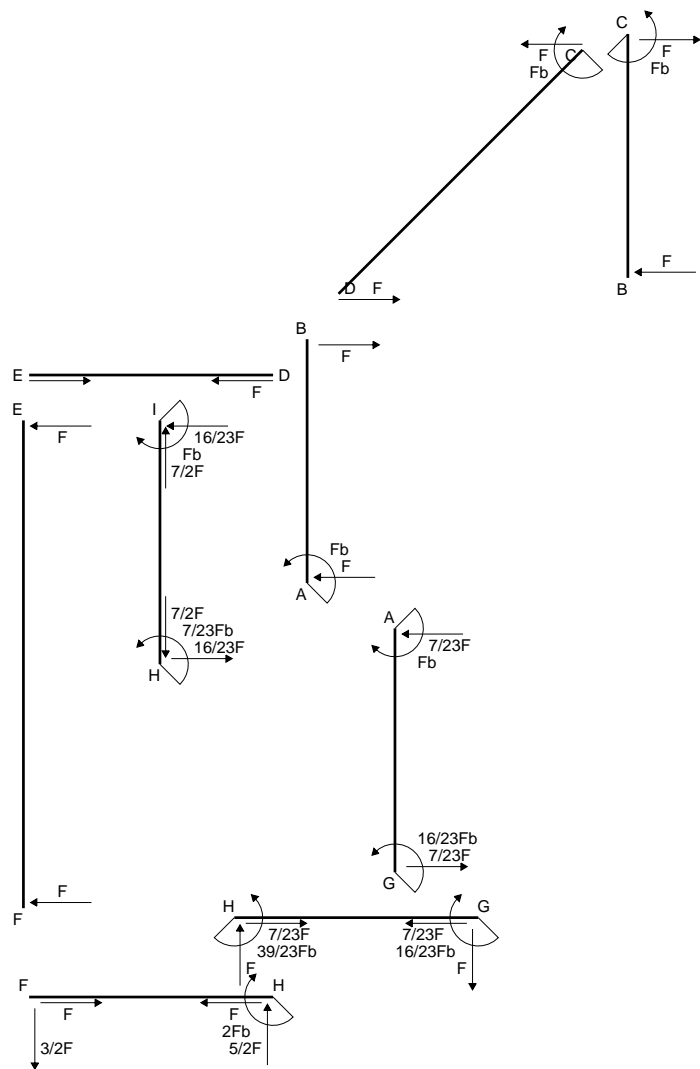
$$L_{GH}^{xo} = \int_0^b (x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

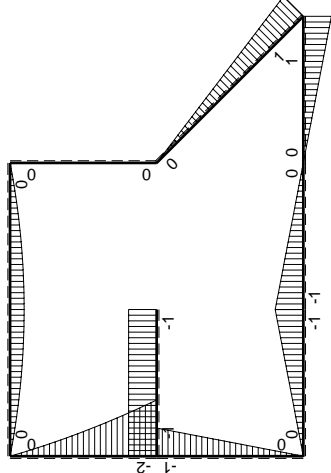
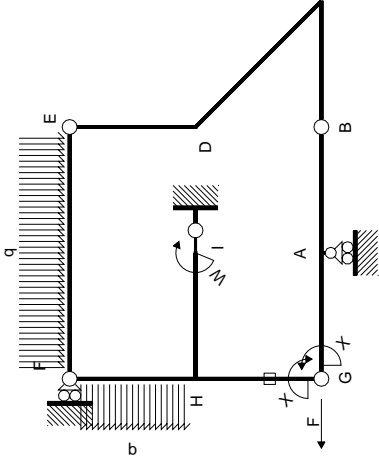
$$= [1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/3 Fb^2/EJ$$

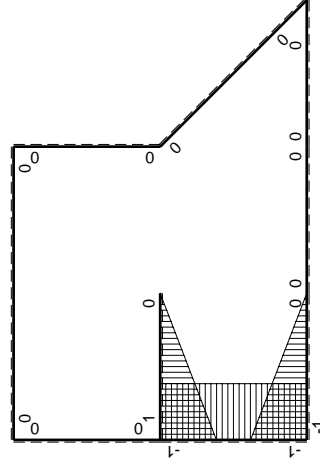


- A = 185.6 mm²
- J_u = 108358. mm⁴
- J_v = 18662. mm⁴
- J_t = 158.6 mm⁴
- y_o = -15.26 mm
- y_g = 21.48 mm
- N = -340. N
- T_y = -850. N
- M_x = -688500. Nmm
- x_m = 12. mm
- y_m = 56. mm
- u_m = -12. mm
- v_m = 34.52 mm
- σ_m = N/A-Mv/J_u = 217.5 N/mm²
- x_c = 24. mm
- y_c = 56. mm
- v_c = 34.52 mm
- σ_c = N/A-Mv/J_u = 217.5 N/mm²
- τ_c = TS'/tJ_u = 11.7 N/mm²
- τ_g = TS'/tJ_u = 11.7 N/mm²
- t_c = 340. mm
- σ_o = √σ²+3τ² = 218.4 N/mm²





(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-Fb+Fx	0	0	0	0
BA b	0	Fx	0	0	0	0
BC b	0	Fx	0	0	0	0
CB b	0	-Fb+Fx	0	0	0	0
CD $\sqrt{2}b$	0	$Fb-\sqrt{2}/2Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	$-Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$Fx-1/2qx^2$	0	0	0	0
GA b	$-1+x/b$	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2	$1/6Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$-3/2Fx-1/2qx^2$	0	0	0	0
HF b	0	$2Fb-5/2Fx+1/2qx^2$	0	0	0	0
HI b	$1-x/b$	-Fb	$-Fb+Fx$	$1-2x/b+x^2/b^2$	$-1/2Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	Fb	-Fx	x^2/b^2	$-1/2Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	-Fb+Fx	Fb-Fx	1	$1/2Fb^2/EJ$	Xb/EJ
GH b	1	Fx	Fx	1	$1/2Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG^{\pm}HG^{\pm}HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{0A}+XV_{1A})/k_A$				$-1/2Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-4/3Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$16/23Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (-1 + x/b) Fb 1/EJ dx = [-x + 1/2 x^2/b]_0^b Fb 1/EJ$$

$$= (-b + 1/2 b) Fb 1/EJ = -1/2 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (-x/b) Fb 1/EJ dx = [-1/2 x^2/b]_0^b Fb 1/EJ$$

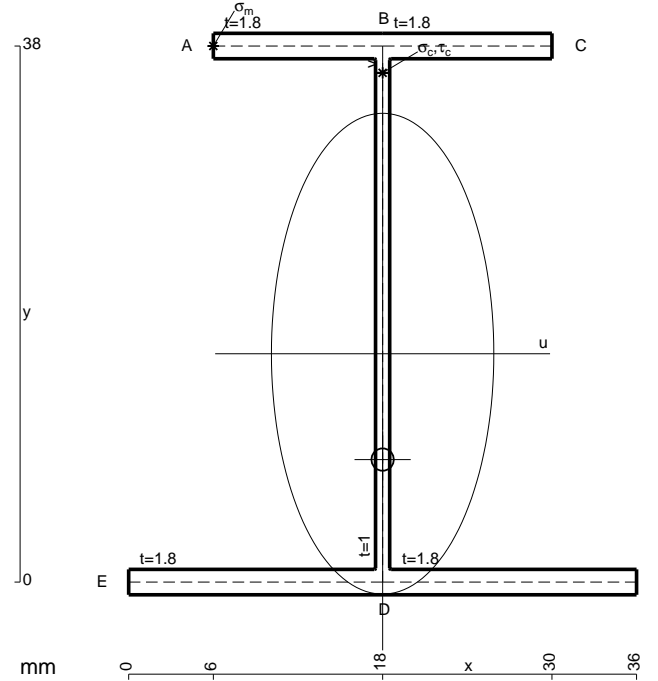
$$= (-1/2 b) Fb 1/EJ = -1/2 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [x - 1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

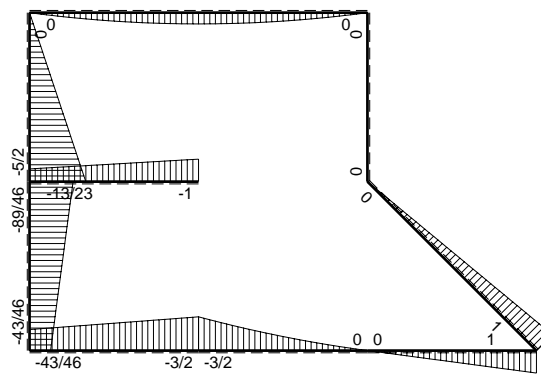
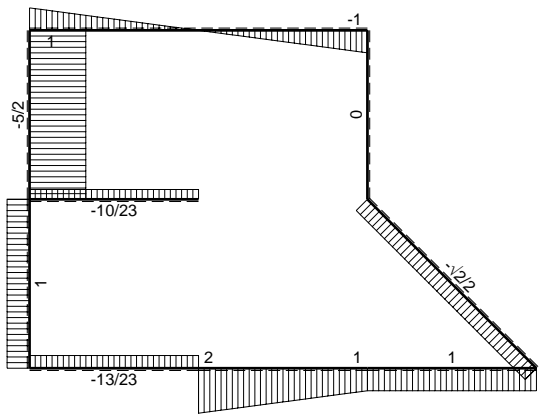
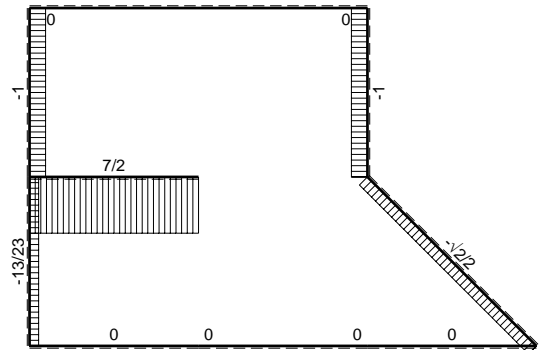
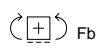
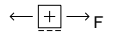
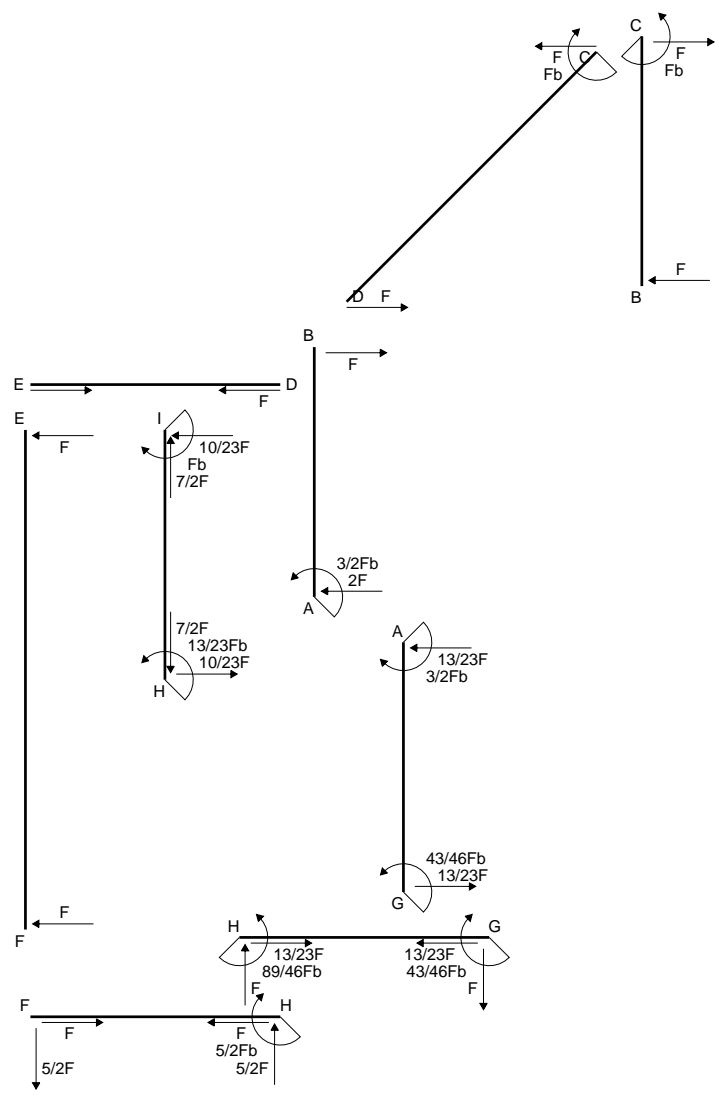
$$= (b - 1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$

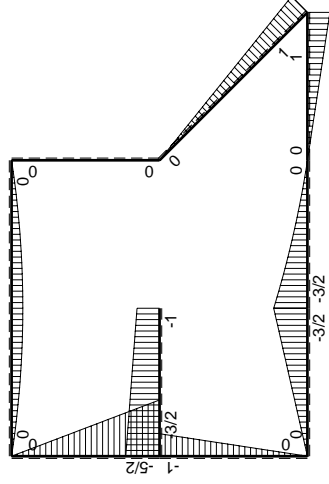
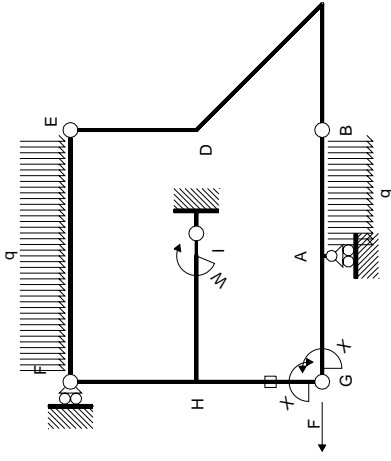
$$L_{GH}^{xo} = \int_0^b (x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$

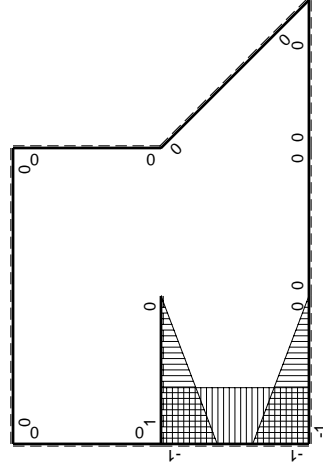


- A = 146. mm²
- J_u = 42407. mm⁴
- J_v = 9072. mm⁴
- J_x = 129.3 mm⁴
- y_o = -7.503 mm
- y_g = 16.19 mm
- N = -390. N
- T_y = -975. N
- M_x = -444600. Nmm
- x_m = 6. mm
- y_m = 38. mm
- u_m = -12. mm
- v_m = 21.81 mm
- σ_m = N/A - Mv/J_u = 226. N/mm²
- x_c = 18. mm
- y_c = 38. mm
- v_c = 21.81 mm
- σ_c = N/A - Mv/J_u = 226. N/mm²
- τ_c = TS¹/tJ_u = 21.66 N/mm²
- τ_g = TS¹/tJ_u = 21.66 N/mm²
- t_c = 390. mm
- σ_o = √σ² + 3τ² = 229.1 N/mm²





(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-3/2Fb+2Fx-1/2qx^2$	0	0	0	0
BA b	0	$Fx+1/2qx^2$	0	0	0	0
BC b	0	Fx	0	0	0	0
CB b	0	$-Fb+Fx$	0	0	0	0
CD $\sqrt{2}b$	0	$Fb-\sqrt{2}/2Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	$-Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$Fx-1/2qx^2$	0	0	0	0
GA b	$-1+x/b$	$-3/2Fx$	$3/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/4Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$3/2Fb-3/2Fx$	$3/2Fx-3/2Fx^2/b$	x^2/b^2	$1/4Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$-5/2Fx$	0	0	0	0
HF b	0	$5/2Fb-5/2Fx$	0	0	0	0
HI b	$1-x/b$	$-3/2Fb+1/2Fx$	$-3/2Fb+2Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$-2/3Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$Fb+1/2Fx$	$-Fx-1/2Fx^2/b$	x^2/b^2	$-2/3Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	$-Fb+Fx$	$Fb-Fx$	1	$1/2Fb^2/EJ$	Xb/EJ
GH b	1	Fx	Fx	1	$1/2Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG} \delta_{HG}^{HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{GA}+XV_{1A})/k_A$				$-7/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-43/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$43/46Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (-3/2 + 2x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [-3/2 x + x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-3/2 b + b - 1/6 b) Fb 1/EJ = -2/3 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (-x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

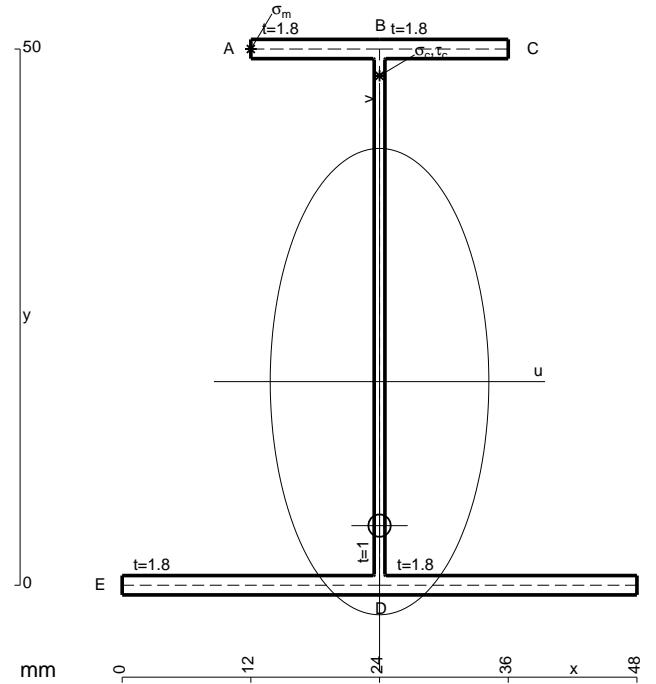
$$= (-1/2 b - 1/6 b) Fb 1/EJ = -2/3 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [x - 1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

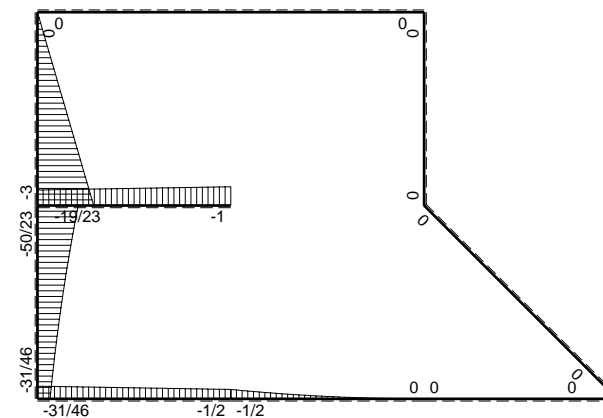
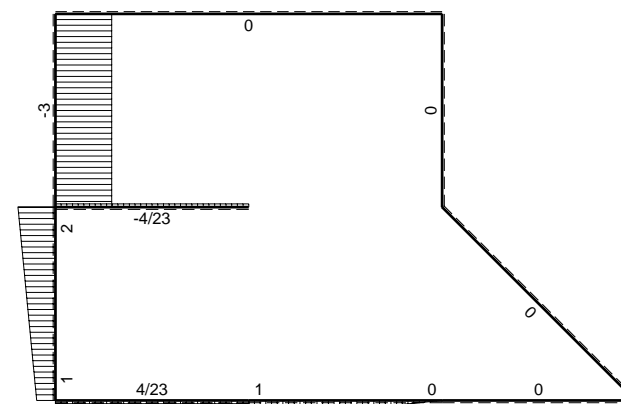
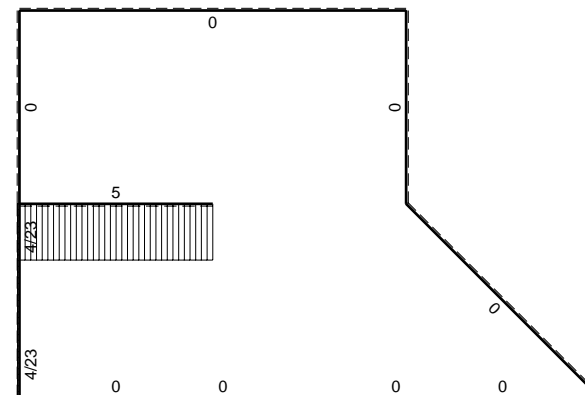
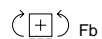
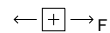
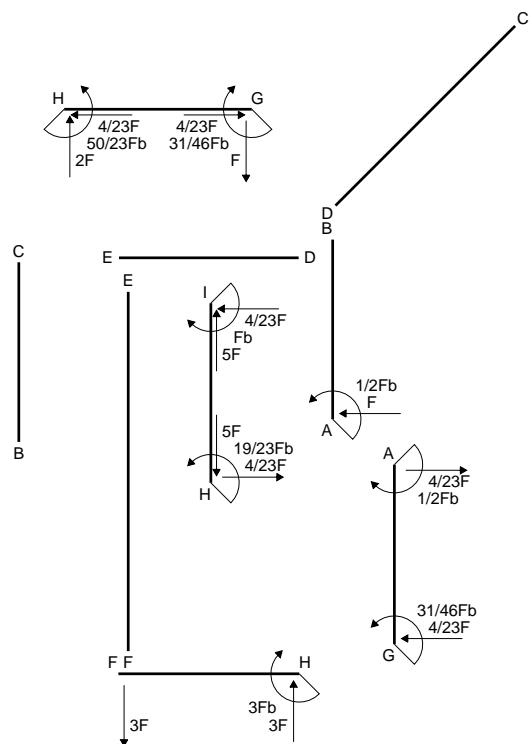
$$= (b - 1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$

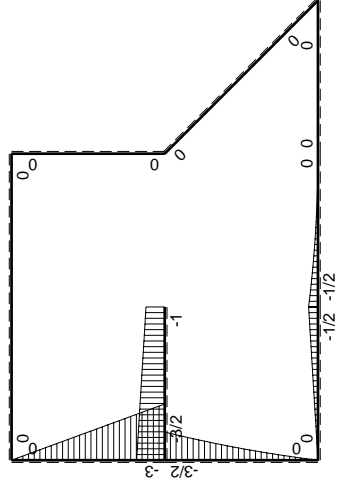
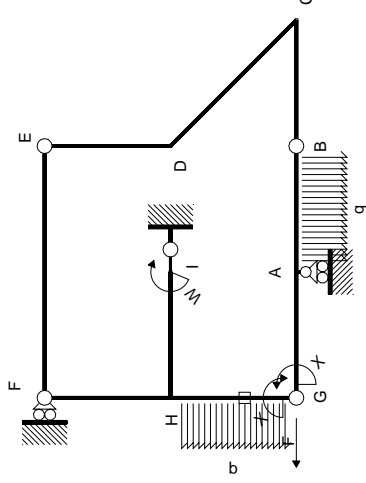
$$L_{GH}^{xo} = \int_0^b (x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$



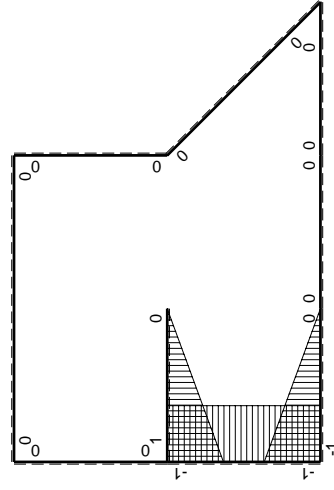
- A = 179.6 mm²
- J_u = 84922. mm⁴
- J_v = 18662. mm⁴
- J_t = 156.6 mm⁴
- y_o = -13.43 mm
- y_g = 18.99 mm
- N = -320. N
- T_y = -800. N
- M_x = -648000. Nmm
- x_m = 12. mm
- y_m = 50. mm
- u_m = -12. mm
- v_m = 31.01 mm
- σ_m = N/A - Mv/J_u = 234.9 N/mm²
- x_c = 24. mm
- y_c = 50. mm
- v_c = 31.01 mm
- σ_c = N/A - Mv/J_u = 234.9 N/mm²
- τ_c = TS_y/tJ_u = 12.62 N/mm²
- τ_g = TS_y/tJ_u = 12.62 N/mm²
- t_c = 320. mm
- σ_o = √σ² + 3τ² = 235.9 N/mm²





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-1/2Fb + Fx - 1/2qx^2$	0	0	0	0	0
BA b	0	$1/2qx^2$	0	0	0	0	0
BC b	0	0	0	0	0	0	0
CB b	0	0	0	0	0	0	0
CD $\sqrt{2}b$	0	0	0	0	0	0	0
DE b	0	0	0	0	0	0	0
ED b	0	0	0	0	0	0	0
EF 2b	0	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0	0
GA b	$-1+x/b$	$-1/2Fx$	$1/2Fx - 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1-2x/b + x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$1/2Fb - 1/2Fx$	$1/2Fx - 1/2Fx^2/b$	x^2/b^2	x^2/b^2	$1/12Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$-3Fx$	0	0	0	0	0
HF b	0	$3Fb - 3Fx$	0	0	0	0	0
HI b	$1-x/b$	$-3/2Fb + 1/2Fx$	$-3/2Fb + 2Fx - 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1-2x/b + x^2/b^2$	$-2/3Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$Fb + 1/2Fx$	$-Fx - 1/2Fx^2/b$	x^2/b^2	x^2/b^2	$-2/3Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	$-3/2Fb + 2Fx - 1/2qx^2$	$3/2Fb - 2Fx + 1/2Fx^2/b$	1	1	$2/3Fb^2/EJ$	Xb/EJ
GH b	1	$Fx + 1/2qx^2$	$Fx + 1/2Fx^2/b$	1	1	$2/3Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG}^{HG} - HG$						
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$						
	totali						
	iperstatica X=W _{GA}						

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (-3/2 + 2x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [-3/2 x + x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-3/2 b + b - 1/6 b) Fb 1/EJ = -2/3 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (-x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b - 1/6 b) Fb 1/EJ = -2/3 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (3/2 - 2x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

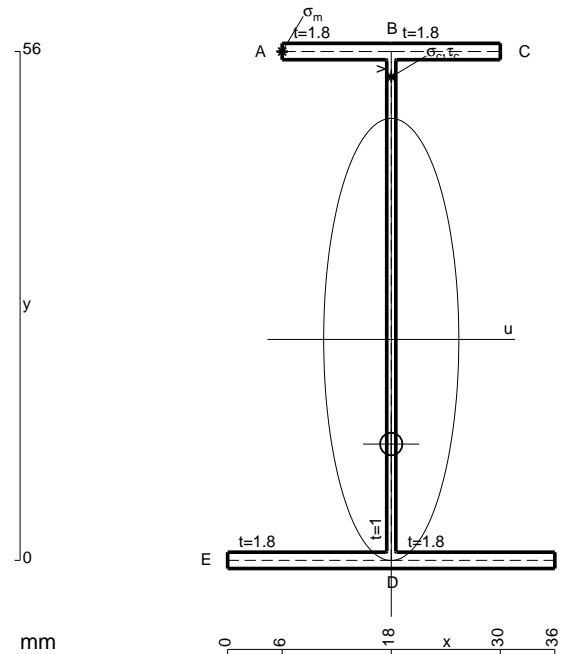
$$= [3/2 x - x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (3/2 b - b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/3 Fb^2/EJ$$

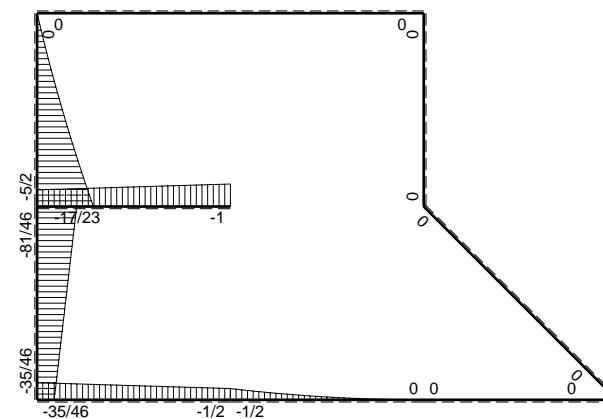
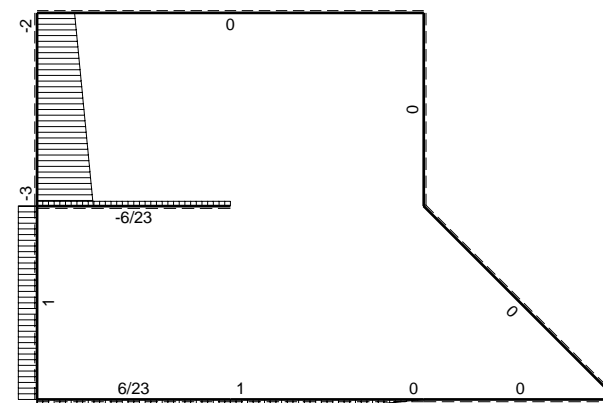
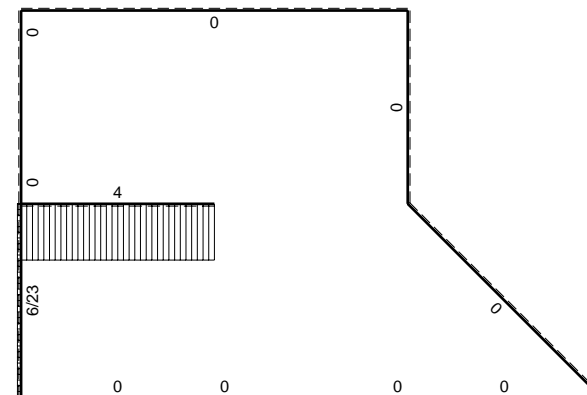
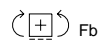
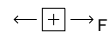
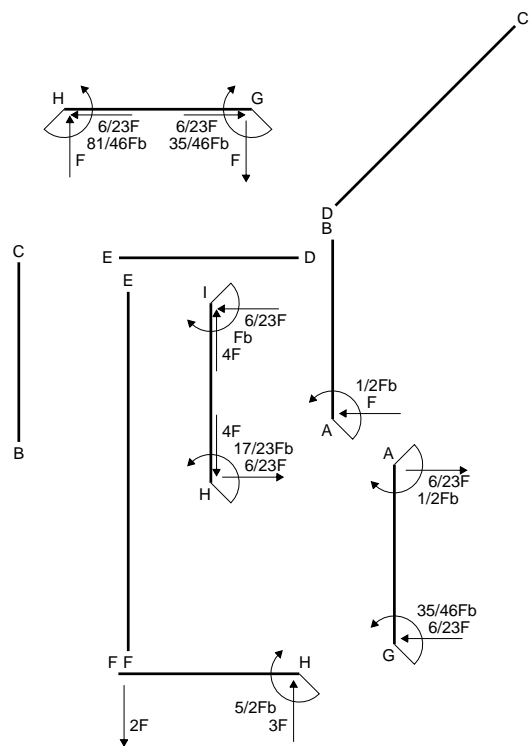
$$L_{GH}^{xo} = \int_0^b (x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

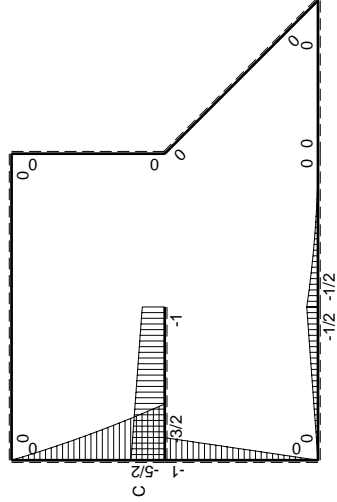
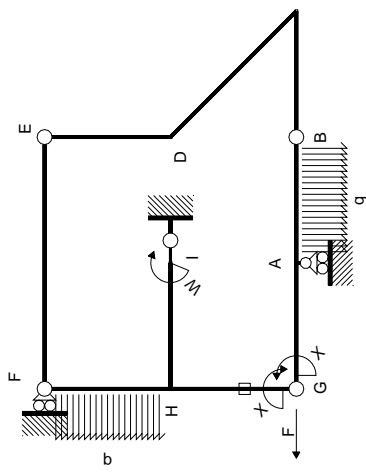
$$= [1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/3 Fb^2/EJ$$



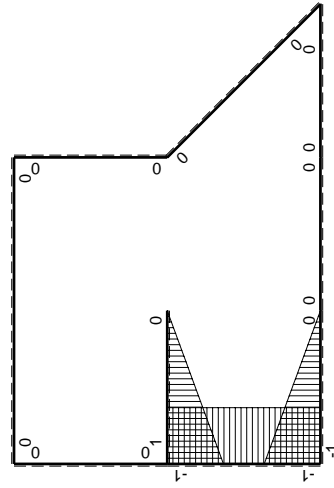
- A = 164. mm²
- J_u = 97076. mm⁴
- J_v = 9072. mm⁴
- J_t = 135.3 mm⁴
- y_o = -11.51 mm
- y_g = 24.31 mm
- T_y = -1260. N
- M_x = -604800. Nmm
- x_m = 6. mm
- y_m = 56. mm
- u_m = -12. mm
- v_m = 31.69 mm
- σ_m = -M_v/J_u = 197.4 N/mm²
- x_c = 18. mm
- y_c = 56. mm
- v_c = 31.69 mm
- σ_c = -M_v/J_u = 197.4 N/mm²
- τ_c = T_S/t_{J_u} = 17.77 N/mm²
- τ_g = T_S/t_{J_u} = 17.77 N/mm²
- t_c = 420. mm
- σ_o = √σ²+3τ² = 199.8 N/mm²





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-1/2Fb + Fx - 1/2qx^2$	0	0	0	0
BA b	0	$1/2qx^2$	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	0	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$-1/2Fx$	$1/2Fx - 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$1/2Fb - 1/2Fx$	$1/2Fx - 1/2Fx^2/b$	x^2/b^2		
FH b	0	$-2Fx - 1/2qx^2$	0	0	0	0
HF b	0	$5/2Fb - 3Fx + 1/2qx^2$	0	0	0	0
HI b	$1-x/b$	$-3/2Fb + 1/2Fx$	$-3/2Fb + 2Fx - 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$-2/3Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$Fb + 1/2Fx$	$-Fx - 1/2Fx^2/b$	x^2/b^2		
HG b	-1	$-Fb + Fx$	$Fb - Fx$	1	$1/2Fb^2/EJ$	Xb/EJ
GH b	1	Fx	Fx	1		
HG	elongazione asta $N_{1HG} = N_{HG} - HG$					
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$					
	totali					
	iperstatica X=W _{GA}					

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (-3/2 + 2x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [-3/2 x + x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-3/2 b + b - 1/6 b) Fb 1/EJ = -2/3 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (-x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

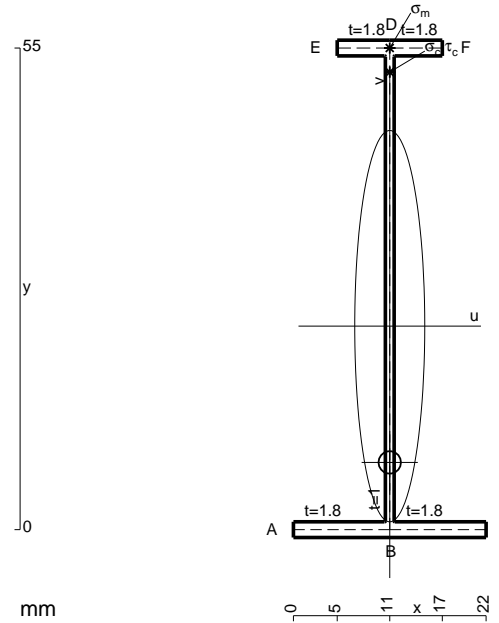
$$= (-1/2 b - 1/6 b) Fb 1/EJ = -2/3 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [x - 1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

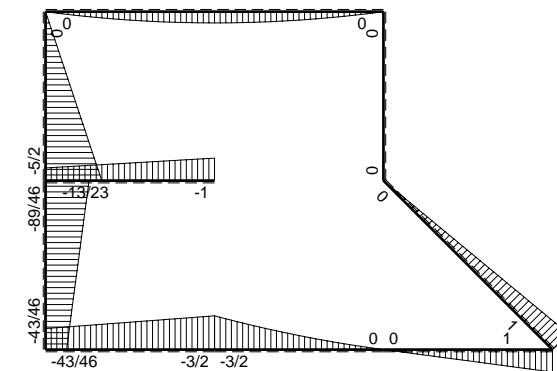
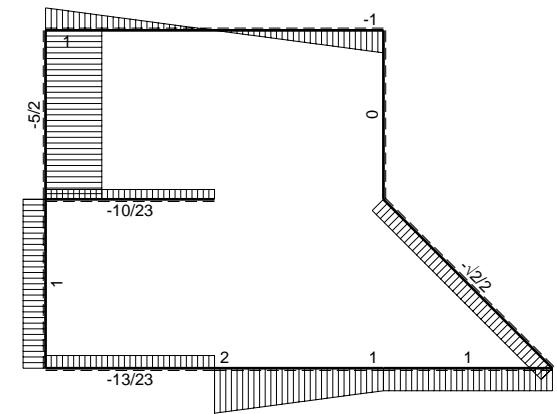
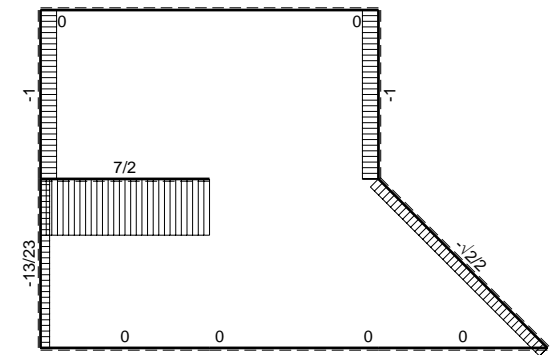
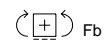
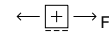
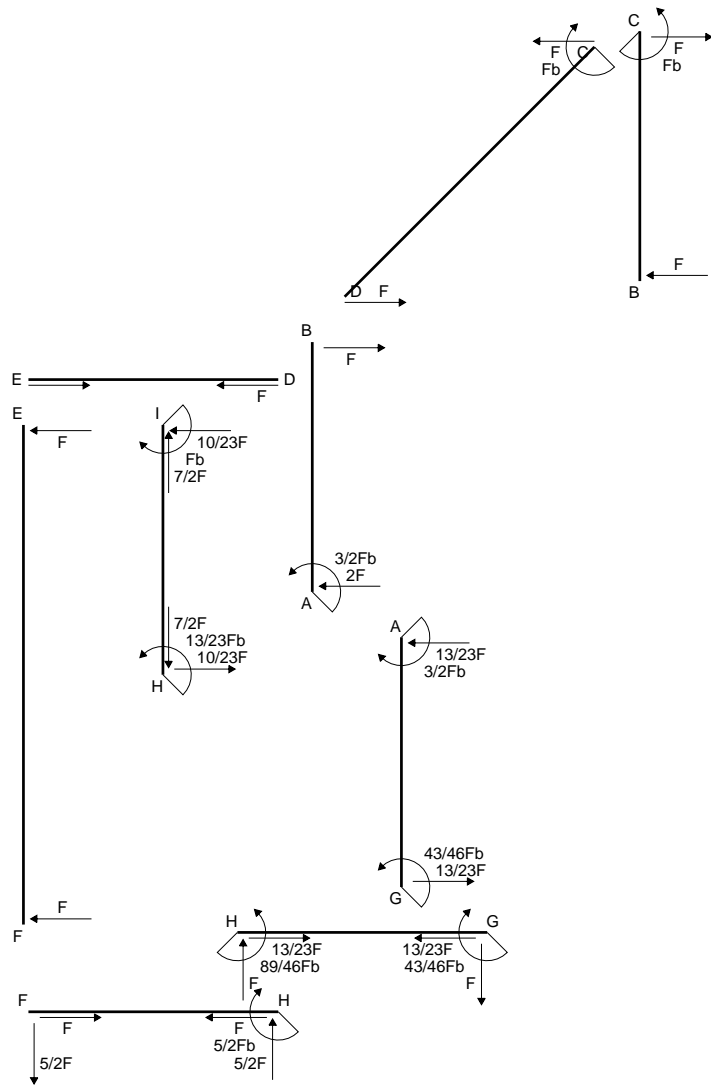
$$= (b - 1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$

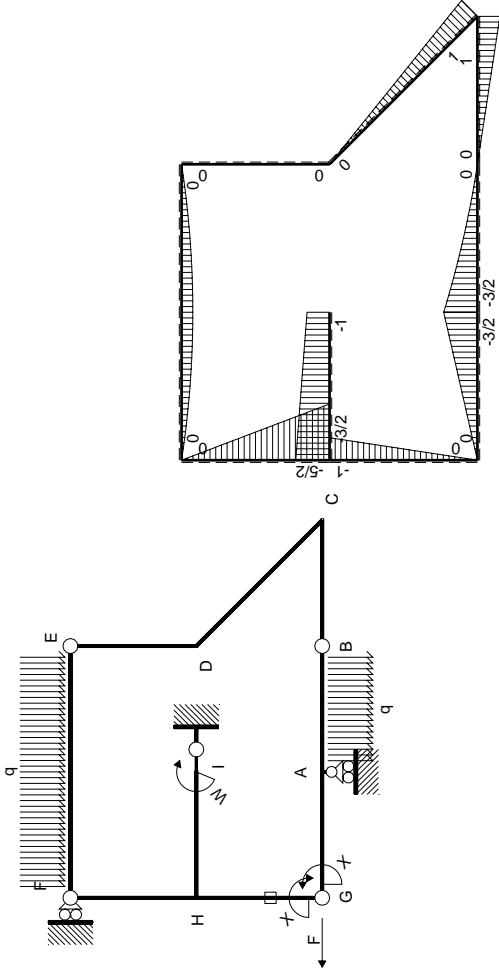
$$L_{GH}^{xo} = \int_0^b (x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$

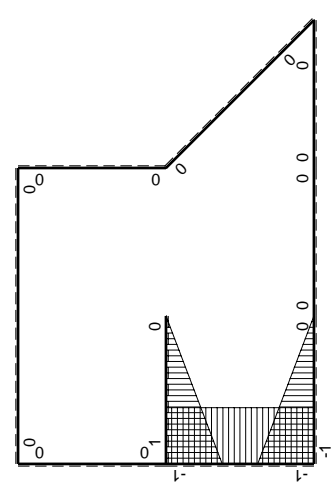


- A = 116.2 mm²
- J_u = 58038. mm⁴
- J_v = 1856. mm⁴
- J_i = 84.43 mm⁴
- y_o = -15.56 mm
- y_g = 23.24 mm
- T_y = -900. N
- M_x = -382500. Nmm
- x_m = 11. mm
- y_m = 55. mm
- v_m = 31.76 mm
- σ_m = -Mv/J_u = 209.3 N/mm²
- y_c = 2. mm
- u_c = -11. mm
- v_c = -21.24 mm
- σ_c = -Mv/J_u = 209.3 N/mm²
- τ_c = TS_i/tJ_u = 10.64 N/mm²
- τ_g = TS_i/tJ_u = 10.64 N/mm²
- t_c = 300. mm
- σ_o = √σ²+3τ² = 210.1 N/mm²





(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-3/2Fb+2Fx-1/2qx^2$	0	0	0	0
BA b	0	$Fx+1/2qx^2$	0	0	0	0
BC b	0	Fx	0	0	0	0
CB b	0	$-Fb+Fx$	0	0	0	0
CD $\sqrt{2}b$	0	$Fb-\sqrt{2}/2Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	$-Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$Fx-1/2qx^2$	0	0	0	0
GA b	$-1+x/b$	$-3/2Fx$	$3/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/4Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$3/2Fb-3/2Fx$	$3/2Fx-3/2Fx^2/b$	x^2/b^2	$1/4Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$-5/2Fx$	0	0	0	0
HF b	0	$5/2Fb-5/2Fx$	0	0	0	0
HI b	$1-x/b$	$-3/2Fb+1/2Fx$	$-3/2Fb+2Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$-2/3Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$Fb+1/2Fx$	$-Fx-1/2Fx^2/b$	x^2/b^2	$-2/3Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	$-Fb+Fx$	$Fb-Fx$	1	$1/2Fb^2/EJ$	Xb/EJ
GH b	1	Fx	Fx	1	$1/2Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG}^{\pm HG} \pm HG$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{GA}+XV_{1A})/k_A$				$-7/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-43/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$43/46Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (-3/2 + 2x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [-3/2 x + x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-3/2 b + b - 1/6 b) Fb 1/EJ = -2/3 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (-x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

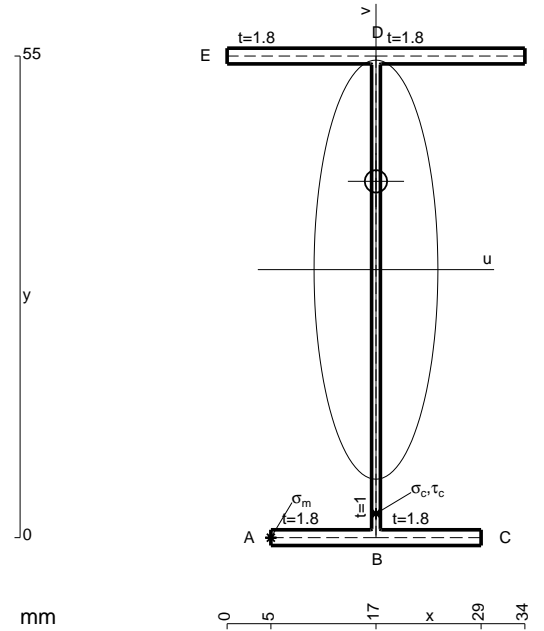
$$= (-1/2 b - 1/6 b) Fb 1/EJ = -2/3 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [x - 1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

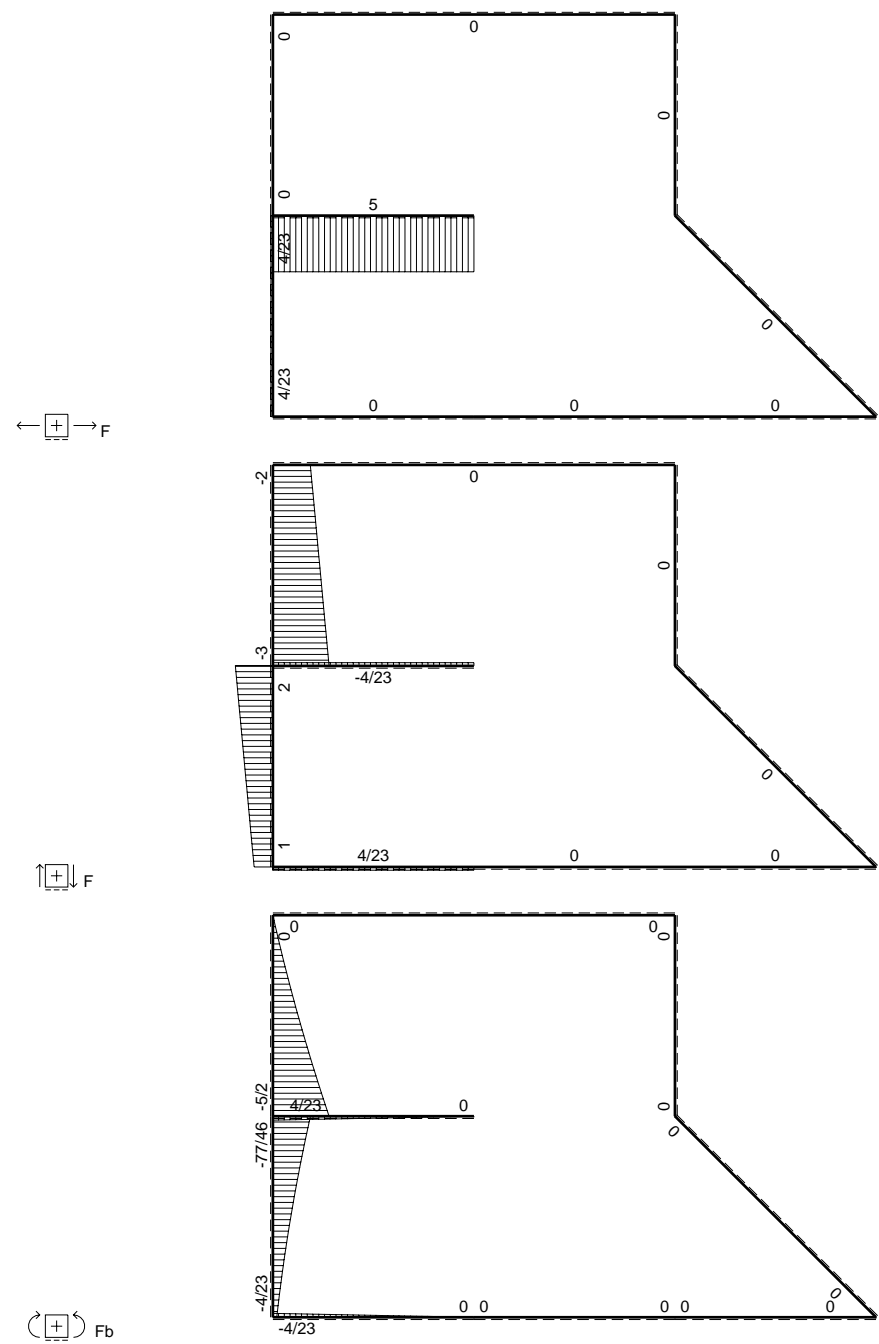
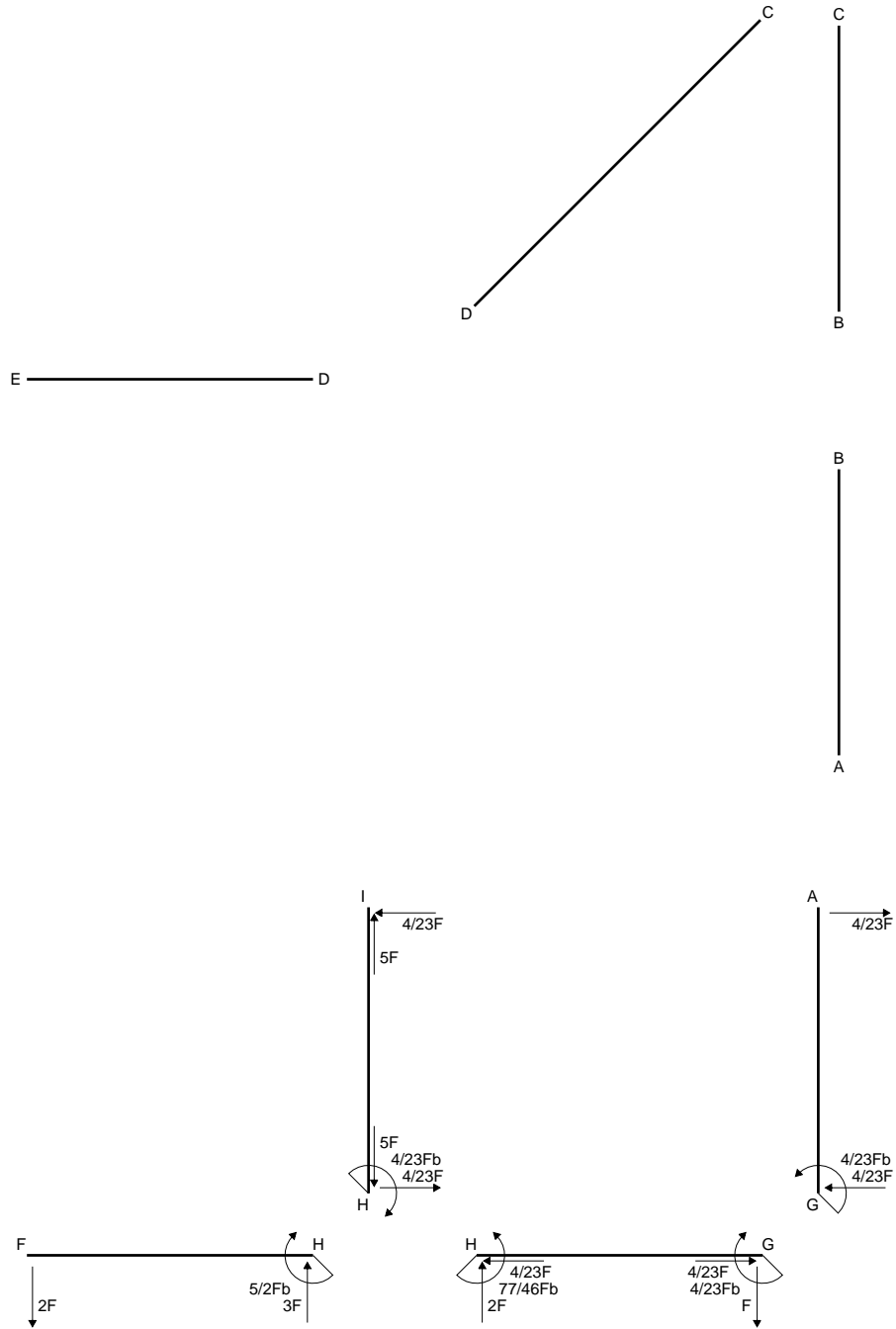
$$= (b - 1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$

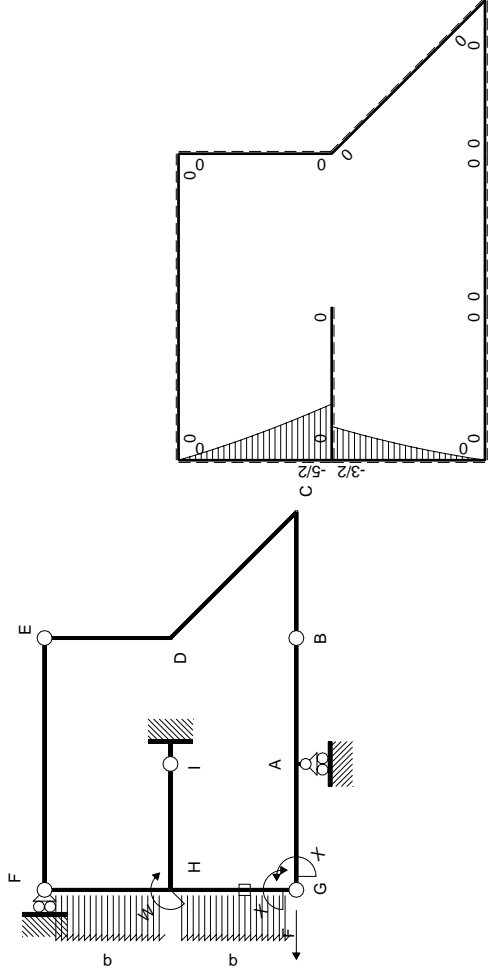
$$L_{GH}^{xo} = \int_0^b (x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$



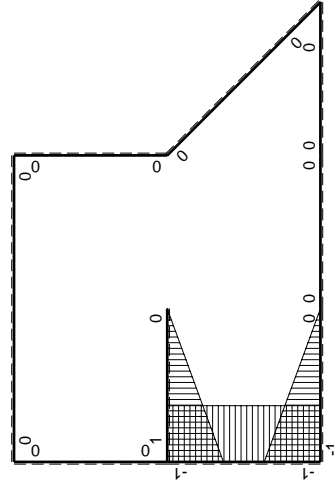
- A = 159.4 mm²
- J_u = 91280. mm⁴
- J_v = 7969. mm⁴
- J_I = 131.1 mm⁴
- y_o = 10.08 mm
- y_g = 30.61 mm
- N = -460. N
- T_y = -1150. N
- M_x = -644000. Nmm
- x_m = 5. mm
- u_m = -12. mm
- v_m = -30.61 mm
- σ_m = N/A-Mv/J_u = -218.8 N/mm²
- x_c = 17. mm
- v_c = -30.61 mm
- σ_c = N/A-Mv/J_u = -218.8 N/mm²
- τ_c = TS'/tJ_u = 16.66 N/mm²
- τ_g = TS'/tJ_u = 16.66 N/mm²
- t_c = 460. mm
- σ_o = √σ²+3τ² = 220.7 N/mm²





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	0	0	0	0	0
BA b	0	0	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	0	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
AG b	x/b	0	0	x^2/b^2	0	$1/3Xb/EJ$
FH b	0	$-2Fx-1/2qx^2$	0	0	0	0
HF b	0	$5/2Fb-3Fx+1/2qx^2$	0	0	0	0
HI b	$1-x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
IH b	$-x/b$	0	0	x^2/b^2	0	$1/3Xb/EJ$
HG b	-1	$-3/2Fb+2Fx-1/2qx^2$	$3/2Fb-2Fx+1/2Fx^2/b$	1	$2/3Fb^2/EJ$	Xb/EJ
GH b	1	$Fx+1/2qx^2$	$Fx+1/2Fx^2/b$	1	$-Fb^2/EJ$	$23/12Xb/EJ$
HG	elongazione asta $N_{1HG}^{HG} \rightarrow HG$					
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$					$1/4Xb/EJ$
	totali				$-1/3Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$4/23Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{HG}^{x_0} = \int_0^b (3/2 - 2x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

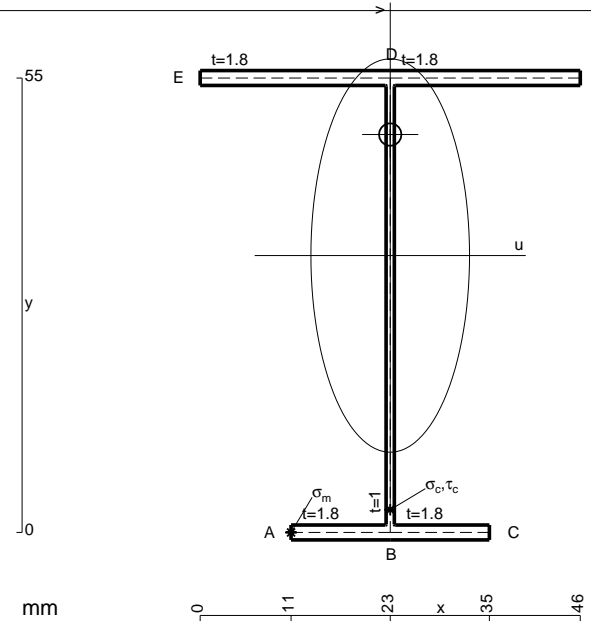
$$= [3/2 x - x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (3/2 b - b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/3 Fb^2/EJ$$

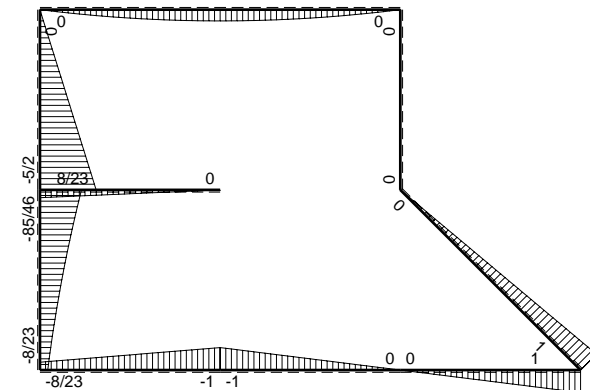
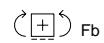
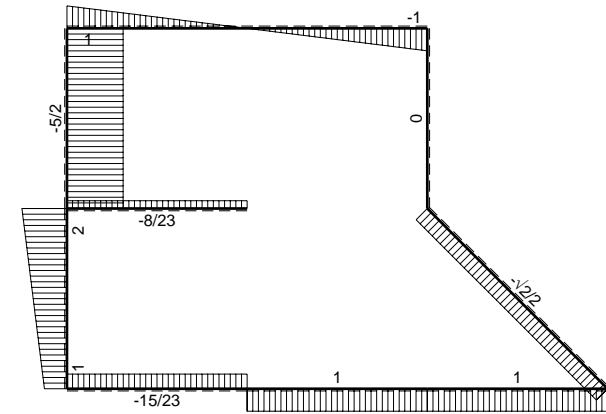
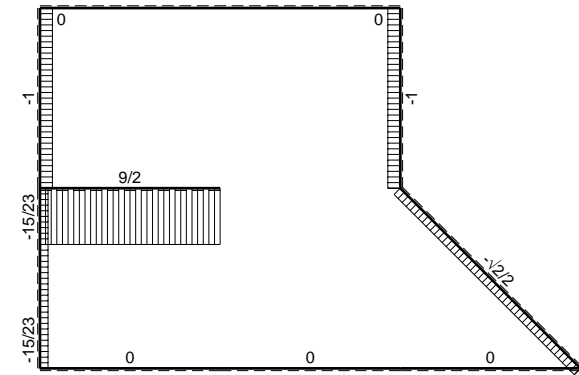
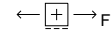
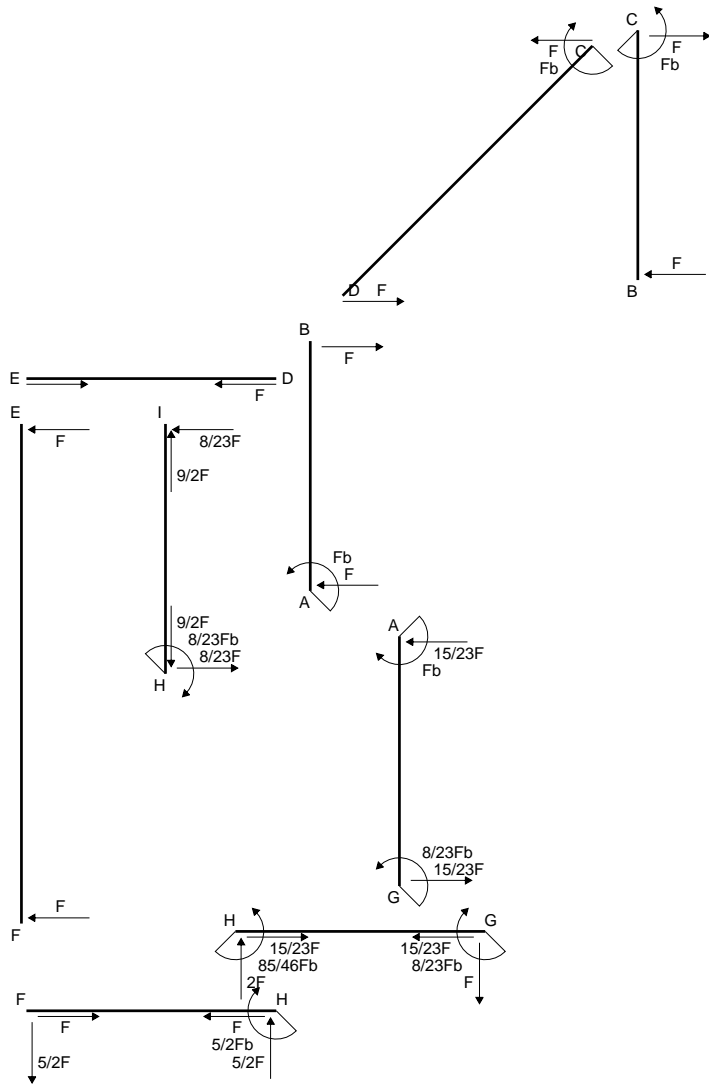
$$L_{GH}^{x_0} = \int_0^b (x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

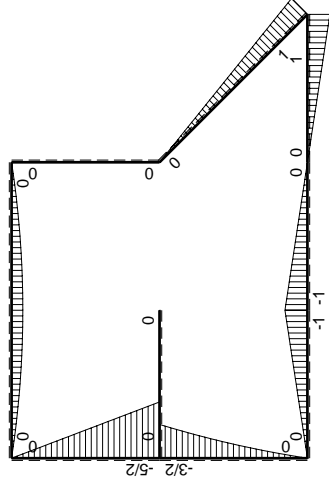
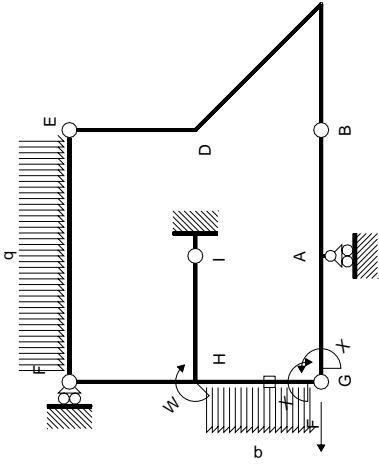
$$= [1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/3 Fb^2/EJ$$

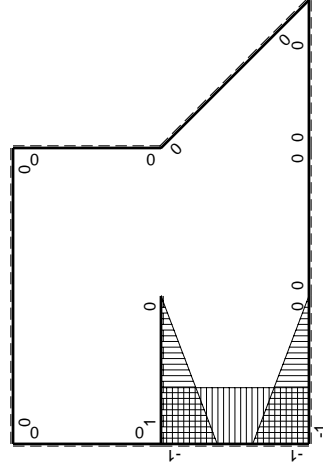


- A = 181. mm²
- J_u = 102600. mm⁴
- J_v = 16674. mm⁴
- J_i = 154.4 mm⁴
- y_o = 14.64 mm
- y_g = 33.52 mm
- T_y = -1380. N
- M_x = -701500. Nmm
- x_m = 11. mm
- u_m = -12. mm
- v_m = -33.52 mm
- σ_m = -Mv/J_u = -229.2 N/mm²
- x_c = 23. mm
- v_c = -33.52 mm
- σ_c = -Mv/J_u = -229.2 N/mm²
- τ_c = TS_v/tJ_u = 19.47 N/mm²
- τ_g = TS_v/tJ_u = 19.47 N/mm²
- t_c = 460. mm
- σ_o = √σ²+3τ² = 231.6 N/mm²





M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$	
AB b	0	-Fb+Fx	0	0	0	0	
BA b	0	Fx	0	0	0	0	
BC b	0	Fx	0	0	0	0	
CB b	0	-Fb+Fx	0	0	0	0	
CD $\sqrt{2}b$	0	Fb- $\sqrt{2}/2Fx$	0	0	0	0	
DE b	0	0	0	0	0	0	
ED b	0	0	0	0	0	0	
EF 2b	0	-Fx+ $1/2qx^2$	0	0	0	0	
FE 2b	0	Fx- $1/2qx^2$	0	0	0	0	
GA b	-1+x/b	-Fx	Fx-Fx ² /b	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$	
AG b	x/b	Fb-Fx	Fx-Fx ² /b	x^2/b^2	0	0	
FH b	0	-5/2Fx	0	0	0	0	
HF b	0	5/2Fb-5/2Fx	0	0	0	0	
HI b	1-x/b	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$	
IH b	-x/b	0	0	x^2/b^2	0	0	
HG b	-1	-3/2Fb+2Fx-1/2qx ²	$3/2Fb-2Fx+1/2Fx^2/b$	1	$2/3Fb^2/EJ$	Xb/EJ	
GH b	1	Fx+1/2qx ²	Fx+1/2Fx ² /b	1	0	0	
HG	elongazione asta $N_{1HG}^{HG} = \dots$						
A	molla nodo -V _{1A} (V _{GA} +XV _{1A})/k _A						
totali							
iperstatica X=W _{GA}							

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (3/2 - 2x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

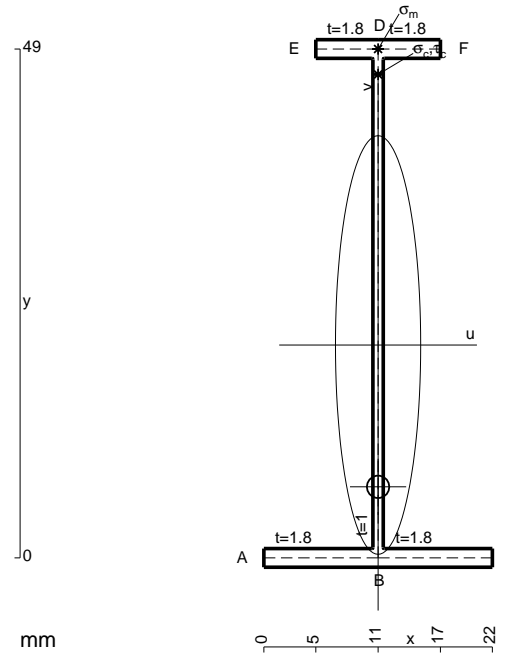
$$= [3/2 x - x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (3/2 b - b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/3 Fb^2/EJ$$

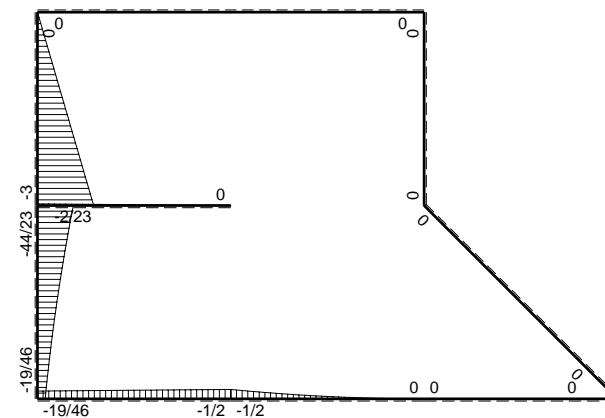
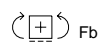
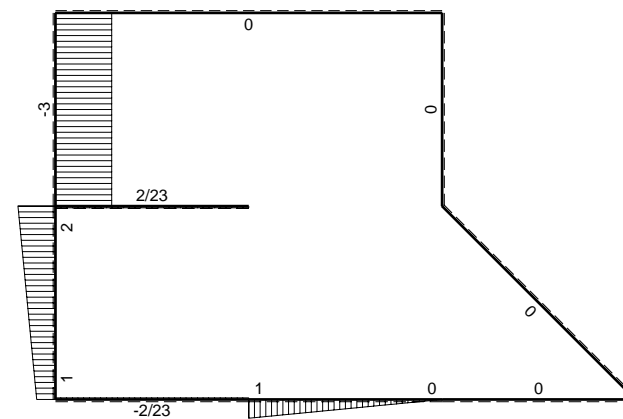
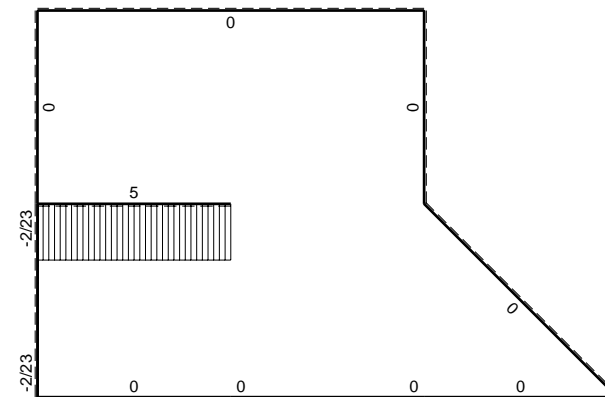
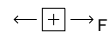
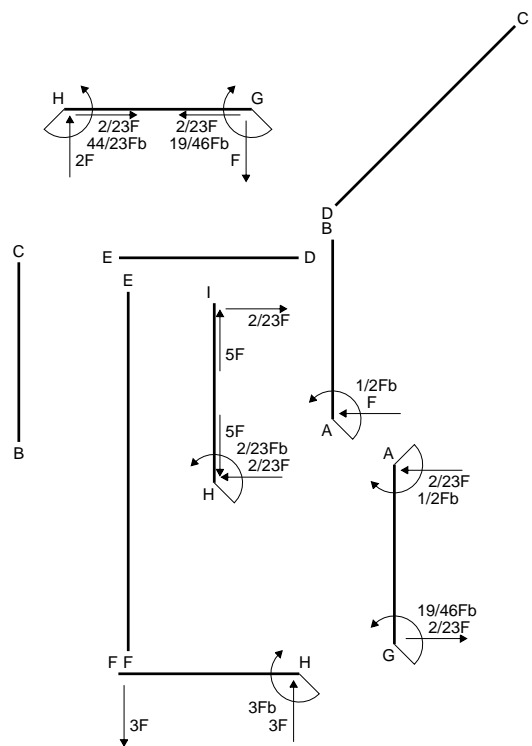
$$L_{GH}^{xo} = \int_0^b (x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

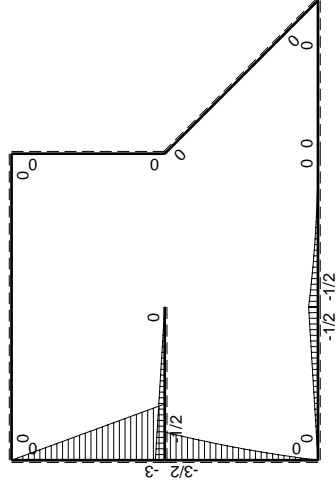
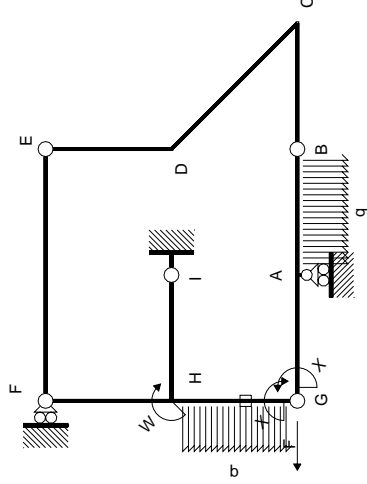
$$= [1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/3 Fb^2/EJ$$



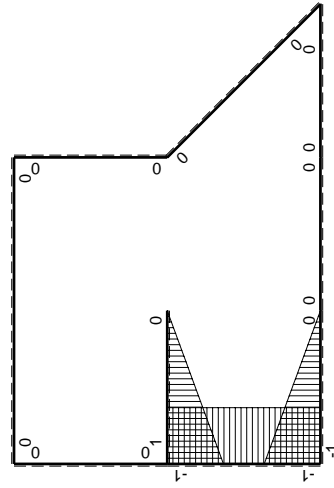
- A = 110.2 mm²
- J_u = 44775. mm⁴
- J_v = 1856. mm⁴
- J_t = 82.43 mm⁴
- y_o = -13.66 mm
- y_g = 20.5 mm
- N = -260. N
- T_y = -650. N
- M_x = -377000. Nmm
- x_m = 11. mm
- y_m = 49. mm
- v_m = 28.5 mm
- σ_m = N/A-Mv/J_u = 237.6 N/mm²
- y_c = 2. mm
- u_c = -11. mm
- v_c = -18.5 mm
- σ_c = N/A-Mv/J_u = 237.6 N/mm²
- τ_c = TS'/tJ_u = 8.937 N/mm²
- τ_g = TS'/tJ_u = 8.937 N/mm²
- t_c = 260. mm
- σ_o = √σ²+3τ² = 238.1 N/mm²





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-1/2Fb + Fx - 1/2qx^2$	0	0	0	0
BA b	0	$1/2qx^2$	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	0	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$-1/2Fx$	$1/2Fx - 1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$1/2Fb - 1/2Fx$	$1/2Fx - 1/2Fx^2/b$	x^2/b^2	$1/12Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$-3Fx$	0	0	0	0
HF b	0	$3Fb - 3Fx$	0	0	0	0
HI b	$1-x/b$	$-1/2Fb + 1/2Fx$	$-1/2Fb + Fx - 1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$1/2Fx$	$-1/2Fx^2/b$	x^2/b^2	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	$-3/2Fb + 2Fx - 1/2qx^2$	$3/2Fb - 2Fx + 1/2Fx^2/b$	1	$2/3Fb^2/EJ$	Xb/EJ
GH b	1	$Fx + 1/2qx^2$	$Fx + 1/2Fx^2/b$	1	$2/3Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG} = N_{HG} - HG$					
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$					
	totali					
	iperstatica X=W _{GA}					
	19/46Fb					

Sviluppi di calcolo iperstatico

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (-1/2 + x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + 1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + 1/2 b - 1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (-1/2 x^2/b^2) Fb 1/EJ dx = [-1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (3/2 - 2x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

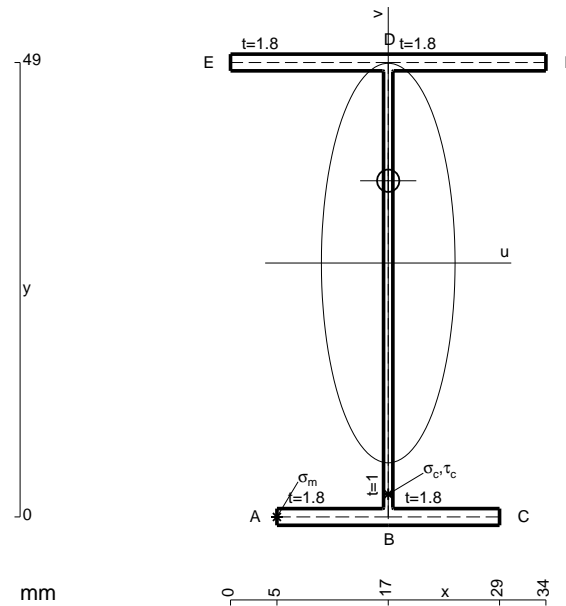
$$= [3/2 x - x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (3/2 b - b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/3 Fb^2/EJ$$

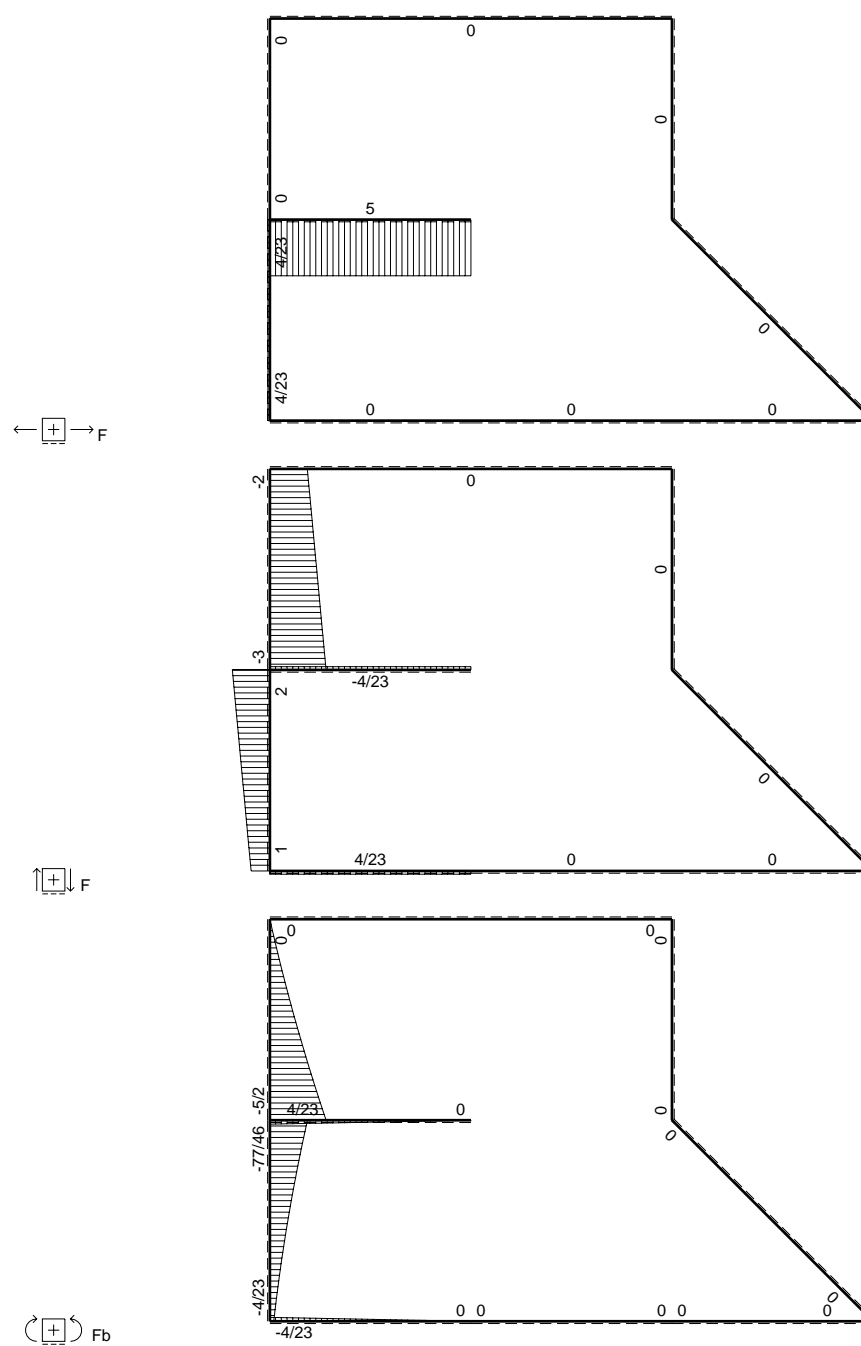
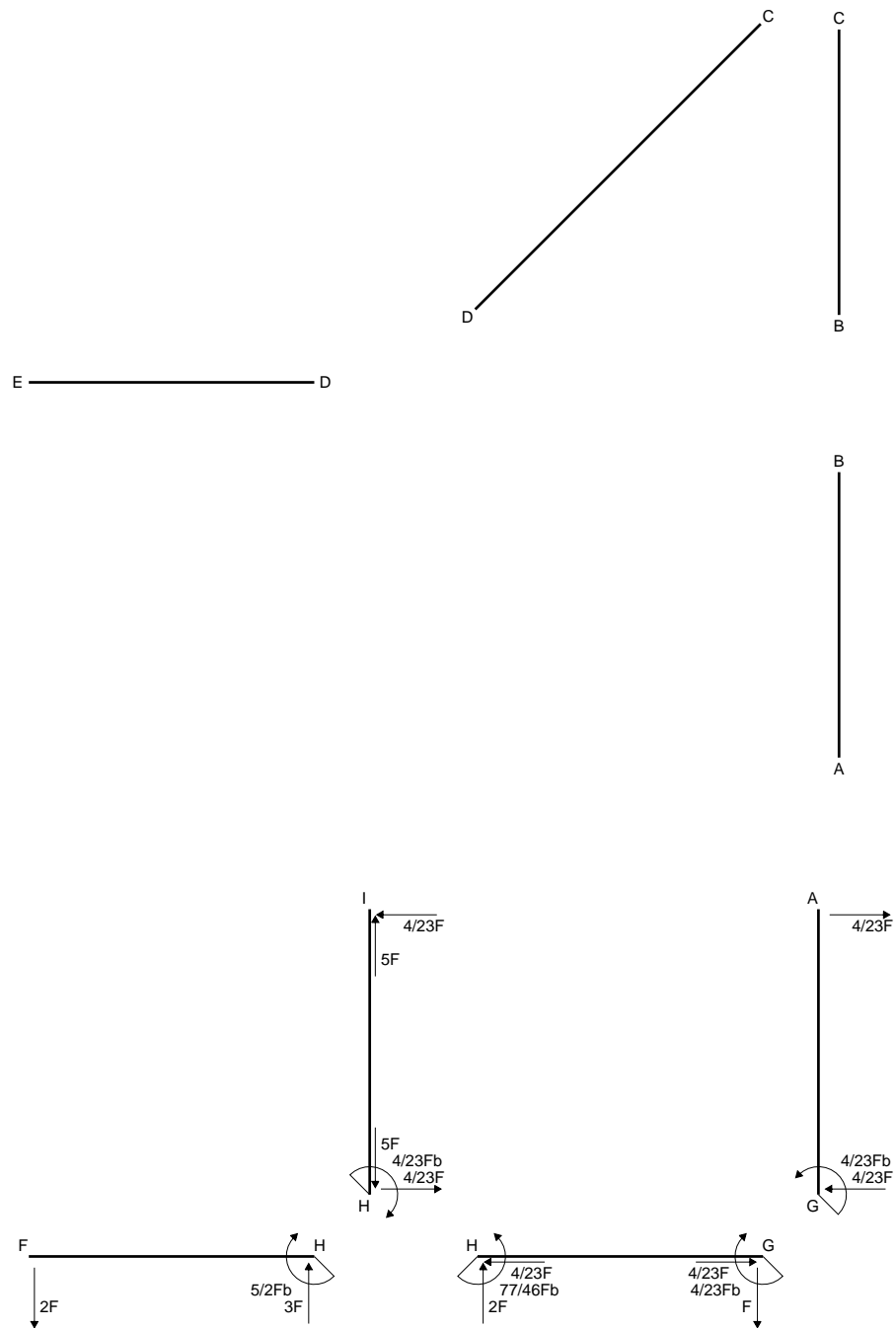
$$L_{GH}^{xo} = \int_0^b (x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

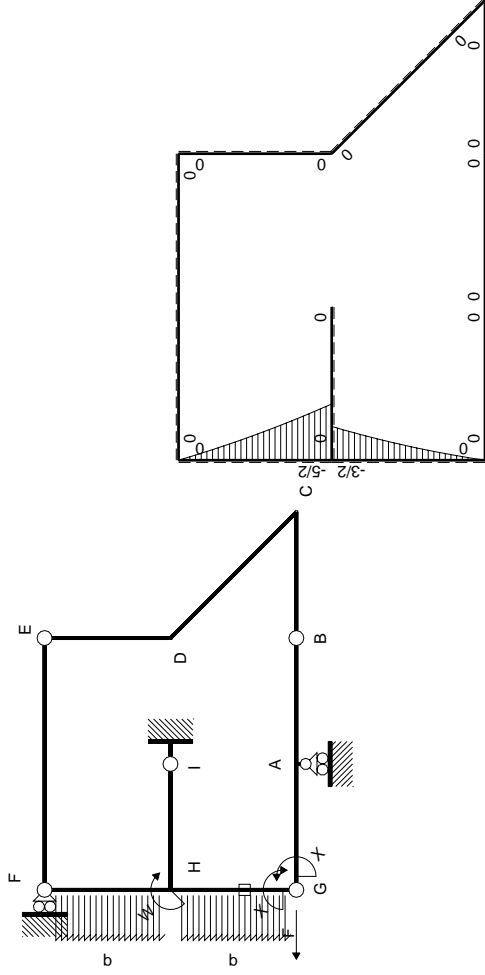
$$= [1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/3 Fb^2/EJ$$



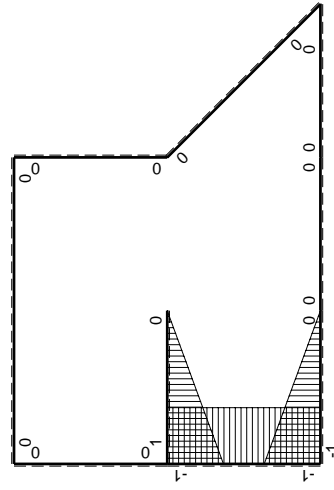
- A = 153.4 mm²
- J_u = 71202. mm⁴
- J_v = 7969. mm⁴
- J_t = 129.1 mm⁴
- y_o = 8.875 mm
- y_g = 27.37 mm
- T_y = -810. N
- M_x = -510300. Nmm
- x_m = 5. mm
- u_m = -12. mm
- v_m = -27.37 mm
- σ_m = -Mv/J_u = -196.2 N/mm²
- x_c = 17. mm
- v_c = -27.37 mm
- σ_c = -Mv/J_u = -196.2 N/mm²
- τ_c = TS'/tJ_u = 13.45 N/mm²
- τ_g = TS'/tJ_u = 13.45 N/mm²
- t_c = 270. mm
- σ_o = √σ²+3τ² = 197.6 N/mm²





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	0	0	0	0	0
BA b	0	0	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	0	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
AG b	x/b	0	0	x^2/b^2	0	$1/3Xb/EJ$
FH b	0	$-2Fx-1/2qx^2$	0	0	0	0
HF b	0	$5/2Fb-3Fx+1/2qx^2$	0	0	0	0
HI b	$1-x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
IH b	$-x/b$	0	0	x^2/b^2	0	$1/3Xb/EJ$
HG b	-1	$-3/2Fb+2Fx-1/2qx^2$	$3/2Fb-2Fx+1/2Fx^2/b$	1	$2/3Fb^2/EJ$	Xb/EJ
GH b	1	$Fx+1/2qx^2$	$Fx+1/2Fx^2/b$	1	$-Fb^2/EJ$	$23/12Xb/EJ$
HG	elongazione asta $N_{1HG}^{HG} - N_{1HG}^{HG}$					
A	molla nodo $-V_{1A}(V_{0A} + XV_{1A})/k_A$					
	totali					
	iperstatica X=W _{GA}					

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{HG}^{x_0} = \int_0^b (3/2 - 2x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

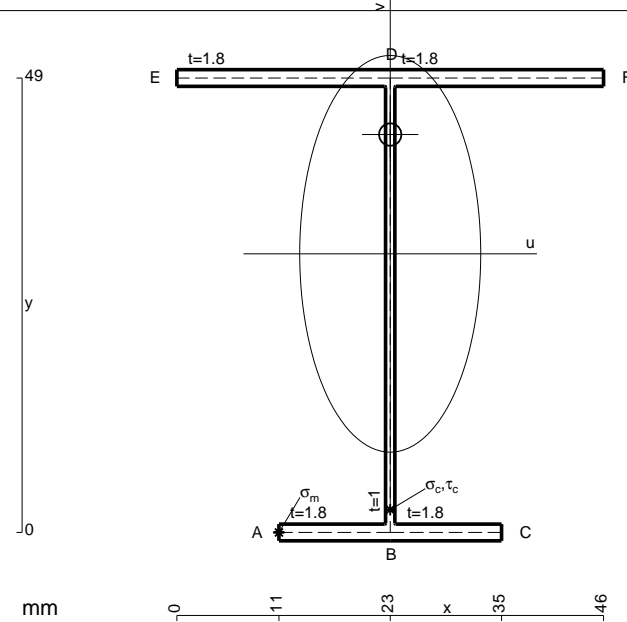
$$= [3/2 x - x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (3/2 b - b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/3 Fb^2/EJ$$

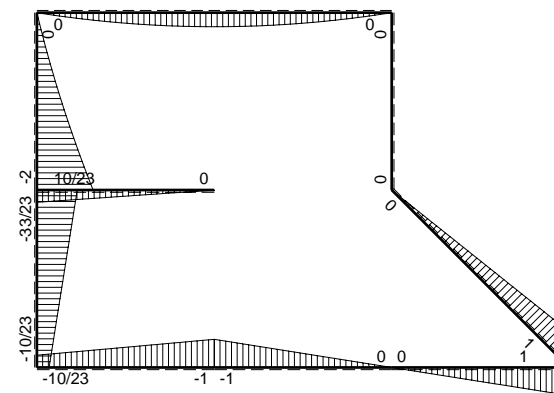
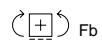
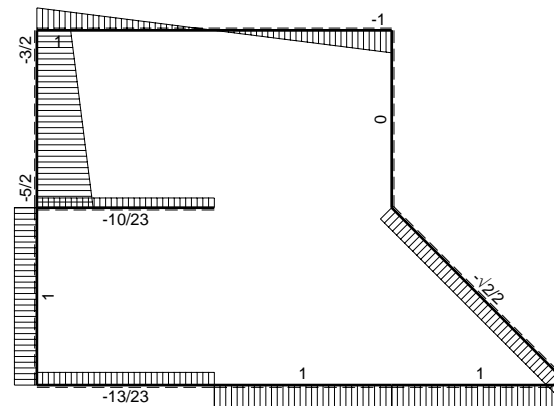
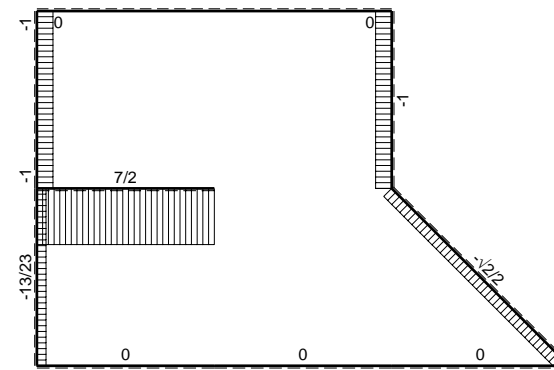
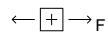
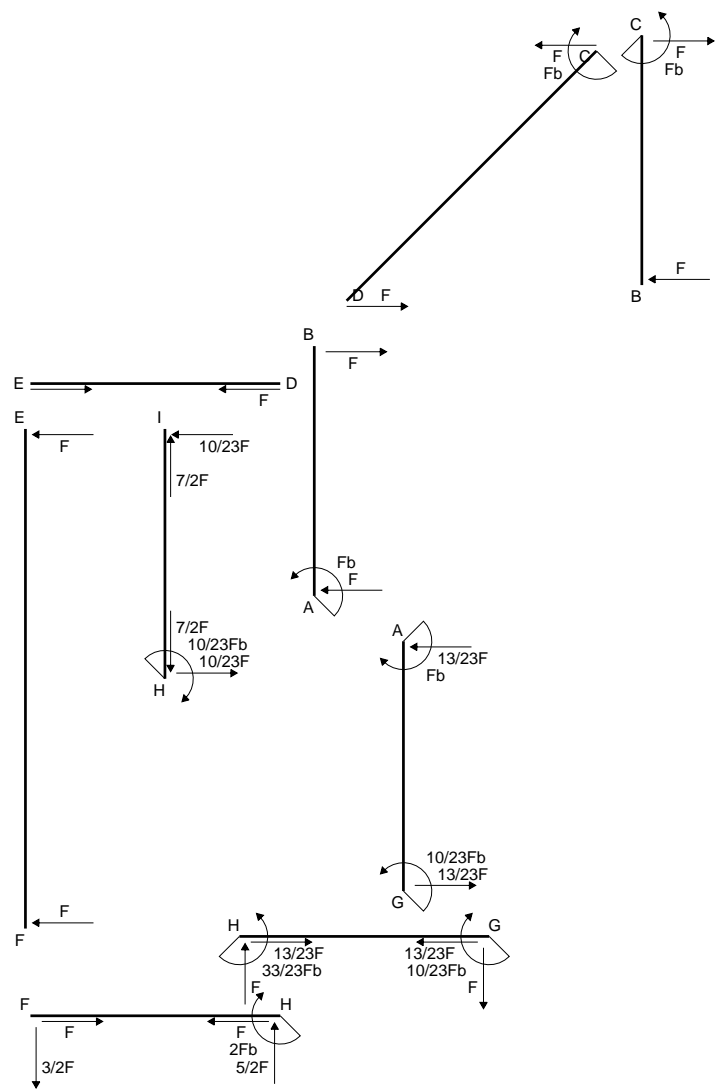
$$L_{GH}^{x_0} = \int_0^b (x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

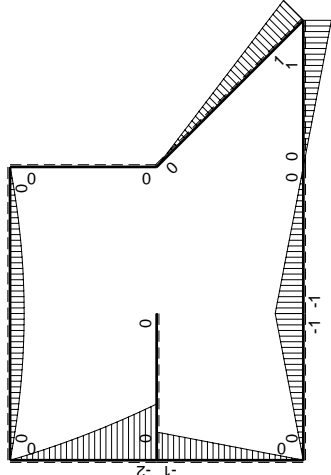
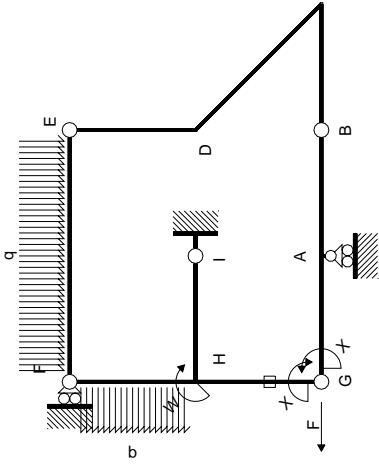
$$= [1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/3 Fb^2/EJ$$

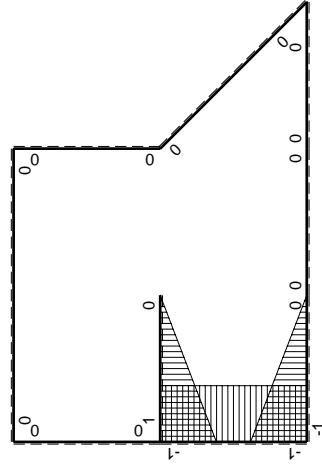


- A = 175. mm²
- J_u = 80057. mm⁴
- J_v = 16674. mm⁴
- J_i = 152.4 mm⁴
- y_o = 12.86 mm
- y_g = 30.04 mm
- T_y = -990. N
- M_x = -552750. Nmm
- x_m = 11. mm
- u_m = -12. mm
- v_m = -30.04 mm
- σ_m = -Mv/J_u = -207.4 N/mm²
- x_c = 23. mm
- v_c = -30.04 mm
- σ_c = -Mv/J_u = -207.4 N/mm²
- τ_c = TS_i/tJ_u = 16.05 N/mm²
- τ_g = TS_i/tJ_u = 16.05 N/mm²
- t_c = 330. mm
- σ_o = √σ²+3τ² = 209.3 N/mm²





(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-Fb+Fx	0	0	0	0
BA b	0	Fx	0	0	0	0
BC b	0	Fx	0	0	0	0
CB b	0	-Fb+Fx	0	0	0	0
CD $\sqrt{2}b$	0	$Fb-\sqrt{2}/2Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	$-Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$Fx-1/2qx^2$	0	0	0	0
GA b	$-1+x/b$	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$Fb-Fx$	$Fx-Fx^2/b$	x^2/b^2	$1/6Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$-3/2Fx-1/2qx^2$	0	0	0	0
HF b	0	$2Fb-5/2Fx+1/2qx^2$	0	0	0	0
HI b	$1-x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
IH b	$-x/b$	0	0	x^2/b^2	0	$1/3Xb/EJ$
HG b	-1	-Fb+Fx	$Fb-Fx$	1	$1/2Fb^2/EJ$	Xb/EJ
GH b	1	Fx	Fx	1	$1/2Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{IHG^{\pm}HG^{\pm}HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{IA}(V_{GA}+XV_{IA})/k_A$				$-1/2Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-5/6Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$10/23Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

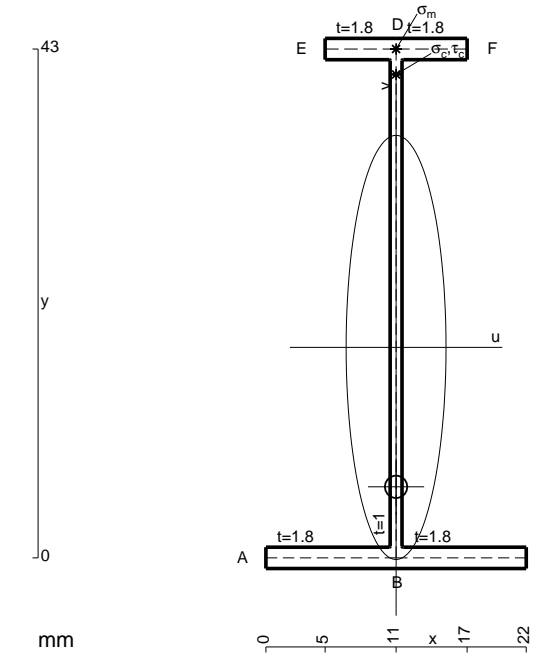
$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [x - 1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

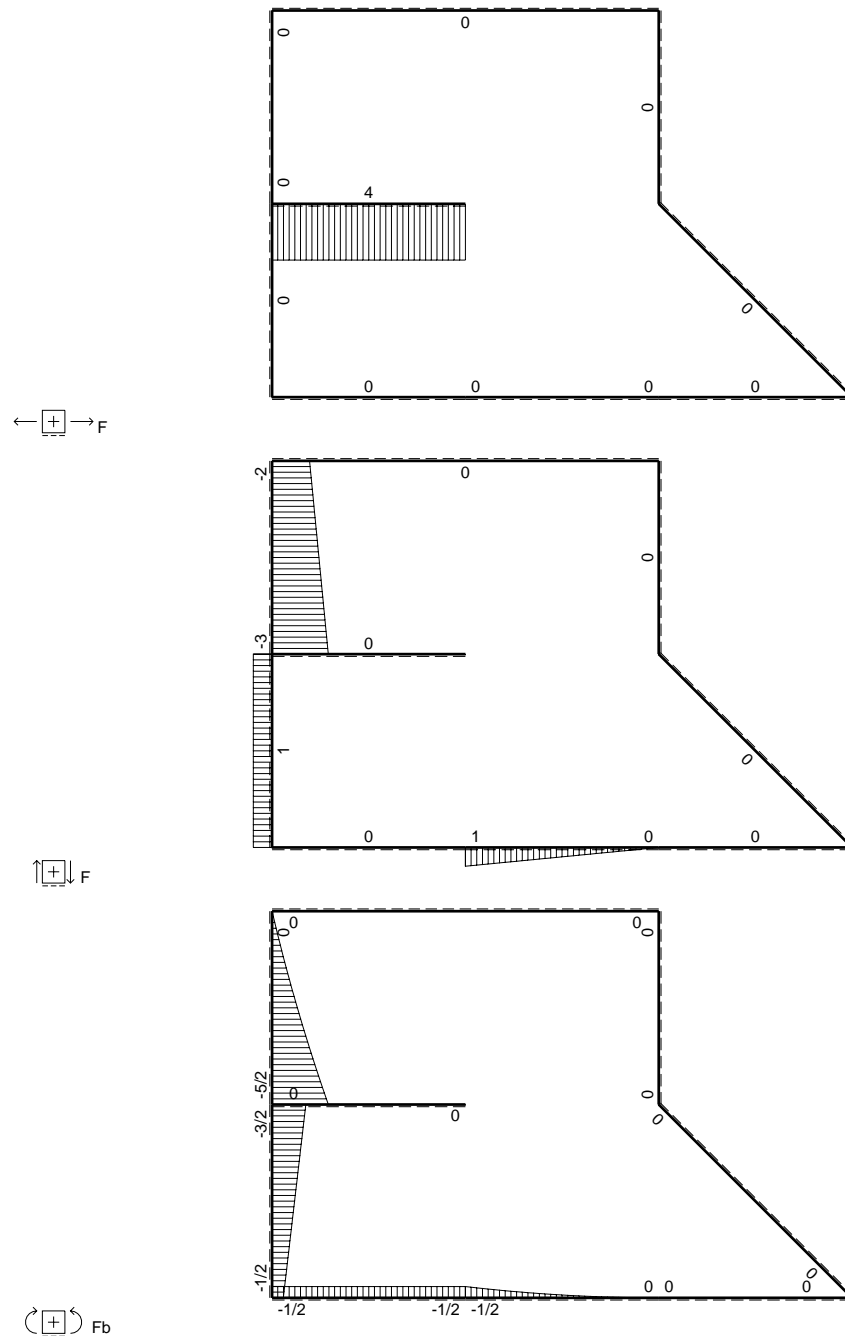
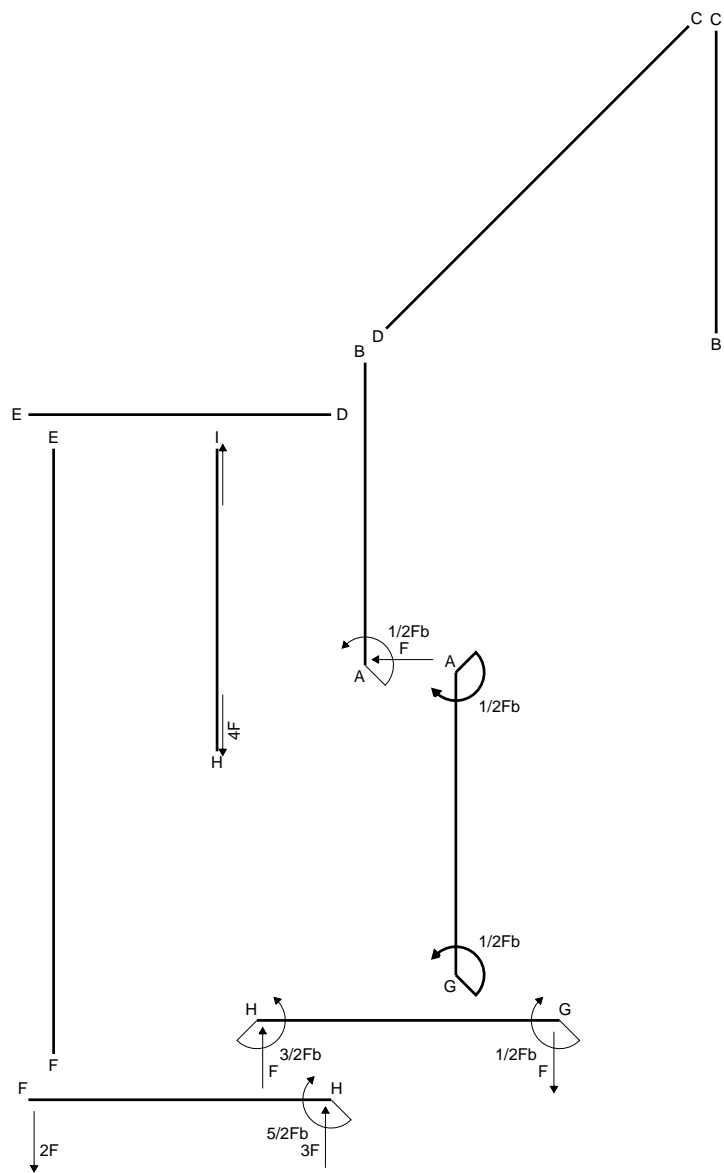
$$= (b - 1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$

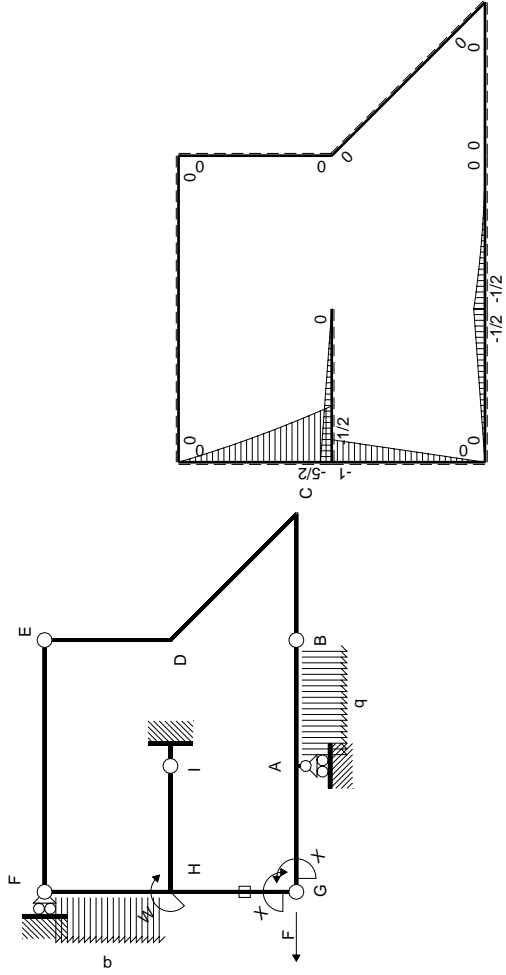
$$L_{GH}^{xo} = \int_0^b (x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$



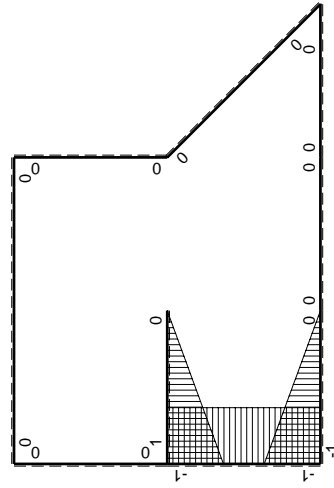
- A = 104.2 mm²
- J_u = 33478. mm⁴
- J_v = 1856. mm⁴
- J_i = 80.43 mm⁴
- y_o = -11.78 mm
- y_g = 17.79 mm
- N = -230. N
- T_y = -575. N
- M_x = -285200. Nmm
- x_m = 11. mm
- y_m = 43. mm
- v_m = 25.21 mm
- σ_m = N/A-Mv/J_u = 212.6 N/mm²
- y_c = 2. mm
- u_c = -11. mm
- v_c = -15.79 mm
- σ_c = N/A-Mv/J_u = 212.6 N/mm²
- τ_c = TS/tJ_u = 9.354 N/mm²
- τ_g = TS/tJ_u = 9.354 N/mm²
- t_c = 230. mm
- σ_o = √σ²+3τ² = 213.2 N/mm²





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int M_x M_x / E J dx$
AB b	0	$-1/2Fb + Fx - 1/2qx^2$	0	0	0	0
BA b	0	$1/2qx^2$	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	0	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$-1/2Fx$	$1/2Fx - 1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$1/2Fb - 1/2Fx$	$1/2Fx - 1/2Fx^2/b$	x^2/b^2	$1/12Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$-2Fx - 1/2qx^2$	0	0	0	0
HF b	0	$5/2Fb - 3Fx + 1/2qx^2$	0	0	0	0
HI b	$1-x/b$	$-1/2Fb + 1/2Fx$	$-1/2Fb + Fx - 1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$1/2Fx$	$-1/2Fx^2/b$	x^2/b^2	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	$-Fb + Fx$	$Fb - Fx$	1	$1/2Fb^2/EJ$	Xb/EJ
GH b	1	Fx	Fx	1	$1/2Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG}^{\pm HG} \pm HG$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$				$-3/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-23/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica X=W _{GA}				$1/2Fb$	

Sviluppi di calcolo iperstatica

M_x flessione da iperstatica X=1

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (-1/2 + x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + 1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + 1/2 b - 1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (-1/2 x^2/b^2) Fb 1/EJ dx = [-1/6 x^3/b^2]_0^b Fb 1/EJ$$

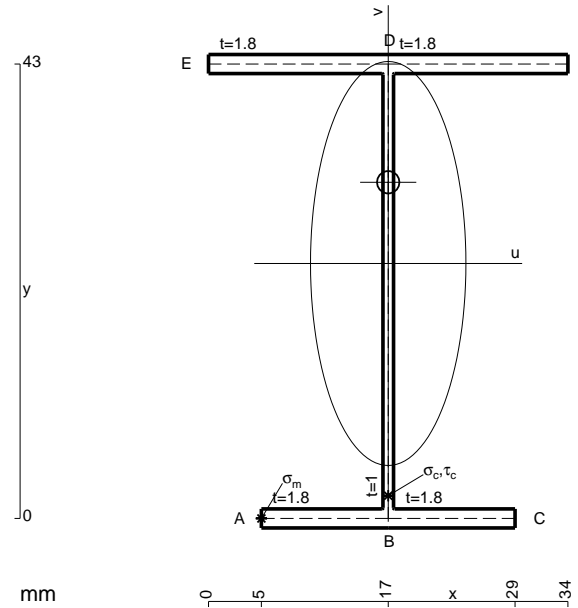
$$= (-1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [x - 1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

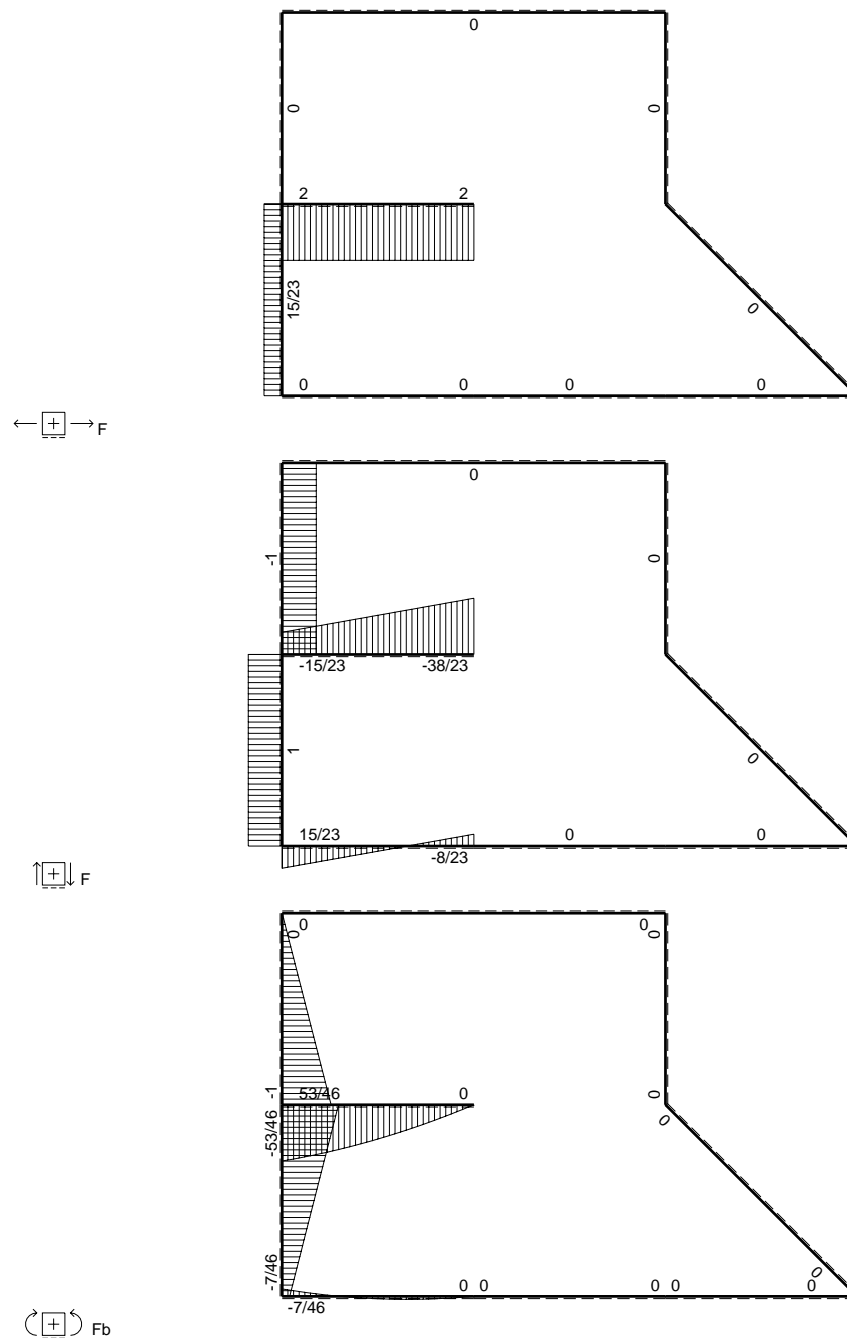
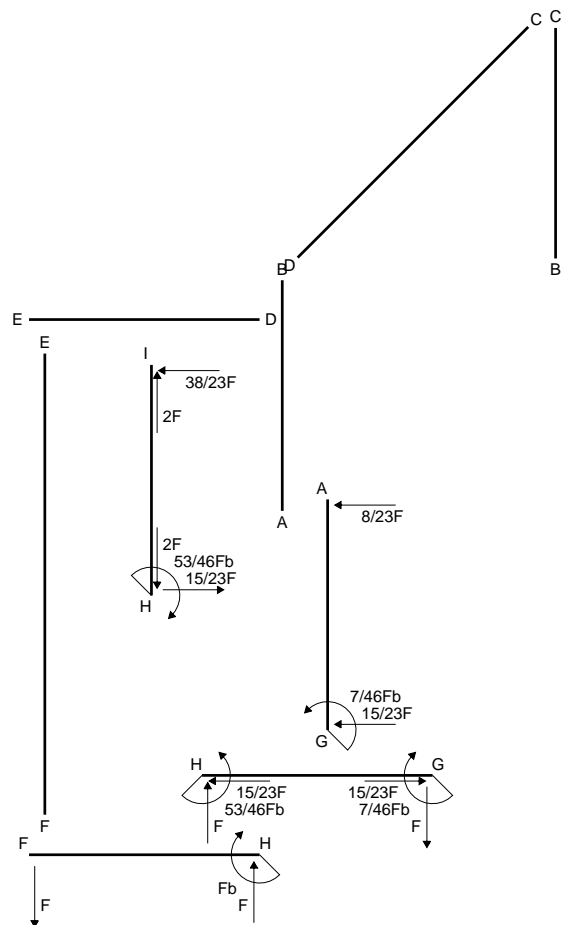
$$= (b - 1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$

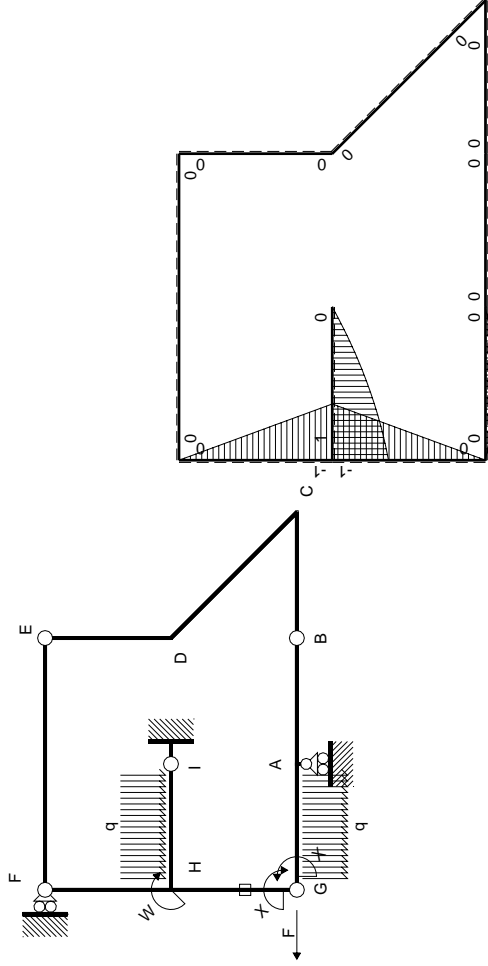
$$L_{GH}^{xo} = \int_0^b (x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$



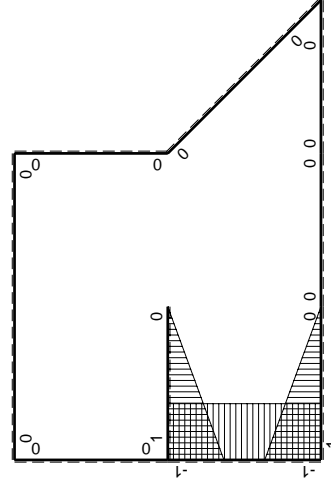
- A = 147.4 mm²
- J_u = 53868. mm⁴
- J_v = 7969. mm⁴
- J_i = 127.1 mm⁴
- y_o = 7.686 mm
- y_g = 24.13 mm
- T_y = -930. N
- M_x = -511500. Nmm
- x_m = 5. mm
- u_m = -12. mm
- v_m = -24.13 mm
- σ_m = -Mv/J_u = -229.1 N/mm²
- x_c = 17. mm
- v_c = -24.13 mm
- σ_c = -Mv/J_u = -229.1 N/mm²
- τ_c = TS_i/tJ_u = 17.99 N/mm²
- τ_g = TS_i/tJ_u = 17.99 N/mm²
- t_c = 310. mm
- σ_o = √σ²+3τ² = 231.2 N/mm²





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	0	0	0	0	0
BA b	0	0	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	0	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$1/2Fx-1/2qx^2$	$-1/2Fx+Fx^2/b-1/2qx^3/b$	$1-2x/b+x^2/b^2$	$-1/24Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$-1/2Fx+1/2qx^2$	$-1/2Fx^2/b+1/2qx^3/b$	x^2/b^2		
FH b	0	-Fx	0	0	0	0
HF b	0	Fb-Fx	0	0	0	0
HI b	$1-x/b$	$Fb-1/2Fx-1/2qx^2$	$Fb-3/2Fx+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$3/8Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$-3/2Fx+1/2qx^2$	$3/2Fx^2/b-1/2qx^3/b$	x^2/b^2		
HG b	-1	-Fb+Fx	Fb-Fx	1	$1/2Fb^2/EJ$	Xb/EJ
GH b	1	Fx	Fx	1		
HG	elongazione asta $N_{1HG} \delta_{HG} \frac{1}{HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{GA}+XV_{1A})/k_A$				$-1/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-7/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica X=W _{GA}				$7/46Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (-1/2 x/b + x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [-1/4 x^2/b + 1/3 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (-1/4 b + 1/3 b - 1/8 b) Fb 1/EJ = -1/24 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (-1/2 x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [-1/6 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (-1/6 b + 1/8 b) Fb 1/EJ = -1/24 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1 - 3/2 x/b + 1/2 x^3/b^3) Fb 1/EJ dx = [x - 3/4 x^2/b + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (b - 3/4 b + 1/8 b) Fb 1/EJ = 3/8 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (3/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [1/2 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

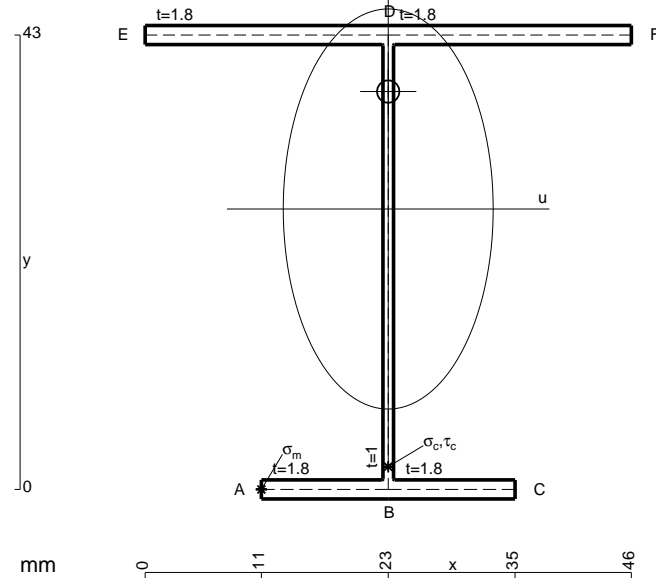
$$= (1/2 b - 1/8 b) Fb 1/EJ = 3/8 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [x - 1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

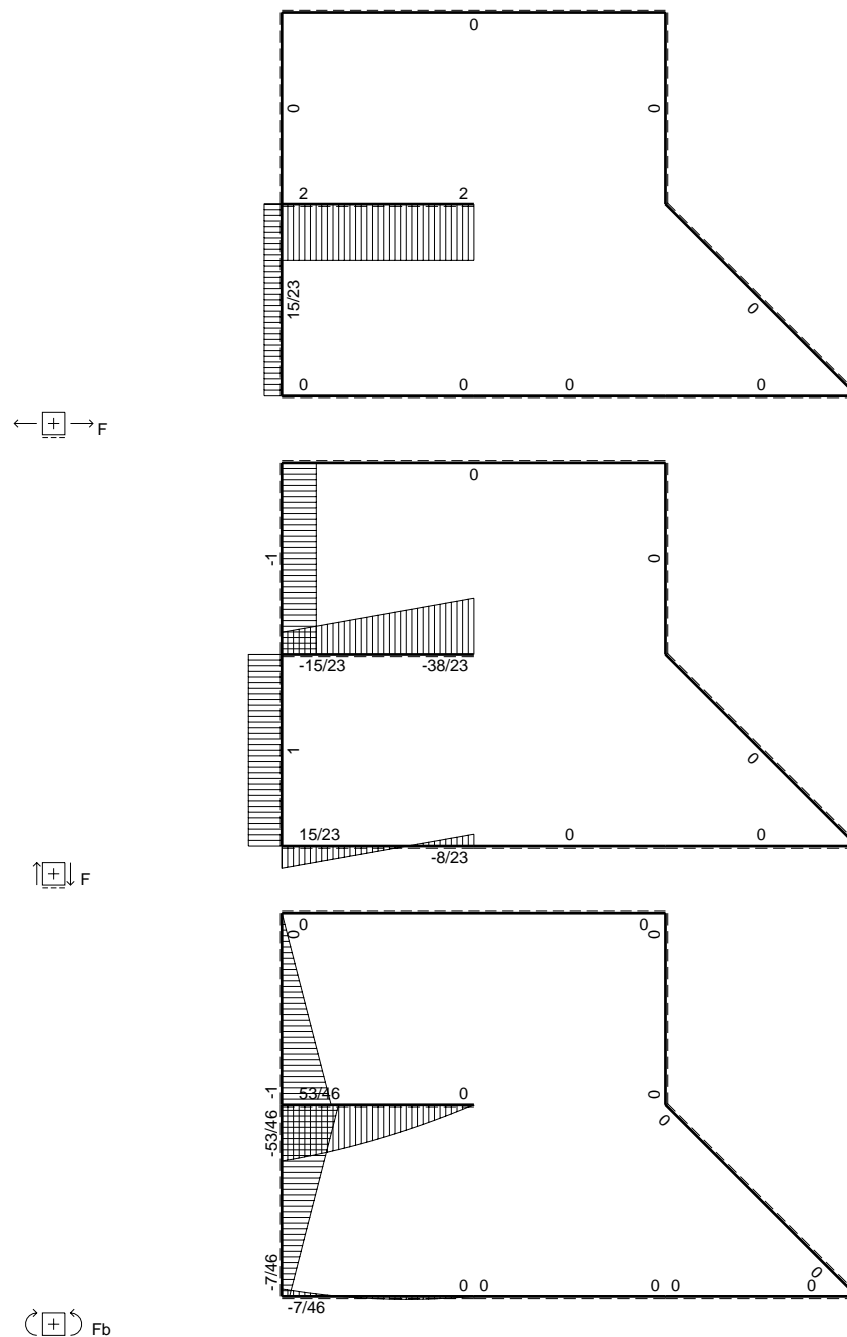
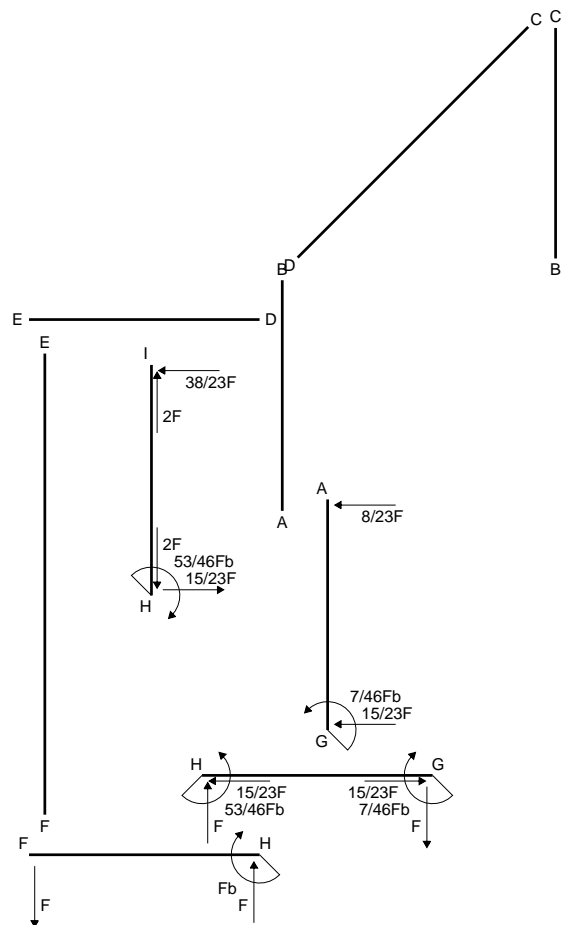
$$= (b - 1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$

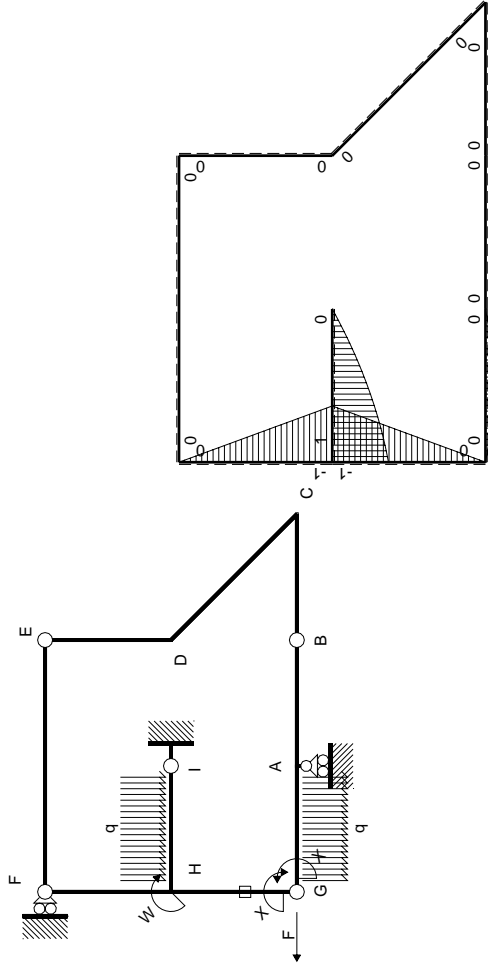
$$L_{GH}^{xo} = \int_0^b (x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$



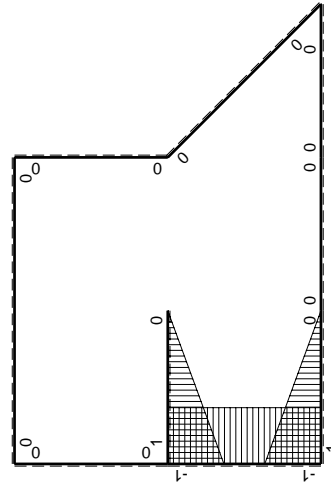
- A = 169. mm²
- J_u = 60580. mm⁴
- J_v = 16674. mm⁴
- J_i = 150.4 mm⁴
- y_o = 11.11 mm
- y_g = 26.54 mm
- T_y = -780. N
- M_x = -546000. Nmm
- x_m = 11. mm
- u_m = -12. mm
- v_m = -26.54 mm
- σ_m = -Mv/J_u = -239.2 N/mm²
- x_c = 23. mm
- v_c = -26.54 mm
- σ_c = -Mv/J_u = -239.2 N/mm²
- τ_c = TS_y/tJ_u = 14.76 N/mm²
- τ_g = TS_y/tJ_u = 14.76 N/mm²
- t_c = 780. mm
- σ_o = √σ²+3τ² = 240.5 N/mm²





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	M _x (x)	M ₀ (x)	M _x M ₀	M _x M _x	∫M _x M ₀ /EJdx	∫XM _x M _x /EJdx
AB b	0	0	0	0	0	0
BA b	0	0	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD √2b	0	0	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	-1+x/b	1/2Fx-1/2qx ²	-1/2Fx+Fx ² /b-1/2qx ³ /b	1-2x/b+x ² /b ²	-1/24Fb ² /EJ	1/3Xb/EJ
AG b	x/b	-1/2Fx+1/2qx ²	-1/2Fx ² /b+1/2qx ³ /b	x ² /b ²		
FH b	0	-Fx	0	0	0	0
HF b	0	Fb-Fx	0	0	0	0
HI b	1-x/b	Fb-1/2Fx-1/2qx ²	Fb-3/2Fx+1/2qx ³ /b	1-2x/b+x ² /b ²	3/8Fb ² /EJ	1/3Xb/EJ
IH b	-x/b	-3/2Fx+1/2qx ²	3/2Fx ² /b-1/2qx ³ /b	x ² /b ²		
HG b	-1	-Fb+Fx	Fb-Fx	1	1/2Fb ² /EJ	Xb/EJ
GH b	1	Fx	Fx	1		
HG	elongazione asta N _{1HG} [±] HG				-Fb ² /EJ	
A	molla nodo -V _{1A} (V _{GA} +XV _{1A})/k _A				-1/8Fb ² /EJ	1/4Xb/EJ
	totali				-7/24Fb ² /EJ	23/12Xb/EJ
	iperstatica X=W _{GA}				7/46Fb	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (-1/2 x/b + x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [-1/4 x^2/b + 1/3 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (-1/4 b + 1/3 b - 1/8 b) Fb 1/EJ = -1/24 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (-1/2 x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [-1/6 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (-1/6 b + 1/8 b) Fb 1/EJ = -1/24 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1 - 3/2 x/b + 1/2 x^3/b^3) Fb 1/EJ dx = [x - 3/4 x^2/b + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (b - 3/4 b + 1/8 b) Fb 1/EJ = 3/8 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (3/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [1/2 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

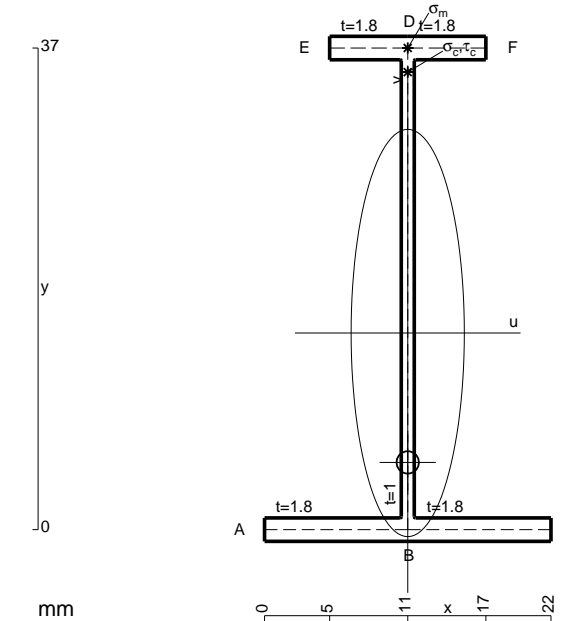
$$= (1/2 b - 1/8 b) Fb 1/EJ = 3/8 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [x - 1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

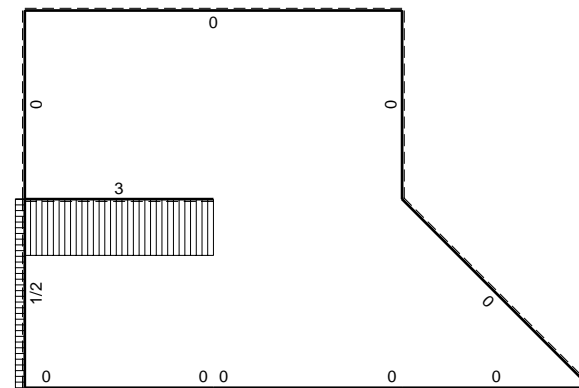
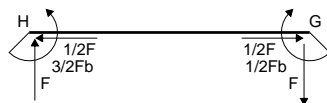
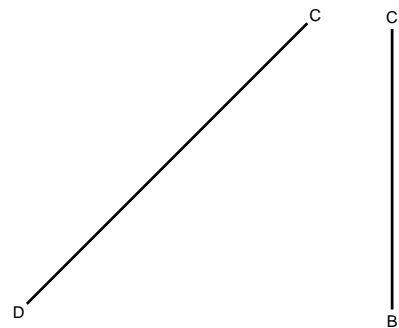
$$= (b - 1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$

$$L_{GH}^{xo} = \int_0^b (x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

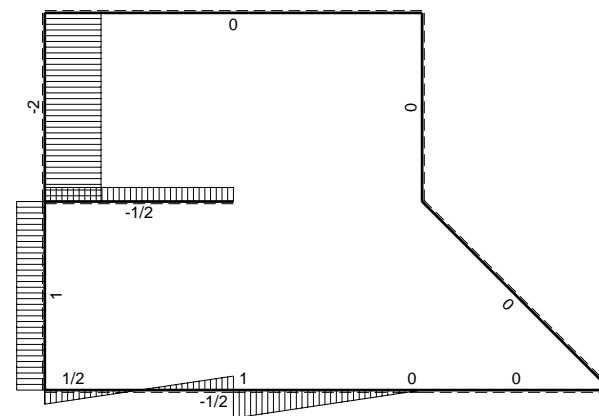
$$= (1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$



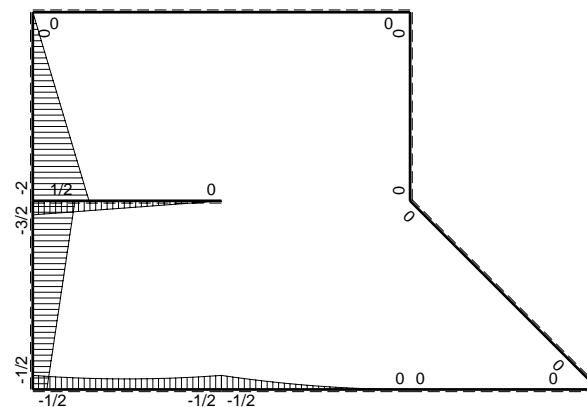
$A = 98.2 \text{ mm}^2$
 $J_u = 24038. \text{ mm}^4$
 $J_v = 1856. \text{ mm}^4$
 $J_t = 78.43 \text{ mm}^4$
 $y_o = -9.943 \text{ mm}$
 $y_g = 15.11 \text{ mm}$
 $T_y = -700. \text{ N}$
 $M_x = -217000. \text{ Nmm}$
 $x_m = 11. \text{ mm}$
 $y_m = 37. \text{ mm}$
 $v_m = 21.89 \text{ mm}$
 $\sigma_m = -Mv/J_u = 197.6 \text{ N/mm}^2$
 $y_c = 2. \text{ mm}$
 $u_c = -11. \text{ mm}$
 $v_c = -13.11 \text{ mm}$
 $\sigma_c = -Mv/J_u = 197.6 \text{ N/mm}^2$
 $\tau_c = TS_t/J_u = 13.77 \text{ N/mm}^2$
 $\tau_g = TS_t/J_u = 13.77 \text{ N/mm}^2$
 $t_c = 700. \text{ mm}$
 $\sigma_o = \sqrt{\sigma^2 + 3\tau^2} = 199.1 \text{ N/mm}^2$



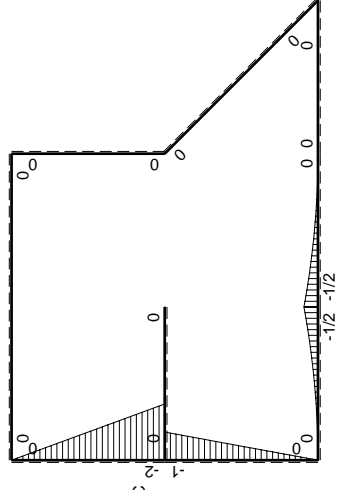
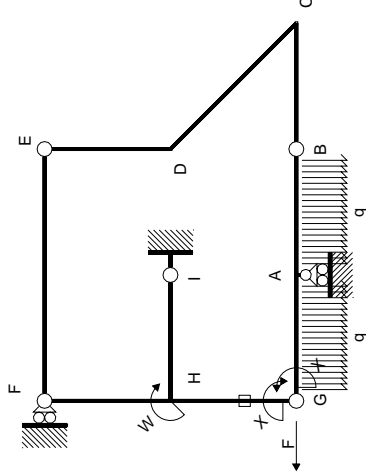
← ⊕ → F



↑ ⊕ ↓ F

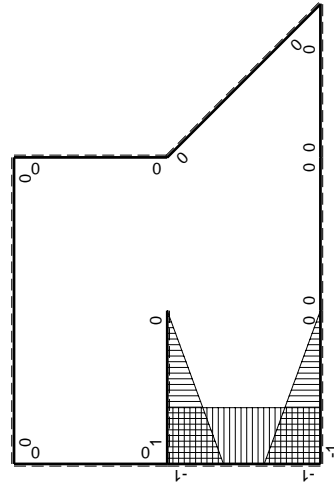


⊕ ⊖ Fb



Schema di calcolo iperstatico

(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-1/2Fb + Fx - 1/2qx^2$	0	0	0	0
BA b	0	$1/2qx^2$	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	0	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$-1/2qx^2$	$1/2Fx^2/b - 1/2qx^3/b$	$1-2x/b+x^2/b^2$	$1/24Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$1/2Fb-Fx+1/2qx^2$	$1/2Fx-Fx^2/b+1/2qx^3/b$	x^2/b^2	$1/24Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$-2Fx$	0	0	0	0
HF b	0	$2Fb-2Fx$	0	0	0	0
HI b	$1-x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
IH b	$-x/b$	0	0	x^2/b^2	0	$1/3Xb/EJ$
HG b	-1	$-Fb+Fx$	$Fb-Fx$	1	$1/2Fb^2/EJ$	Xb/EJ
GH b	1	Fx	Fx	1	$1/2Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG+HG+HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{GA}+XV_{1A})/k_A$				$-1/2Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-23/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$1/2Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{x_0} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/6 b - 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{AG}^{x_0} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

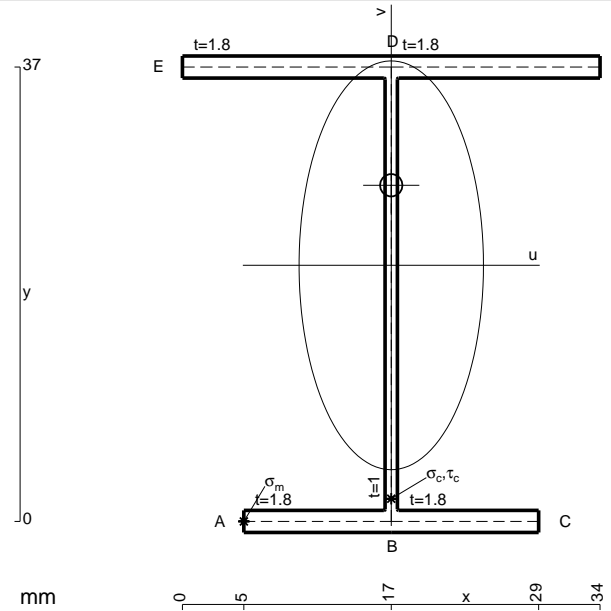
$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{HG}^{x_0} = \int_0^b (1 - x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [x - 1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

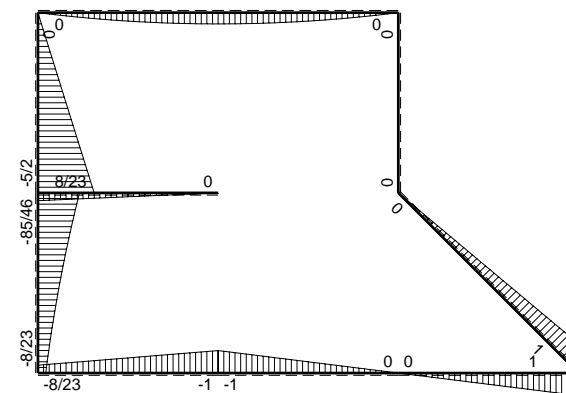
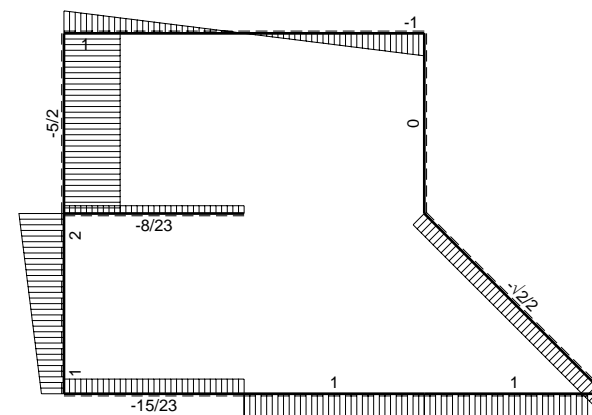
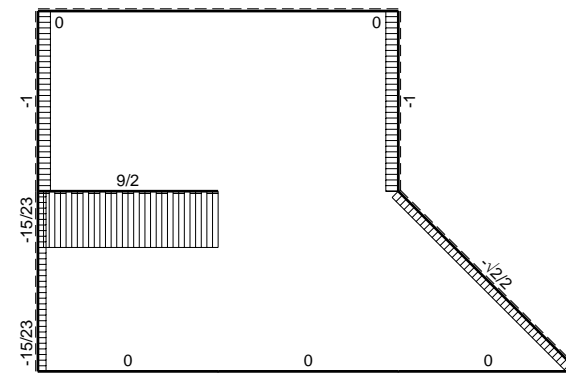
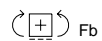
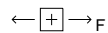
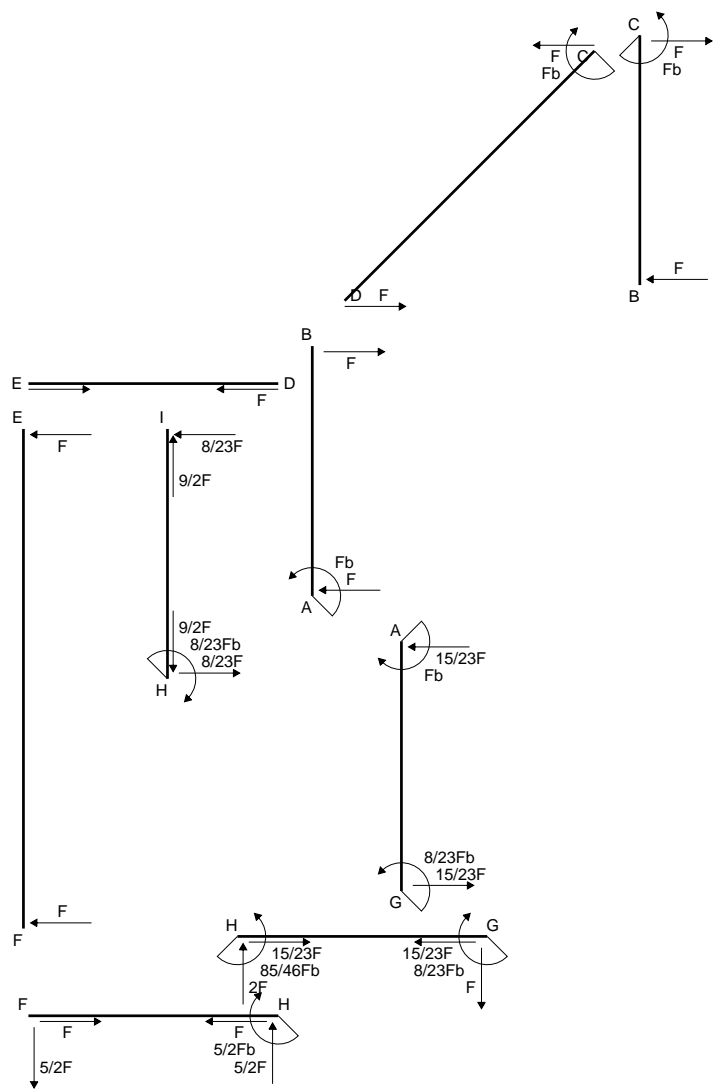
$$= (b - 1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$

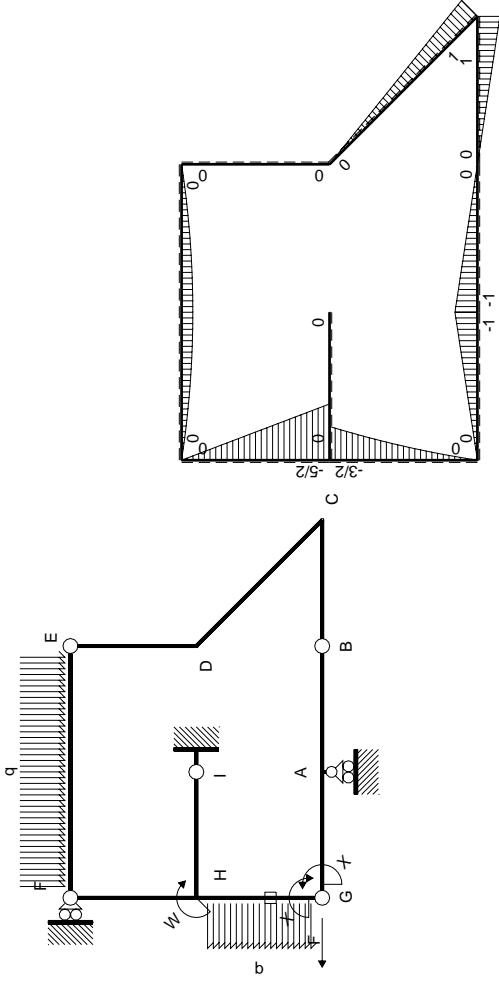
$$L_{GH}^{x_0} = \int_0^b (x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$

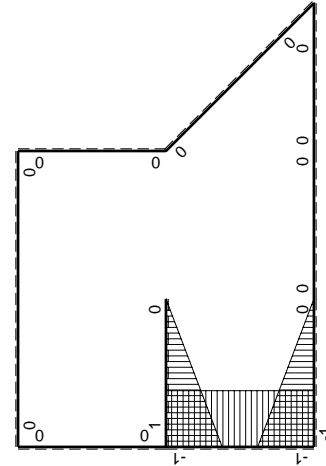


- A = 141.4 mm²
- J_u = 39168. mm⁴
- J_v = 7969. mm⁴
- J_t = 125.1 mm⁴
- y_o = 6.518 mm
- y_g = 20.85 mm
- T_y = -1160. N
- M_x = -394400. Nmm
- x_m = 5. mm
- u_m = -12. mm
- v_m = -20.85 mm
- σ_m = -Mv/J_u = -210. N/mm²
- x_c = 17. mm
- v_c = -20.85 mm
- σ_c = -Mv/J_u = -210. N/mm²
- τ_c = TS/tJ_u = 26.68 N/mm²
- τ_g = TS/tJ_u = 26.68 N/mm²
- t_c = 580. mm
- σ_o = √σ²+3τ² = 215. N/mm²





M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$	
AB b	0	-Fb+Fx	0	0	0	0	
BA b	0	Fx	0	0	0	0	
BC b	0	Fx	0	0	0	0	
CB b	0	-Fb+Fx	0	0	0	0	
CD $\sqrt{2}b$	0	Fb- $\sqrt{2}/2Fx$	0	0	0	0	
DE b	0	0	0	0	0	0	
ED b	0	0	0	0	0	0	
EF 2b	0	-Fx+ $1/2qx^2$	0	0	0	0	
FE 2b	0	Fx- $1/2qx^2$	0	0	0	0	
GA b	-1+x/b	-Fx	Fx-Fx $^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$	
AG b	x/b	Fb-Fx	Fx-Fx $^2/b$	x^2/b^2	0	0	
FH b	0	-5/2Fx	0	0	0	0	
HF b	0	5/2Fb-5/2Fx	0	0	0	0	
HI b	1-x/b	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$	
IH b	-x/b	0	0	x^2/b^2	0	0	
HG b	-1	-3/2Fb+2Fx- $1/2qx^2$	$3/2Fb-2Fx+1/2Fx^2/b$	1	$2/3Fb^2/EJ$	Xb/EJ	
GH b	1	Fx+ $1/2qx^2$	Fx+ $1/2Fx^2/b$	1	0	0	
HG	elongazione asta $N_{1HG}^{HG} - N_{1HG}^{HG}$						
A	molla nodo $-V_{1A}(V_{0A} + XV_{1A})/k_A$						
	totali						
	iperstatica $X=W_{GA}$						

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[1/2 x^2/b - 1/3 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[1/2 x^2/b - 1/3 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (3/2 - 2x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ$$

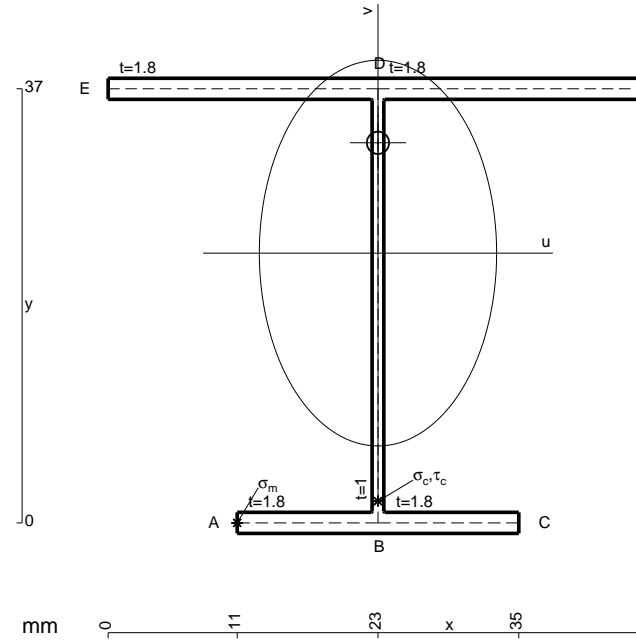
$$= \left[3/2 x - x^2/b + 1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ$$

$$= (3/2 b - b + 1/6 b) \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ = -1/3 \cdot Fb^2/EJ$$

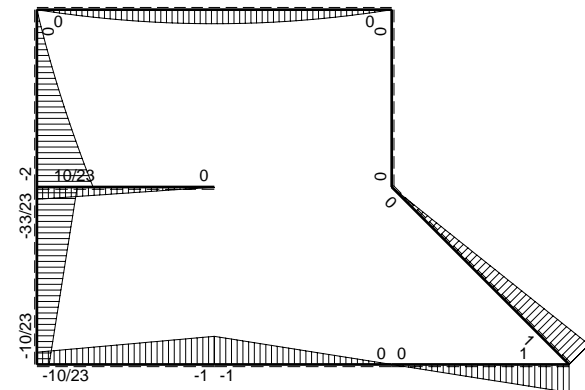
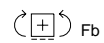
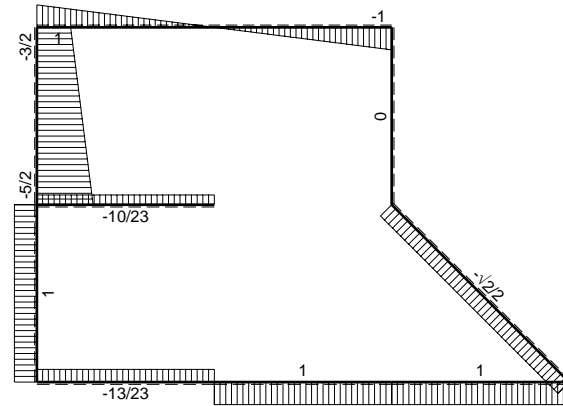
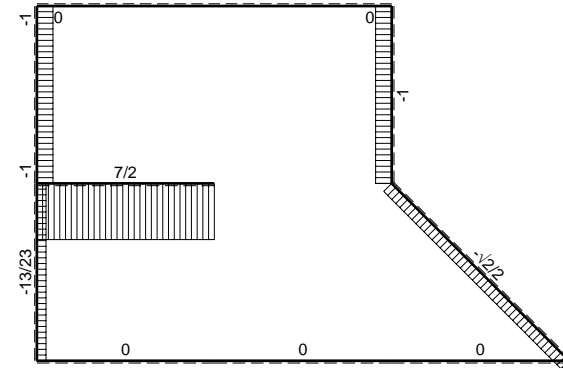
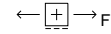
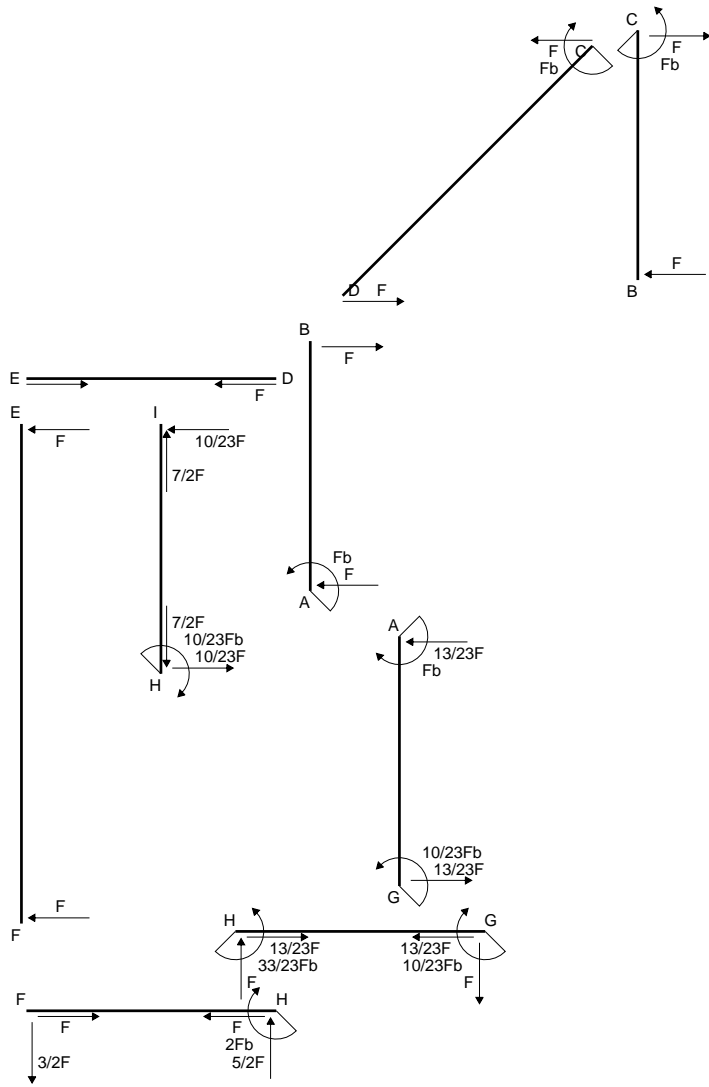
$$L_{GH}^{xo} = \int_0^b (x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ$$

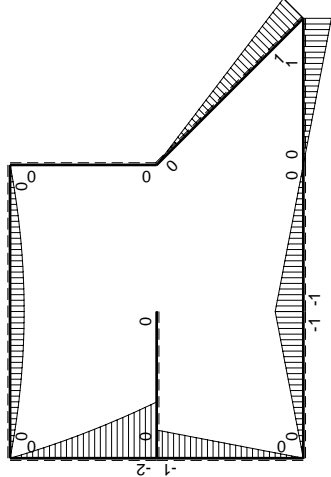
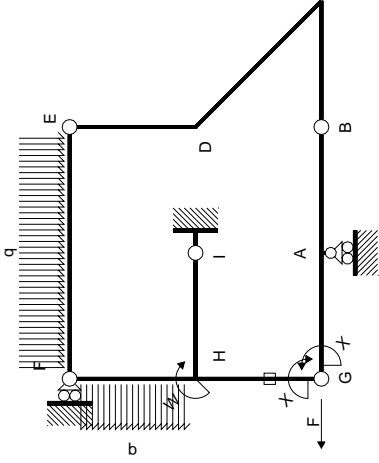
$$= \left[1/2 x^2/b + 1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ$$

$$= (1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ = -1/3 \cdot Fb^2/EJ$$

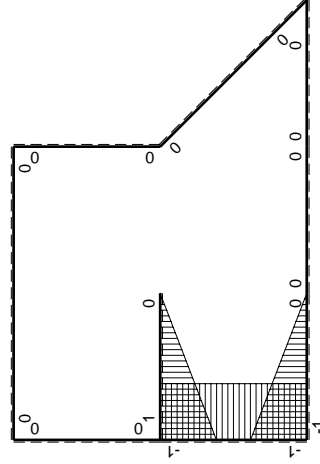


- A = 163. mm²
- J_u = 44052. mm⁴
- J_v = 16674. mm⁴
- J_t = 148.4 mm⁴
- y_o = 9.404 mm
- y_g = 22.99 mm
- N = -440. N
- T_y = -1100. N
- M_x = -407000. Nmm
- x_m = 11. mm
- u_m = -12. mm
- v_m = -22.99 mm
- σ_m = N/A-Mv/J_u = -215.1 N/mm²
- x_c = 23. mm
- v_c = -22.99 mm
- σ_c = N/A-Mv/J_u = -215.1 N/mm²
- τ_c = TS'/tJ_u = 24.8 N/mm²
- τ_g = TS'/tJ_u = 24.8 N/mm²
- t_c = 440. mm
- σ_o = √σ²+3τ² = 219.4 N/mm²





(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-Fb+Fx	0	0	0	0
BA b	0	Fx	0	0	0	0
BC b	0	Fx	0	0	0	0
CB b	0	-Fb+Fx	0	0	0	0
CD $\sqrt{2}b$	0	$Fb-\sqrt{2}/2Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	$-Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$Fx-1/2qx^2$	0	0	0	0
GA b	$-1+x/b$	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2	$1/6Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$-3/2Fx-1/2qx^2$	0	0	0	0
HF b	0	$2Fb-5/2Fx+1/2qx^2$	0	0	0	0
HI b	$1-x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
IH b	$-x/b$	0	0	x^2/b^2	0	$1/3Xb/EJ$
HG b	-1	-Fb+Fx	Fb-Fx	1	$1/2Fb^2/EJ$	Xb/EJ
GH b	1	Fx	Fx	1	$1/2Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG^{\pm}HG^{\pm}HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{0A}+XV_{1A})/k_A$				$-1/2Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-5/6Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$10/23Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

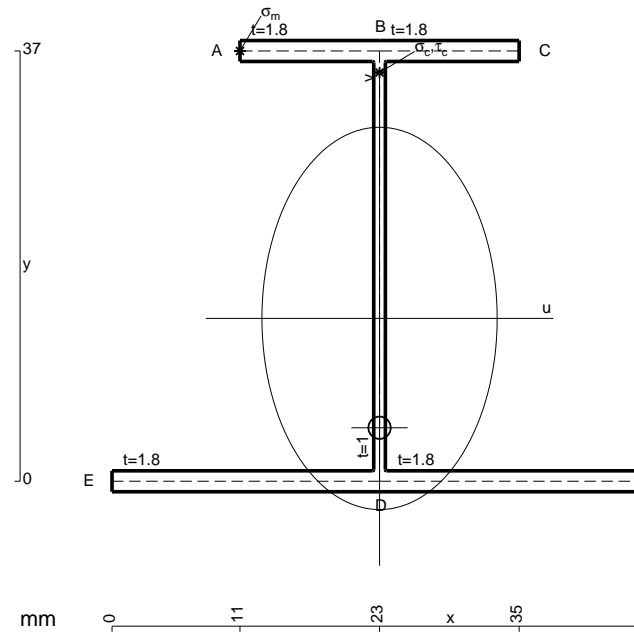
$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [x - 1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

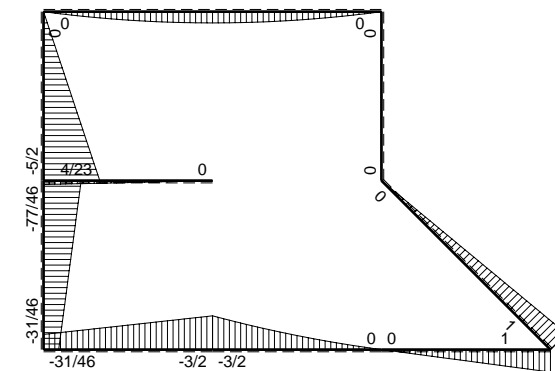
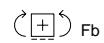
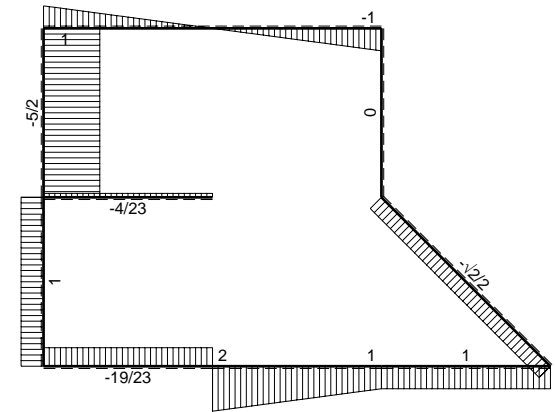
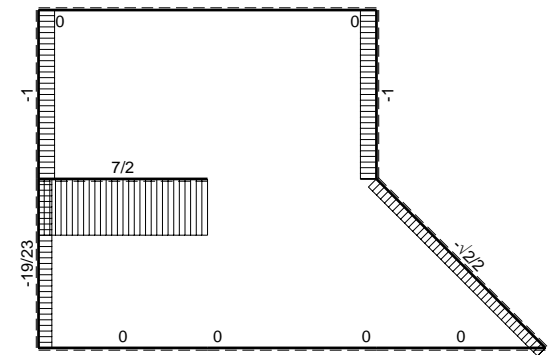
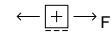
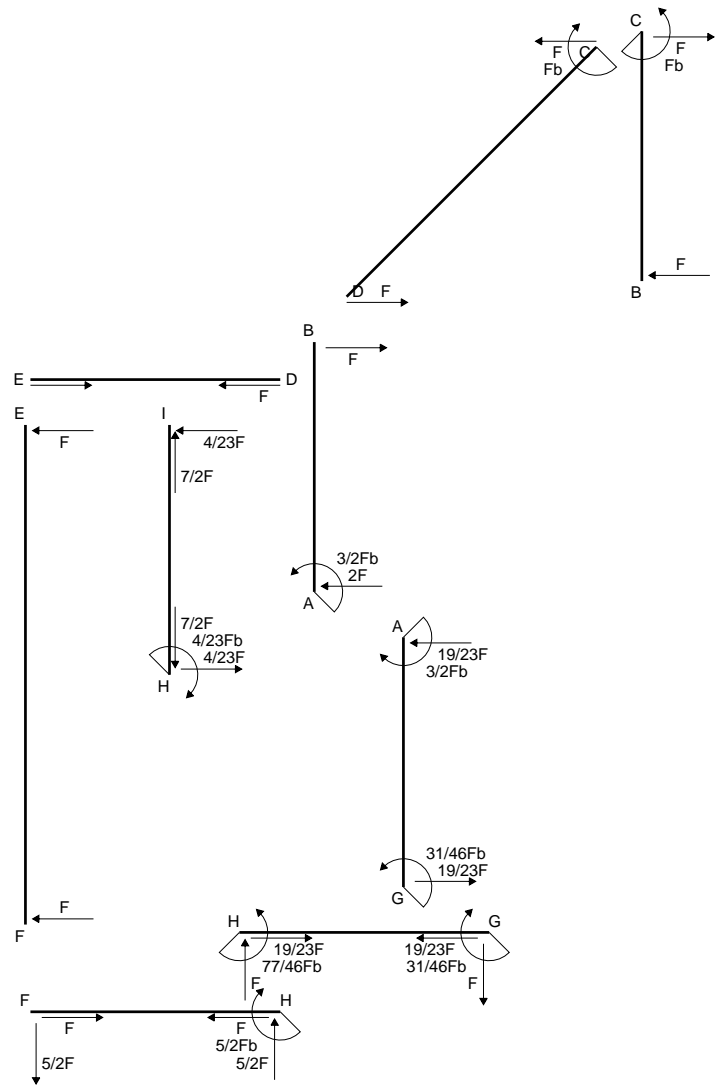
$$= (b - 1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$

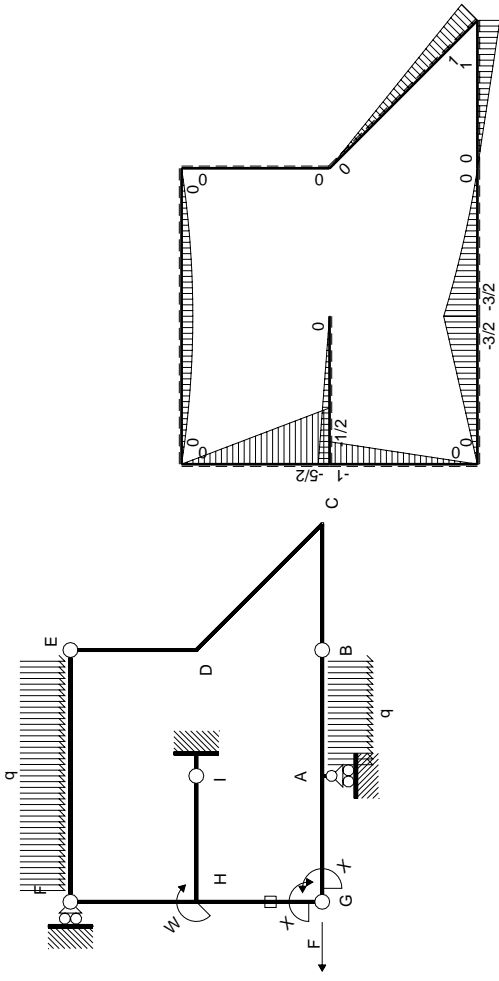
$$L_{GH}^{xo} = \int_0^b (x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$

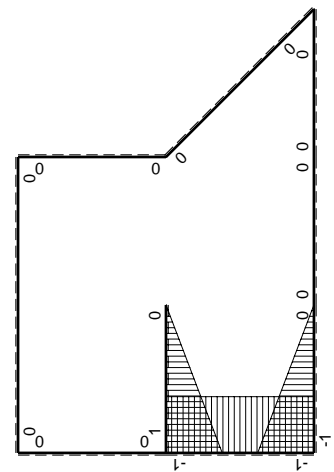


- A = 163. mm²
- J_u = 44052. mm⁴
- J_v = 16674. mm⁴
- J_t = 148.4 mm⁴
- y_o = -9.404 mm
- y_g = 14.01 mm
- N = -550. N
- T_y = -1375. N
- M_x = -440000. Nmm
- x_m = 11. mm
- y_m = 37. mm
- u_m = -12. mm
- v_m = 22.99 mm
- σ_m = N/A-Mv/J_u = 226.3 N/mm²
- x_c = 23. mm
- y_c = 37. mm
- v_c = 22.99 mm
- σ_c = N/A-Mv/J_u = 226.3 N/mm²
- τ_c = TS_t/tJ_u = 31.01 N/mm²
- τ_g = TS_t/tJ_u = 31.01 N/mm²
- t_c = 550. mm
- σ_o = √σ²+3τ² = 232.6 N/mm²





M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x^2 M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	$-3/2Fb+2Fx-1/2qx^2$	0	0	0	0
BA b	0	$Fx+1/2qx^2$	0	0	0	0
BC b	0	Fx	0	0	0	0
CB b	0	$-Fb+Fx$	0	0	0	0
CD $\sqrt{2}b$	0	$Fb-\sqrt{2}2Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	$-Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$Fx-1/2qx^2$	0	0	0	0
GA b	$-1+x/b$	$-3/2Fx$	$3/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/4Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$3/2Fb-3/2Fx$	$3/2Fx-3/2Fx^2/b$	x^2/b^2	$1/4Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$-5/2Fx$	0	0	0	0
HF b	0	$5/2Fb-5/2Fx$	0	0	0	0
HI b	$1-x/b$	$-1/2Fb+1/2Fx$	$-1/2Fb+Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$1/2Fx$	$-1/2Fx^2/b$	x^2/b^2	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	$-Fb+Fx$	$Fb-Fx$	1	$1/2Fb^2/EJ$	Xb/EJ
GH b	1	Fx	Fx	1	$1/2Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG^{\pm}HG^{\pm}HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{GA}+XV_{1A})/k_A$				$-7/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-31/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				31/46Fb	

Sviluppi di calcolo iperstatica

M_x flessione da iperstatica $X=1$

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (-1/2 + x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + 1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + 1/2 b - 1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (-1/2 x^2/b^2) Fb 1/EJ dx = [-1/6 x^3/b^2]_0^b Fb 1/EJ$$

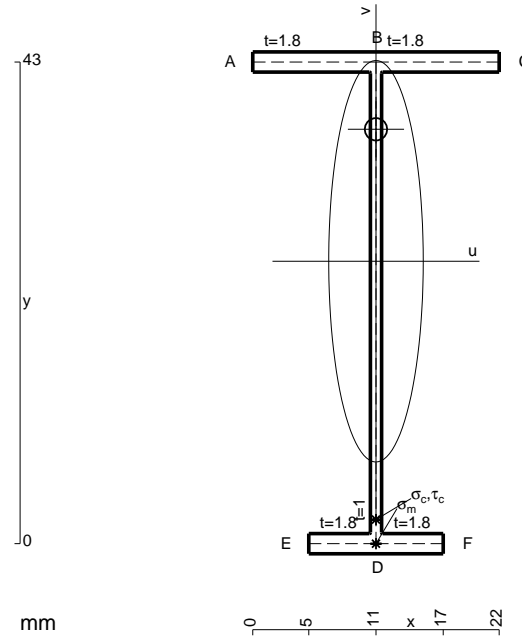
$$= (-1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [x - 1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

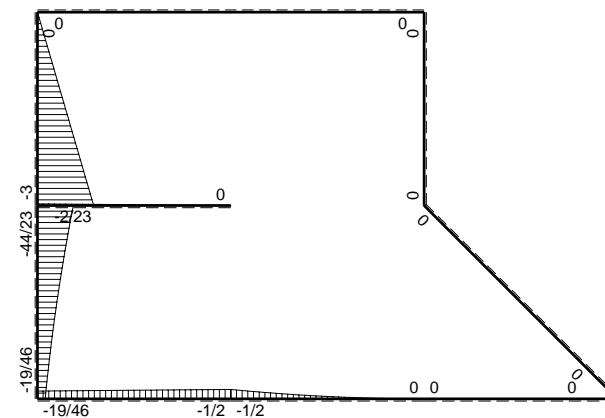
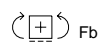
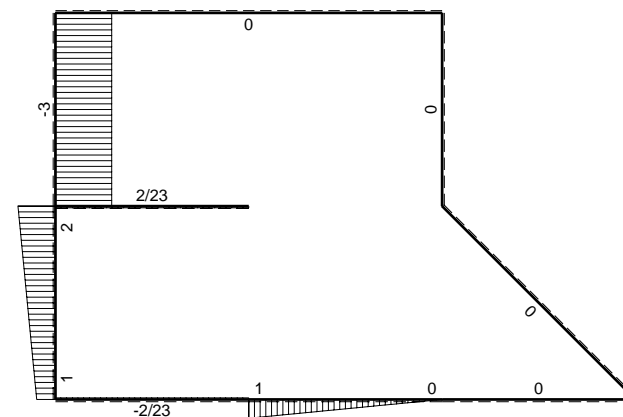
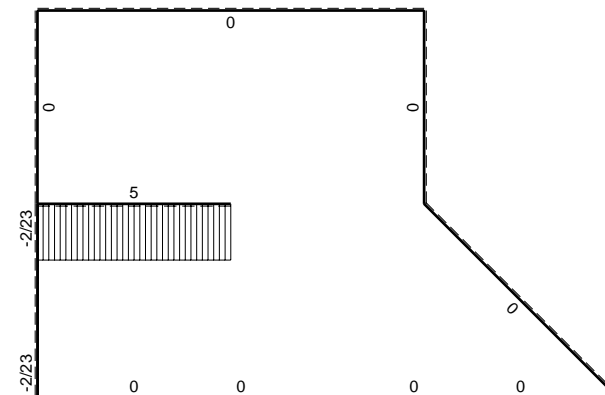
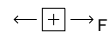
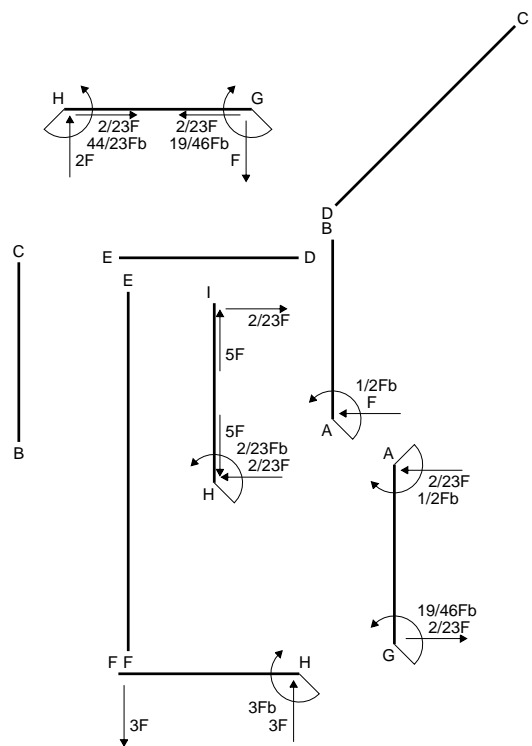
$$= (b - 1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$

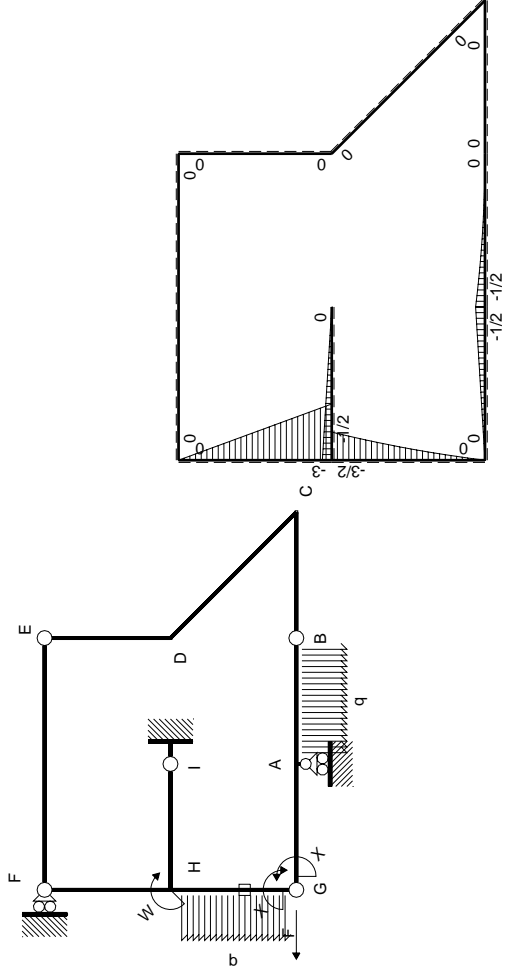
$$L_{GH}^{xo} = \int_0^b (x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$



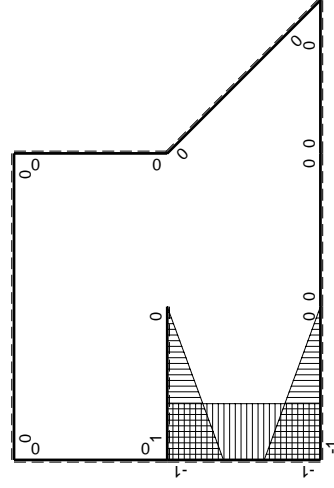
- A = 104.2 mm²
- J_u = 33478. mm⁴
- J_v = 1856. mm⁴
- J_t = 80.43 mm⁴
- y_o = 11.78 mm
- y_g = 25.21 mm
- N = -240. N
- T_y = -600. N
- M_x = -306000. Nmm
- x_m = 11. mm
- v_m = -25.21 mm
- σ_m = N/A-Mv/J_u = -232.8 N/mm²
- y_c = 3. mm
- u_c = -11. mm
- v_c = -22.21 mm
- σ_c = N/A-Mv/J_u = -232.8 N/mm²
- τ_c = TS_t/tJ_u = 9.761 N/mm²
- τ_g = TS_t/tJ_u = 9.761 N/mm²
- t_c = 240. mm
- σ_o = √σ²+3τ² = 233.4 N/mm²





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-1/2Fb + Fx - 1/2qx^2$	0	0	0	0
BA b	0	$1/2qx^2$	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	0	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$-1/2Fx$	$1/2Fx - 1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$1/2Fb - 1/2Fx$	$1/2Fx - 1/2Fx^2/b$	x^2/b^2	$1/12Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$-3Fx$	0	0	0	0
HF b	0	$3Fb - 3Fx$	0	0	0	0
HI b	$1-x/b$	$-1/2Fb + 1/2Fx$	$-1/2Fb + Fx - 1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$1/2Fx$	$-1/2Fx^2/b$	x^2/b^2	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	$-3/2Fb + 2Fx - 1/2qx^2$	$3/2Fb - 2Fx + 1/2Fx^2/b$	1	$2/3Fb^2/EJ$	Xb/EJ
GH b	1	$Fx + 1/2qx^2$	$Fx + 1/2Fx^2/b$	1	$2/3Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG}^{HG} - N_{HG}^{HG}$					
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$					
	totali					
	iperstatica X=W _{GA}					
	19/46Fb					

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (-1/2 + x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + 1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + 1/2 b - 1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (-1/2 x^2/b^2) Fb 1/EJ dx = [-1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (3/2 - 2x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

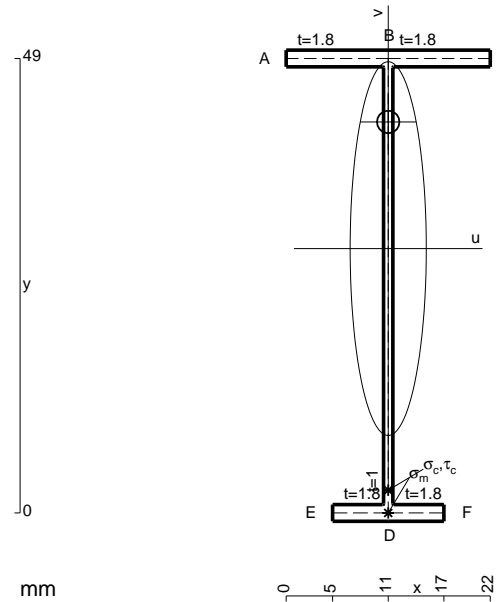
$$= [3/2 x - x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (3/2 b - b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/3 Fb^2/EJ$$

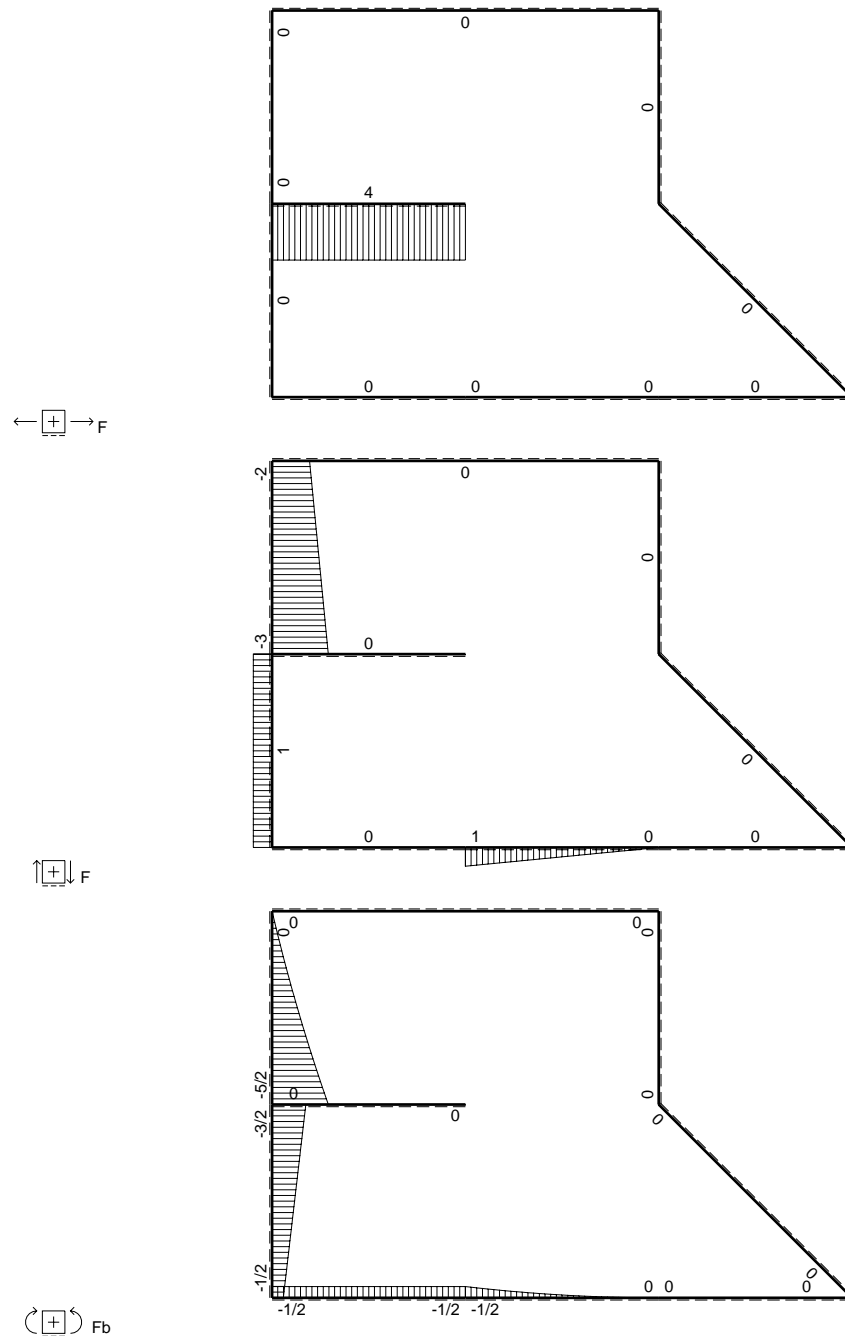
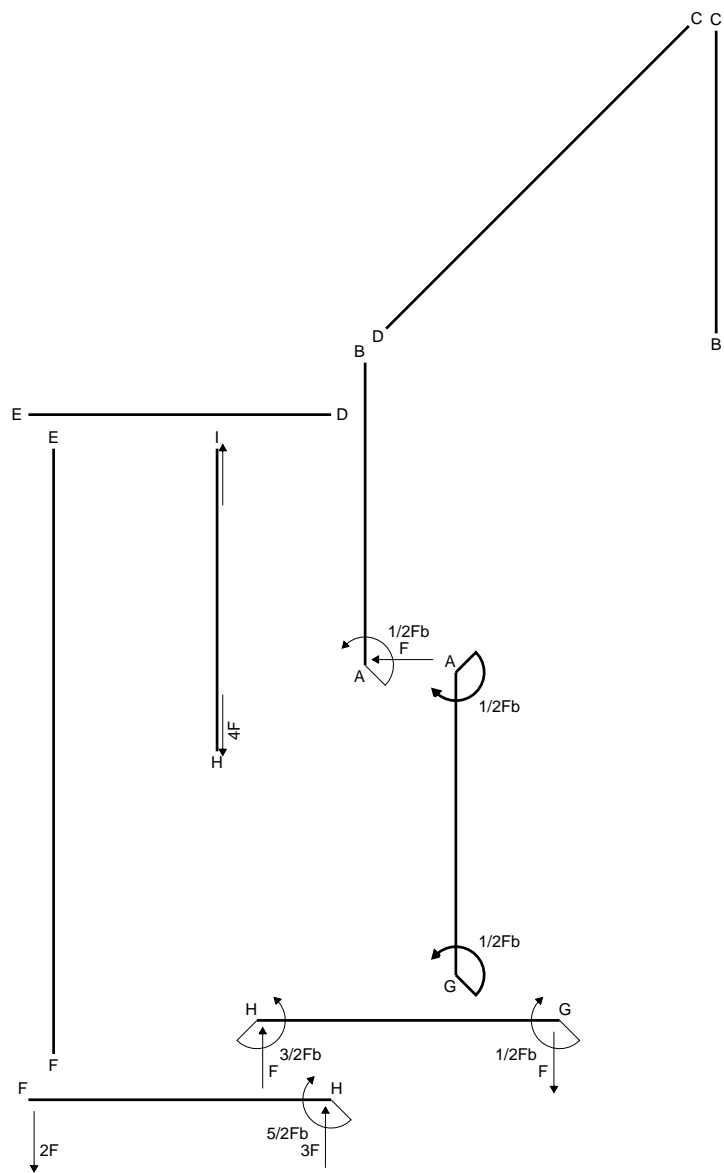
$$L_{GH}^{xo} = \int_0^b (x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

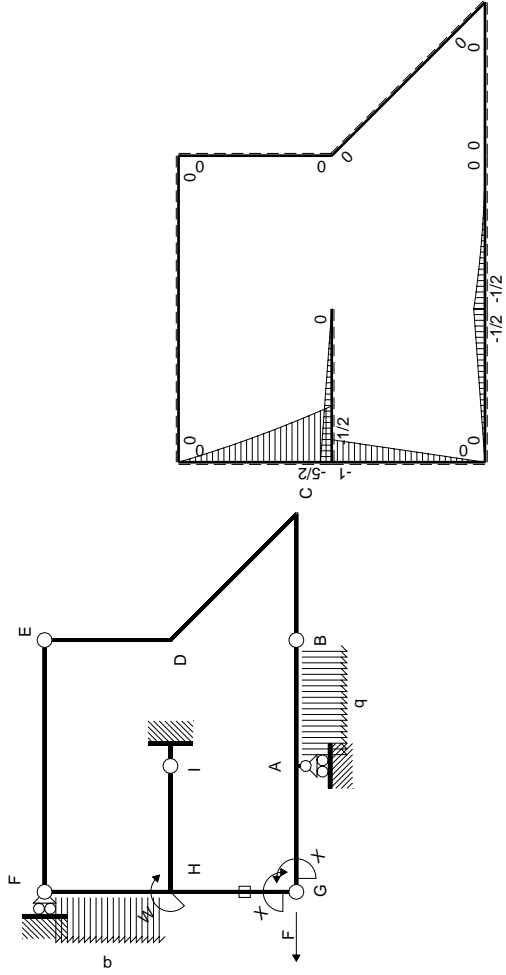
$$= [1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/3 Fb^2/EJ$$



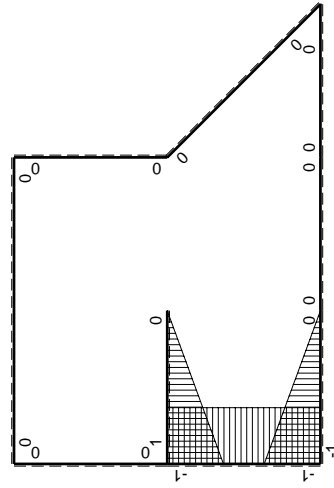
- A = 110.2 mm²
- J_u = 44775. mm⁴
- J_v = 1856. mm⁴
- J_t = 82.43 mm⁴
- y_o = 13.66 mm
- y_g = 28.5 mm
- T_y = -480. N
- M_x = -302400. Nmm
- x_m = 11. mm
- v_m = -28.5 mm
- σ_m = -Mv/J_u = -192.5 N/mm²
- y_c = 3. mm
- u_c = -11. mm
- v_c = -25.5 mm
- σ_c = -Mv/J_u = -192.5 N/mm²
- τ_c = TS_v/tJ_u = 6.6 N/mm²
- τ_g = TS_v/tJ_u = 6.6 N/mm²
- t_c = 160. mm
- σ_o = √σ²+3τ² = 192.8 N/mm²





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	M _x (x)	M ₀ (x)	M _x M ₀	M _x M _x	∫M _x M ₀ /EJdx	∫M _x M _x /EJdx
AB b	0	-1/2Fb+Fx-1/2qx ²	0	0	0	0
BA b	0	1/2qx ²	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD √2b	0	0	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	-1+x/b	-1/2Fx	1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	1/12Fb ² /EJ	1/3Xb/EJ
AG b	x/b	1/2Fb-1/2Fx	1/2Fx-1/2Fx ² /b	x ² /b ²		
FH b	0	-2Fx-1/2qx ²	0	0	0	0
HF b	0	5/2Fb-3Fx+1/2qx ²	0	0	0	0
HI b	1-x/b	-1/2Fb+1/2Fx	-1/2Fb+Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	-1/6Fb ² /EJ	1/3Xb/EJ
IH b	-x/b	1/2Fx	-1/2Fx ² /b	x ² /b ²		
HG b	-1	-Fb+Fx	Fb-Fx	1	1/2Fb ² /EJ	Xb/EJ
GH b	1	Fx	Fx	1		
HG	elongazione asta N _{1HG} ^{±HG} ±HG				-Fb ² /EJ	
A	molla nodo -V _{1A} (V _{GA} +XV _{1A})/k _A				-3/8Fb ² /EJ	1/4Xb/EJ
	totali				-23/24Fb ² /EJ	23/12Xb/EJ
	iperstatica X=W _{GA}				1/2Fb	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (-1/2 + x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + 1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + 1/2 b - 1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (-1/2 x^2/b^2) Fb 1/EJ dx = [-1/6 x^3/b^2]_0^b Fb 1/EJ$$

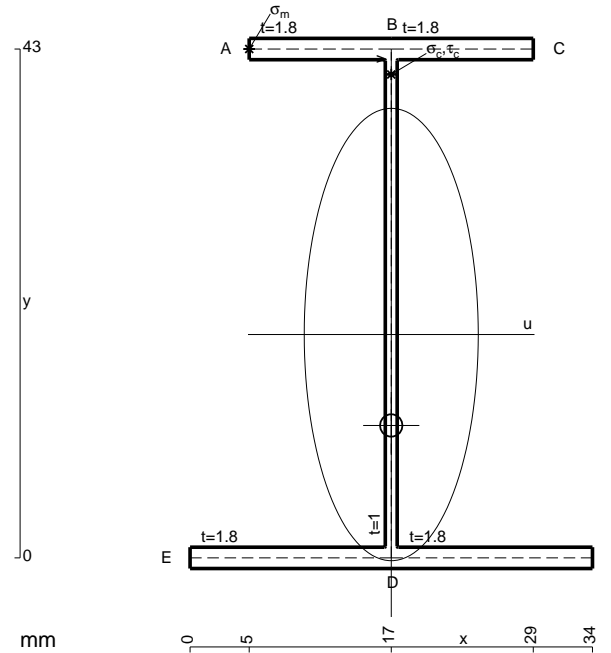
$$= (-1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [x - 1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

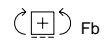
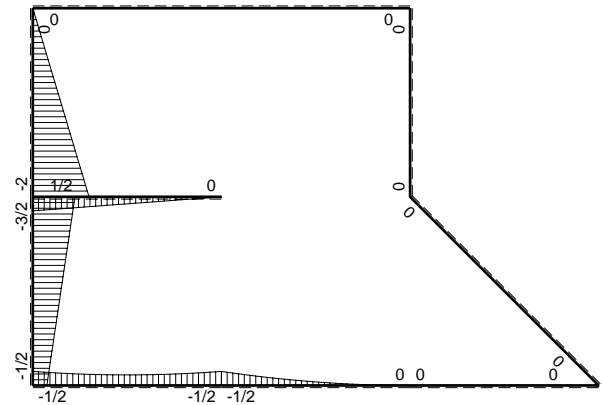
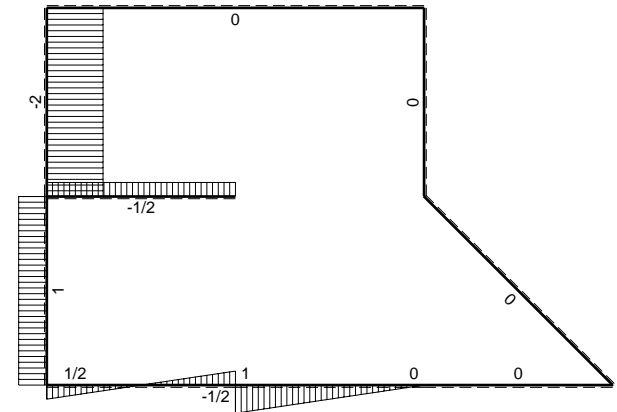
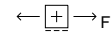
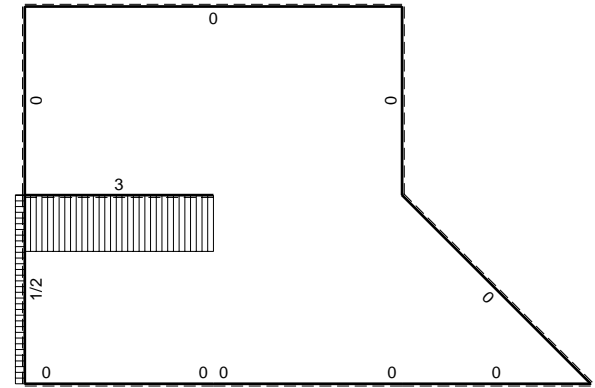
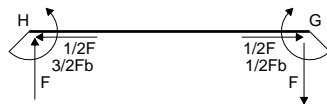
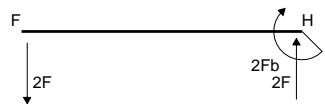
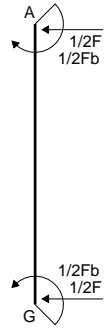
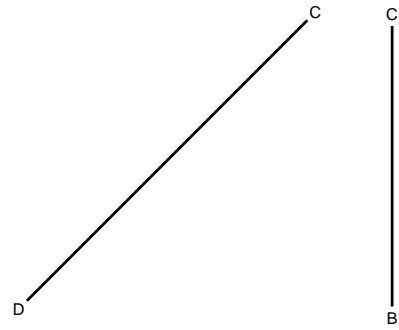
$$= (b - 1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$

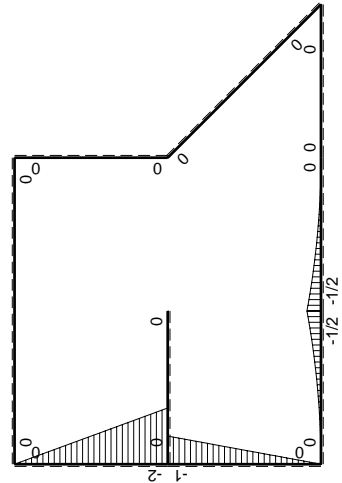
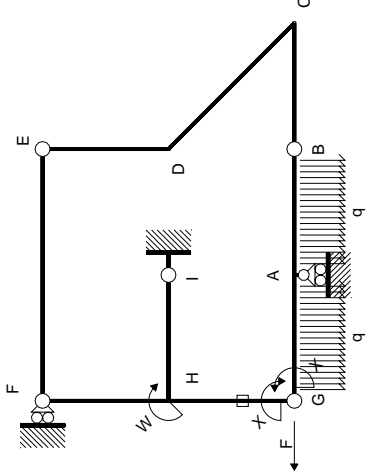
$$L_{GH}^{xo} = \int_0^b (x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$



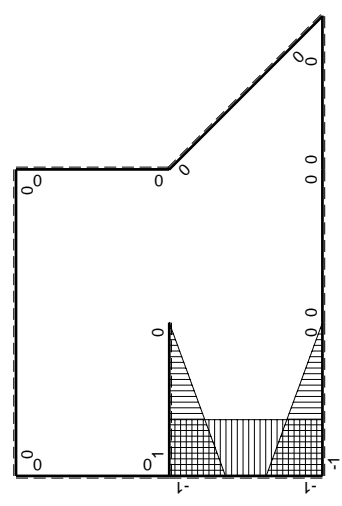
- A = 147.4 mm²
- J_u = 53868. mm⁴
- J_v = 7969. mm⁴
- J_i = 127.1 mm⁴
- y_o = -7.686 mm
- y_g = 18.87 mm
- T_y = -930. N
- M_x = -457250. Nmm
- x_m = 5. mm
- y_m = 43. mm
- u_m = -12. mm
- v_m = 24.13 mm
- σ_m = -M_v/J_u = 204.8 N/mm²
- x_c = 17. mm
- y_c = 43. mm
- v_c = 24.13 mm
- σ_c = -M_v/J_u = 204.8 N/mm²
- τ_c = T_S/t_{J_u} = 17.99 N/mm²
- τ_g = T_S/t_{J_u} = 17.99 N/mm²
- t_c = 310. mm
- σ_o = √(σ²+3τ²) = 207.1 N/mm²





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-1/2Fb + Fx - 1/2qx^2$	0	0	0	0
BA b	0	$1/2qx^2$	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	0	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$-1/2qx^2$	$1/2Fx^2/b - 1/2qx^3/b$	$1-2x/b+x^2/b^2$	$1/24Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$1/2Fb-Fx+1/2qx^2$	$1/2Fx-Fx^2/b+1/2qx^3/b$	x^2/b^2	$1/24Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$-2Fx$	0	0	0	0
HF b	0	$2Fb-2Fx$	0	0	0	0
HI b	$1-x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
IH b	$-x/b$	0	0	x^2/b^2	0	$1/3Xb/EJ$
HG b	-1	$-Fb+Fx$	$Fb-Fx$	1	$1/2Fb^2/EJ$	Xb/EJ
GH b	1	Fx	Fx	1	$1/2Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG+HG-HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{GA}+XV_{1A})/k_A$				$-1/2Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-23/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica X=W _{GA}				$1/2Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{GA}^{x_0} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[1/6 x^3/b^2 - 1/8 x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/6 b - 1/8 b) \cdot Fb \cdot 1/EJ = 1/24 \cdot Fb^2/EJ$$

$$L_{AG}^{x_0} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) \cdot Fb \cdot 1/EJ \, dx = \left[1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3 \right]_0^b \cdot Fb \cdot 1/EJ$$

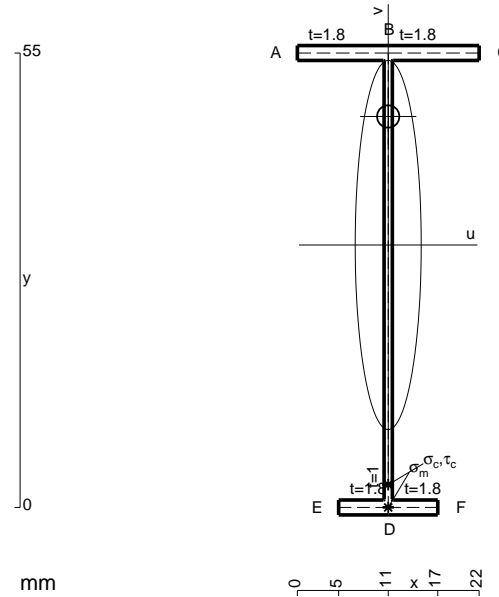
$$= (1/4 b - 1/3 b + 1/8 b) \cdot Fb \cdot 1/EJ = 1/24 \cdot Fb^2/EJ$$

$$L_{HG}^{x_0} = \int_0^b (1 - x/b) \cdot Fb \cdot 1/EJ \, dx - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ = \left[x - 1/2 x^2/b \right]_0^b \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ$$

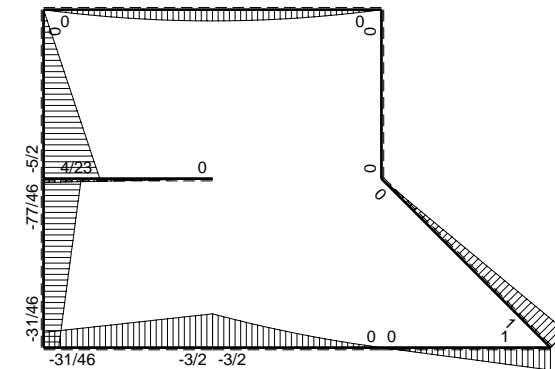
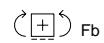
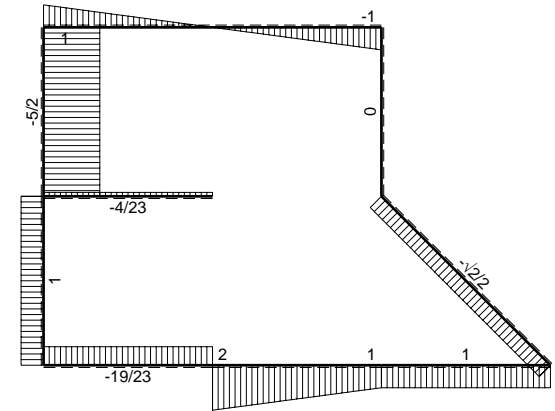
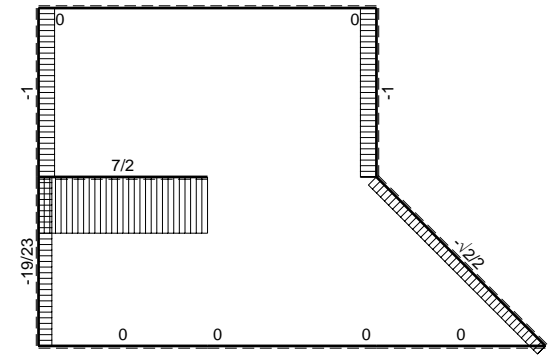
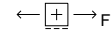
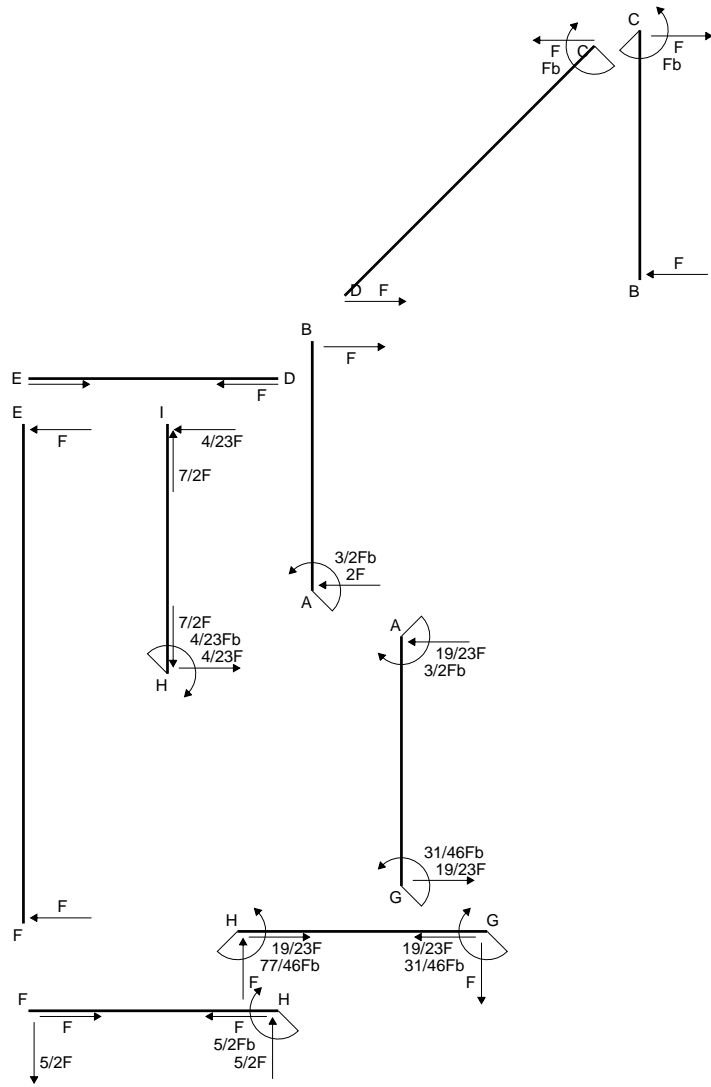
$$= (b - 1/2 b) \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ = -1/2 \cdot Fb^2/EJ$$

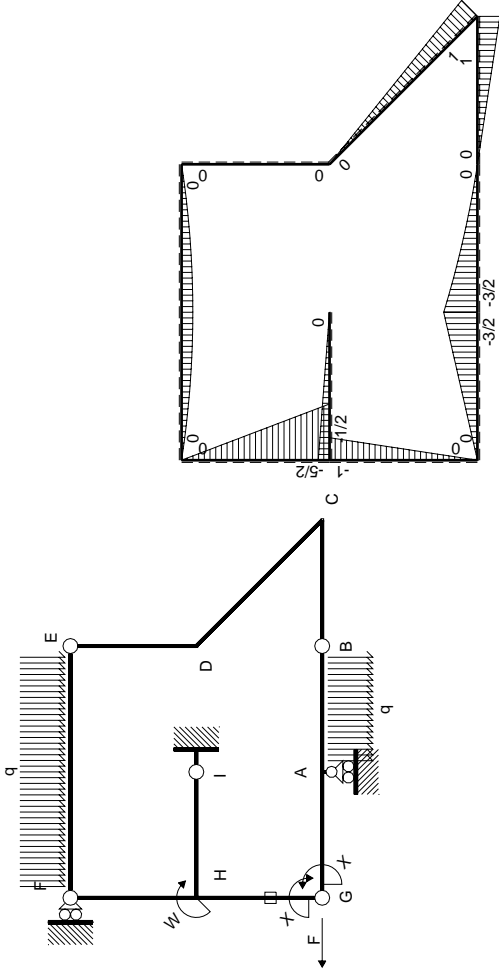
$$L_{GH}^{x_0} = \int_0^b (x/b) \cdot Fb \cdot 1/EJ \, dx - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ = \left[1/2 x^2/b \right]_0^b \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ$$

$$= (1/2 b) \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ = -1/2 \cdot Fb^2/EJ$$

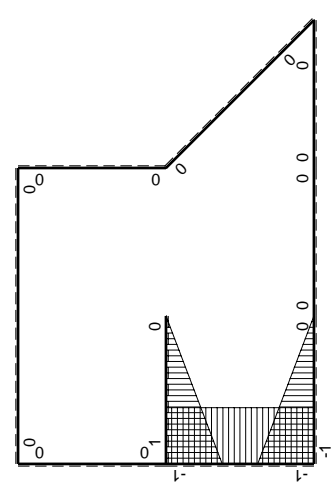


- A = 116.2 mm²
- J_u = 58038. mm⁴
- J_v = 1856. mm⁴
- J_i = 84.43 mm⁴
- y_o = 15.56 mm
- y_g = 31.76 mm
- T_y = -500. N
- M_x = -395000. Nmm
- x_m = 11. mm
- v_m = -31.76 mm
- σ_m = -Mv/J_u = -216.2 N/mm²
- y_c = 3. mm
- u_c = -11. mm
- v_c = -28.76 mm
- σ_c = -Mv/J_u = -216.2 N/mm²
- τ_c = TS'/tJ_u = 5.91 N/mm²
- τ_g = TS'/tJ_u = 5.91 N/mm²
- t_c = 250. mm
- σ_o = √σ²+3τ² = 216.4 N/mm²





M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x^2 M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	$-3/2Fb+2Fx-1/2qx^2$	0	0	0	0
BA b	0	$Fx+1/2qx^2$	0	0	0	0
BC b	0	Fx	0	0	0	0
CB b	0	$-Fb+Fx$	0	0	0	0
CD $\sqrt{2}b$	0	$Fb-\sqrt{2}/2Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	$-Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$Fx-1/2qx^2$	0	0	0	0
GA b	$-1+x/b$	$-3/2Fx$	$3/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/4Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$3/2Fb-3/2Fx$	$3/2Fx-3/2Fx^2/b$	x^2/b^2	$1/4Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$-5/2Fx$	0	0	0	0
HF b	0	$5/2Fb-5/2Fx$	0	0	0	0
HI b	$1-x/b$	$-1/2Fb+1/2Fx$	$-1/2Fb+Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$1/2Fx$	$-1/2Fx^2/b$	x^2/b^2	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	$-Fb+Fx$	Fb-Fx	1	$1/2Fb^2/EJ$	Xb/EJ
GH b	1	Fx	Fx	1	$1/2Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG^{\pm}HG^{\pm}HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{GA}+XV_{1A})/k_A$				$-7/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-31/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				31/46Fb	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (-1/2 + x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + 1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + 1/2 b - 1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (-1/2 x^2/b^2) Fb 1/EJ dx = [-1/6 x^3/b^2]_0^b Fb 1/EJ$$

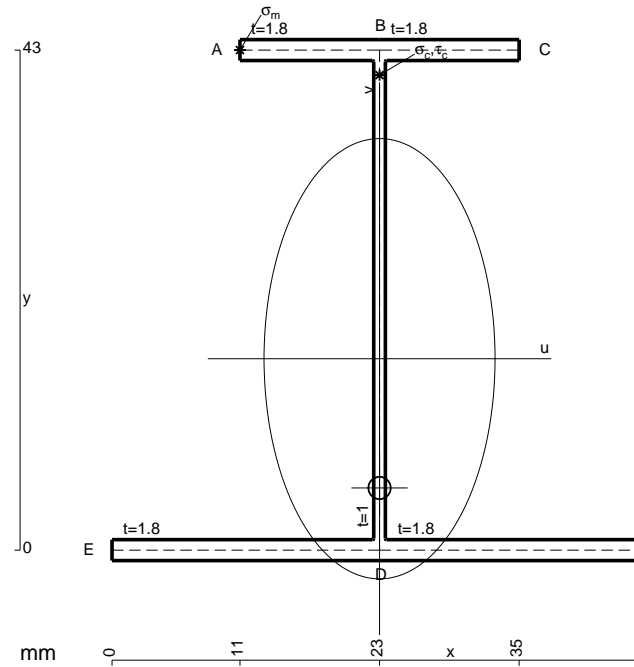
$$= (-1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [x - 1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

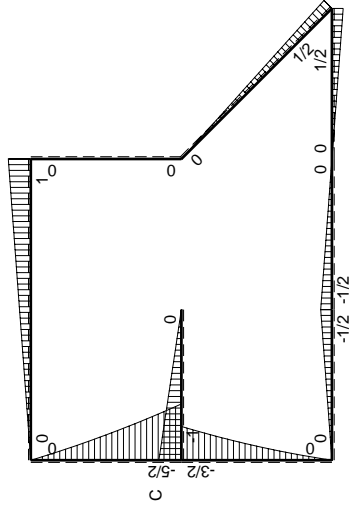
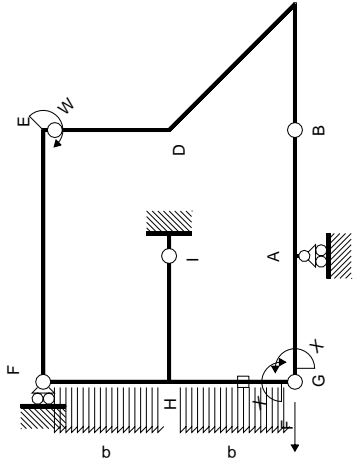
$$= (b - 1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$

$$L_{GH}^{xo} = \int_0^b (x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$

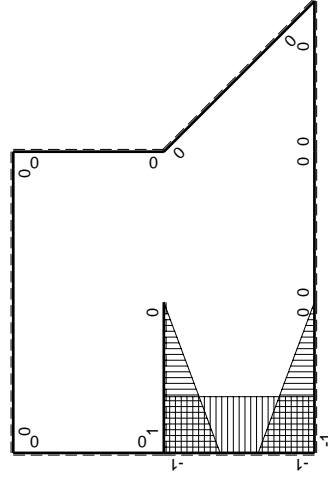


- A = 169. mm²
- J_u = 60580. mm⁴
- J_v = 16674. mm⁴
- J_t = 150.4 mm⁴
- y_o = -11.11 mm
- y_g = 16.46 mm
- N = -320. N
- T_y = -800. N
- M_x = -528000. Nmm
- x_m = 11. mm
- y_m = 43. mm
- u_m = -12. mm
- v_m = 26.54 mm
- σ_m = N/A-Mv/J_u = 229.4 N/mm²
- x_c = 23. mm
- y_c = 43. mm
- v_c = 26.54 mm
- σ_c = N/A-Mv/J_u = 229.4 N/mm²
- τ_c = TS_y/tJ_u = 15.14 N/mm²
- τ_g = TS_y/tJ_u = 15.14 N/mm²
- t_c = 320. mm
- σ_o = √σ²+3τ² = 230.9 N/mm²



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$	
AB b	0	$-1/2Fb+1/2Fx$	0	0	0	0	
BA b	0	$1/2Fx$	0	0	0	0	
BC b	0	$1/2Fx$	0	0	0	0	
CB b	0	$-1/2Fb+1/2Fx$	0	0	0	0	
CD $\sqrt{2}b$	0	$1/2Fb-\sqrt{2}/4Fx$	0	0	0	0	
DE b	0	0	0	0	0	0	
ED b	0	0	0	0	0	0	
EF 2b	0	$Fb-1/2Fx$	0	0	0	0	
FE 2b	0	$-1/2Fx$	0	0	0	0	
GA b	$-1+x/b$	$-1/2Fx$	$1/2Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$	
AG b	x/b	$1/2Fb-1/2Fx$	$1/2Fx-1/2Fx^2/b$	x^2/b^2			
FH b	0	$-2Fx-1/2qx^2$	0	0	0	0	
HF b	0	$5/2Fb-3Fx+1/2qx^2$	0	0	0	0	
HI b	$1-x/b$	$-Fb+Fx$	$-Fb+2Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$-1/3Fb^2/EJ$	$1/3Xb/EJ$	
IH b	$-x/b$	Fx	$-Fx^2/b$	x^2/b^2			
HG b	-1	$-3/2Fb+2Fx-1/2qx^2$	$3/2Fb-2Fx+1/2Fx^2/b$	1	$2/3Fb^2/EJ$	Xb/EJ	
GH b	1	$Fx+1/2qx^2$	$Fx+1/2Fx^2/b$	1			
HG	elongazione asta $N_{1HG}^{HG} - N_{HG}^{HG}$						
A	molla nodo $-V_{1A}(V_{0A} + XV_{1A})/k_A$						
	totali						
	iperstatica X=W _{GA}						
	10/23Fb						

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (-1 + 2x/b - x^2/b^2) Fb 1/EJ dx = [-x + x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-b + b - 1/3 b) Fb 1/EJ = -1/3 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (-x^2/b^2) Fb 1/EJ dx = [-1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/3 b) Fb 1/EJ = -1/3 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (3/2 - 2x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

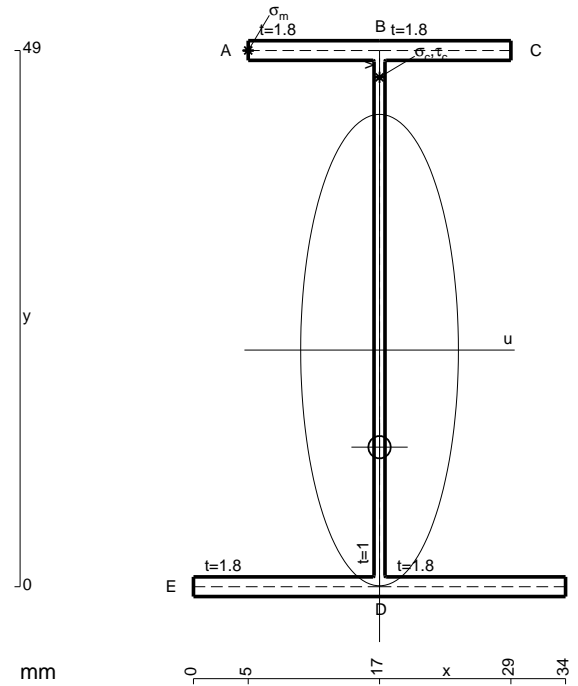
$$= [3/2 x - x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (3/2 b - b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/3 Fb^2/EJ$$

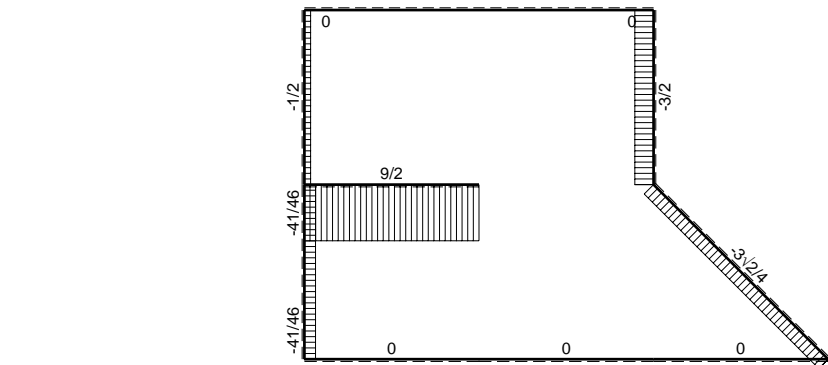
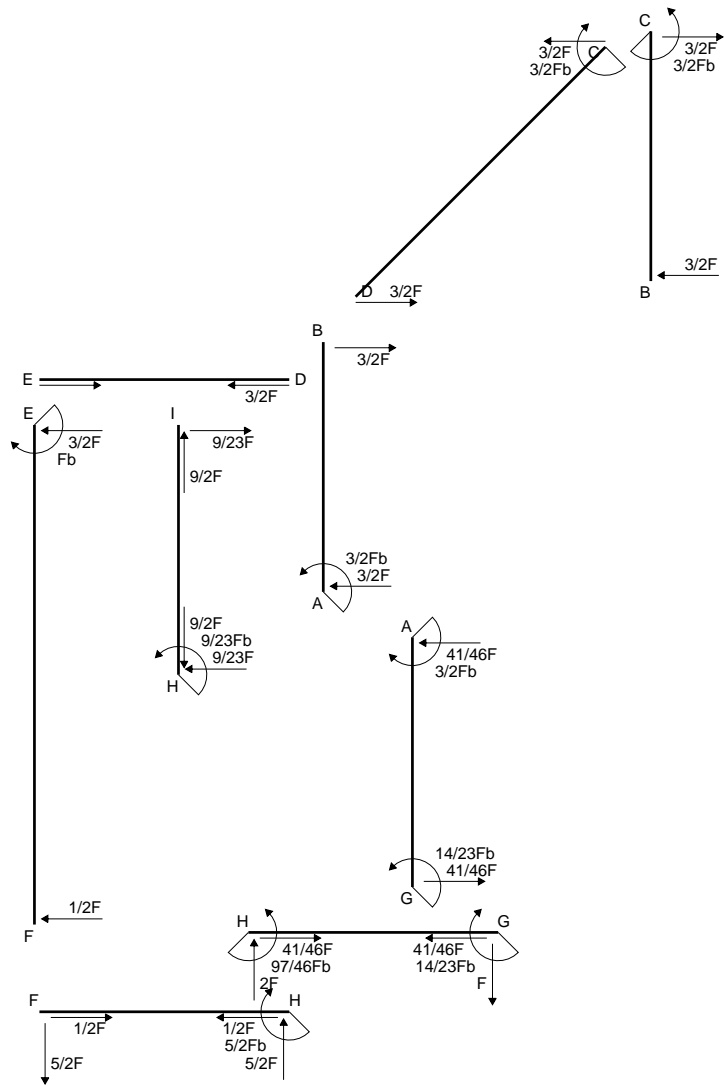
$$L_{GH}^{xo} = \int_0^b (x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

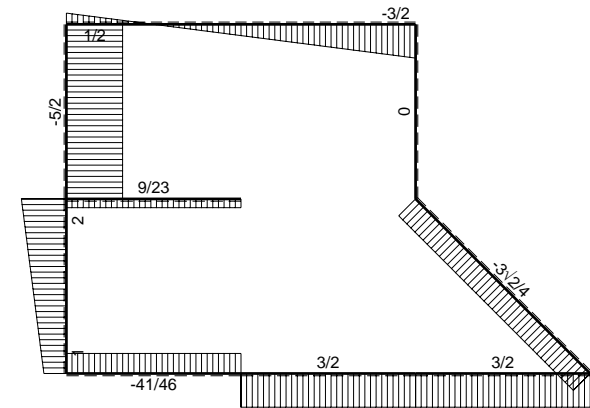
$$= (1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/3 Fb^2/EJ$$



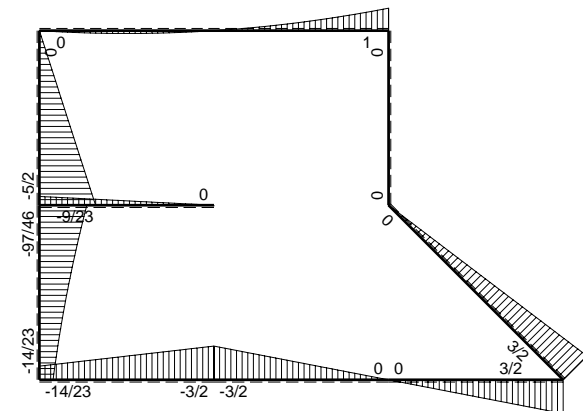
- A = 153.4 mm²
- J_u = 71202. mm⁴
- J_v = 7969. mm⁴
- J_t = 129.1 mm⁴
- y_o = -8.875 mm
- y_g = 21.63 mm
- N = 155. N
- T_y = -930. N
- M_x = -612250. Nmm
- x_m = 5. mm
- y_m = 49. mm
- u_m = -12. mm
- v_m = 27.37 mm
- σ_m = N/A - Mv/J_u = 236.4 N/mm²
- x_c = 17. mm
- y_c = 49. mm
- v_c = 27.37 mm
- σ_c = N/A - Mv/J_u = 236.4 N/mm²
- τ_c = TS/tJ_u = 15.45 N/mm²
- τ_g = TS/tJ_u = 15.45 N/mm²
- t_c = 310. mm
- σ_o = √σ² + 3τ² = 237.9 N/mm²



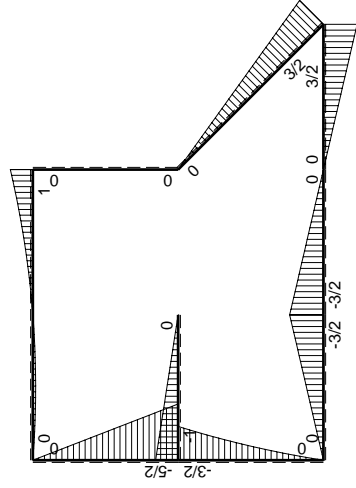
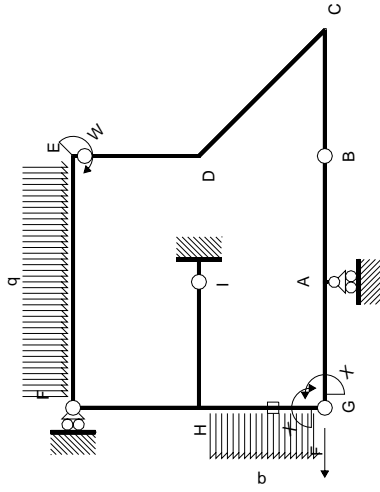
← ⊕ → F



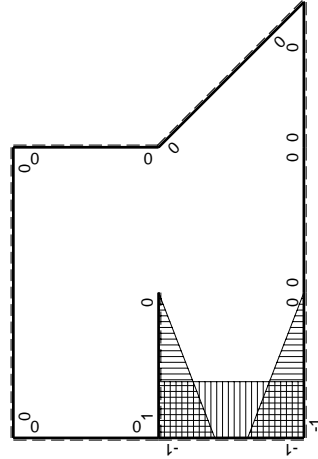
↑ ⊕ ↓ F



⊕ ⊖ F_b



$\left(\begin{smallmatrix} + \\ - \end{smallmatrix} \right) M_0$ flessione da carichi assegnati



$\left(\begin{smallmatrix} + \\ - \end{smallmatrix} \right) M_x$ flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$	
AB b	0	$-3/2Fb+3/2Fx$	0	0	0	0	
BA b	0	$3/2Fx$	0	0	0	0	
BC b	0	$3/2Fx$	0	0	0	0	
CB b	0	$-3/2Fb+3/2Fx$	0	0	0	0	
CD $\sqrt{2}b$	0	$3/2Fb-3\sqrt{2}/4Fx$	0	0	0	0	
DE b	0	0	0	0	0	0	
ED b	0	0	0	0	0	0	
EF 2b	0	$Fb-3/2Fx+1/2qx^2$	0	0	0	0	
FE 2b	0	$1/2Fx-1/2qx^2$	0	0	0	0	
GA b	$-1+x/b$	$-3/2Fx$	$3/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/4Fb^2/EJ$	$1/3Xb/EJ$	
AG b	x/b	$3/2Fb-3/2Fx$	$3/2Fx-3/2Fx^2/b$	x^2/b^2			
FH b	0	$-5/2Fx$	0	0	0	0	
HF b	0	$5/2Fb-5/2Fx$	0	0	0	0	
HI b	$1-x/b$	$-Fb+Fx$	$-Fb+2Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$-1/3Fb^2/EJ$	$1/3Xb/EJ$	
IH b	$-x/b$	Fx	$-Fx^2/b$	x^2/b^2			
HG b	-1	$-3/2Fb+2Fx-1/2qx^2$	$3/2Fb-2Fx+1/2Fx^2/b$	1	$2/3Fb^2/EJ$	Xb/EJ	
GH b	1	$Fx+1/2qx^2$	$Fx+1/2Fx^2/b$	1			
HG	elongazione asta $N_{1HG} = N_{HG} + HG$						
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$						
totali							
iperstatica $X=W_{GA}$							

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (-1 + 2x/b - x^2/b^2) Fb 1/EJ dx = [-x + x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-b + b - 1/3 b) Fb 1/EJ = -1/3 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (-x^2/b^2) Fb 1/EJ dx = [-1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/3 b) Fb 1/EJ = -1/3 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (3/2 - 2x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

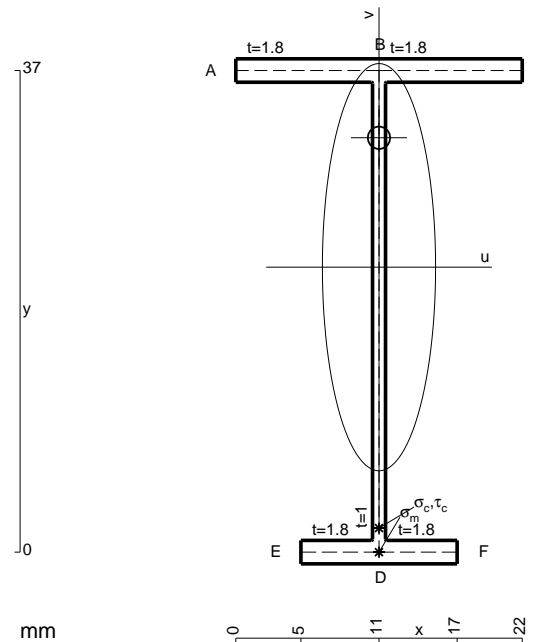
$$= [3/2 x - x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (3/2 b - b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/3 Fb^2/EJ$$

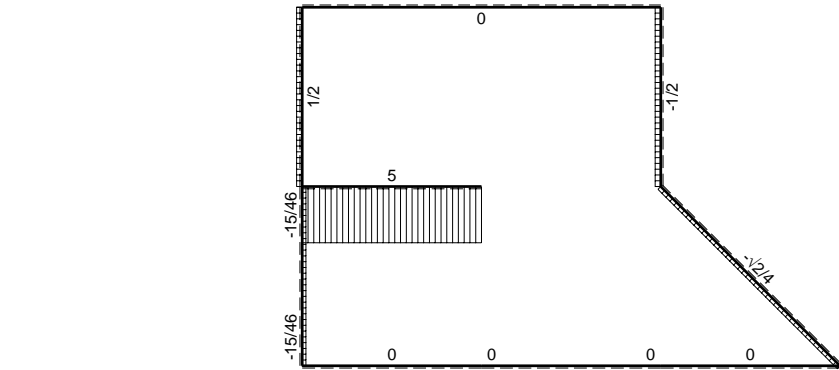
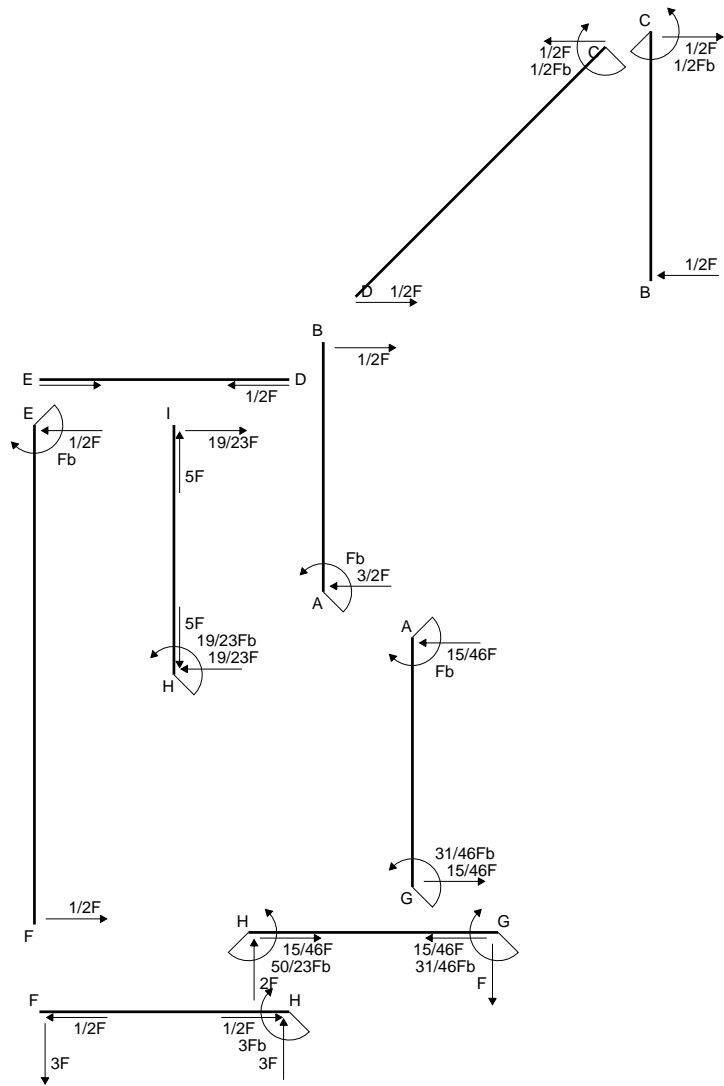
$$L_{GH}^{xo} = \int_0^b (x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

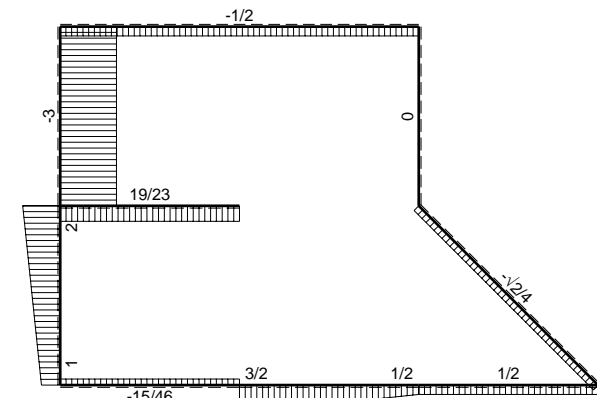
$$= (1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/3 Fb^2/EJ$$



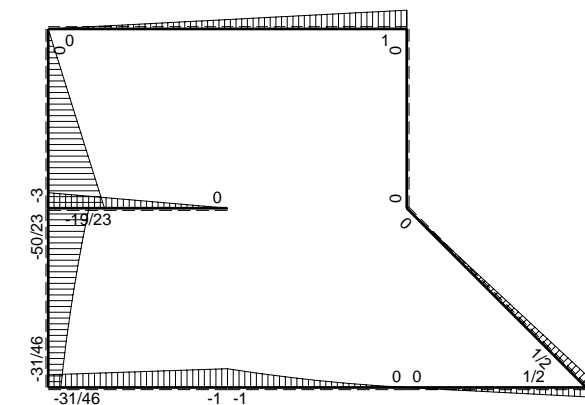
- A = 98.2 mm²
- J_u = 24038. mm⁴
- J_v = 1856. mm⁴
- J_t = 78.43 mm⁴
- y_o = 9.943 mm
- y_g = 21.89 mm
- N = -140. N
- T_y = -700. N
- M_x = -217000. Nmm
- x_m = 11. mm
- v_m = -21.89 mm
- σ_m = N/A - Mv/J_u = -199. N/mm²
- y_c = 3. mm
- u_c = -11. mm
- v_c = -18.89 mm
- σ_c = N/A - Mv/J_u = -199. N/mm²
- τ_c = TS_t/tJ_u = 13.77 N/mm²
- τ_g = TS_t/tJ_u = 13.77 N/mm²
- t_c = 280. mm
- σ_o = √σ² + 3τ² = 200.5 N/mm²



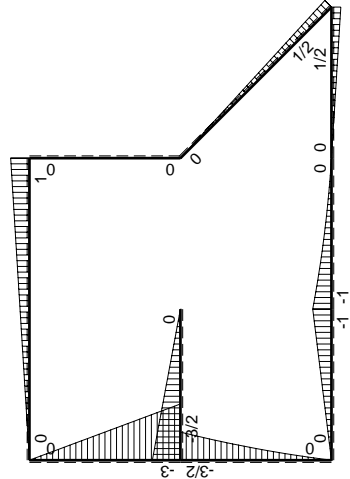
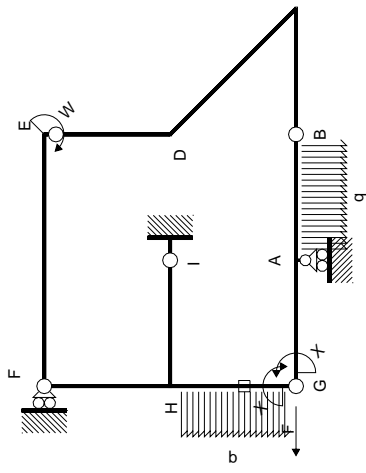
← ⊕ → F



↑ ⊕ ↓ F

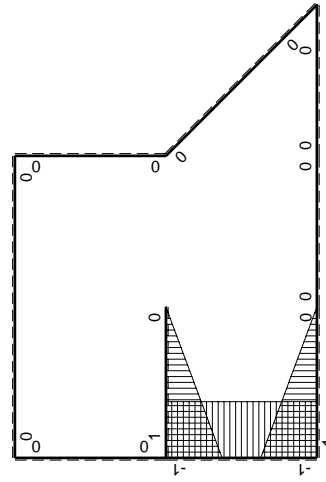


⊕ ⊖ F_b



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contribuiti PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-Fb+3/2Fx-1/2qx^2$	0	0	0	0
BA b	0	$1/2Fx+1/2qx^2$	0	0	0	0
BC b	0	$1/2Fx$	0	0	0	0
CB b	0	$-1/2Fb+1/2Fx$	0	0	0	0
CD $\sqrt{2}b$	0	$1/2Fb-\sqrt{2}/4Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	$Fb-1/2Fx$	0	0	0	0
FE 2b	0	$-1/2Fx$	0	0	0	0
GA b	$-1+x/b$	$-Fx$	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$Fb-Fx$	$Fx-Fx^2/b$	x^2/b^2	$1/6Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$-3Fx$	0	0	0	0
HF b	0	$3Fb-3Fx$	0	0	0	0
HI b	$1-x/b$	$-3/2Fb+3/2Fx$	$-3/2Fb+3Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	$-1/2Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$3/2Fx$	$-3/2Fx^2/b$	x^2/b^2	$-1/2Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	$-3/2Fb+2Fx-1/2qx^2$	$3/2Fb-2Fx+1/2Fx^2/b$	1	$2/3Fb^2/EJ$	Xb/EJ
GH b	1	$Fx+1/2qx^2$	$Fx+1/2Fx^2/b$	1	$2/3Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1,HG^{\pm}HG^{\mp}HG}$					
A	molla nodo $-V_{1A}(V_{0A}+XV_{1A})/k_A$					
	totali					
	iperstatica X=W _{GA}					
	31/46Fb					

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (-3/2 + 3x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [-3/2 x + 3/2 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-3/2 b + 3/2 b - 1/2 b) Fb 1/EJ = -1/2 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (-3/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b) Fb 1/EJ = -1/2 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (3/2 - 2x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

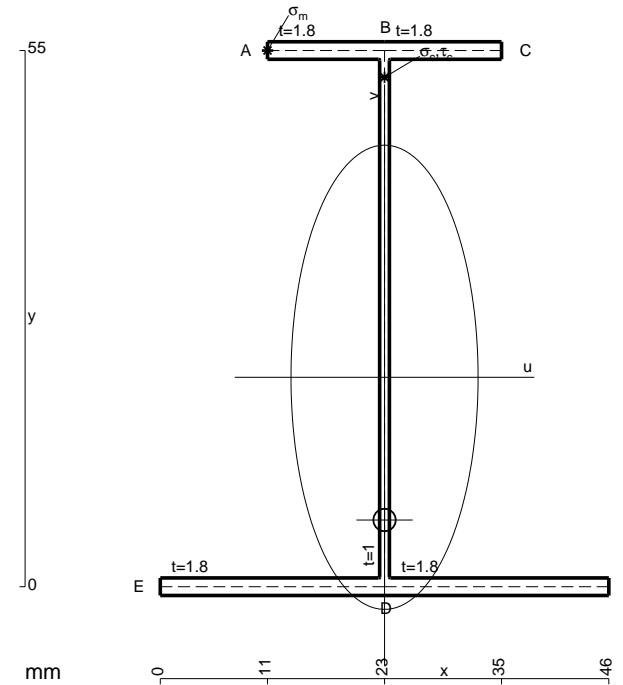
$$= [3/2 x - x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (3/2 b - b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/3 Fb^2/EJ$$

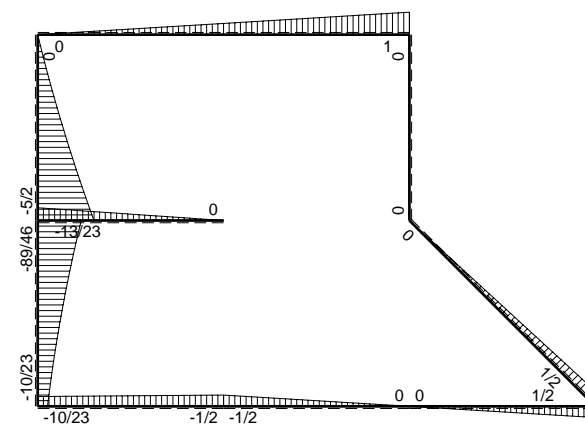
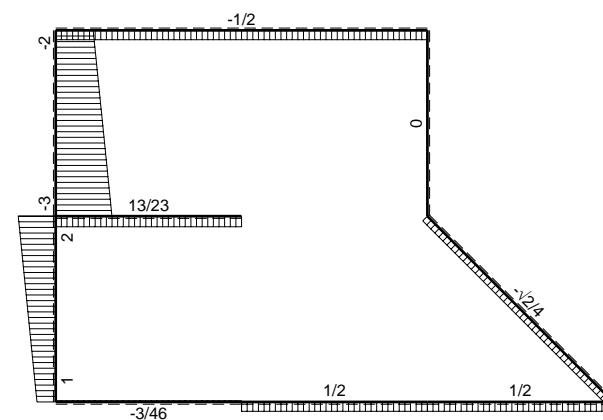
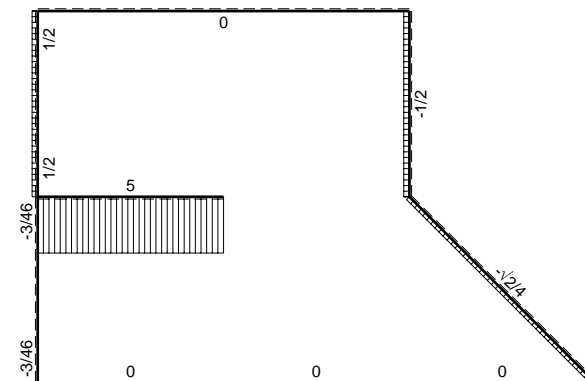
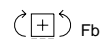
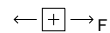
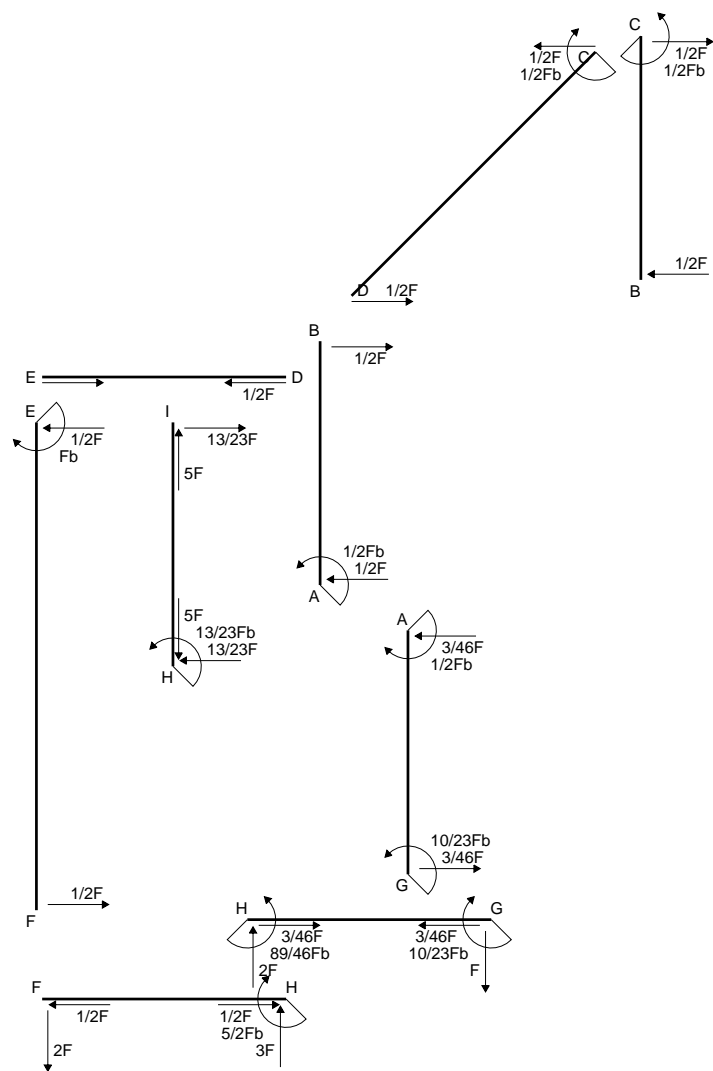
$$L_{GH}^{xo} = \int_0^b (x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

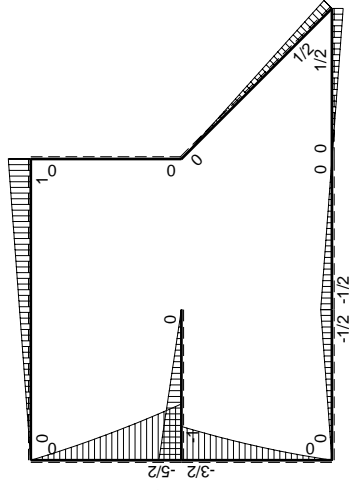
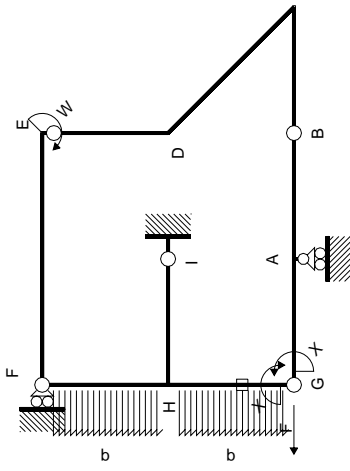
$$= [1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/3 Fb^2/EJ$$



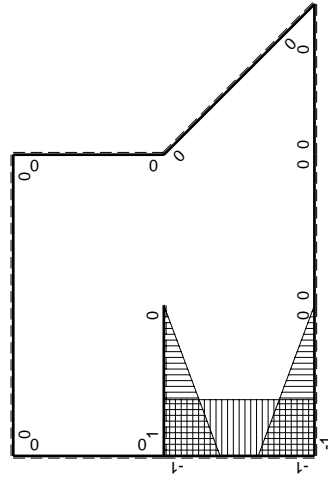
- A = 181. mm²
- J_u = 102600. mm⁴
- J_v = 16674. mm⁴
- J_t = 154.4 mm⁴
- y_o = -14.64 mm
- y_g = 21.48 mm
- N = 205. N
- T_y = -1230. N
- M_x = -627300. Nmm
- x_m = 11. mm
- y_m = 55. mm
- u_m = -12. mm
- v_m = 33.52 mm
- σ_m = N/A - Mv/J_u = 206.1 N/mm²
- x_c = 23. mm
- y_c = 55. mm
- v_c = 33.52 mm
- σ_c = N/A - Mv/J_u = 206.1 N/mm²
- τ_c = TS_y/tJ_u = 17.36 N/mm²
- τ_g = TS_y/tJ_u = 17.36 N/mm²
- t_c = 410. mm
- σ_o = √σ² + 3τ² = 208.2 N/mm²





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-1/2Fb+1/2Fx	0	0	0	0
BA b	0	1/2Fx	0	0	0	0
BC b	0	1/2Fx	0	0	0	0
CB b	0	-1/2Fb+1/2Fx	0	0	0	0
CD 1/2b	0	1/2Fb-1/2/4Fx	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	Fb-1/2Fx	0	0	0	0
FE 2b	0	-1/2Fx	0	0	0	0
GA b	-1+x/b	-1/2Fx	1/2Fx-1/2Fx ² /b	1-2x/b+x ² /b ²	1/12Fb ² /EJ	1/3Xb/EJ
AG b	x/b	1/2Fb-1/2Fx	1/2Fx-1/2Fx ² /b	x ² /b ²		
FH b	0	-2Fx-1/2qx ²	0	0	0	0
HF b	0	5/2Fb-3Fx+1/2qx ²	0	0	0	0
HI b	1-x/b	-Fb+Fx	-Fb+2Fx-Fx ² /b	1-2x/b+x ² /b ²	-1/3Fb ² /EJ	1/3Xb/EJ
IH b	-x/b	Fx	-Fx ² /b	x ² /b ²		
HG b	-1	-3/2Fb+2Fx-1/2qx ²	3/2Fb-2Fx+1/2Fx ² /b	1	2/3Fb ² /EJ	Xb/EJ
GH b	1	Fx+1/2qx ²	Fx+1/2Fx ² /b	1		
HG	elongazione asta $N_{1HG}^{HG} = -HG$				-Fb ² /EJ	
A	molla nodo $-V_{1A}(V_{0A} + XV_{1A})/k_A$				-1/4Fb ² /EJ	1/4Xb/EJ
	totali				-5/6Fb ² /EJ	23/12Xb/EJ
	iperstatica X=W _{GA}				10/23Fb	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (-1 + 2x/b - x^2/b^2) Fb 1/EJ dx = [-x + x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-b + b - 1/3 b) Fb 1/EJ = -1/3 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (-x^2/b^2) Fb 1/EJ dx = [-1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/3 b) Fb 1/EJ = -1/3 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (3/2 - 2x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

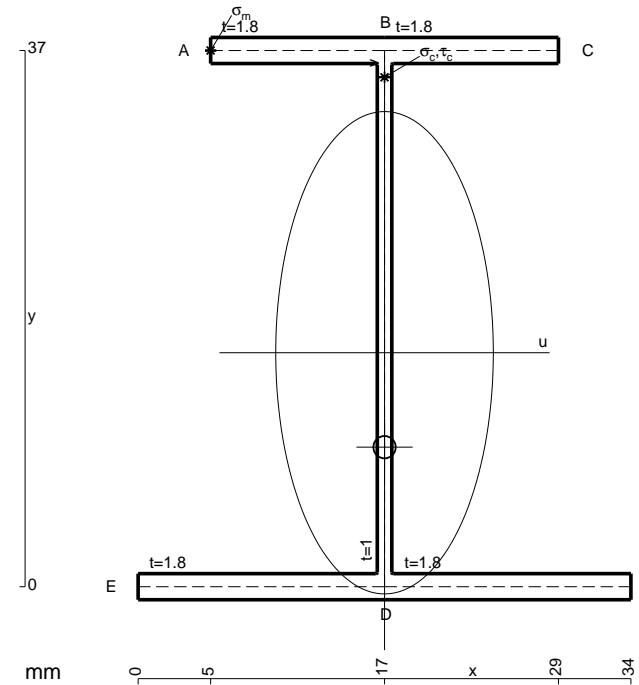
$$= [3/2 x - x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (3/2 b - b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/3 Fb^2/EJ$$

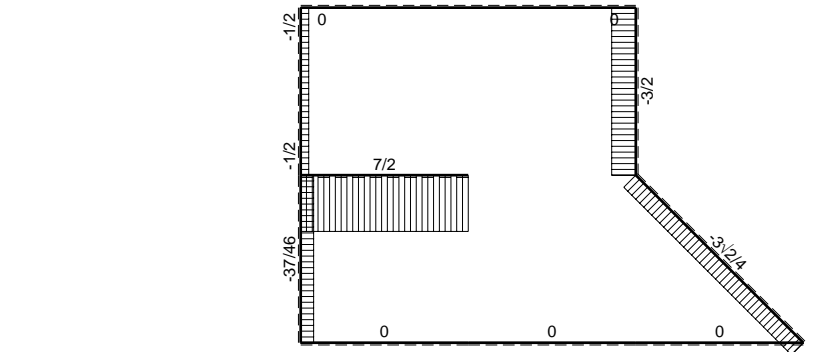
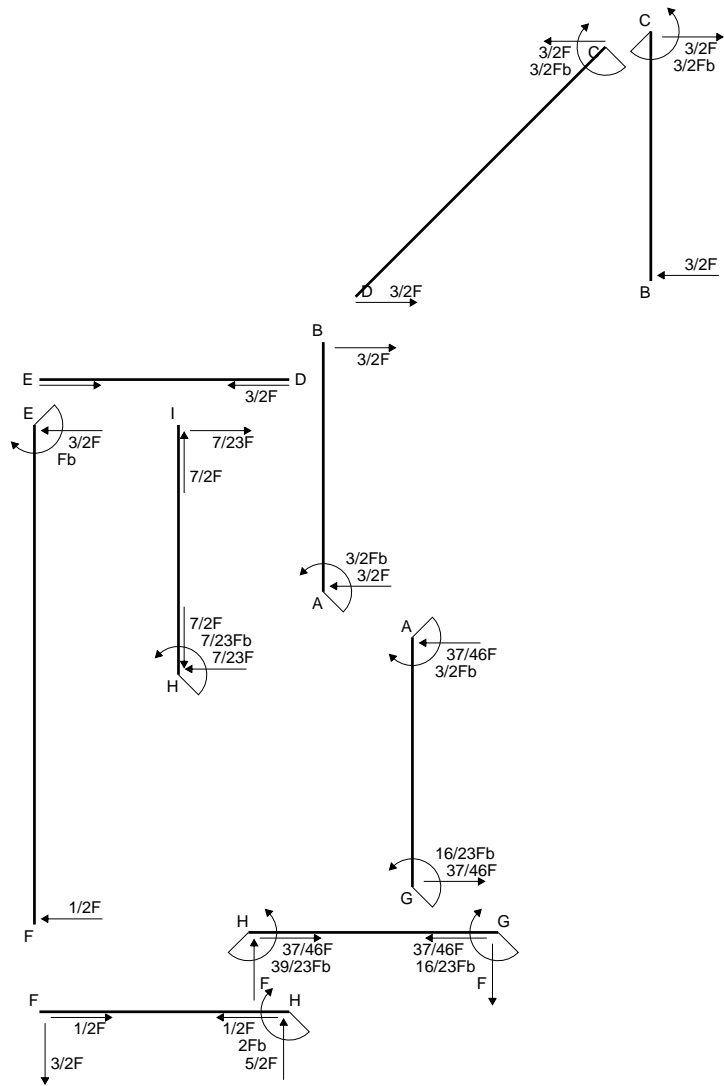
$$L_{GH}^{xo} = \int_0^b (x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

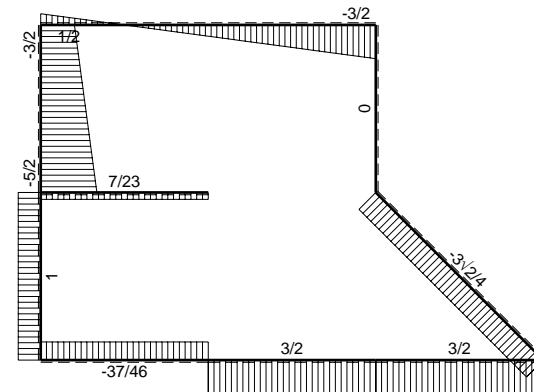
$$= (1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/3 Fb^2/EJ$$



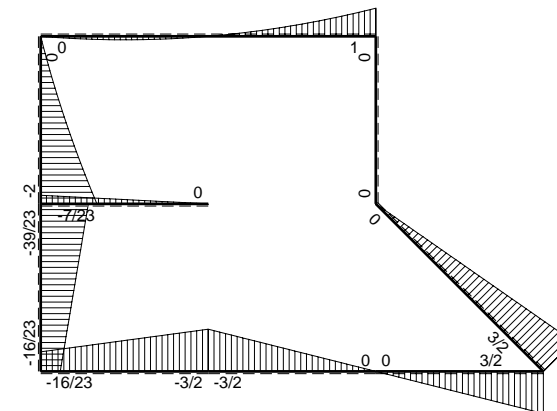
- A = 141.4 mm²
- J_u = 39168. mm⁴
- J_v = 7969. mm⁴
- J_t = 125.1 mm⁴
- y_o = -6.518 mm
- y_g = 16.15 mm
- N = 220. N
- T_y = -1320. N
- M_x = -407000. Nmm
- x_m = 5. mm
- y_m = 37. mm
- u_m = -12. mm
- v_m = 20.85 mm
- σ_m = N/A-Mv/J_u = 218.3 N/mm²
- x_c = 17. mm
- y_c = 37. mm
- v_c = 20.85 mm
- σ_c = N/A-Mv/J_u = 218.3 N/mm²
- τ_c = TS'/tJ_u = 30.36 N/mm²
- τ_g = TS'/tJ_u = 30.36 N/mm²
- t_c = 440. mm
- σ_o = √σ²+3τ² = 224.5 N/mm²



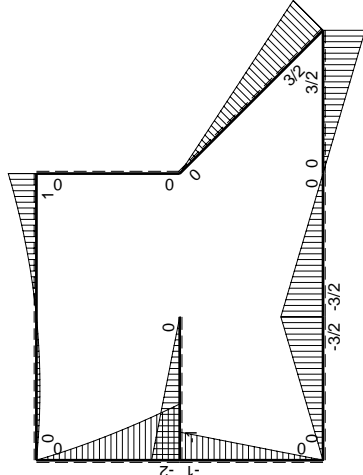
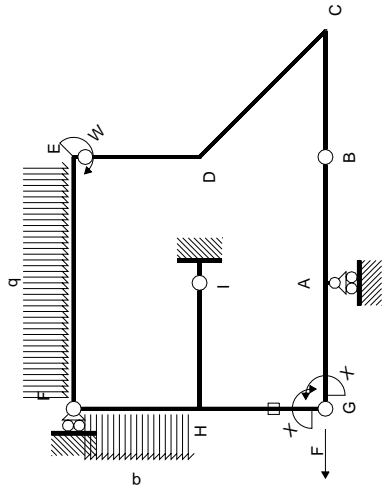
← ⊕ → F



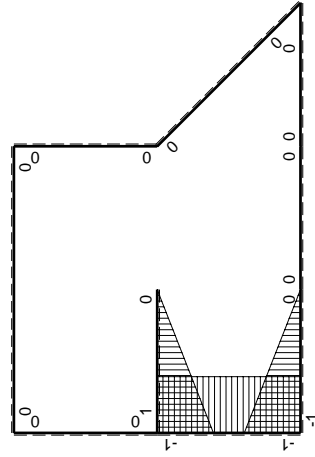
↑ ⊕ ↓ F



⊕ ⊖ F_b



(\oplus) M_x flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-3/2Fb+3/2Fx$	0	0	0	0
BA b	0	$3/2Fx$	0	0	0	0
BC b	0	$3/2Fx$	0	0	0	0
CB b	0	$-3/2Fb+3/2Fx$	0	0	0	0
CD $\sqrt{2}b$	0	$3/2Fb-3\sqrt{2}/4Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	$Fb-3/2Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$1/2Fx-1/2qx^2$	0	0	0	0
GA b	$-1+x/b$	$-3/2Fx$	$3/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/4Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$3/2Fb-3/2Fx$	$3/2Fx-3/2Fx^2/b$	x^2/b^2		
FH b	0	$-3/2Fx-1/2qx^2$	0	0	0	0
HF b	0	$2Fb-5/2Fx+1/2qx^2$	0	0	0	0
HI b	$1-x/b$	$-Fb+Fx$	$-Fb+2Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$-1/3Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	Fx	$-Fx^2/b$	x^2/b^2		
HG b	-1	$-Fb+Fx$	$Fb-Fx$	1	$1/2Fb^2/EJ$	Xb/EJ
GH b	1	Fx	Fx	1		
HG	elongazione asta $N_{1HG} \pm HG \pm HG$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{0A} + XV_{1A})/k_A$				$-3/4Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-4/3Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$16/23Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (-1 + 2x/b - x^2/b^2) Fb 1/EJ dx = [-x + x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-b + b - 1/3 b) Fb 1/EJ = -1/3 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (-x^2/b^2) Fb 1/EJ dx = [-1/3 x^3/b^2]_0^b Fb 1/EJ$$

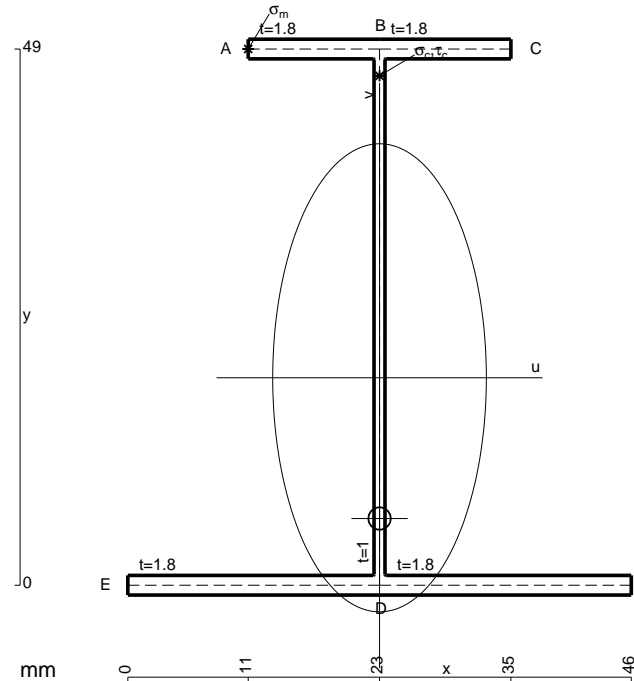
$$= (-1/3 b) Fb 1/EJ = -1/3 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [x - 1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

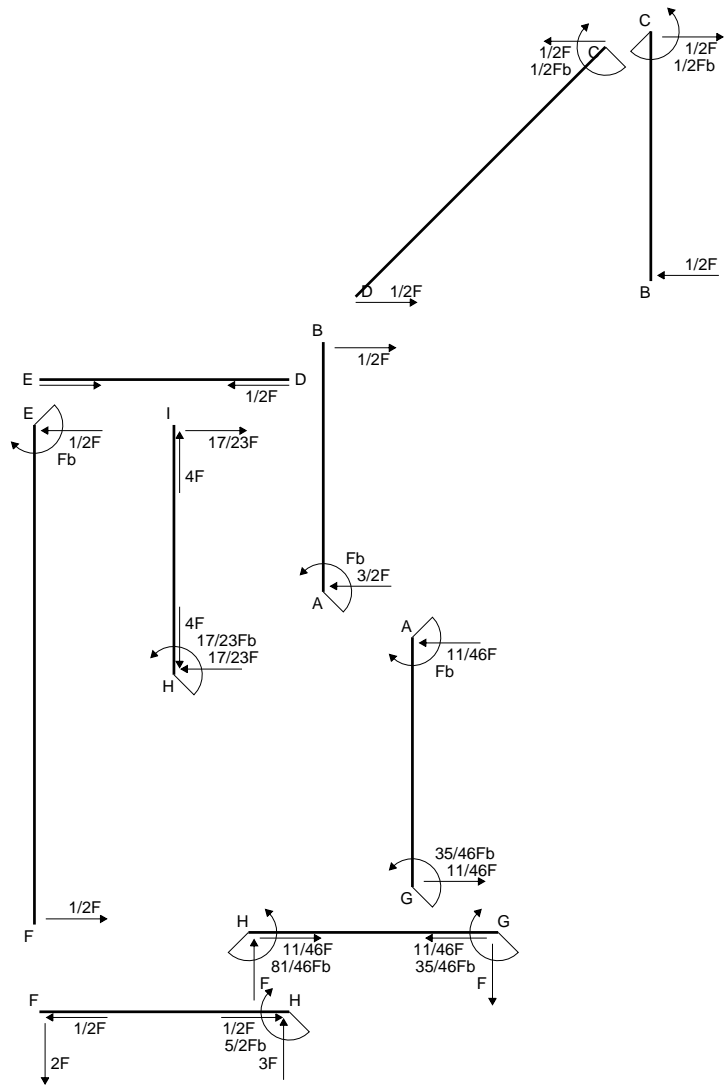
$$= (b - 1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$

$$L_{GH}^{xo} = \int_0^b (x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

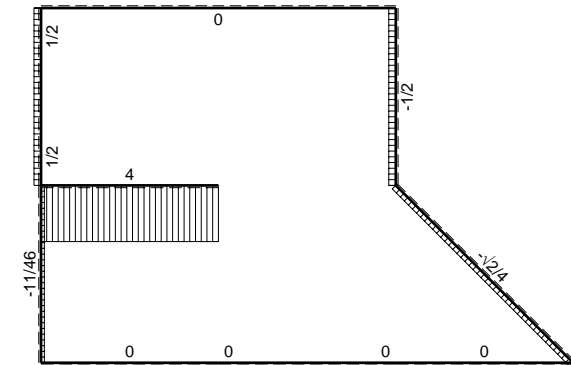
$$= (1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$



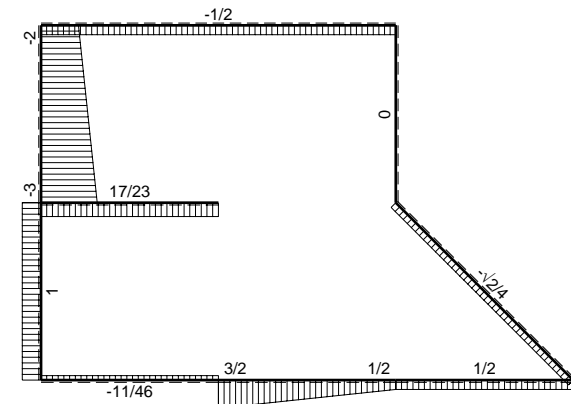
- A = 175. mm²
- J_u = 80057. mm⁴
- J_v = 16674. mm⁴
- J_t = 152.4 mm⁴
- y_o = -12.86 mm
- y_g = 18.96 mm
- N = -285. N
- T_y = -1425. N
- M_x = -615600. Nmm
- x_m = 11. mm
- y_m = 49. mm
- u_m = -12. mm
- v_m = 30.04 mm
- σ_m = N/A-Mv/J_u = 229.4 N/mm²
- x_c = 23. mm
- y_c = 49. mm
- v_c = 30.04 mm
- σ_c = N/A-Mv/J_u = 229.4 N/mm²
- τ_c = TS_y/tJ_u = 23.1 N/mm²
- τ_g = TS_y/tJ_u = 23.1 N/mm²
- t_c = 570. mm
- σ_o = √σ²+3τ² = 232.9 N/mm²



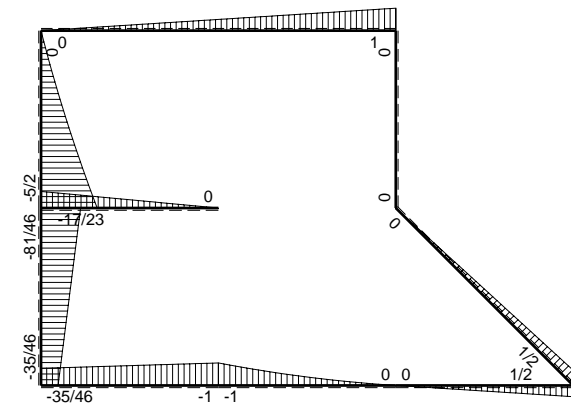
← ⊕ → F

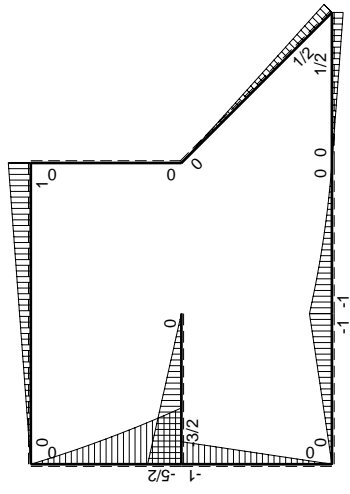
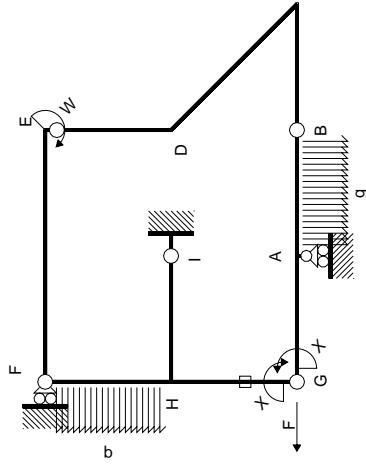


↑ ⊕ ↓ F



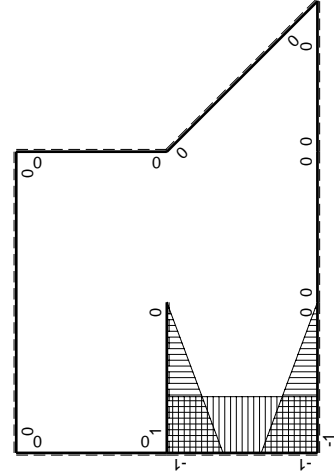
⊕ ⊖ F_b





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-Fb+3/2Fx-1/2qx^2$	0	0	0	0
BA b	0	$1/2Fx+1/2qx^2$	0	0	0	0
BC b	0	$1/2Fx$	0	0	0	0
CB b	0	$-1/2Fb+1/2Fx$	0	0	0	0
CD $\sqrt{2}b$	0	$1/2Fb-\sqrt{2}/4Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	$Fb-1/2Fx$	0	0	0	0
FE 2b	0	$-1/2Fx$	0	0	0	0
GA b	$-1+x/b$	$-Fx$	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$Fb-Fx$	$Fx-Fx^2/b$	x^2/b^2		
FH b	0	$-2Fx-1/2qx^2$	0	0	0	0
HF b	0	$5/2Fb-3Fx+1/2qx^2$	0	0	0	0
HI b	$1-x/b$	$-3/2Fb+3/2Fx$	$-3/2Fb+3Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	$-1/2Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$3/2Fx$	$-3/2Fx^2/b$	x^2/b^2		
HG b	-1	$-Fb+Fx$	$Fb-Fx$	1	$1/2Fb^2/EJ$	Xb/EJ
GH b	1	Fx	Fx	1		
HG	elongazione asta $N_{1HG^{\pm}HG^{\pm}HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{0A}+XV_{1A})/k_A$				$-5/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-35/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica X=W _{GA}				$35/46Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (-3/2 + 3x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [-3/2 x + 3/2 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-3/2 b + 3/2 b - 1/2 b) Fb 1/EJ = -1/2 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (-3/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x^3/b^2]_0^b Fb 1/EJ$$

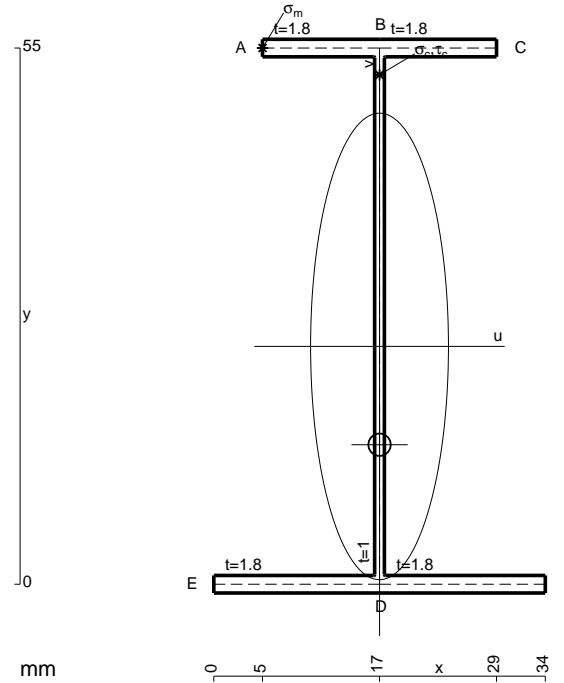
$$= (-1/2 b) Fb 1/EJ = -1/2 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [x - 1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

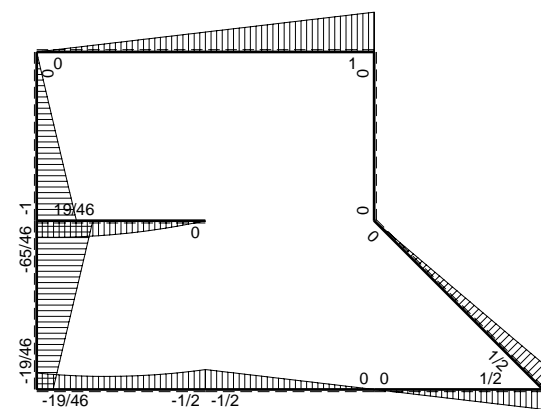
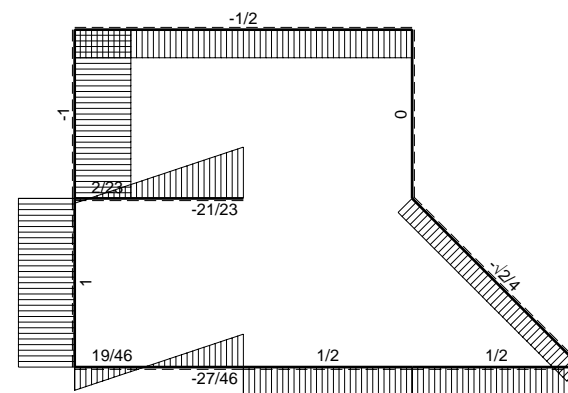
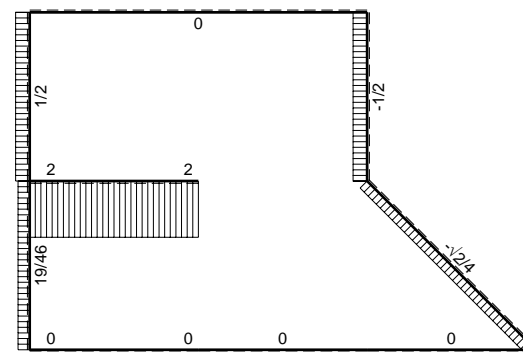
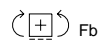
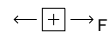
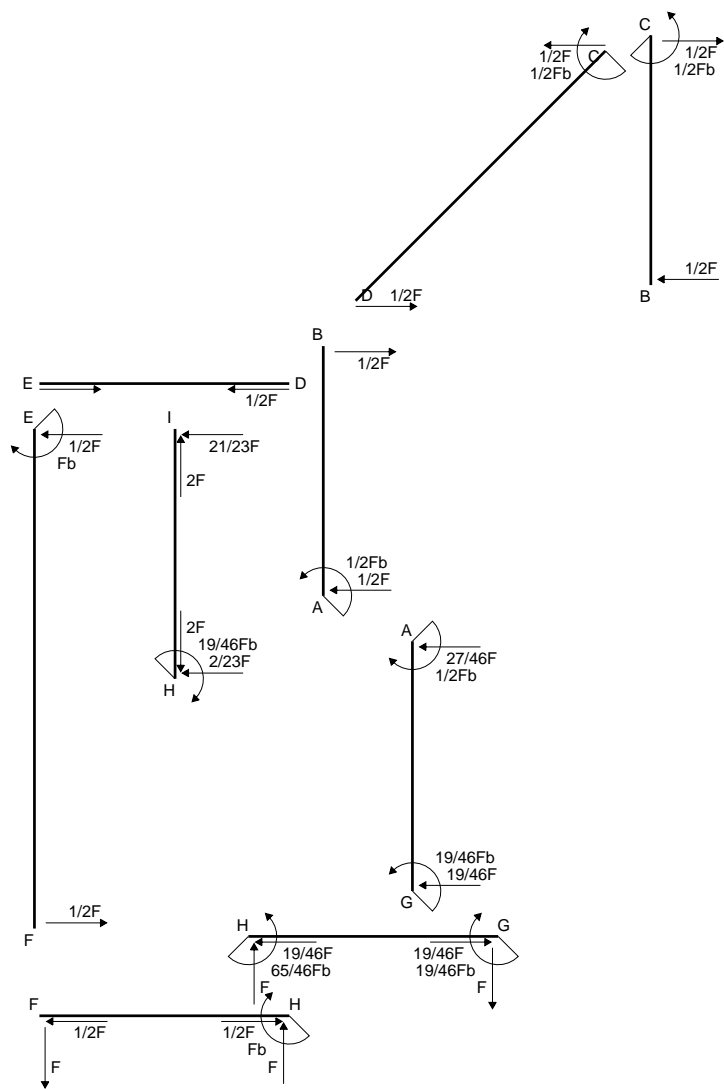
$$= (b - 1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$

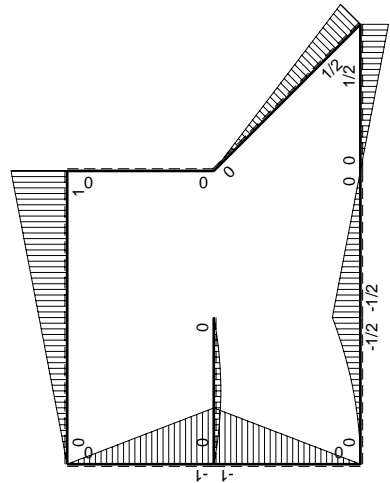
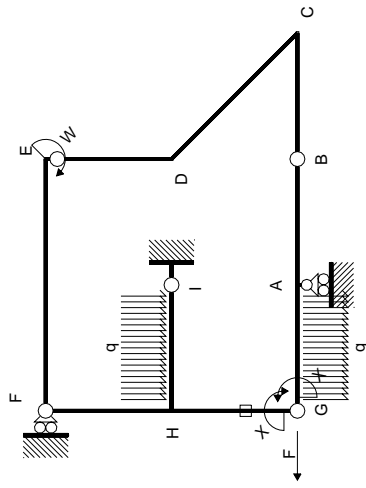
$$L_{GH}^{xo} = \int_0^b (x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$

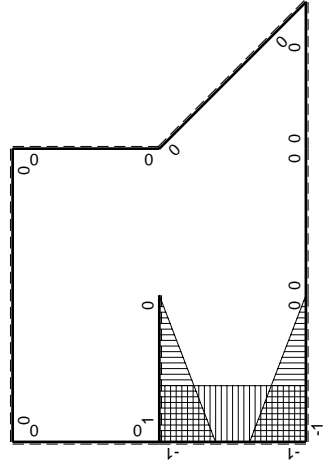


- A = 159.4 mm²
- J_u = 91280. mm⁴
- J_v = 7969. mm⁴
- J_t = 131.1 mm⁴
- y_o = -10.08 mm
- y_g = 24.39 mm
- N = 215. N
- T_y = -1290. N
- M_x = -698750. Nmm
- x_m = 5. mm
- y_m = 55. mm
- u_m = -12. mm
- v_m = 30.61 mm
- σ_m = N/A - Mv/J_u = 235.6 N/mm²
- x_c = 17. mm
- y_c = 55. mm
- v_c = 30.61 mm
- σ_c = N/A - Mv/J_u = 235.6 N/mm²
- τ_c = TS_y/tJ_u = 18.69 N/mm²
- τ_g = TS_y/tJ_u = 18.69 N/mm²
- t_c = 430. mm
- σ_o = √σ² + 3τ² = 237.8 N/mm²





M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-1/2Fb+1/2Fx$	0	0	0	0
BA b	0	$1/2Fx$	0	0	0	0
BC b	0	$1/2Fx$	0	0	0	0
CB b	0	$-1/2Fb+1/2Fx$	0	0	0	0
CD $\sqrt{2}b$	0	$1/2Fb-\sqrt{2}/4Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	$Fb-1/2Fx$	0	0	0	0
FE 2b	0	$-1/2Fx$	0	0	0	0
GA b	$-1+x/b$	$-1/2qx^2$	$1/2Fx^2/b-1/2qx^3/b$	$1-2x/b+x^2/b^2$	$1/24Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$1/2Fb-Fx+1/2qx^2$	$1/2Fx^2/b+1/2qx^3/b$	x^2/b^2	$1/24Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$-Fx$	0	0	0	0
HF b	0	$Fb-Fx$	0	0	0	0
HI b	$1-x/b$	$1/2Fx-1/2qx^2$	$1/2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$1/24Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$-1/2Fx+1/2qx^2$	$1/2Fx^2/b-1/2qx^3/b$	x^2/b^2	$1/24Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	$-Fb+Fx$	$Fb-Fx$	1	$1/2Fb^2/EJ$	Xb/EJ
GH b	1	Fx	Fx	1	$1/2Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG}^{\pm HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{GA}+XV_{1A})/k_A$				$-3/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-19/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica X=W _{GA}				$19/46Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/6 b - 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

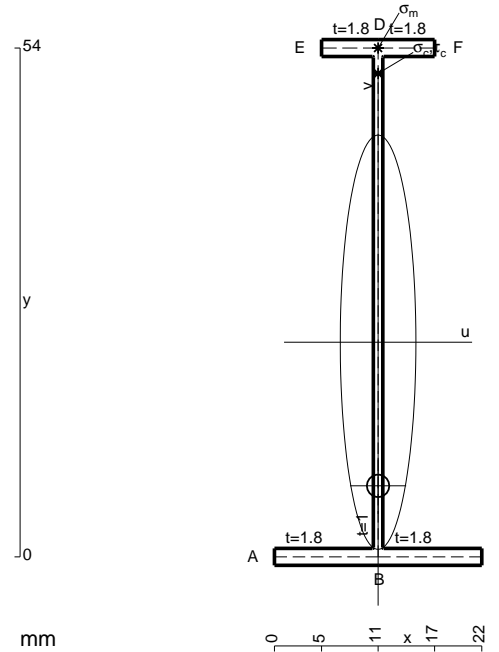
$$= (1/6 b - 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [x - 1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

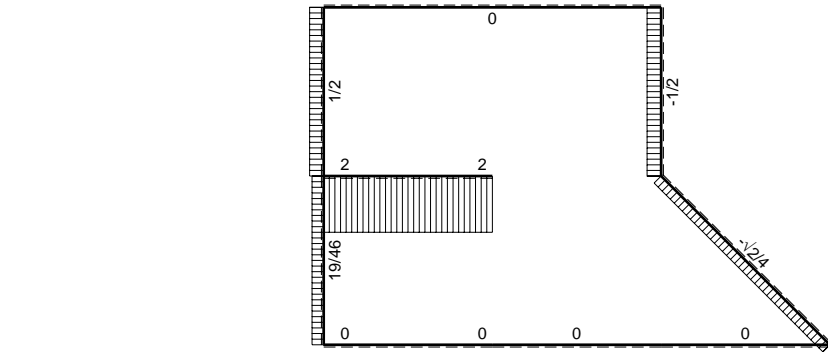
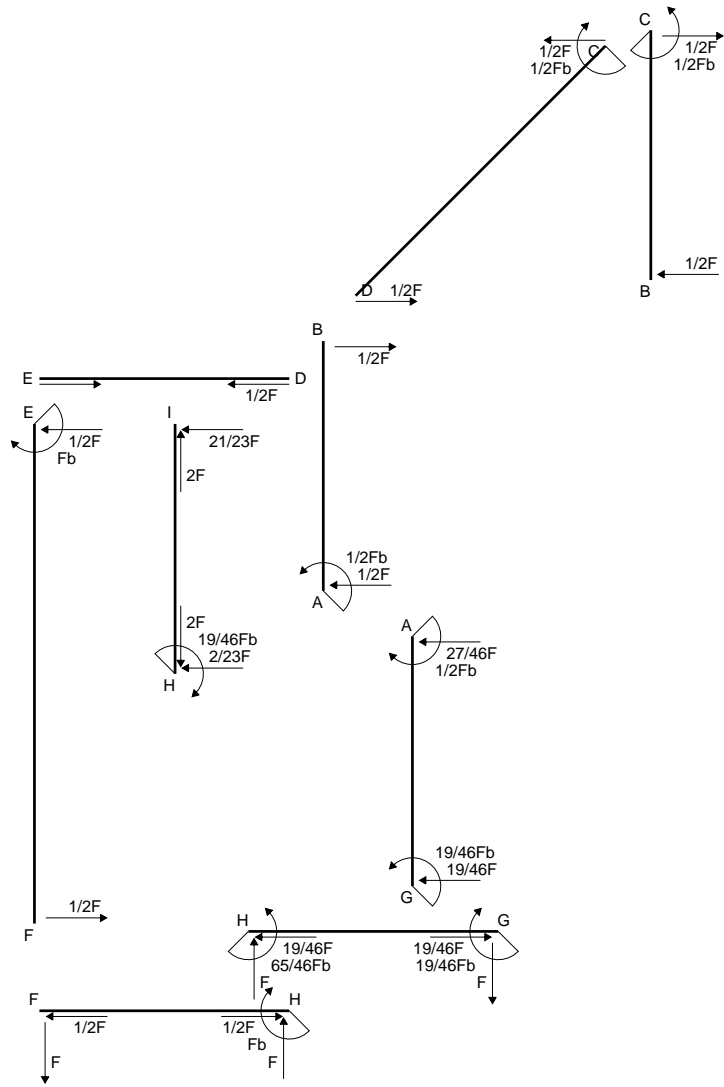
$$= (b - 1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$

$$L_{GH}^{xo} = \int_0^b (x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

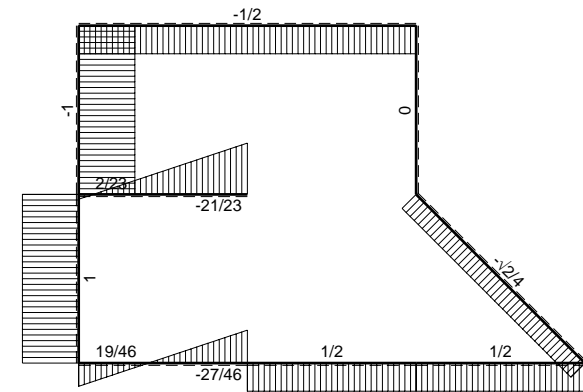
$$= (1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$



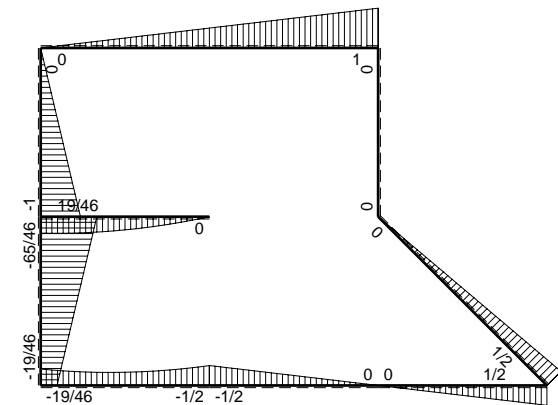
- A = 115.2 mm²
- J_u = 55687. mm⁴
- J_v = 1856. mm⁴
- J_t = 84.1 mm⁴
- y_o = -15.24 mm
- y_g = 22.78 mm
- N = 255. N
- T_y = -510. N
- M_x = -351900. Nmm
- x_m = 11. mm
- y_m = 54. mm
- v_m = 31.22 mm
- σ_m = N/A-Mv/J_u = 199.5 N/mm²
- y_c = 2. mm
- u_c = -11. mm
- v_c = -20.78 mm
- σ_c = N/A-Mv/J_u = 199.5 N/mm²
- τ_c = TS/tJ_u = 6.176 N/mm²
- τ_g = TS/tJ_u = 6.176 N/mm²
- t_c = 510. mm
- σ_o = √σ²+3τ² = 199.8 N/mm²



← ⊕ → F



↑ ⊕ ↓ F



⊕ ⊖ F_b

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/6 b - 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1/2 x/b - x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [1/4 x^2/b - 1/3 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/3 b + 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (1/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [1/6 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

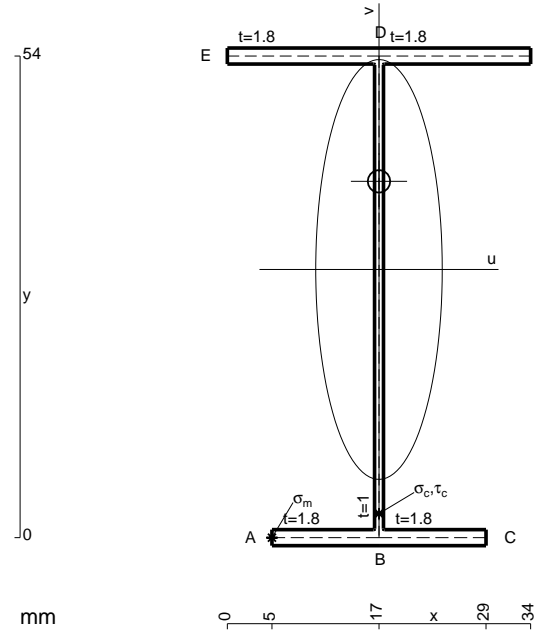
$$= (1/6 b - 1/8 b) Fb 1/EJ = 1/24 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [x - 1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

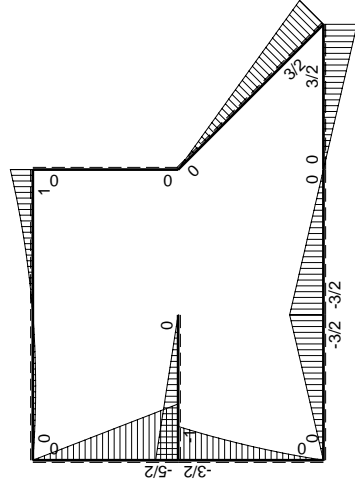
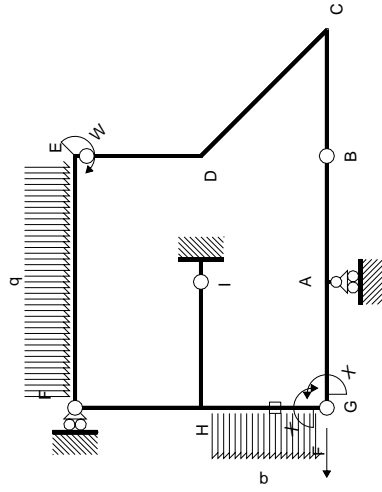
$$= (b - 1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$

$$L_{GH}^{xo} = \int_0^b (x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

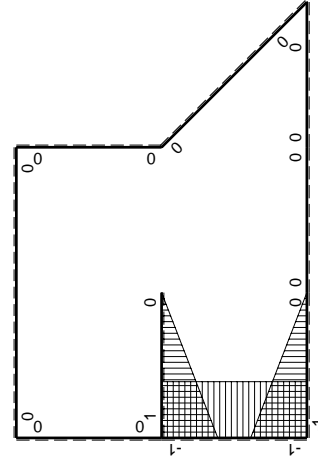
$$= (1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$



- A = 158.4 mm²
- J_u = 87739. mm⁴
- J_v = 7969. mm⁴
- J_t = 130.8 mm⁴
- y_o = 9.881 mm
- y_g = 30.07 mm
- N = 425. N
- T_y = -850. N
- M_x = -620500. Nmm
- x_m = 5. mm
- u_m = -12. mm
- v_m = -30.07 mm
- σ_m = N/A-Mv/J_u = -210. N/mm²
- x_c = 17. mm
- v_c = -30.07 mm
- σ_c = N/A-Mv/J_u = -210. N/mm²
- τ_c = TS_v/tJ_u = 12.58 N/mm²
- τ_g = TS_v/tJ_u = 12.58 N/mm²
- t_c = 850. mm
- σ_o = √σ²+3τ² = 211.1 N/mm²



(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$	
AB b	0	$-3/2Fb+3/2Fx$	0	0	0	0	
BA b	0	$3/2Fx$	0	0	0	0	
BC b	0	$3/2Fx$	0	0	0	0	
CB b	0	$-3/2Fb+3/2Fx$	0	0	0	0	
CD $\sqrt{2}b$	0	$3/2Fb-3\sqrt{2}/4Fx$	0	0	0	0	
DE b	0	0	0	0	0	0	
ED b	0	0	0	0	0	0	
EF 2b	0	$Fb-3/2Fx+1/2qx^2$	0	0	0	0	
FE 2b	0	$1/2Fx-1/2qx^2$	0	0	0	0	
GA b	$-1+x/b$	$-3/2Fx$	$3/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/4Fb^2/EJ$	$1/3Xb/EJ$	
AG b	x/b	$3/2Fb-3/2Fx$	$3/2Fx-3/2Fx^2/b$	x^2/b^2			
FH b	0	$-5/2Fx$	0	0	0	0	
HF b	0	$5/2Fb-5/2Fx$	0	0	0	0	
HI b	$1-x/b$	$-Fb+Fx$	$-Fb+2Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$-1/3Fb^2/EJ$	$1/3Xb/EJ$	
IH b	$-x/b$	Fx	$-Fx^2/b$	x^2/b^2			
HG b	-1	$-3/2Fb+2Fx-1/2qx^2$	$3/2Fb-2Fx+1/2Fx^2/b$	1	$2/3Fb^2/EJ$	Xb/EJ	
GH b	1	$Fx+1/2qx^2$	$Fx+1/2Fx^2/b$	1			
HG	elongazione asta $N_{1HG}^{HG} \rightarrow HG$						
A	molla nodo $-V_{1A}(V_{0A}+XV_{1A})/k_A$						
totali							
iperstatica $X=W_{GA}$							

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (-1 + 2x/b - x^2/b^2) Fb 1/EJ dx = [-x + x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-b + b - 1/3 b) Fb 1/EJ = -1/3 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (-x^2/b^2) Fb 1/EJ dx = [-1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/3 b) Fb 1/EJ = -1/3 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (3/2 - 2x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

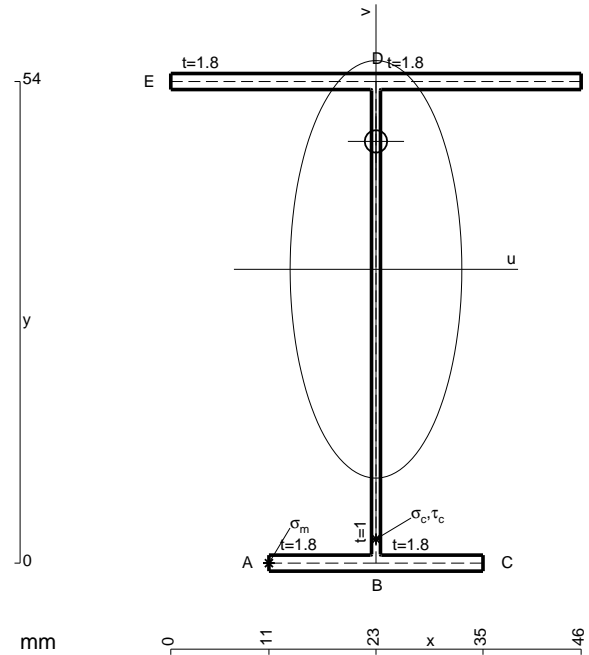
$$= [3/2 x - x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (3/2 b - b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/3 Fb^2/EJ$$

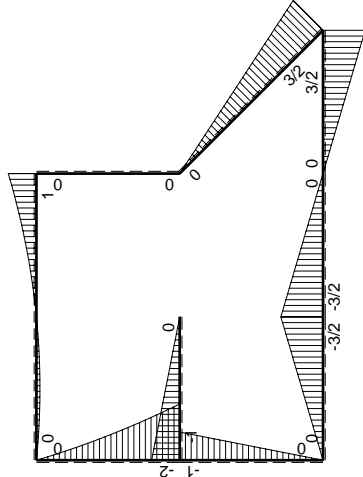
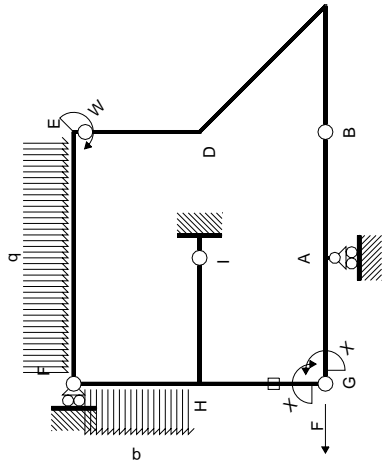
$$L_{GH}^{xo} = \int_0^b (x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

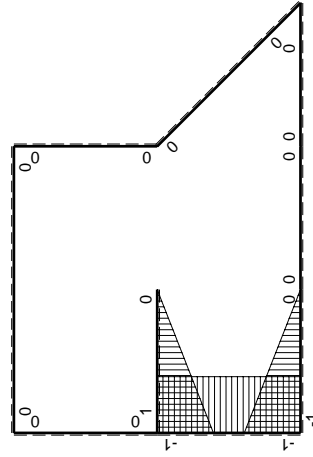
$$= (1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/3 Fb^2/EJ$$



- A = 180. mm²
- J_u = 98625. mm⁴
- J_v = 16674. mm⁴
- J_t = 154.1 mm⁴
- y_o = 14.34 mm
- y_g = 32.94 mm
- N = -165. N
- T_y = -825. N
- M_x = -643500. Nmm
- x_m = 11. mm
- u_m = -12. mm
- v_m = -32.94 mm
- σ_m = N/A - Mv/J_u = -215.8 N/mm²
- x_c = 23. mm
- v_c = -32.94 mm
- σ_c = N/A - Mv/J_u = -215.8 N/mm²
- τ_c = TS/tJ_u = 11.9 N/mm²
- τ_g = TS/tJ_u = 11.9 N/mm²
- t_c = 330. mm
- σ_o = √σ² + 3τ² = 216.8 N/mm²



(\oplus) M_x flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-3/2Fb+3/2Fx$	0	0	0	0
BA b	0	$3/2Fx$	0	0	0	0
BC b	0	$3/2Fx$	0	0	0	0
CB b	0	$-3/2Fb+3/2Fx$	0	0	0	0
CD $\sqrt{2}b$	0	$3/2Fb-3\sqrt{2}/4Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	$Fb-3/2Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$1/2Fx-1/2qx^2$	0	0	0	0
GA b	$-1+x/b$	$-3/2Fx$	$3/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/4Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$3/2Fb-3/2Fx$	$3/2Fx-3/2Fx^2/b$	x^2/b^2		
FH b	0	$-3/2Fx-1/2qx^2$	0	0	0	0
HF b	0	$2Fb-5/2Fx+1/2qx^2$	0	0	0	0
HI b	$1-x/b$	$-Fb+Fx$	$-Fb+2Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$-1/3Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	Fx	$-Fx^2/b$	x^2/b^2		
HG b	-1	$-Fb+Fx$	$Fb-Fx$	1	$1/2Fb^2/EJ$	Xb/EJ
GH b	1	Fx	Fx	1		
HG	elongazione asta $N_{1HG} \pm HG \pm HG$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{0A} + XV_{1A})/k_A$				$-3/4Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-4/3Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$16/23Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (-1 + 2x/b - x^2/b^2) Fb 1/EJ dx = [-x + x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-b + b - 1/3 b) Fb 1/EJ = -1/3 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (-x^2/b^2) Fb 1/EJ dx = [-1/3 x^3/b^2]_0^b Fb 1/EJ$$

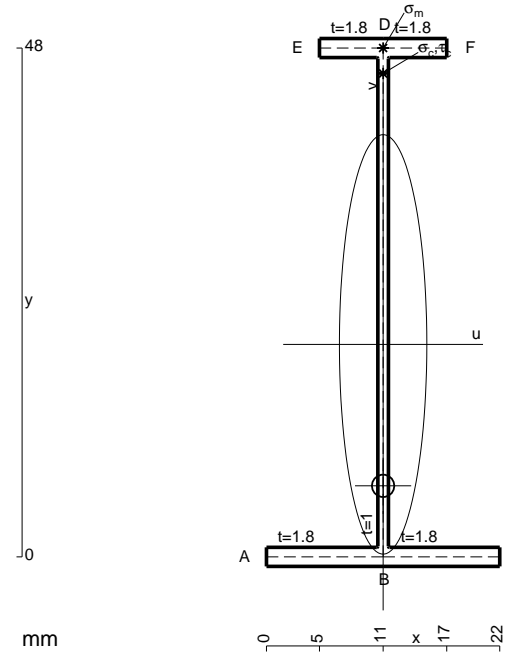
$$= (-1/3 b) Fb 1/EJ = -1/3 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [x - 1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

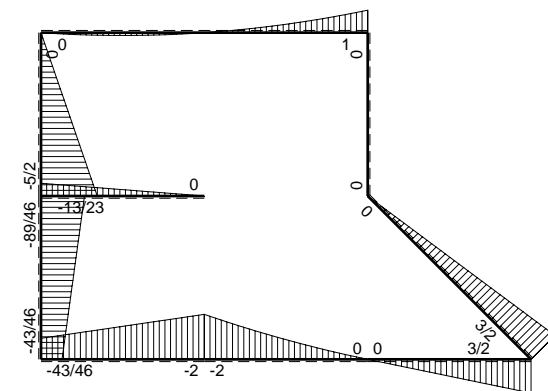
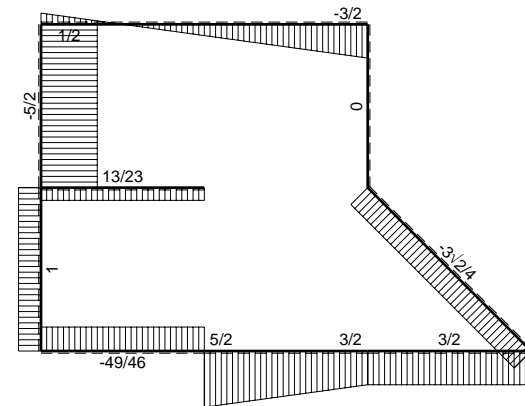
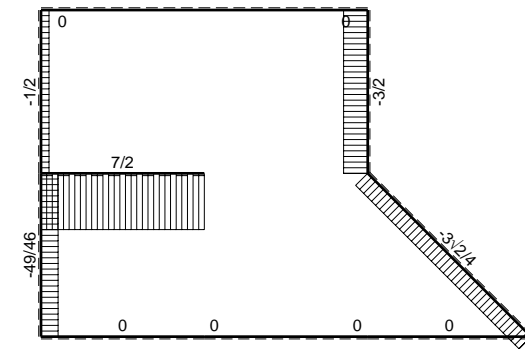
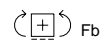
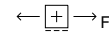
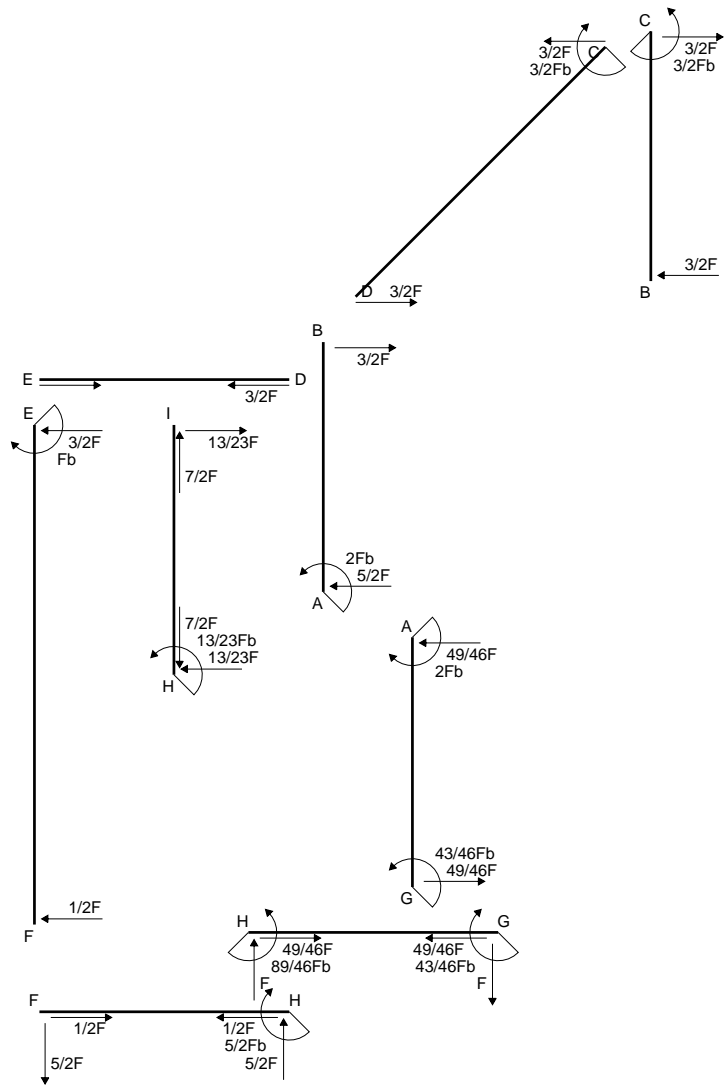
$$= (b - 1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$

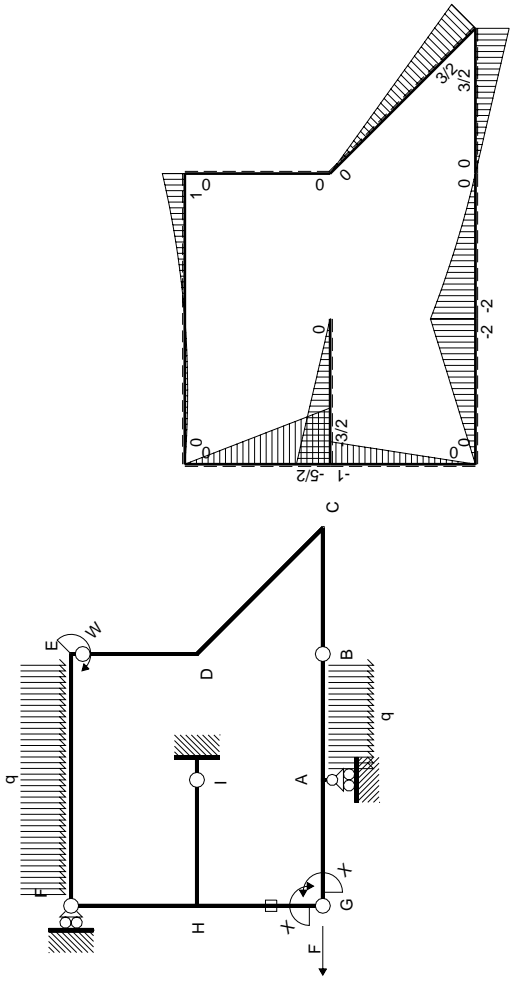
$$L_{GH}^{xo} = \int_0^b (x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$

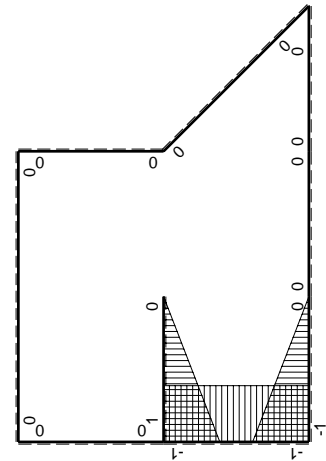


- A = 109.2 mm²
- J_u = 42758. mm⁴
- J_v = 1856. mm⁴
- J_i = 82.1 mm⁴
- y_o = -13.34 mm
- y_g = 20.04 mm
- N = -120. N
- T_y = -600. N
- M_x = -350400. Nmm
- x_m = 11. mm
- y_m = 48. mm
- v_m = 27.96 mm
- σ_m = N/A - Mv/J_u = 228. N/mm²
- y_c = 2. mm
- u_c = -11. mm
- v_c = -18.04 mm
- σ_c = N/A - Mv/J_u = 228. N/mm²
- τ_c = TS'/tJ_u = 8.473 N/mm²
- τ_g = TS'/tJ_u = 8.473 N/mm²
- t_c = 240. mm
- σ_o = √σ² + 3τ² = 228.5 N/mm²





M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-2Fb+5/2Fx-1/2qx^2$	0	0	0	0
BA b	0	$3/2Fx+1/2qx^2$	0	0	0	0
BC b	0	$3/2Fx$	0	0	0	0
CB b	0	$-3/2Fb+3/2Fx$	0	0	0	0
CD $\sqrt{2}b$	0	$3/2Fb-3\sqrt{2}/4Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	$Fb-3/2Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$1/2Fx-1/2qx^2$	0	0	0	0
GA b	$-1+x/b$	$-2Fx$	$2Fx-2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/3Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$2Fb-2Fx$	$2Fx-2Fx^2/b$	x^2/b^2	0	0
FH b	0	$-5/2Fx$	0	0	0	0
HF b	0	$5/2Fb-5/2Fx$	0	0	0	0
HI b	$1-x/b$	$-3/2Fb+3/2Fx$	$-3/2Fb+3Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	$-1/2Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$3/2Fx$	$-3/2Fx^2/b$	x^2/b^2	0	0
HG b	-1	$-Fb+Fx$	$Fb-Fx$	1	$1/2Fb^2/EJ$	Xb/EJ
GH b	1	Fx	Fx	1	0	0
HG	elongazione asta $N_{1HG^{\pm}HG^{\pm}HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{0A}+XV_{1A})/k_A$				$-9/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-43/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica X=W _{GA}				43/46Fb	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (2x/b - 2x^2/b^2) Fb 1/EJ dx = [x^2/b - 2/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 2/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (2x/b - 2x^2/b^2) Fb 1/EJ dx = [x^2/b - 2/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 2/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (-3/2 + 3x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [-3/2 x + 3/2 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-3/2 b + 3/2 b - 1/2 b) Fb 1/EJ = -1/2 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (-3/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x^3/b^2]_0^b Fb 1/EJ$$

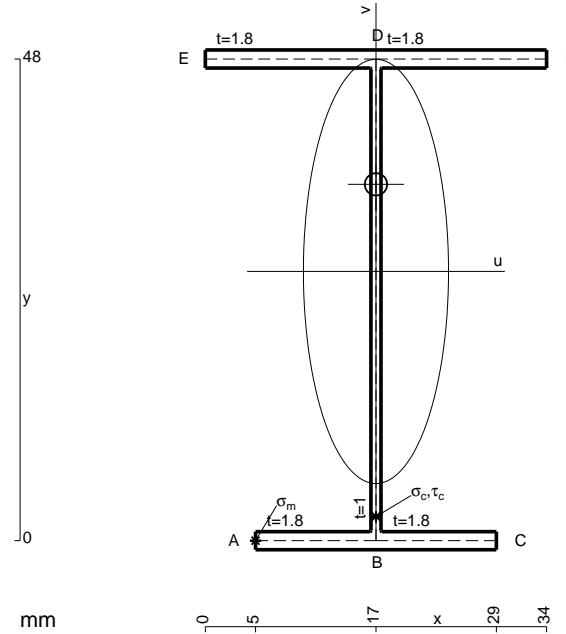
$$= (-1/2 b) Fb 1/EJ = -1/2 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [x - 1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

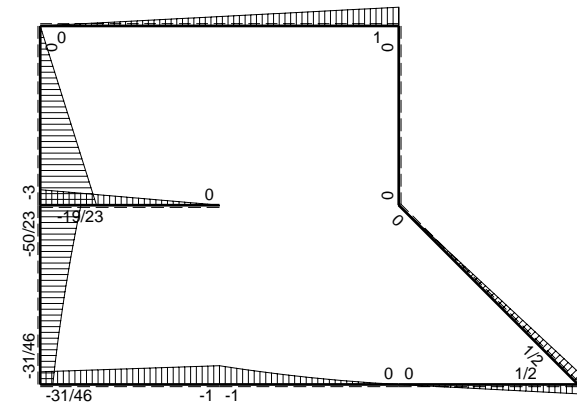
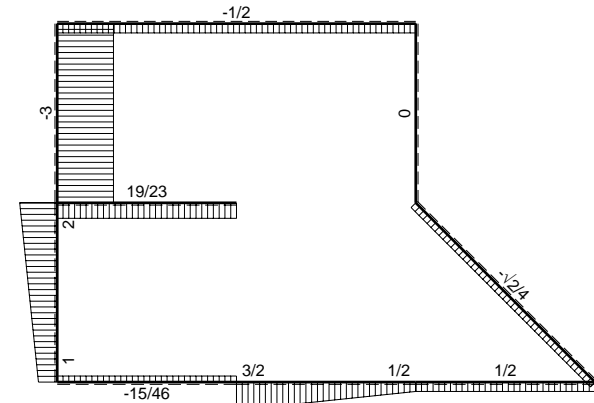
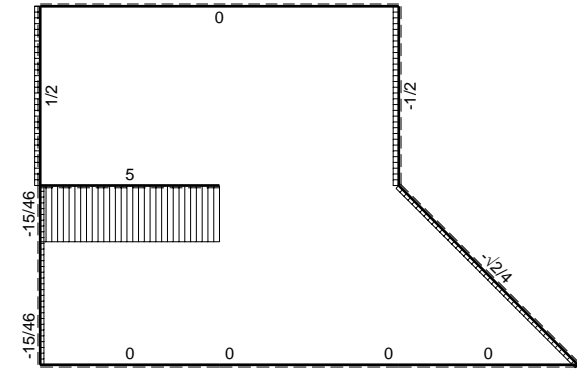
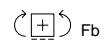
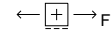
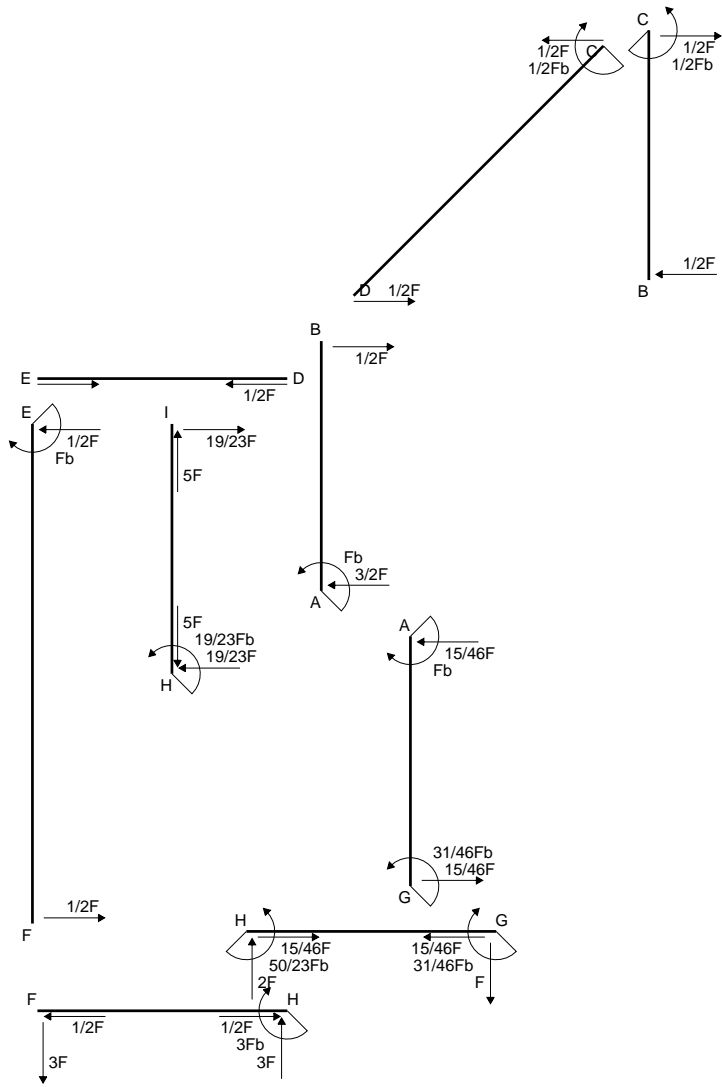
$$= (b - 1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$

$$L_{GH}^{xo} = \int_0^b (x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$



- A = 152.4 mm²
- J_u = 68126. mm⁴
- J_v = 7969. mm⁴
- J_t = 128.8 mm⁴
- y_o = 8.676 mm
- y_g = 26.83 mm
- N = -155. N
- T_y = -775. N
- M_x = -596750. Nmm
- x_m = 5. mm
- u_m = -12. mm
- v_m = -26.83 mm
- σ_m = N/A - Mv/J_u = -236.1 N/mm²
- x_c = 17. mm
- v_c = -26.83 mm
- σ_c = N/A - Mv/J_u = -236.1 N/mm²
- τ_c = TS'/tJ_u = 13.19 N/mm²
- τ_g = TS'/tJ_u = 13.19 N/mm²
- t_c = 310. mm
- σ_o = √σ² + 3τ² = 237.2 N/mm²



$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[1/2 x^2/b - 1/3 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[1/2 x^2/b - 1/3 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (-3/2 + 3x/b - 3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[-3/2 x + 3/2 x^2/b - 1/2 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-3/2 b + 3/2 b - 1/2 b) \cdot Fb \cdot 1/EJ = -1/2 \cdot Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (-3/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[-1/2 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (-1/2 b) \cdot Fb \cdot 1/EJ = -1/2 \cdot Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (3/2 - 2x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ$$

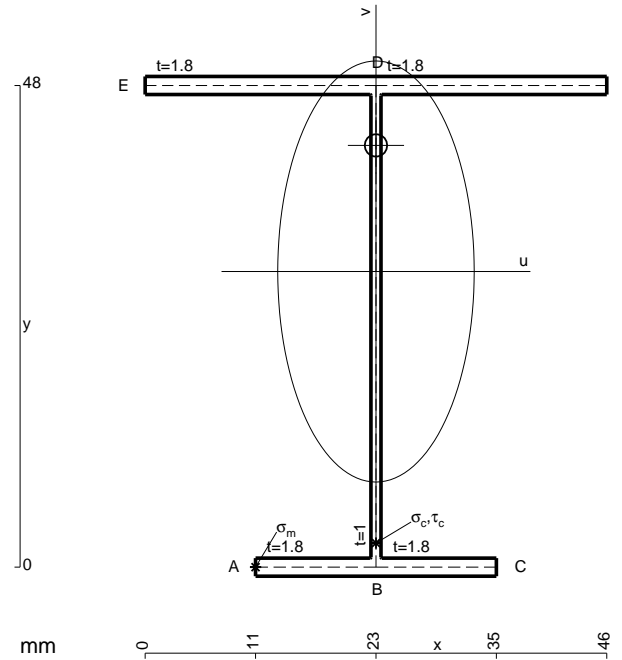
$$= \left[3/2 x - x^2/b + 1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ$$

$$= (3/2 b - b + 1/6 b) \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ = -1/3 \cdot Fb^2/EJ$$

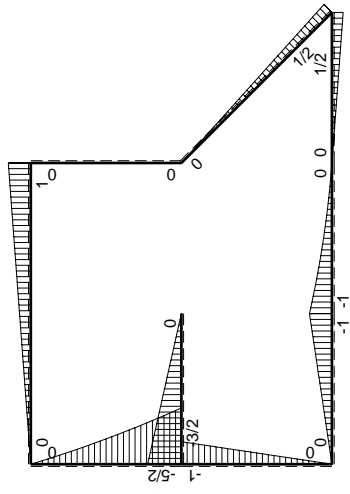
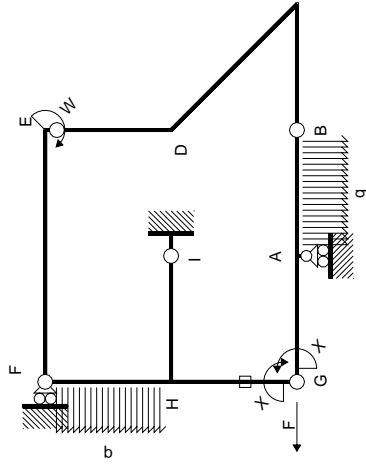
$$L_{GH}^{xo} = \int_0^b (x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ$$

$$= \left[1/2 x^2/b + 1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ$$

$$= (1/2 b + 1/6 b) \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ = -1/3 \cdot Fb^2/EJ$$

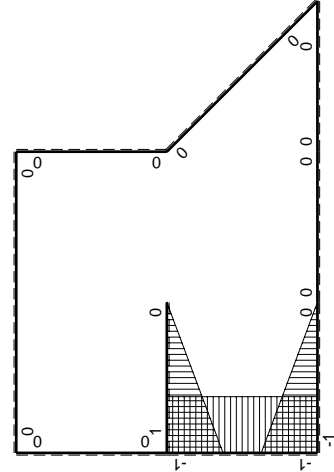


- A = 174. mm²
- J_u = 76601. mm⁴
- J_v = 16674. mm⁴
- J_t = 152.1 mm⁴
- y_o = 12.57 mm
- y_g = 29.46 mm
- N = 210. N
- T_y = -1260. N
- M_x = -516600. Nmm
- x_m = 11. mm
- u_m = -12. mm
- v_m = -29.46 mm
- σ_m = N/A - Mv/J_u = -197.5 N/mm²
- x_c = 23. mm
- v_c = -29.46 mm
- σ_c = N/A - Mv/J_u = -197.5 N/mm²
- τ_c = TS/tJ_u = 20.94 N/mm²
- τ_g = TS/tJ_u = 20.94 N/mm²
- t_c = 420. mm
- σ_o = √σ² + 3τ² = 200.8 N/mm²



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-Fb+3/2Fx-1/2qx^2$	0	0	0	0
BA b	0	$1/2Fx+1/2qx^2$	0	0	0	0
BC b	0	$1/2Fx$	0	0	0	0
CB b	0	$-1/2Fb+1/2Fx$	0	0	0	0
CD $\sqrt{2}b$	0	$1/2Fb-\sqrt{2}/4Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	$Fb-1/2Fx$	0	0	0	0
FE 2b	0	$-1/2Fx$	0	0	0	0
GA b	$-1+x/b$	$-Fx$	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$Fb-Fx$	$Fx-Fx^2/b$	x^2/b^2		
FH b	0	$-2Fx-1/2qx^2$	0	0	0	0
HF b	0	$5/2Fb-3Fx+1/2qx^2$	0	0	0	0
HI b	$1-x/b$	$-3/2Fb+3/2Fx$	$-3/2Fb+3Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	$-1/2Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$3/2Fx$	$-3/2Fx^2/b$	x^2/b^2		
HG b	-1	$-Fb+Fx$	$Fb-Fx$	1	$1/2Fb^2/EJ$	Xb/EJ
GH b	1	Fx	Fx	1		
HG	elongazione asta $N_{1,HG^{\pm}HG^{\pm}HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{0A}+XV_{1A})/k_A$				$-5/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-35/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica X=W _{GA}				$35/46Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (-3/2 + 3x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [-3/2 x + 3/2 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-3/2 b + 3/2 b - 1/2 b) Fb 1/EJ = -1/2 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (-3/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x^3/b^2]_0^b Fb 1/EJ$$

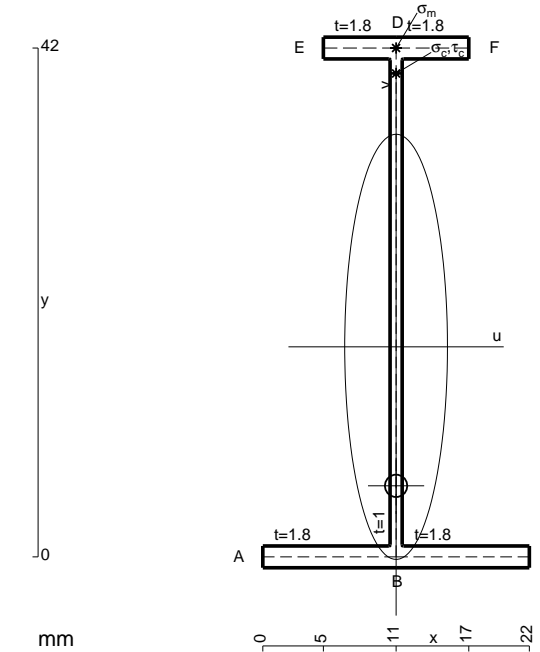
$$= (-1/2 b) Fb 1/EJ = -1/2 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [x - 1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

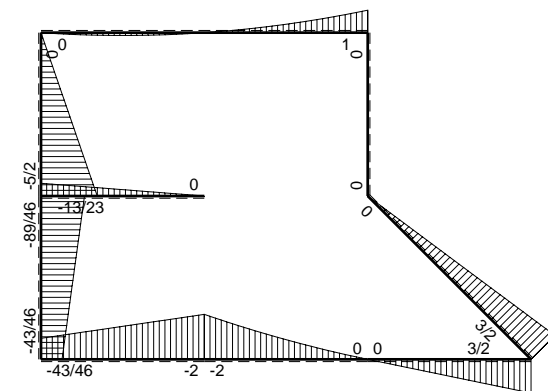
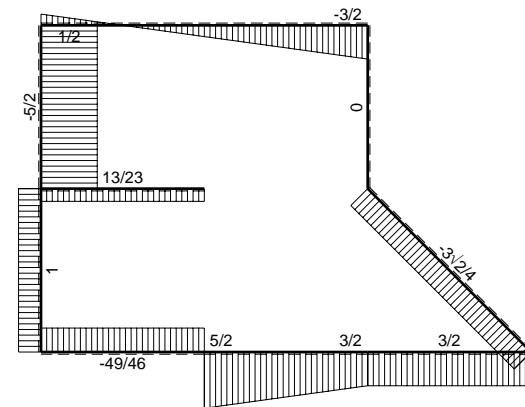
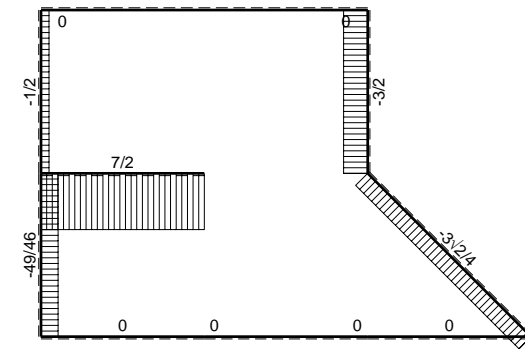
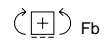
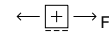
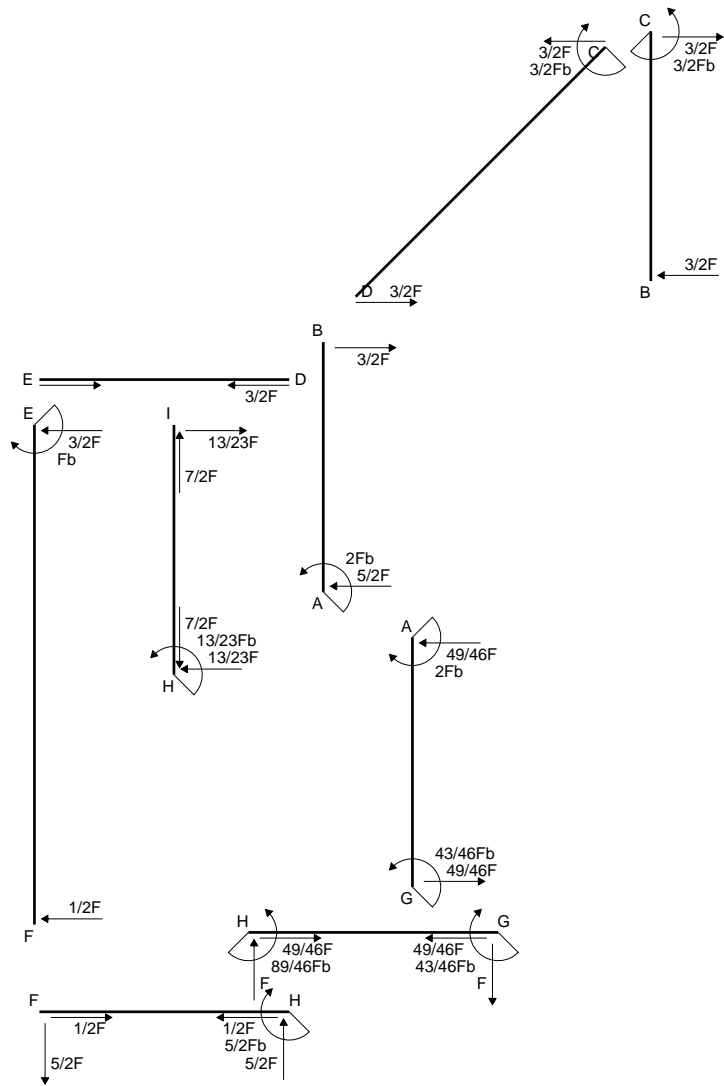
$$= (b - 1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$

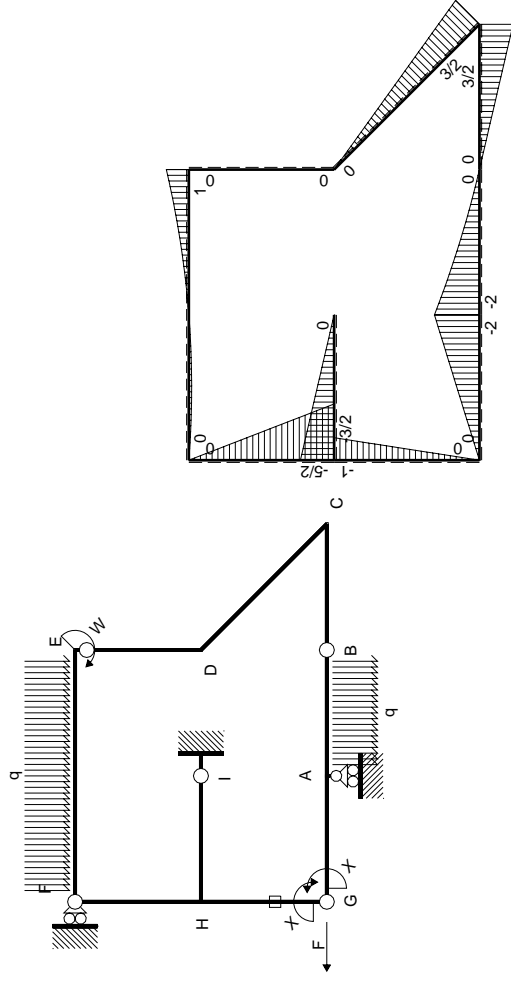
$$L_{GH}^{xo} = \int_0^b (x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$

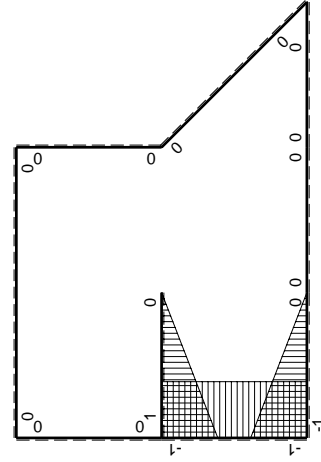


- A = 103.2 mm²
- J_u = 31779. mm⁴
- J_v = 1856. mm⁴
- J_t = 80.1 mm⁴
- y_o = -11.47 mm
- y_g = 17.34 mm
- N = 135. N
- T_y = -810. N
- M_x = -263250. Nmm
- x_m = 11. mm
- y_m = 42. mm
- v_m = 24.66 mm
- σ_m = N/A-Mv/J_u = 205.6 N/mm²
- y_c = 2. mm
- u_c = -11. mm
- v_c = -15.34 mm
- σ_c = N/A-Mv/J_u = 205.6 N/mm²
- τ_c = TS¹/tJ_u = 13.58 N/mm²
- τ_g = TS¹/tJ_u = 13.58 N/mm²
- t_c = 270. mm
- σ_o = √σ²+3τ² = 207. N/mm²





M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	$-2Fb+5/2Fx-1/2qx^2$	0	0	0	0
BA b	0	$3/2Fx+1/2qx^2$	0	0	0	0
BC b	0	$3/2Fx$	0	0	0	0
CB b	0	$-3/2Fb+3/2Fx$	0	0	0	0
CD $\sqrt{2}b$	0	$3/2Fb-3\sqrt{2}/4Fx$	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	$Fb-3/2Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$1/2Fx-1/2qx^2$	0	0	0	0
GA b	$-1+x/b$	$-2Fx$	$2Fx-2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/3Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$2Fb-2Fx$	$2Fx-2Fx^2/b$	x^2/b^2	0	0
FH b	0	$-5/2Fx$	0	0	0	0
HF b	0	$5/2Fb-5/2Fx$	0	0	0	0
HI b	$1-x/b$	$-3/2Fb+3/2Fx$	$-3/2Fb+3Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	$-1/2Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$3/2Fx$	$-3/2Fx^2/b$	x^2/b^2	0	0
HG b	-1	$-Fb+Fx$	$Fb-Fx$	1	$1/2Fb^2/EJ$	Xb/EJ
GH b	1	Fx	Fx	1	0	0
HG	elongazione asta $N_{1HG}^{HG} - N_{HG}^{HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$				$-9/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-43/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica X=W _{GA}				43/46Fb	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (2x/b - 2x^2/b^2) Fb 1/EJ dx = [x^2/b - 2/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 2/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (2x/b - 2x^2/b^2) Fb 1/EJ dx = [x^2/b - 2/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (b - 2/3 b) Fb 1/EJ = 1/3 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (-3/2 + 3x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [-3/2 x + 3/2 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-3/2 b + 3/2 b - 1/2 b) Fb 1/EJ = -1/2 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (-3/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x^3/b^2]_0^b Fb 1/EJ$$

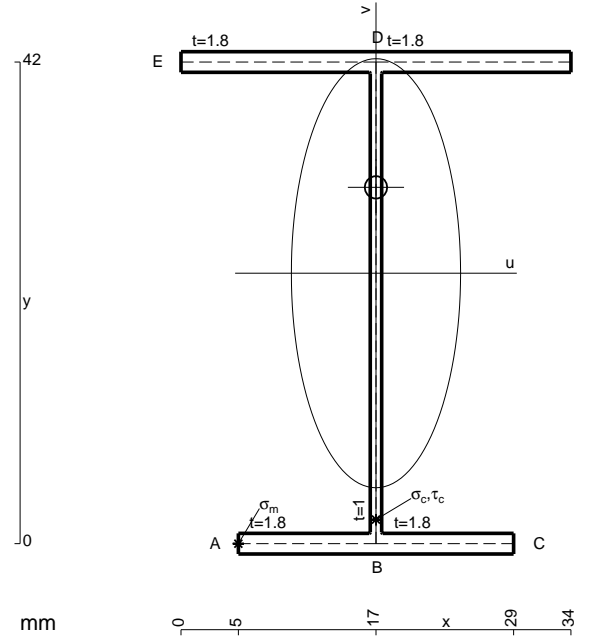
$$= (-1/2 b) Fb 1/EJ = -1/2 Fb^2/EJ$$

$$L_{HG}^{xo} = \int_0^b (1 - x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [x - 1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (b - 1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$

$$L_{GH}^{xo} = \int_0^b (x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [1/2 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/2 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/2 Fb^2/EJ$$



- A = 146.4 mm²
- J_u = 51238. mm⁴
- J_v = 7969. mm⁴
- J_t = 126.8 mm⁴
- y_o = 7.49 mm
- y_g = 23.58 mm
- N = -220. N
- T_y = -1100. N
- M_x = -473000. Nmm
- x_m = 5. mm
- u_m = -12. mm
- v_m = -23.58 mm
- σ_m = N/A - Mv/J_u = -219.2 N/mm²
- x_c = 17. mm
- v_c = -23.58 mm
- σ_c = N/A - Mv/J_u = -219.2 N/mm²
- τ_c = TS'/tJ_u = 21.87 N/mm²
- τ_g = TS'/tJ_u = 21.87 N/mm²
- t_c = 440. mm
- σ_o = √σ² + 3τ² = 222.4 N/mm²

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{HG}^{x_0} = \int_0^b (2 - 5/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

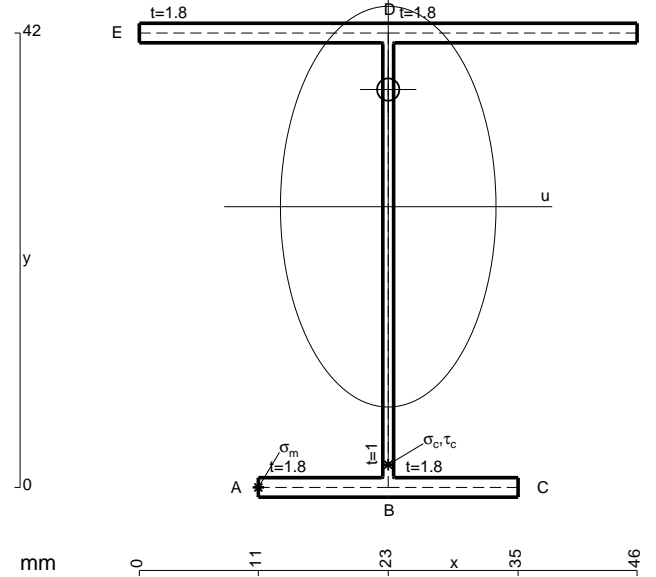
$$= [2x - 5/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (2b - 5/4 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/12 Fb^2/EJ$$

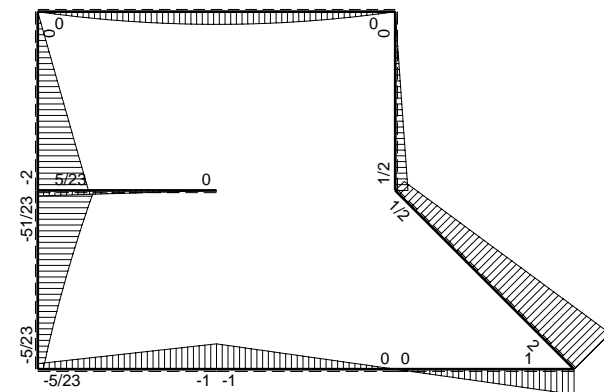
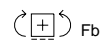
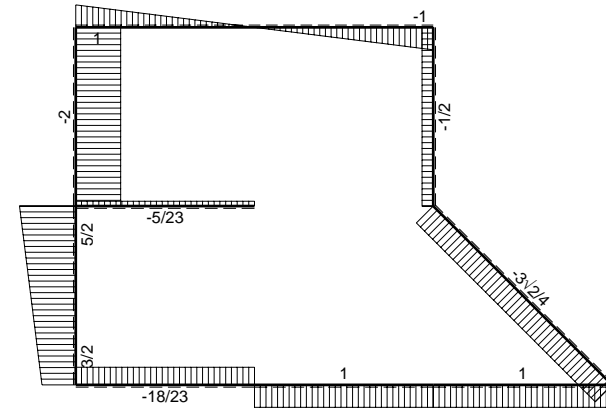
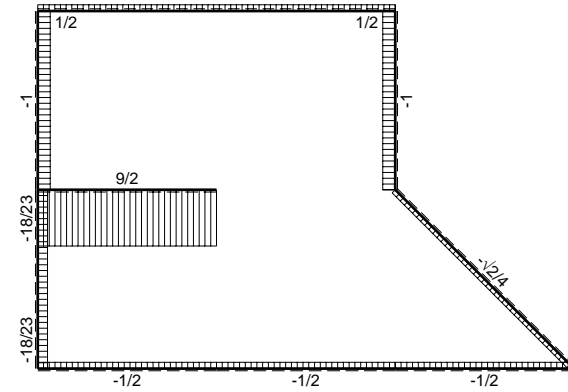
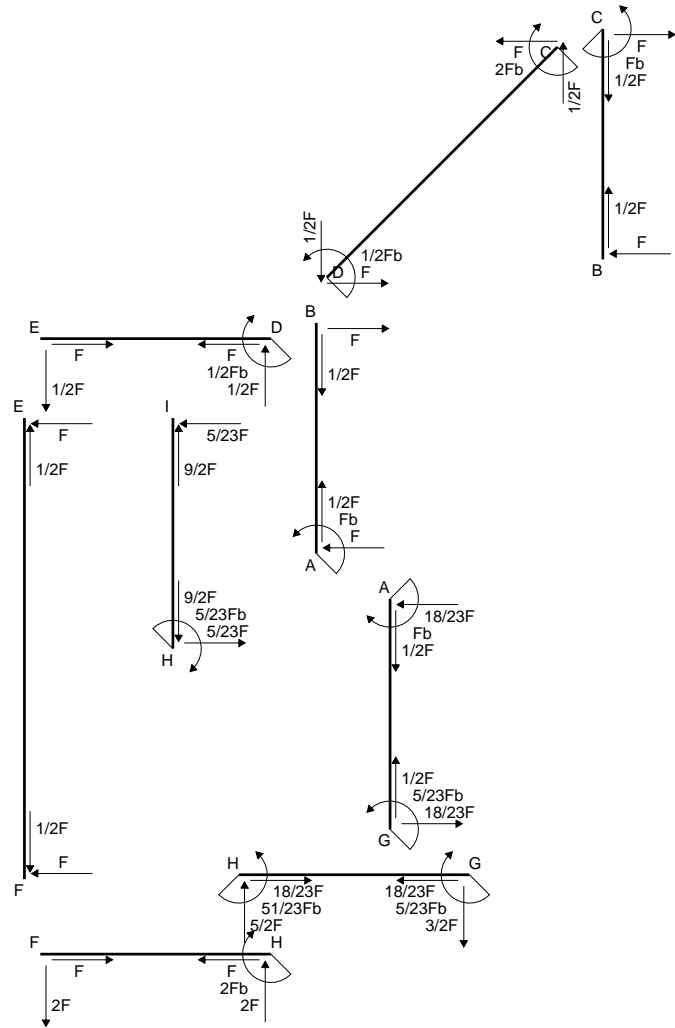
$$L_{GH}^{x_0} = \int_0^b (3/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

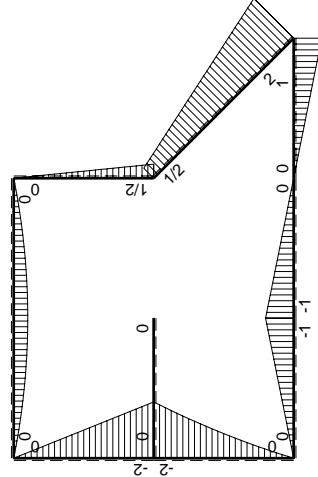
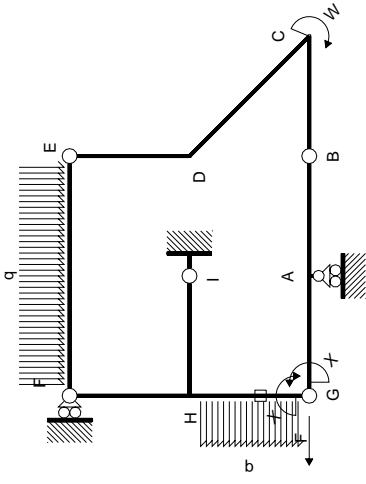
$$= [3/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (3/4 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/12 Fb^2/EJ$$

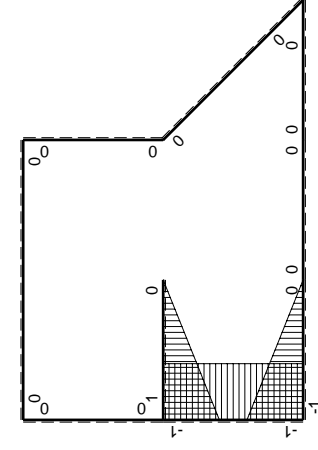


- A = 168. mm²
- J_u = 57624. mm⁴
- J_v = 16674. mm⁴
- J_i = 150.1 mm⁴
- y_o = 10.83 mm
- y_g = 25.95 mm
- T_y = -1375. N
- M_x = -506000. Nmm
- x_m = 11. mm
- u_m = -12. mm
- v_m = -25.95 mm
- σ_m = -Mv/J_u = -227.9 N/mm²
- x_c = 23. mm
- v_c = -25.95 mm
- σ_c = -Mv/J_u = -227.9 N/mm²
- τ_c = TS'/tJ_u = 26.75 N/mm²
- τ_g = TS'/tJ_u = 26.75 N/mm²
- t_c = 550. mm
- σ_o = √σ²+3τ² = 232.5 N/mm²





(\oplus) M_x flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-Fb+Fx	0	0	0	0
BA b	0	Fx	0	0	0	0
BC b	0	Fx	0	0	0	0
CB b	0	-Fb+Fx	0	0	0	0
CD $\sqrt{2}b$	0	$2Fb-3\sqrt{2}/4Fx$	0	0	0	0
DE b	0	$1/2Fb-1/2Fx$	0	0	0	0
ED b	0	-1/2Fx	0	0	0	0
EF 2b	0	-Fx+1/2qx ²	0	0	0	0
FE 2b	0	Fx-1/2qx ²	0	0	0	0
GA b	-1+x/b	-Fx	Fx-Fx ² /b	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	Fb-Fx	Fx-Fx ² /b	x^2/b^2	$1/6Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	-2Fx	0	0	0	0
HF b	0	2Fb-2Fx	0	0	0	0
HI b	1-x/b	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
IH b	-x/b	0	0	x^2/b^2	0	$1/3Xb/EJ$
HG b	-1	$-2Fb+5/2Fx-1/2qx^2$	$2Fb-5/2Fx+1/2Fx^2/b$	1	$11/12Fb^2/EJ$	Xb/EJ
GH b	1	$3/2Fx+1/2qx^2$	$3/2Fx+1/2Fx^2/b$	1	$11/12Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG}^{HG} \rightarrow HG$				-Fb ² /EJ	
A	molla nodo $-V_{1A}(V_{0A}+XV_{1A})/k_A$				-1/2Fb ² /EJ	1/4Xb/EJ
	totali				-5/12Fb ² /EJ	23/12Xb/EJ
	iperstatica $X=W_{GA}$				5/23Fb	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{x_0} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{AG}^{x_0} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{HG}^{x_0} = \int_0^b (2 - 5/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

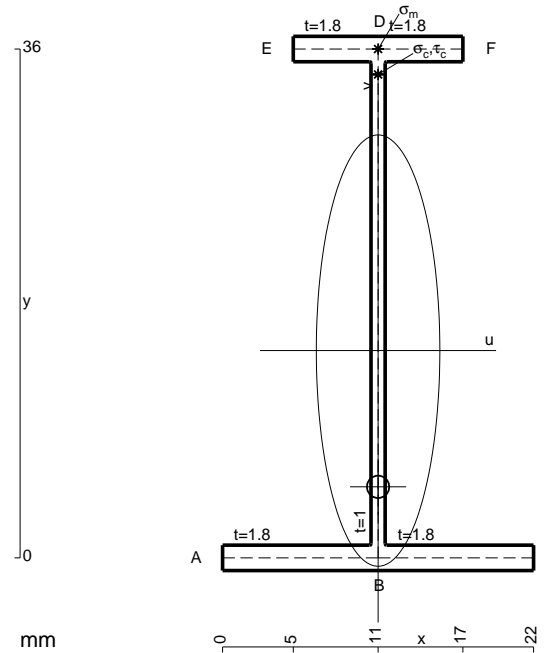
$$= [2x - 5/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (2b - 5/4 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/12 Fb^2/EJ$$

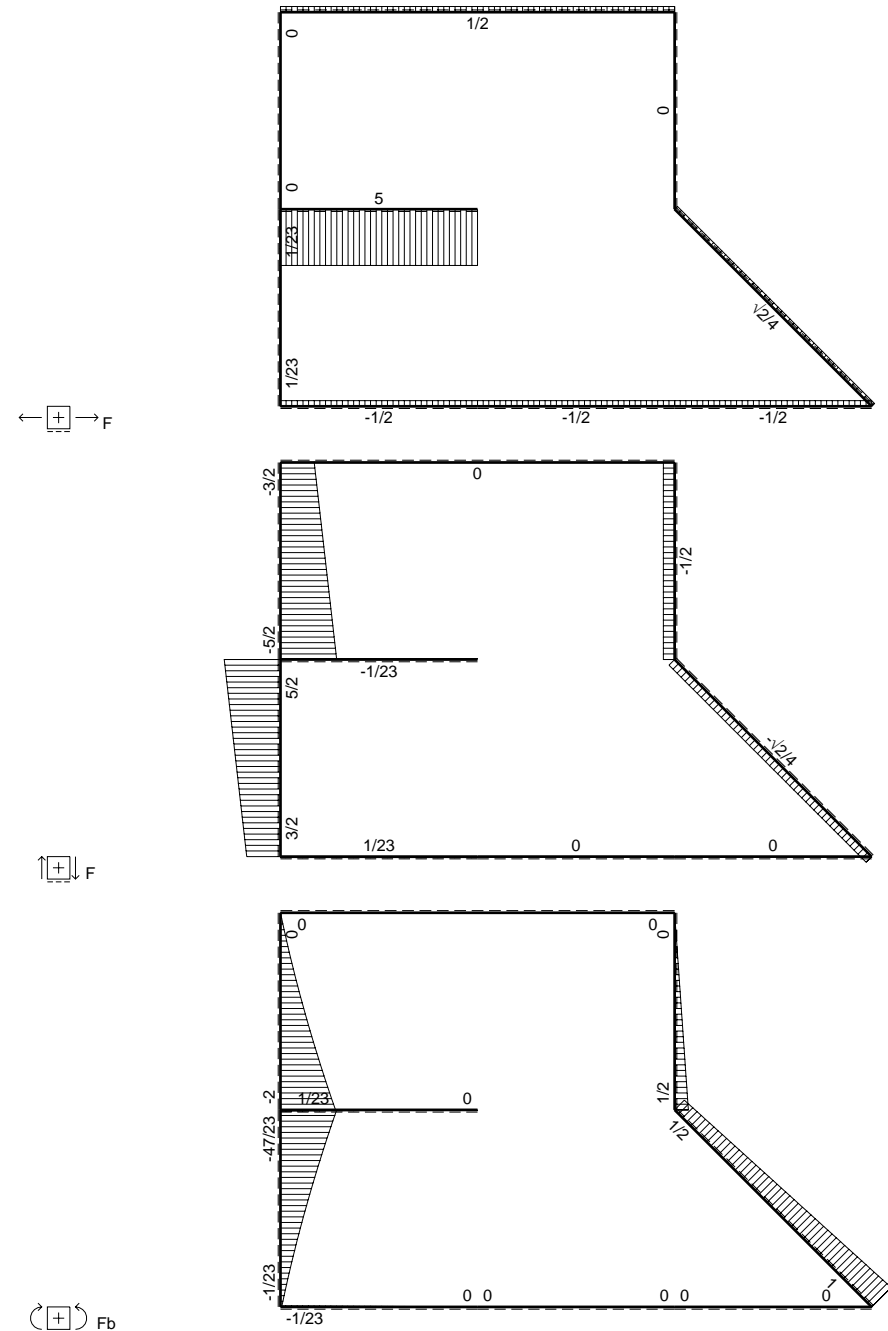
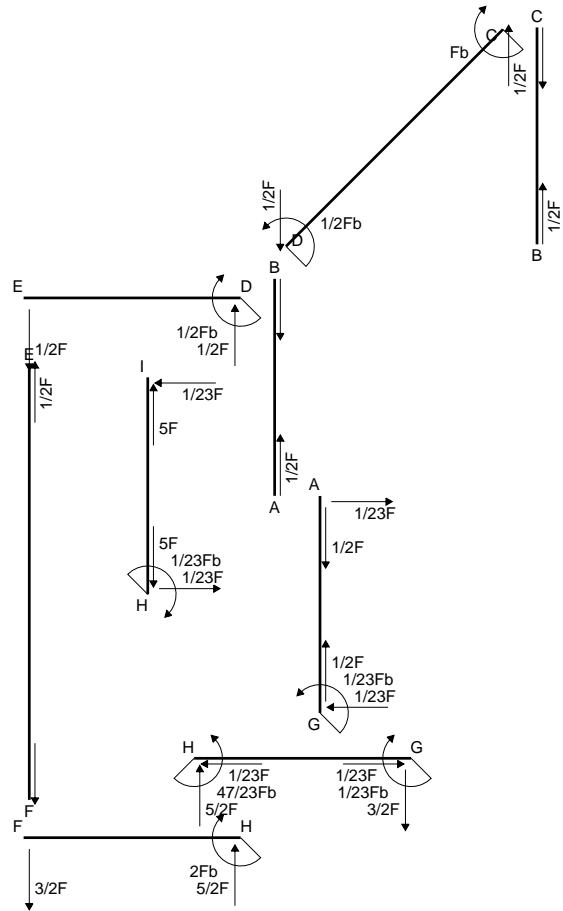
$$L_{GH}^{x_0} = \int_0^b (3/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [3/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (3/4 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/12 Fb^2/EJ$$



- A = 97.2 mm²
- J_u = 22637. mm⁴
- J_v = 1856. mm⁴
- J_t = 78.1 mm⁴
- y_o = -9.64 mm
- y_g = 14.67 mm
- N = -290. N
- T_y = -580. N
- M_x = -249400. Nmm
- x_m = 11. mm
- y_m = 36. mm
- v_m = 21.33 mm
- σ_m = N/A-Mv/J_u = 232.1 N/mm²
- y_c = 2. mm
- u_c = -11. mm
- v_c = -12.67 mm
- σ_c = N/A-Mv/J_u = 232.1 N/mm²
- τ_c = TS/tJ_u = 11.81 N/mm²
- τ_g = TS/tJ_u = 11.81 N/mm²
- t_c = 290. mm
- σ_o = √σ²+3τ² = 233. N/mm²



$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{HG}^{x_0} = \int_0^b (2 - 5/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

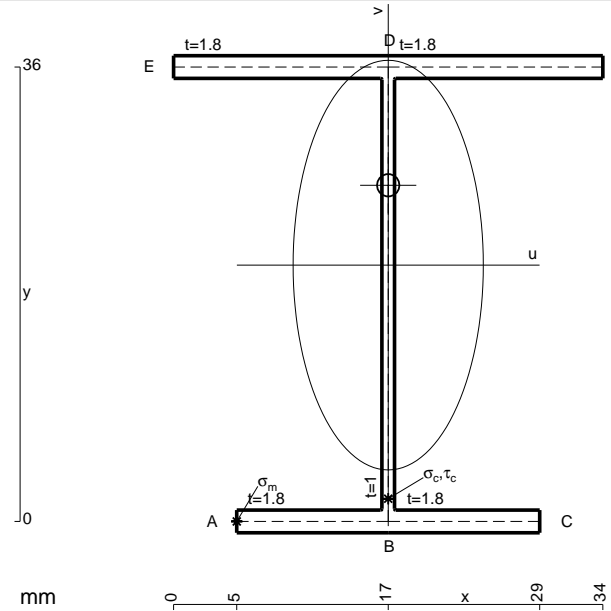
$$= [2x - 5/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (2b - 5/4 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/12 Fb^2/EJ$$

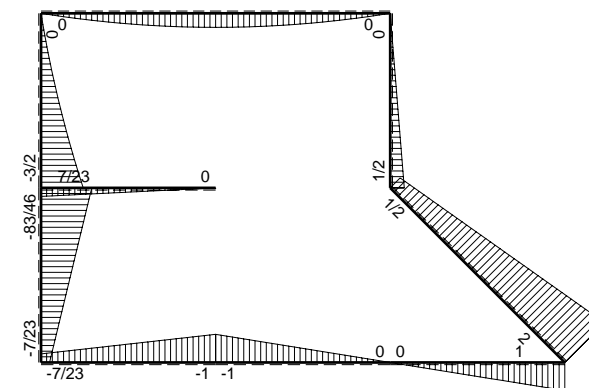
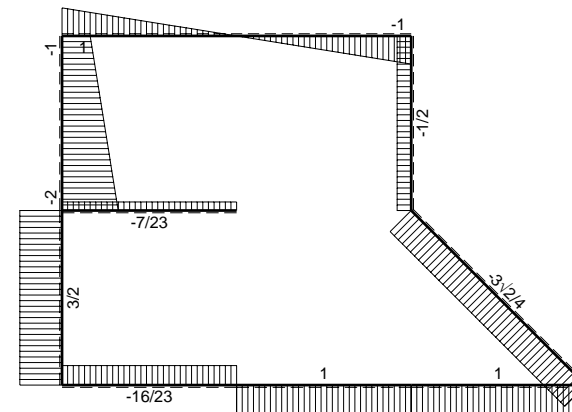
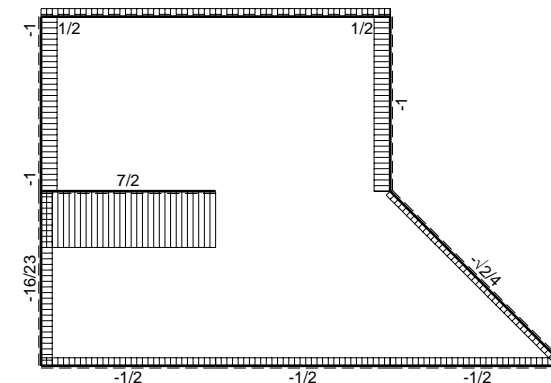
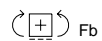
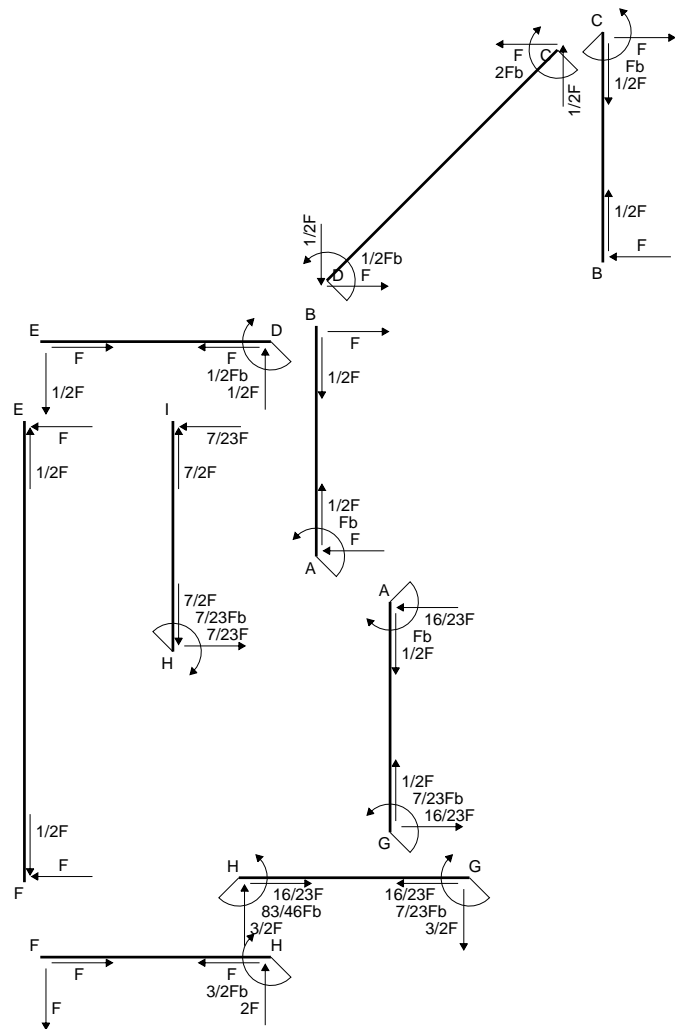
$$L_{GH}^{x_0} = \int_0^b (3/2 x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

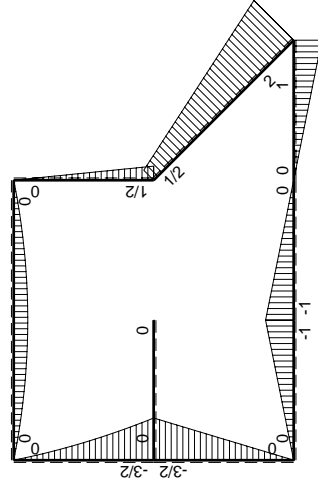
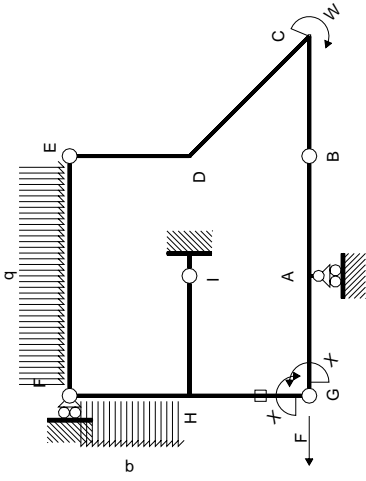
$$= [3/4 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (3/4 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/12 Fb^2/EJ$$

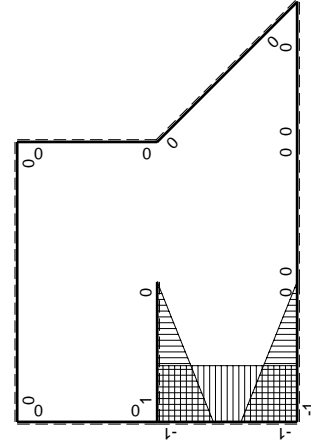


- A = 140.4 mm²
- J_u = 36966. mm⁴
- J_v = 7969. mm⁴
- J_i = 124.8 mm⁴
- y_o = 6.325 mm
- y_g = 20.31 mm
- T_y = -975. N
- M_x = -358800. Nmm
- x_m = 5. mm
- u_m = -12. mm
- v_m = -20.31 mm
- σ_m = -Mv/J_u = -197.1 N/mm²
- x_c = 17. mm
- v_c = -20.31 mm
- σ_c = -Mv/J_u = -197.1 N/mm²
- τ_c = TS'/tJ_u = 23.14 N/mm²
- τ_g = TS'/tJ_u = 23.14 N/mm²
- t_c = 390. mm
- σ_o = √σ²+3τ² = 201.1 N/mm²





(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-Fb+Fx	0	0	0	0
BA b	0	Fx	0	0	0	0
BC b	0	Fx	0	0	0	0
CB b	0	-Fb+Fx	0	0	0	0
CD $\sqrt{2}b$	0	$2Fb-3\sqrt{2}/4Fx$	0	0	0	0
DE b	0	$1/2Fb-1/2Fx$	0	0	0	0
ED b	0	-1/2Fx	0	0	0	0
EF 2b	0	-Fx+1/2qx ²	0	0	0	0
FE 2b	0	Fx-1/2qx ²	0	0	0	0
GA b	-1+x/b	-Fx	Fx-Fx ² /b	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	Fb-Fx	Fx-Fx ² /b	x^2/b^2		
FH b	0	-Fx-1/2qx ²	0	0	0	0
HF b	0	$3/2Fb-2Fx+1/2qx^2$	0	0	0	0
HI b	1-x/b	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
IH b	-x/b	0	0	x^2/b^2	0	
HG b	-1	$-3/2Fb+3/2Fx$	$3/2Fb-3/2Fx$	1	$3/4Fb^2/EJ$	Xb/EJ
GH b	1	$3/2Fx$	$3/2Fx$	1		
HG	elongazione asta $N_{1HG^{\pm}HG^{\pm}HG}$					
A	molla nodo $-V_{1A}(V_{0A}+XV_{1A})/k_A$					
	totali					
	iperstatica $X=W_{GA}$					

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{x_0} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{AG}^{x_0} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

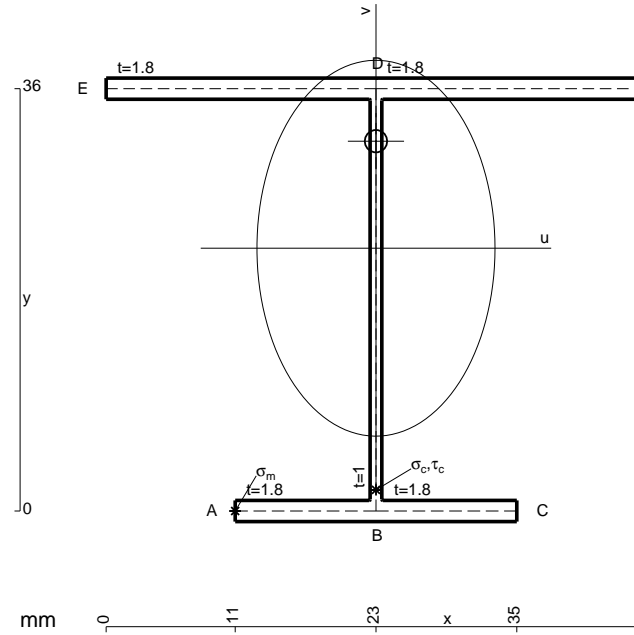
$$L_{HG}^{x_0} = \int_0^b (3/2 - 3/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [3/2 x - 3/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

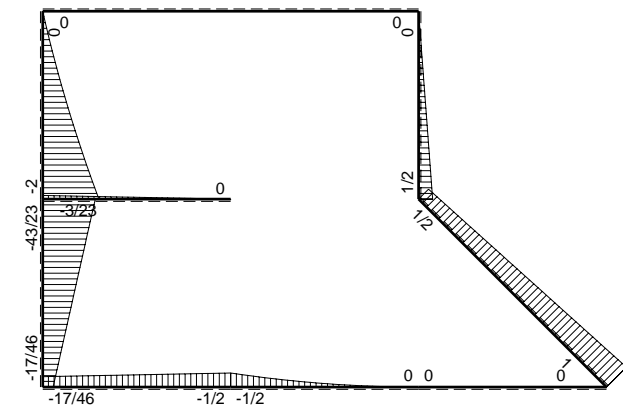
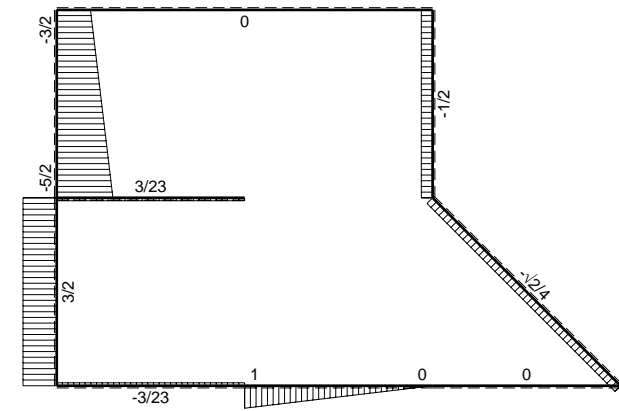
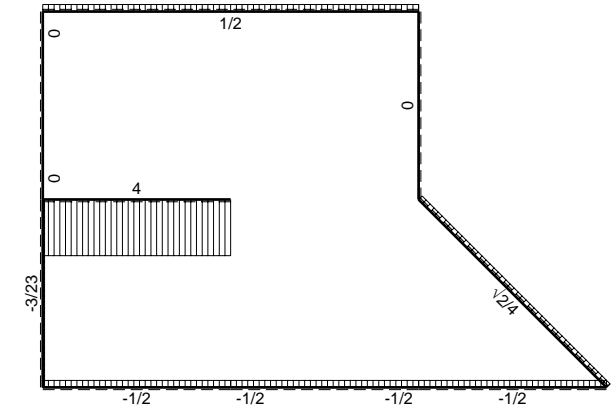
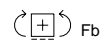
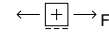
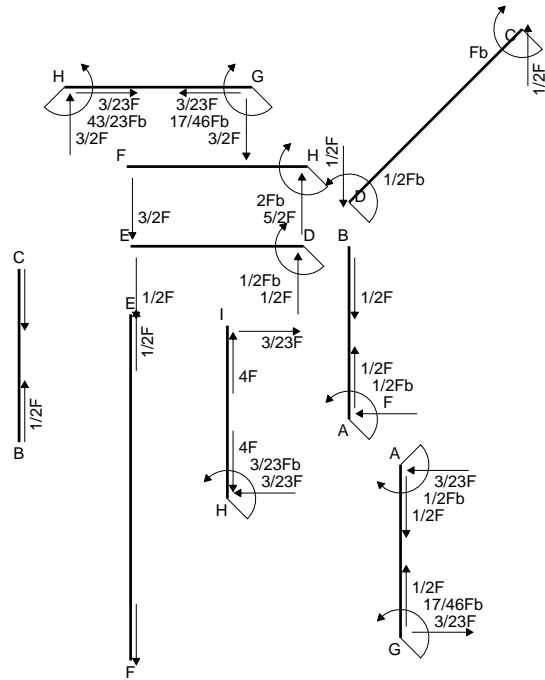
$$= (3/2 b - 3/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/4 Fb^2/EJ$$

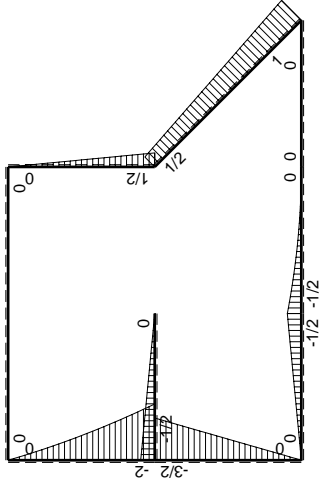
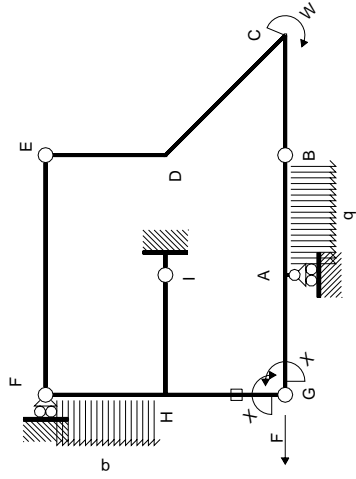
$$L_{GH}^{x_0} = \int_0^b (3/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [3/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (3/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/4 Fb^2/EJ$$

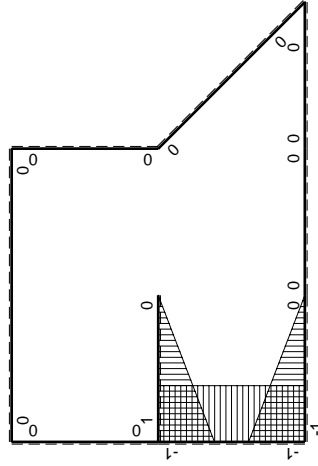


- A = 162. mm²
- J_u = 41576. mm⁴
- J_v = 16674. mm⁴
- J_t = 148.1 mm⁴
- y_o = 9.123 mm
- y_g = 22.4 mm
- N = -520. N
- T_y = -1040. N
- M_x = -382200. Nmm
- x_m = 11. mm
- u_m = -12. mm
- v_m = -22.4 mm
- σ_m = N/A-Mv/J_u = -209.1 N/mm²
- x_c = 23. mm
- v_c = -22.4 mm
- σ_c = N/A-Mv/J_u = -209.1 N/mm²
- τ_c = TS_t/tJ_u = 24.21 N/mm²
- τ_g = TS_t/tJ_u = 24.21 N/mm²
- t_c = 520. mm
- σ_o = √σ²+3τ² = 213.3 N/mm²





(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int M_x M_x / E J dx$
AB b	0	$-1/2Fb + Fx - 1/2qx^2$	0	0	0	0
BA b	0	$1/2qx^2$	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	$Fb - \sqrt{2}/4Fx$	0	0	0	0
DE b	0	$1/2Fb - 1/2Fx$	0	0	0	0
ED b	0	$-1/2Fx$	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$-1/2Fx$	$1/2Fx - 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$1/2Fb - 1/2Fx$	$1/2Fx - 1/2Fx^2/b$	x^2/b^2		
FH b	0	$-3/2Fx - 1/2qx^2$	0	0	0	0
HF b	0	$2Fb - 5/2Fx + 1/2qx^2$	0	0	0	0
HI b	$1-x/b$	$-1/2Fb + 1/2Fx$	$-1/2Fb + Fx - 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$1/2Fx$	$-1/2Fx^2/b$	x^2/b^2		
HG b	-1	$-3/2Fb + 3/2Fx$	$3/2Fb - 3/2Fx$	1	$3/4Fb^2/EJ$	Xb/EJ
GH b	1	$3/2Fx$	$3/2Fx$	1		
HG	elongazione asta $N_{1HG} = N_{HG} - HG$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$				$-3/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-17/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$17/46Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{x_0} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{AG}^{x_0} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{HI}^{x_0} = \int_0^b (-1/2 + x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + 1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + 1/2 b - 1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

$$L_{IH}^{x_0} = \int_0^b (-1/2 x^2/b^2) Fb 1/EJ dx = [-1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

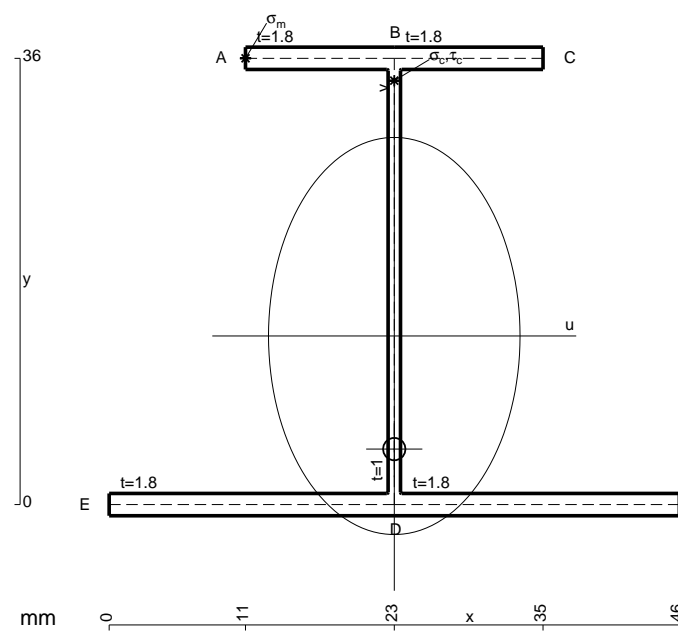
$$L_{HG}^{x_0} = \int_0^b (3/2 - 3/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [3/2 x - 3/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

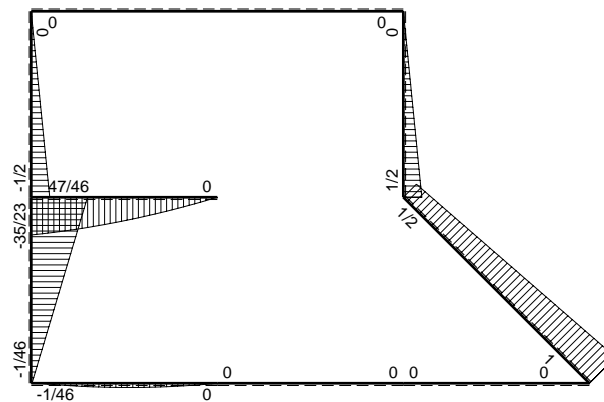
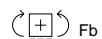
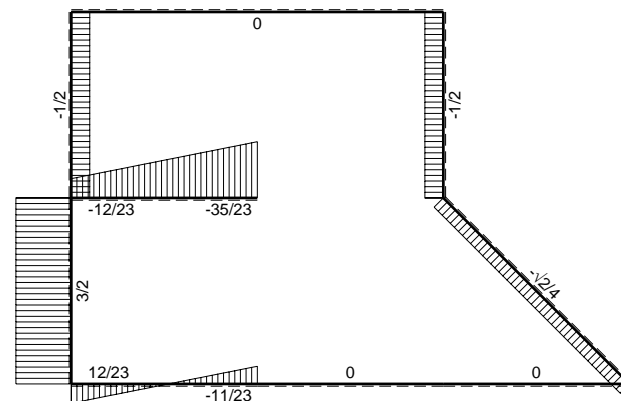
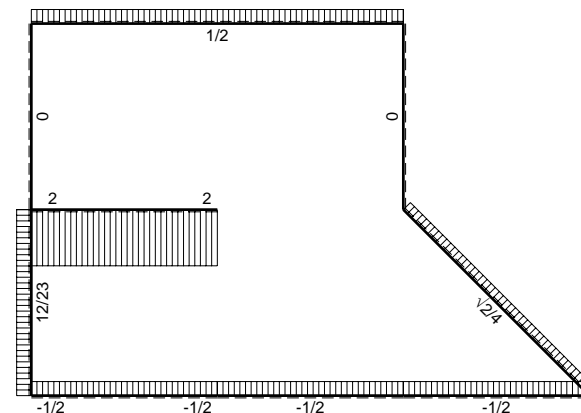
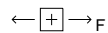
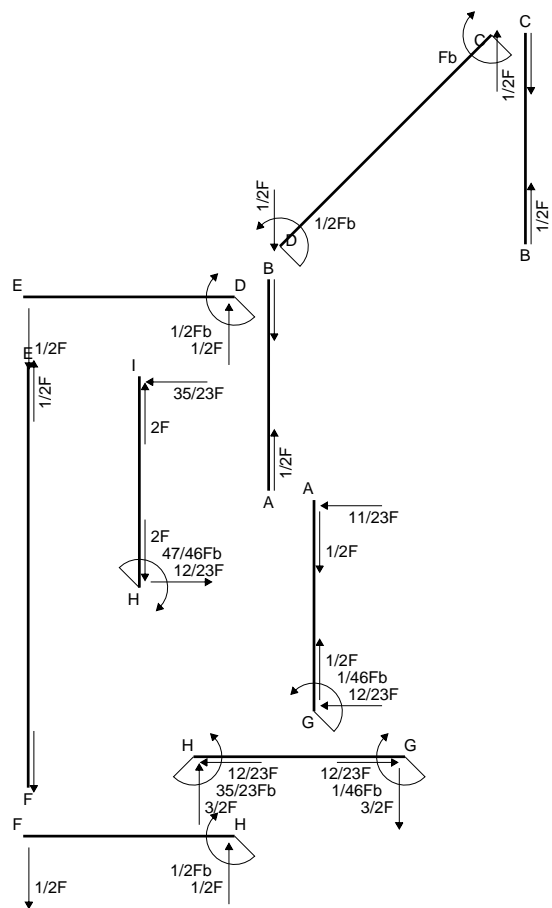
$$= (3/2 b - 3/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/4 Fb^2/EJ$$

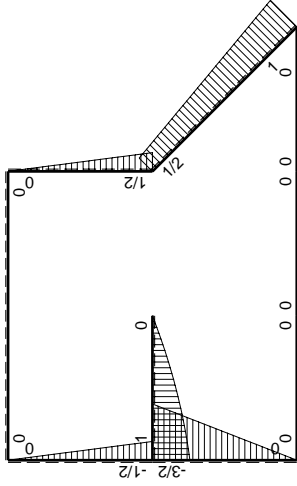
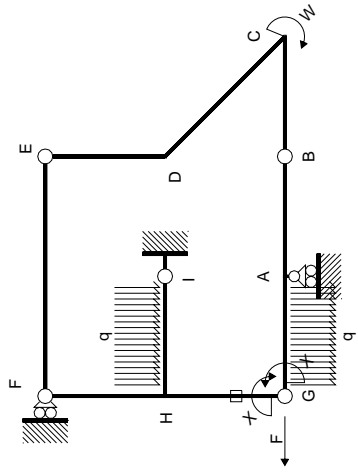
$$L_{GH}^{x_0} = \int_0^b (3/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [3/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (3/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/4 Fb^2/EJ$$

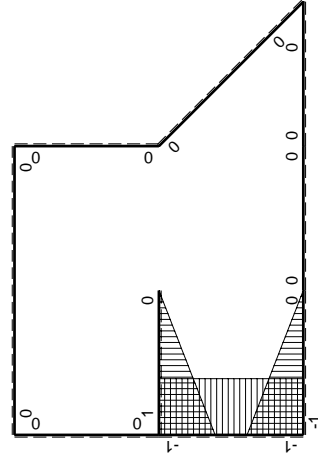


- A = 162. mm²
- J_u = 41576. mm⁴
- J_v = 16674. mm⁴
- J_t = 148.1 mm⁴
- y_o = -9.123 mm
- y_g = 13.6 mm
- T_y = -975. N
- M_x = -405600. Nmm
- x_m = 11. mm
- y_m = 36. mm
- u_m = -12. mm
- v_m = 22.4 mm
- σ_m = -Mv/J_u = 218.5 N/mm²
- x_c = 23. mm
- y_c = 36. mm
- v_c = 22.4 mm
- F σ_c = -Mv/J_u = 218.5 N/mm²
- τ_c = TS/tJ_u = 22.69 N/mm²
- τ_g = TS/tJ_u = 22.69 N/mm²
- t_c = 390. mm
- σ_o = √σ²+3τ² = 222. N/mm²





(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$	
AB b	0	0	0	0	0	0	
BA b	0	0	0	0	0	0	
BC b	0	0	0	0	0	0	
CB b	0	0	0	0	0	0	
CD $\sqrt{2}b$	0	$Fb-\sqrt{2}/4Fx$	0	0	0	0	
DE b	0	$1/2Fb-1/2Fx$	0	0	0	0	
ED b	0	$-1/2Fx$	0	0	0	0	
EF 2b	0	0	0	0	0	0	
FE 2b	0	0	0	0	0	0	
GA b	$-1+x/b$	$1/2Fx-1/2qx^2$	$-1/2Fx+Fx^2/b-1/2qx^3/b$	$1-2x/b+x^2/b^2$	$-1/24Fb^2/EJ$	$1/3Xb/EJ$	
AG b	x/b	$-1/2Fx+1/2qx^2$	$-1/2Fx^2/b+1/2qx^3/b$	x^2/b^2			
FH b	0	$-1/2Fx$	0	0	0	0	
HF b	0	$1/2Fb-1/2Fx$	0	0	0	0	
HI b	$1-x/b$	$Fb-1/2Fx-1/2qx^2$	$Fb-3/2Fx+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$3/8Fb^2/EJ$	$1/3Xb/EJ$	
IH b	$-x/b$	$-3/2Fx+1/2qx^2$	$3/2Fx^2/b-1/2qx^3/b$	x^2/b^2			
HG b	-1	$-3/2Fb+3/2Fx$	$3/2Fb-3/2Fx$	1	$3/4Fb^2/EJ$	Xb/EJ	
GH b	1	$3/2Fx$	$3/2Fx$	1			
HG	elongazione asta $N_{1HG^{\pm}HG^{\pm}HG}$						
A	molla nodo $-V_{1A}(V_{GA}+XV_{1A})/k_A$						
	totali						
	iperstatica $X=W_{GA}$						
						$1/46Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (-1/2 x/b + x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [-1/4 x^2/b + 1/3 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (-1/4 b + 1/3 b - 1/8 b) Fb 1/EJ = -1/24 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (-1/2 x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [-1/6 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (-1/6 b + 1/8 b) Fb 1/EJ = -1/24 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1 - 3/2 x/b + 1/2 x^3/b^3) Fb 1/EJ dx = [x - 3/4 x^2/b + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (b - 3/4 b + 1/8 b) Fb 1/EJ = 3/8 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (3/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [1/2 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/8 b) Fb 1/EJ = 3/8 Fb^2/EJ$$

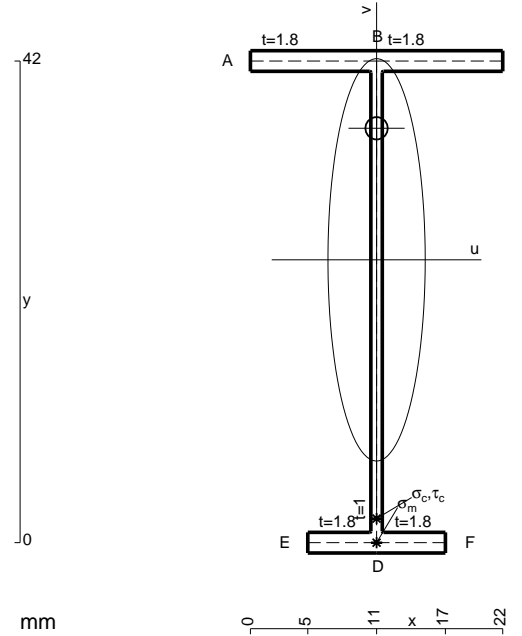
$$L_{HG}^{xo} = \int_0^b (3/2 - 3/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [3/2 x - 3/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

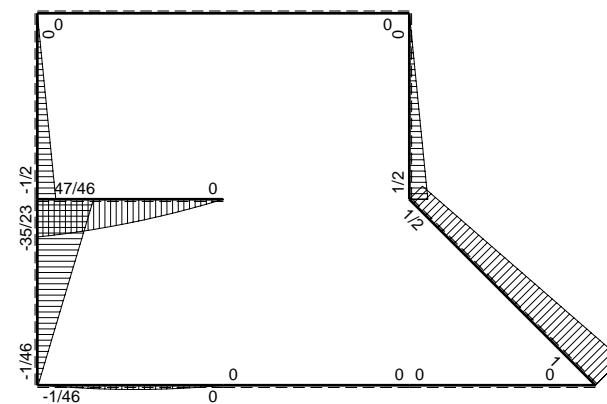
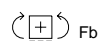
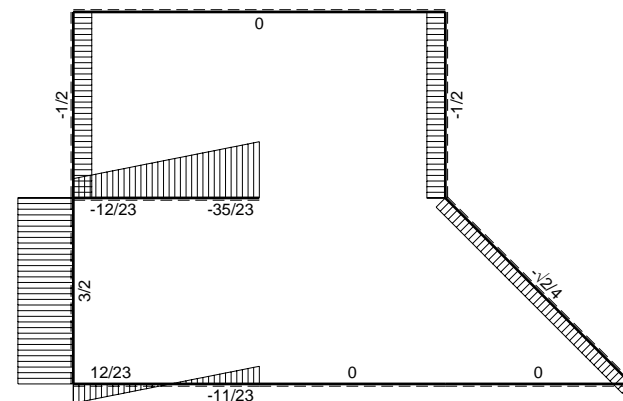
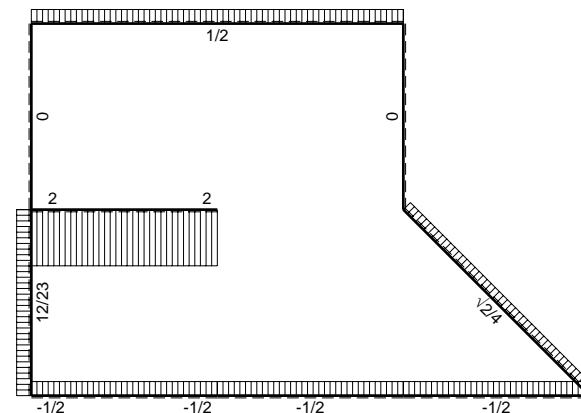
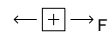
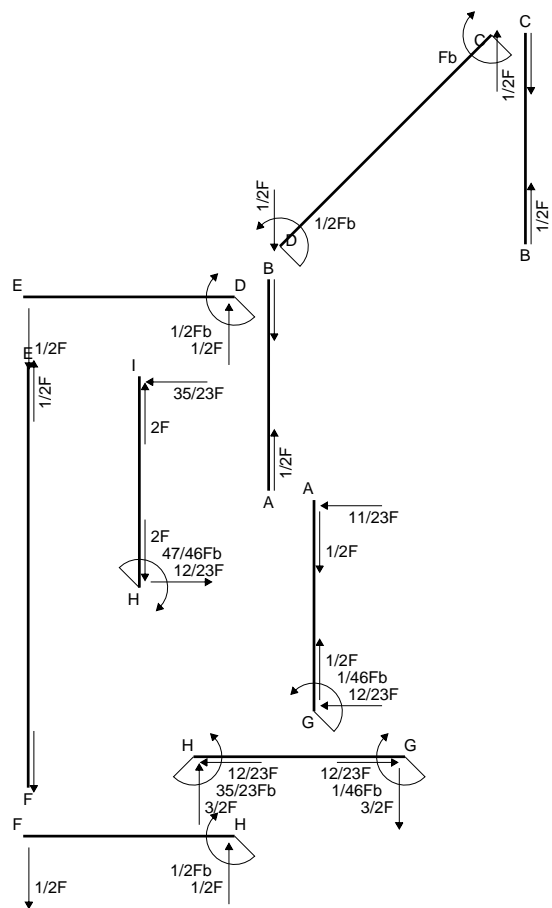
$$= (3/2 b - 3/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/4 Fb^2/EJ$$

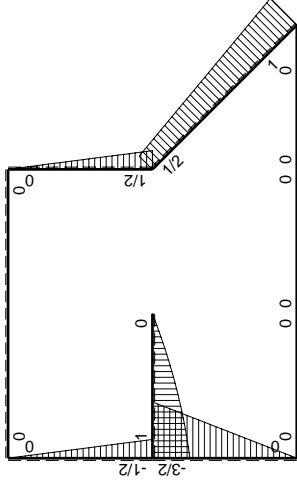
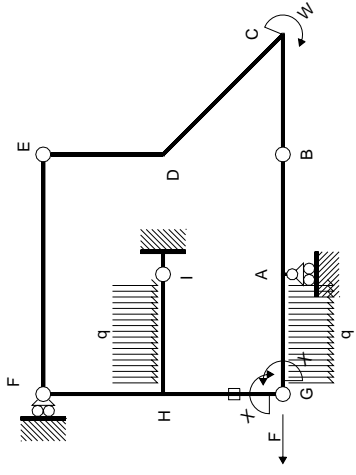
$$L_{GH}^{xo} = \int_0^b (3/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [3/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (3/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/4 Fb^2/EJ$$

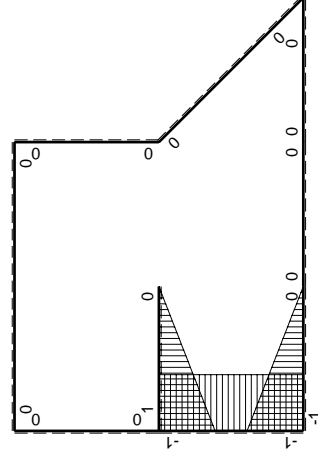


- A = 103.2 mm²
- J_u = 31779. mm⁴
- J_v = 1856. mm⁴
- J_t = 80.1 mm⁴
- y_o = 11.47 mm
- y_g = 24.66 mm
- N = 159.1 N
- T_y = -159.1 N
- M_x = 288000. Nmm
- x_m = 11. mm
- v_m = -24.66 mm
- σ_m = N/A-Mv/J_u = 225.1 N/mm²
- y_c = 3. mm
- u_c = -11. mm
- v_c = -21.66 mm
- σ_c = N/A-Mv/J_u = 225.1 N/mm²
- τ_c = TS_t/tJ_u = 2.667 N/mm²
- τ_g = TS_t/tJ_u = 2.667 N/mm²
- t_c = 450. mm
- σ_o = √σ²+3τ² = 225.1 N/mm²





(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	0	0	0	0	0
BA b	0	0	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	$Fb - \sqrt{2}/4Fx$	0	0	0	0
DE b	0	$1/2Fb - 1/2Fx$	0	0	0	0
ED b	0	$-1/2Fx$	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$1/2Fx - 1/2qx^2$	$-1/2Fx + Fx^2/b - 1/2qx^3/b$	$1-2x/b + x^2/b^2$	$-1/24Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$-1/2Fx + 1/2qx^2$	$-1/2Fx^2/b + 1/2qx^3/b$	x^2/b^2		
FH b	0	$-1/2Fx$	0	0	0	0
HF b	0	$1/2Fb - 1/2Fx$	0	0	0	0
HI b	$1-x/b$	$Fb - 1/2Fx - 1/2qx^2$	$Fb - 3/2Fx + 1/2qx^3/b$	$1-2x/b + x^2/b^2$	$3/8Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$-3/2Fx + 1/2qx^2$	$3/2Fx^2/b - 1/2qx^3/b$	x^2/b^2		
HG b	-1	$-3/2Fb + 3/2Fx$	$3/2Fb - 3/2Fx$	1	$3/4Fb^2/EJ$	Xb/EJ
GH b	1	$3/2Fx$	$3/2Fx$	1		
HG	elongazione asta $N_{1HG}^{\pm HG} \pm HG$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$				$-1/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-1/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$1/46Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (-1/2 x/b + x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [-1/4 x^2/b + 1/3 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (-1/4 b + 1/3 b - 1/8 b) Fb 1/EJ = -1/24 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (-1/2 x^2/b^2 + 1/2 x^3/b^3) Fb 1/EJ dx = [-1/6 x^3/b^2 + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (-1/6 b + 1/8 b) Fb 1/EJ = -1/24 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (1 - 3/2 x/b + 1/2 x^3/b^3) Fb 1/EJ dx = [x - 3/4 x^2/b + 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (b - 3/4 b + 1/8 b) Fb 1/EJ = 3/8 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (3/2 x^2/b^2 - 1/2 x^3/b^3) Fb 1/EJ dx = [1/2 x^3/b^2 - 1/8 x^4/b^3]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/8 b) Fb 1/EJ = 3/8 Fb^2/EJ$$

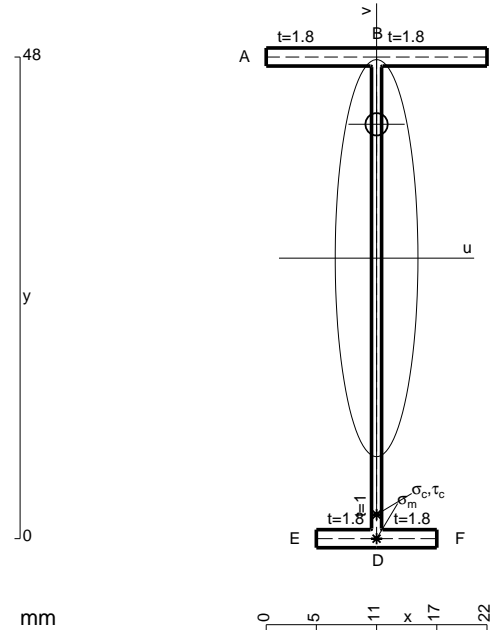
$$L_{HG}^{xo} = \int_0^b (3/2 - 3/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [3/2 x - 3/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

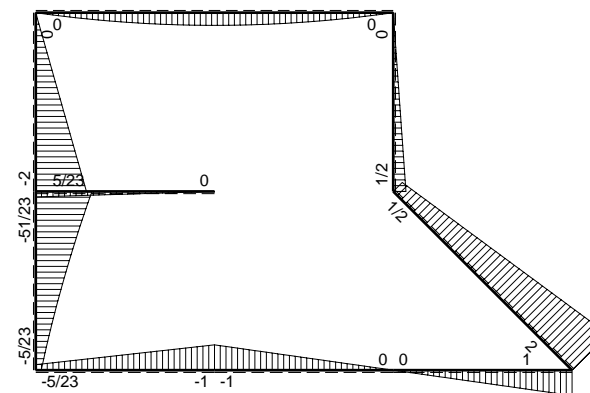
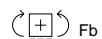
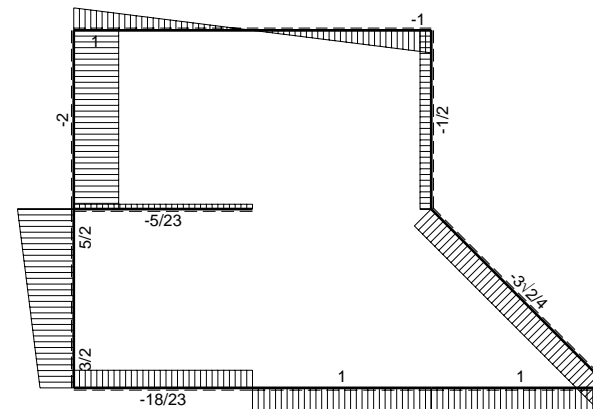
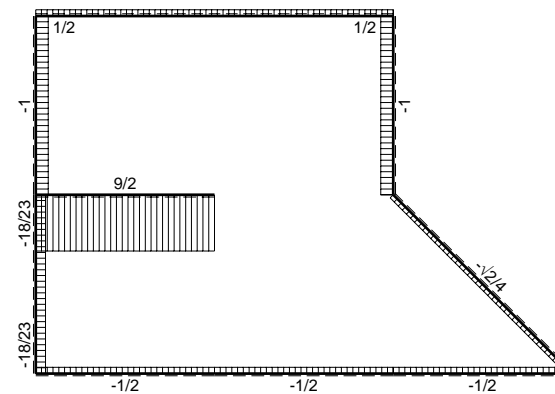
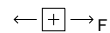
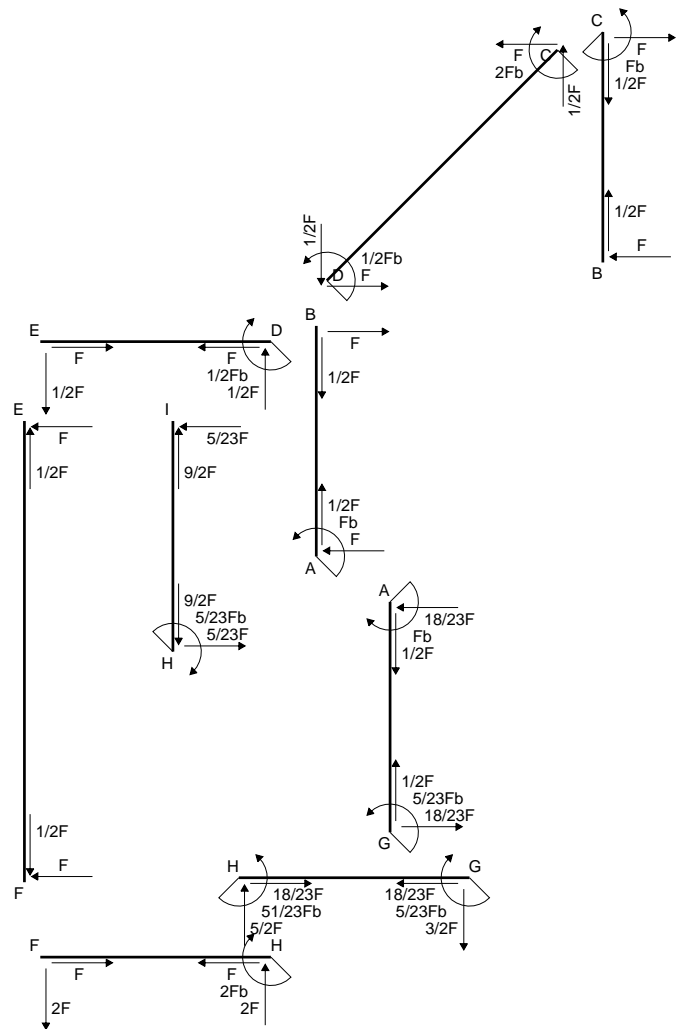
$$= (3/2 b - 3/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/4 Fb^2/EJ$$

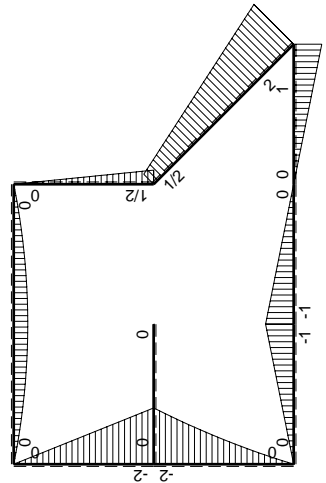
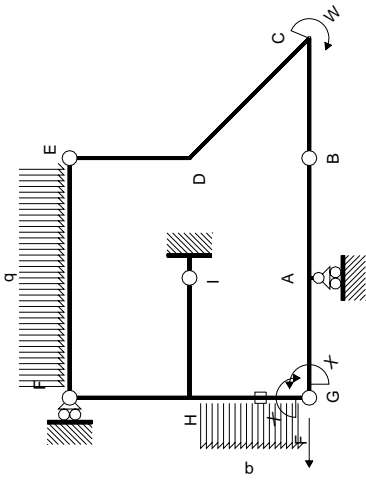
$$L_{GH}^{xo} = \int_0^b (3/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [3/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (3/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/4 Fb^2/EJ$$

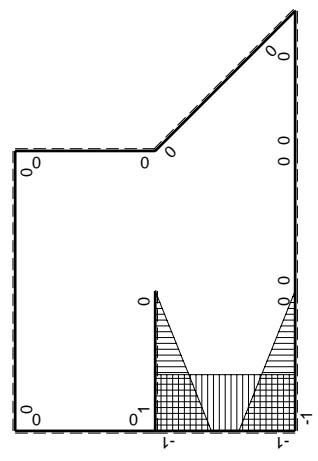


- A = 109.2 mm²
- J_u = 42758. mm⁴
- J_v = 1856. mm⁴
- J_t = 82.1 mm⁴
- y_o = 13.34 mm
- y_g = 27.96 mm
- N = 166.2 N
- T_y = -166.2 N
- M_x = 361900. Nmm
- x_m = 11. mm
- v_m = -27.96 mm
- σ_m = N/A-Mv/J_u = 238.1 N/mm²
- y_c = 3. mm
- u_c = -11. mm
- v_c = -24.96 mm
- σ_c = N/A-Mv/J_u = 238.1 N/mm²
- τ_c = TS_t/tJ_u = 2.347 N/mm²
- τ_g = TS_t/tJ_u = 2.347 N/mm²
- t_c = 470. mm
- σ_o = √σ²+3τ² = 238.2 N/mm²





(\oplus) M_x flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	-Fb+Fx	0	0	0	0
BA b	0	Fx	0	0	0	0
BC b	0	Fx	0	0	0	0
CB b	0	-Fb+Fx	0	0	0	0
CD $\sqrt{2}b$	0	$2Fb-3\sqrt{2}/4Fx$	0	0	0	0
DE b	0	$1/2Fb-1/2Fx$	0	0	0	0
ED b	0	-1/2Fx	0	0	0	0
EF 2b	0	$-Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$Fx-1/2qx^2$	0	0	0	0
GA b	-1+x/b	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2	$1/6Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	-2Fx	0	0	0	0
HF b	0	$2Fb-2Fx$	0	0	0	0
HI b	1-x/b	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
IH b	-x/b	0	0	x^2/b^2	0	$1/3Xb/EJ$
HG b	-1	$-2Fb+5/2Fx-1/2qx^2$	$2Fb-5/2Fx+1/2Fx^2/b$	1	$11/12Fb^2/EJ$	Xb/EJ
GH b	1	$3/2Fx+1/2qx^2$	$3/2Fx+1/2Fx^2/b$	1	$11/12Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG}^{HG} \rightarrow HG$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{GA}+XV_{1A})/k_A$				$-1/2Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-5/12Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$5/23Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) \cdot 1/EJ \, dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (b - b + 1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) \cdot 1/EJ \, dx = \left[1/3 x^3/b^2 \right]_0^b \cdot 1/EJ$$

$$= (1/3 b) \cdot 1/EJ = 1/3 \cdot b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) \cdot 1/EJ \, dx = \left[x \right]_0^b \cdot 1/EJ$$

$$= (b) \cdot 1/EJ = b/EJ$$

$$L_{GA}^{x_0} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[1/2 x^2/b - 1/3 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

$$L_{AG}^{x_0} = \int_0^b (x/b - x^2/b^2) \cdot Fb \cdot 1/EJ \, dx = \left[1/2 x^2/b - 1/3 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ$$

$$= (1/2 b - 1/3 b) \cdot Fb \cdot 1/EJ = 1/6 \cdot Fb^2/EJ$$

$$L_{HG}^{x_0} = \int_0^b (2 - 5/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ$$

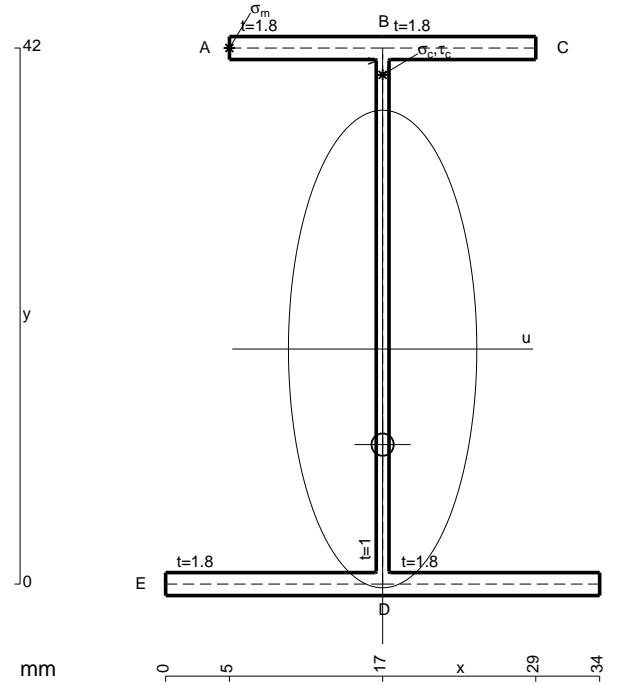
$$= \left[2x - 5/4 x^2/b + 1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ$$

$$= (2b - 5/4 b + 1/6 b) \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ = -1/12 \cdot Fb^2/EJ$$

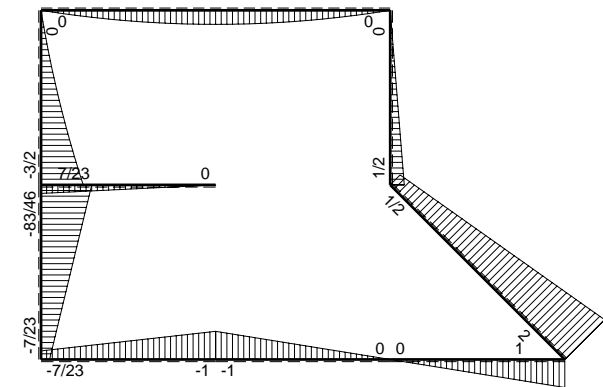
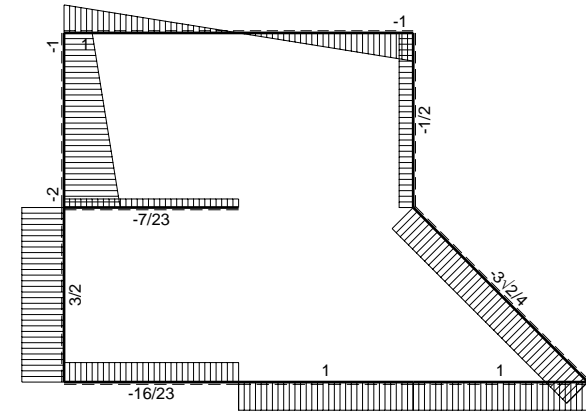
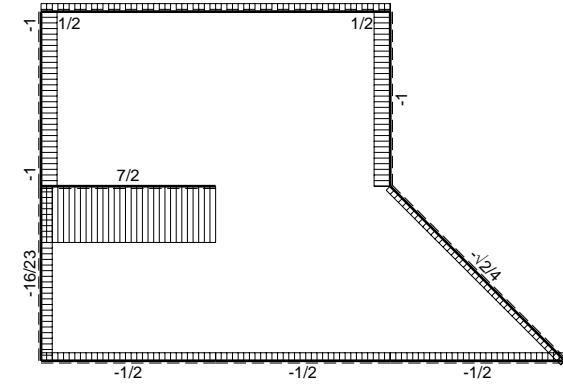
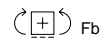
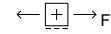
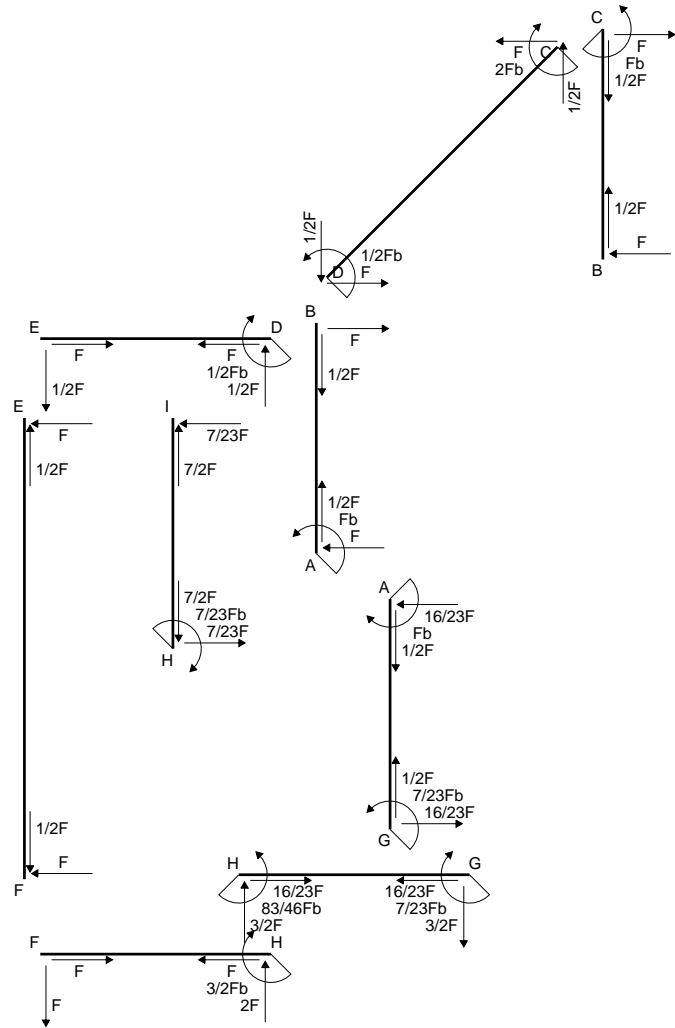
$$L_{GH}^{x_0} = \int_0^b (3/2 x/b + 1/2 x^2/b^2) \cdot Fb \cdot 1/EJ \, dx - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ$$

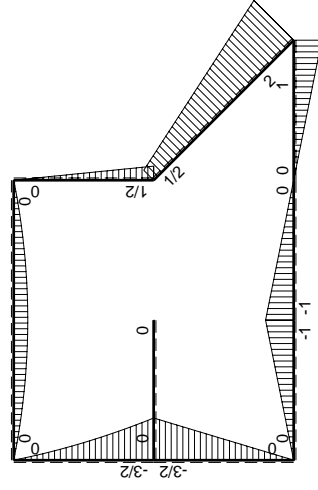
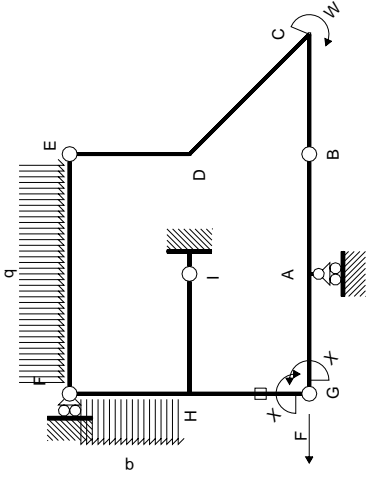
$$= \left[3/4 x^2/b + 1/6 x^3/b^2 \right]_0^b \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ$$

$$= (3/4 b + 1/6 b) \cdot Fb \cdot 1/EJ - 1 \cdot (-1) \cdot (-1) \cdot Fb^2/EJ = -1/12 \cdot Fb^2/EJ$$

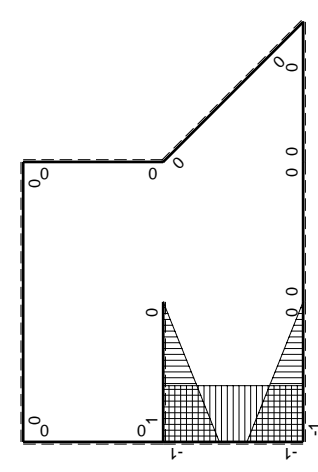


- A = 146.4 mm²
- J_u = 51238. mm⁴
- J_v = 7969. mm⁴
- J_w = 126.8 mm⁴
- y_o = -7.49 mm
- y_g = 18.42 mm
- N = -610. N
- T_y = -1220. N
- M_x = -439200. Nmm
- x_m = 5. mm
- y_m = 42. mm
- u_m = -12. mm
- v_m = 23.58 mm
- σ_m = N/A - Mv/J_u = 198. N/mm²
- x_c = 17. mm
- y_c = 42. mm
- v_c = 23.58 mm
- σ_c = N/A - Mv/J_u = 198. N/mm²
- τ_c = TS'/J_u = 24.26 N/mm²
- τ_g = TS'/J_u = 24.26 N/mm²
- t_c = 610. mm
- σ_o = √(σ² + 3τ²) = 202.4 N/mm²





(\oplus) M_x flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	-Fb+Fx	0	0	0	0
BA b	0	Fx	0	0	0	0
BC b	0	Fx	0	0	0	0
CB b	0	-Fb+Fx	0	0	0	0
CD $\sqrt{2}b$	0	$2Fb-3\sqrt{2}/4Fx$	0	0	0	0
DE b	0	$1/2Fb-1/2Fx$	0	0	0	0
ED b	0	-1/2Fx	0	0	0	0
EF 2b	0	$-Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$Fx-1/2qx^2$	0	0	0	0
GA b	-1+x/b	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2		
FH b	0	$-Fx-1/2qx^2$	0	0	0	0
HF b	0	$3/2Fb-2Fx+1/2qx^2$	0	0	0	0
HI b	1-x/b	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
IH b	-x/b	0	0	x^2/b^2	0	
HG b	-1	$-3/2Fb+3/2Fx$	$3/2Fb-3/2Fx$	1	$3/4Fb^2/EJ$	Xb/EJ
GH b	1	$3/2Fx$	$3/2Fx$	1		
HG	elongazione asta $N_{1HG^{\pm}HG^{\pm}HG}$					
A	molla nodo $-V_{1A}(V_{0A}+XV_{1A})/k_A$					
	totali					
	iperstatica $X=W_{GA}$					
	7/23Fb					

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{x_0} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{AG}^{x_0} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

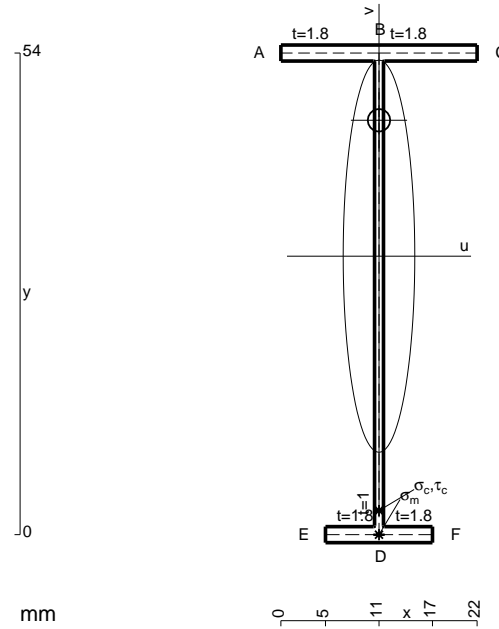
$$L_{HG}^{x_0} = \int_0^b (3/2 - 3/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [3/2 x - 3/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

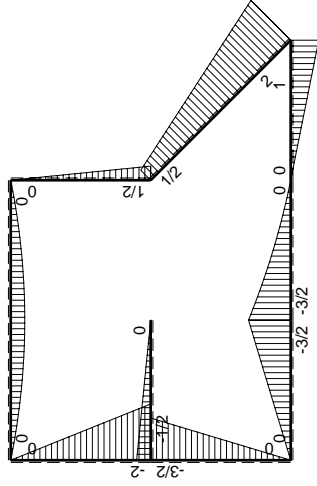
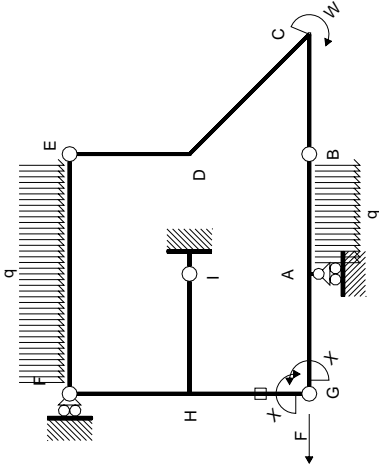
$$= (3/2 b - 3/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/4 Fb^2/EJ$$

$$L_{GH}^{x_0} = \int_0^b (3/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [3/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

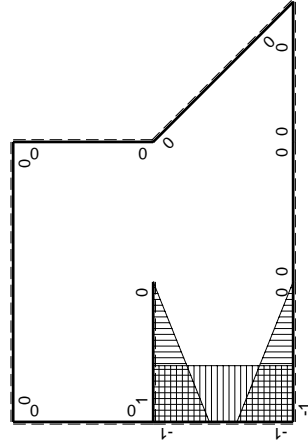
$$= (3/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/4 Fb^2/EJ$$



- A = 115.2 mm²
- J_u = 55687. mm⁴
- J_v = 1856. mm⁴
- J_t = 84.1 mm⁴
- y_o = 15.24 mm
- y_g = 31.22 mm
- N = -480. N
- T_y = -960. N
- M_x = -360000. Nmm
- x_m = 11. mm
- v_m = -31.22 mm
- σ_m = N/A-Mv/J_u = -206. N/mm²
- y_c = 3. mm
- u_c = -11. mm
- v_c = -28.22 mm
- σ_c = N/A-Mv/J_u = -206. N/mm²
- τ_c = TS_v/tJ_u = 11.62 N/mm²
- τ_g = TS_v/tJ_u = 11.62 N/mm²
- t_c = 480. mm
- σ_o = √σ²+3τ² = 207. N/mm²



(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	$-3/2Fb+2Fx-1/2qx^2$	0	0	0	0
BA b	0	$Fx+1/2qx^2$	0	0	0	0
BC b	0	Fx	0	0	0	0
CB b	0	-Fb+Fx	0	0	0	0
CD $\sqrt{2}b$	0	$2Fb-3\sqrt{2}/4Fx$	0	0	0	0
DE b	0	$1/2Fb-1/2Fx$	0	0	0	0
ED b	0	-1/2Fx	0	0	0	0
EF 2b	0	$-Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$Fx-1/2qx^2$	0	0	0	0
GA b	$-1+x/b$	-3/2Fx	$3/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/4Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$3/2Fb-3/2Fx$	$3/2Fx-3/2Fx^2/b$	x^2/b^2	$1/4Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	-2Fx	0	0	0	0
HF b	0	$2Fb-2Fx$	0	0	0	0
HI b	$1-x/b$	$-1/2Fb+1/2Fx$	$-1/2Fb+Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
IH b	-x/b	$1/2Fx$	$-1/2Fx^2/b$	x^2/b^2	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	$-3/2Fb+3/2Fx$	$3/2Fb-3/2Fx$	1	$3/4Fb^2/EJ$	Xb/EJ
GH b	1	$3/2Fx$	$3/2Fx$	1	$3/4Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG}^{HG} + N_{HG}^{HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$				$-7/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-25/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$25/46Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (-1/2 + x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + 1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + 1/2 b - 1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (-1/2 x^2/b^2) Fb 1/EJ dx = [-1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

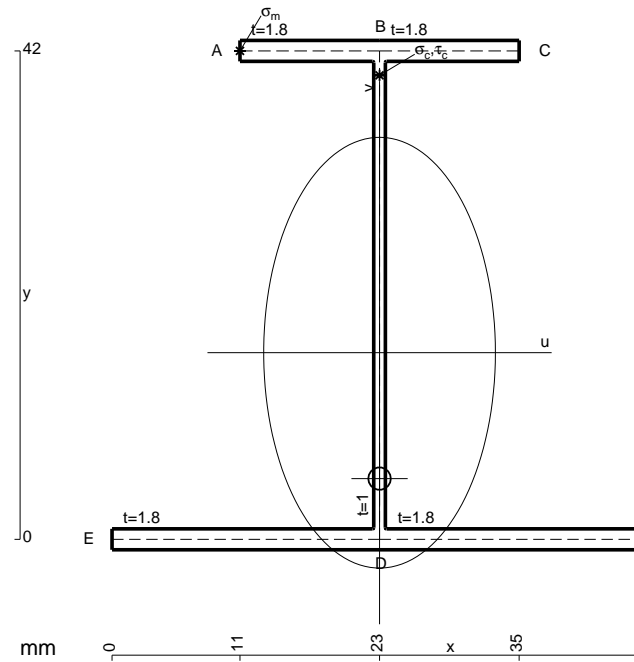
$$L_{HG}^{xo} = \int_0^b (3/2 - 3/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [3/2 x - 3/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

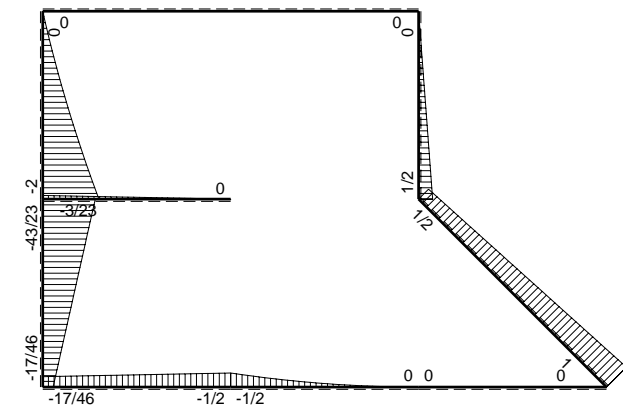
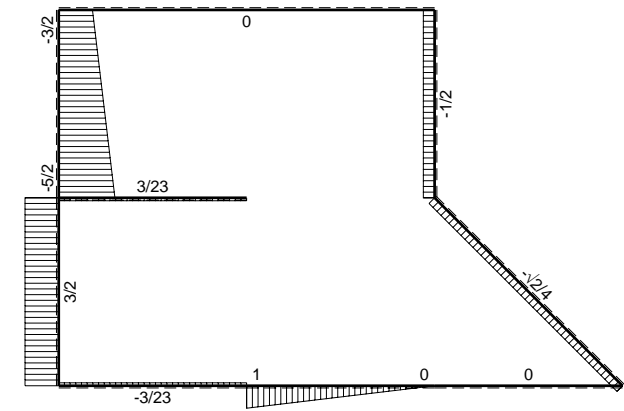
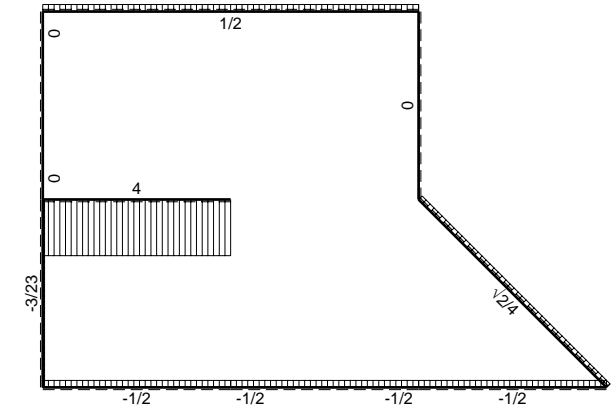
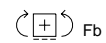
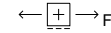
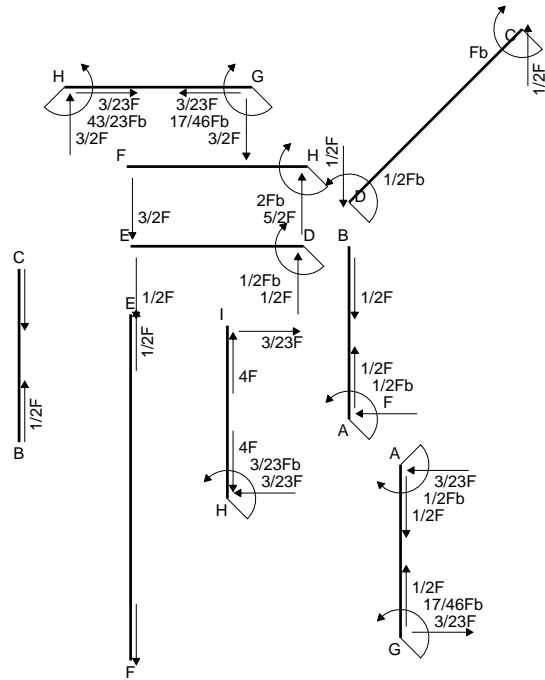
$$= (3/2 b - 3/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/4 Fb^2/EJ$$

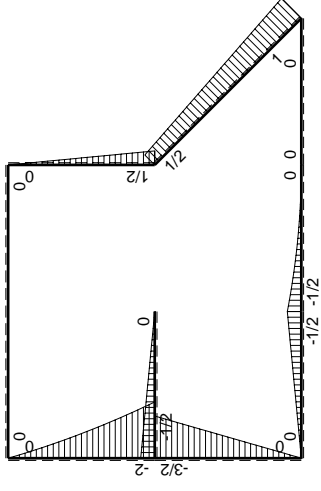
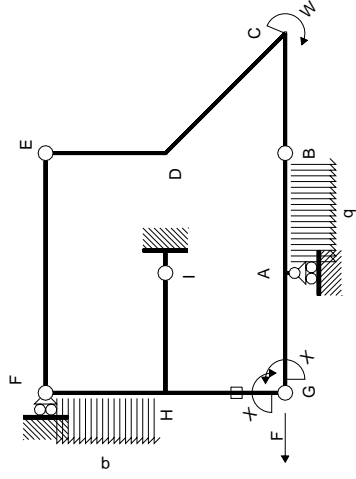
$$L_{GH}^{xo} = \int_0^b (3/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [3/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (3/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/4 Fb^2/EJ$$

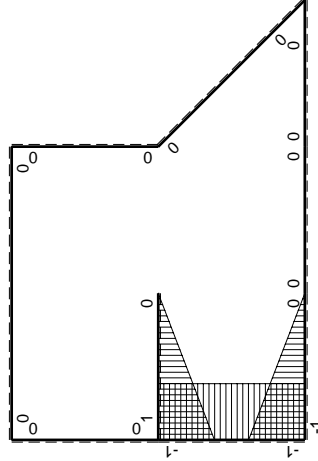


- A = 168. mm²
- J_u = 57624. mm⁴
- J_v = 16674. mm⁴
- J_i = 150.1 mm⁴
- y_o = -10.83 mm
- y_g = 16.05 mm
- N = -570. N
- T_y = -1140. N
- M_x = -490200. Nmm
- x_m = 11. mm
- y_m = 42. mm
- u_m = -12. mm
- v_m = 25.95 mm
- σ_m = N/A-Mv/J_u = 217.4 N/mm²
- x_c = 23. mm
- y_c = 42. mm
- v_c = 25.95 mm
- σ_c = N/A-Mv/J_u = 217.4 N/mm²
- τ_c = TS²/tJ_u = 22.18 N/mm²
- τ_g = TS²/tJ_u = 22.18 N/mm²
- t_c = 570. mm
- σ_o = √σ²+3τ² = 220.7 N/mm²





M_0 flessione da carichi assegnati



M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / E J dx$	$\int X M_x M_x / E J dx$
AB b	0	$-1/2Fb + Fx - 1/2qx^2$	0	0	0	0
BA b	0	$1/2qx^2$	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	$Fb - \sqrt{2}/4Fx$	0	0	0	0
DE b	0	$1/2Fb - 1/2Fx$	0	0	0	0
ED b	0	$-1/2Fx$	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	$-1/2Fx$	$1/2Fx - 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$1/2Fb - 1/2Fx$	$1/2Fx - 1/2Fx^2/b$	x^2/b^2	$1/12Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$-3/2Fx - 1/2qx^2$	0	0	0	0
HF b	0	$2Fb - 5/2Fx + 1/2qx^2$	0	0	0	0
HI b	$1-x/b$	$-1/2Fb + 1/2Fx$	$-1/2Fb + Fx - 1/2Fx^2/b$	$1-2x/b + x^2/b^2$	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$1/2Fx$	$-1/2Fx^2/b$	x^2/b^2	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	$-3/2Fb + 3/2Fx$	$3/2Fb - 3/2Fx$	1	$3/4Fb^2/EJ$	Xb/EJ
GH b	1	$3/2Fx$	$3/2Fx$	1	$3/4Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG} = N_{HG} - HG$					
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$					
	totali					
	iperstatica $X=W_{GA}$					
	17/46Fb					

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{x_0} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{AG}^{x_0} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{HI}^{x_0} = \int_0^b (-1/2 + x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + 1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + 1/2 b - 1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

$$L_{IH}^{x_0} = \int_0^b (-1/2 x^2/b^2) Fb 1/EJ dx = [-1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

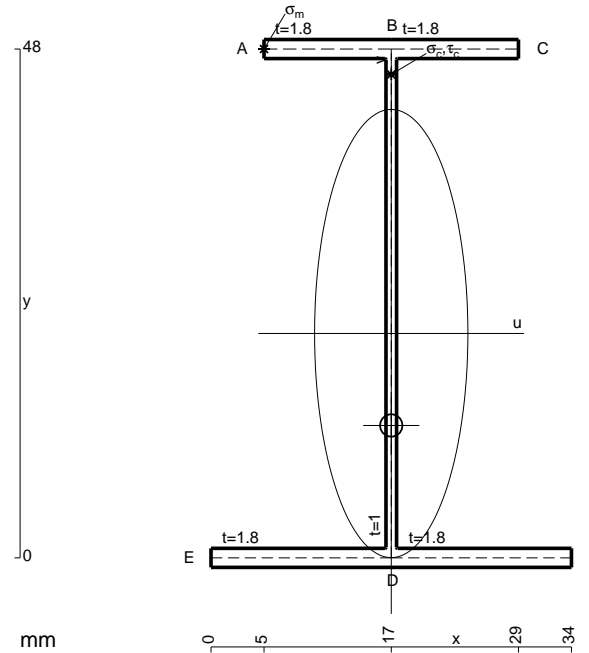
$$L_{HG}^{x_0} = \int_0^b (3/2 - 3/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [3/2 x - 3/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

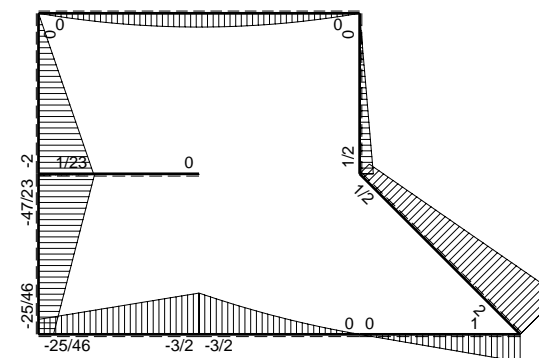
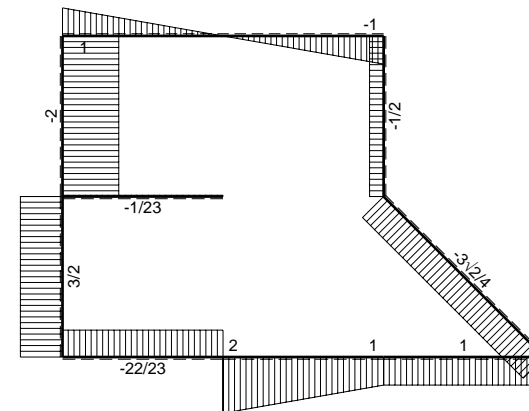
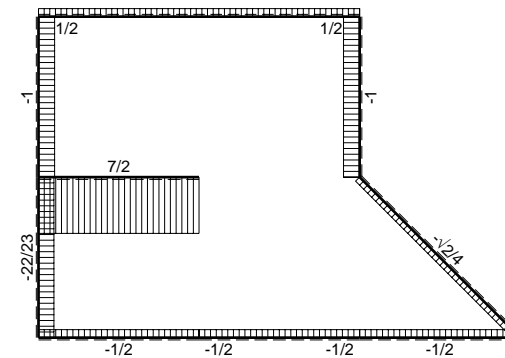
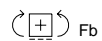
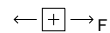
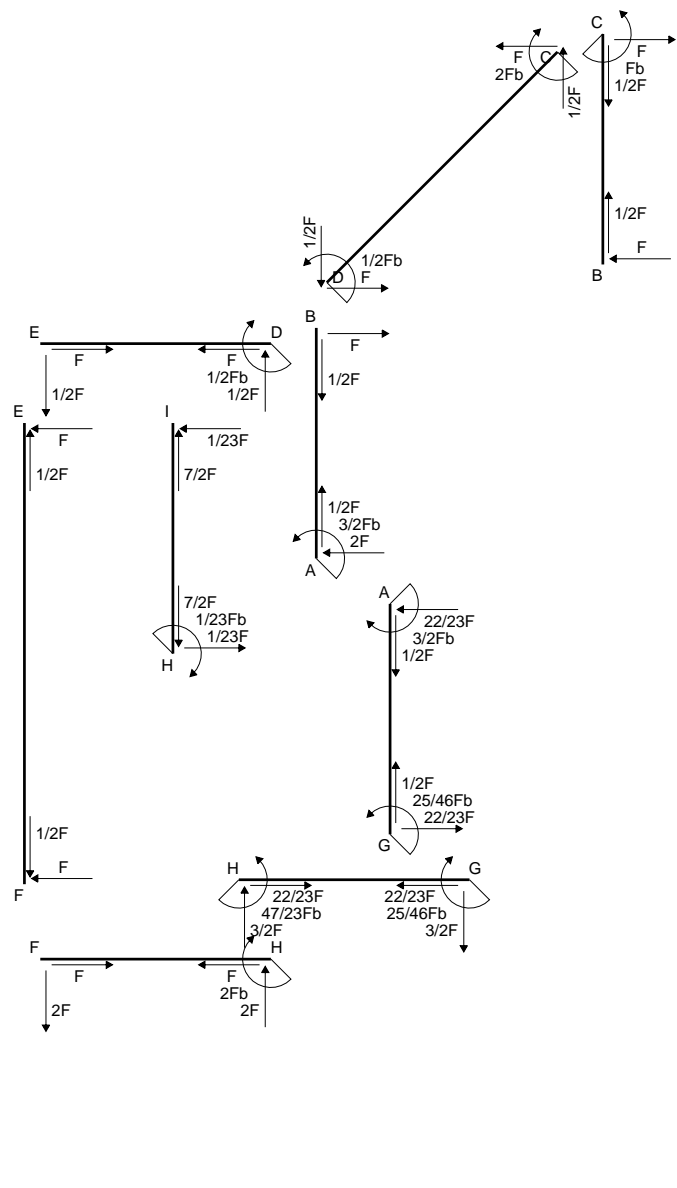
$$= (3/2 b - 3/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/4 Fb^2/EJ$$

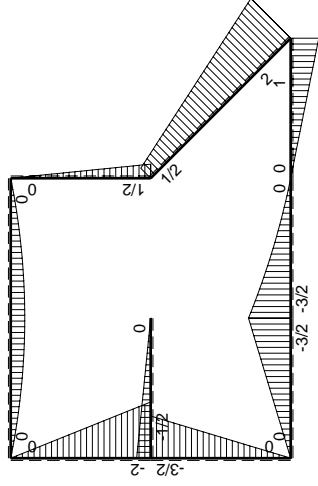
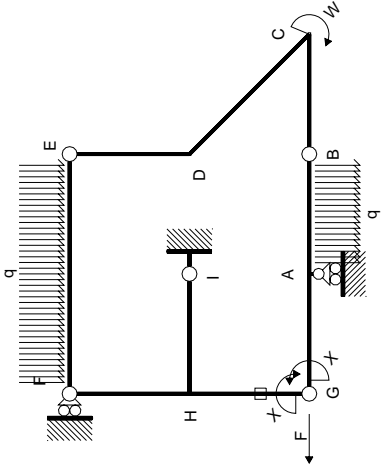
$$L_{GH}^{x_0} = \int_0^b (3/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [3/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (3/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/4 Fb^2/EJ$$

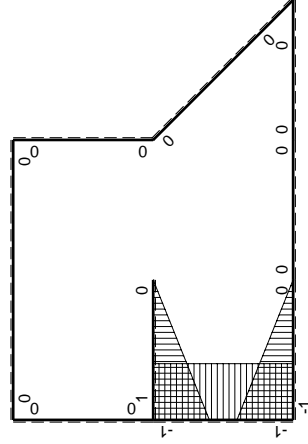


- A = 152.4 mm²
- J_u = 68126. mm⁴
- J_v = 7969. mm⁴
- J_i = 128.8 mm⁴
- y_o = -8.676 mm
- y_g = 21.17 mm
- T_y = -1375. N
- M_x = -583000. Nmm
- x_m = 5. mm
- y_m = 48. mm
- u_m = -12. mm
- v_m = 26.83 mm
- σ_m = -M_y/J_u = 229.6 N/mm²
- x_c = 17. mm
- y_c = 48. mm
- v_c = 26.83 mm
- σ_c = -M_y/J_u = 229.6 N/mm²
- τ_c = T_S/t_{J_u} = 23.4 N/mm²
- τ_g = T_S/t_{J_u} = 23.4 N/mm²
- t_c = 550. mm
- σ_o = √(σ²+3τ²) = 233.2 N/mm²





(\oplus) M_0 flessione da carichi assegnati



(\oplus) M_x flessione da iperstatica $X=1$

Quadro contributi PLV per iperstatica $X=W_{GA}$

\rightarrow	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x^2 M_x$	$\int M_x M_0 / EJ dx$	$\int X M_x M_x / EJ dx$
AB b	0	$-3/2Fb+2Fx-1/2qx^2$	0	0	0	0
BA b	0	$Fx+1/2qx^2$	0	0	0	0
BC b	0	Fx	0	0	0	0
CB b	0	$-Fb+Fx$	0	0	0	0
CD $\sqrt{2}b$	0	$2Fb-3\sqrt{2}/4Fx$	0	0	0	0
DE b	0	$1/2Fb-1/2Fx$	0	0	0	0
ED b	0	$-1/2Fx$	0	0	0	0
EF 2b	0	$-Fx+1/2qx^2$	0	0	0	0
FE 2b	0	$Fx-1/2qx^2$	0	0	0	0
GA b	$-1+x/b$	$-3/2Fx$	$3/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/4Fb^2/EJ$	$1/3Xb/EJ$
AG b	x/b	$3/2Fb-3/2Fx$	$3/2Fx-3/2Fx^2/b$	x^2/b^2	$1/4Fb^2/EJ$	$1/3Xb/EJ$
FH b	0	$-2Fx$	0	0	0	0
HF b	0	$2Fb-2Fx$	0	0	0	0
HI b	$1-x/b$	$-1/2Fb+1/2Fx$	$-1/2Fb+Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
IH b	$-x/b$	$1/2Fx$	$-1/2Fx^2/b$	x^2/b^2	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
HG b	-1	$-3/2Fb+3/2Fx$	$3/2Fb-3/2Fx$	1	$3/4Fb^2/EJ$	Xb/EJ
GH b	1	$3/2Fx$	$3/2Fx$	1	$3/4Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG^{\pm}HG^{\pm}HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{GA}+XV_{1A})/k_A$				$-7/8Fb^2/EJ$	$1/4Xb/EJ$
	totali				$-25/24Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica $X=W_{GA}$				$25/46Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{AG}^{xo} = \int_0^b (3/2 x/b - 3/2 x^2/b^2) Fb 1/EJ dx = [3/4 x^2/b - 1/2 x^3/b^2]_0^b Fb 1/EJ$$

$$= (3/4 b - 1/2 b) Fb 1/EJ = 1/4 Fb^2/EJ$$

$$L_{HI}^{xo} = \int_0^b (-1/2 + x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + 1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + 1/2 b - 1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

$$L_{IH}^{xo} = \int_0^b (-1/2 x^2/b^2) Fb 1/EJ dx = [-1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

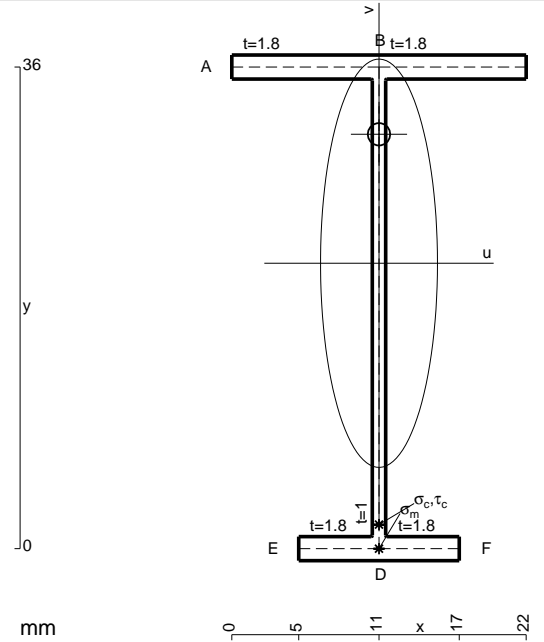
$$L_{HG}^{xo} = \int_0^b (3/2 - 3/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [3/2 x - 3/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

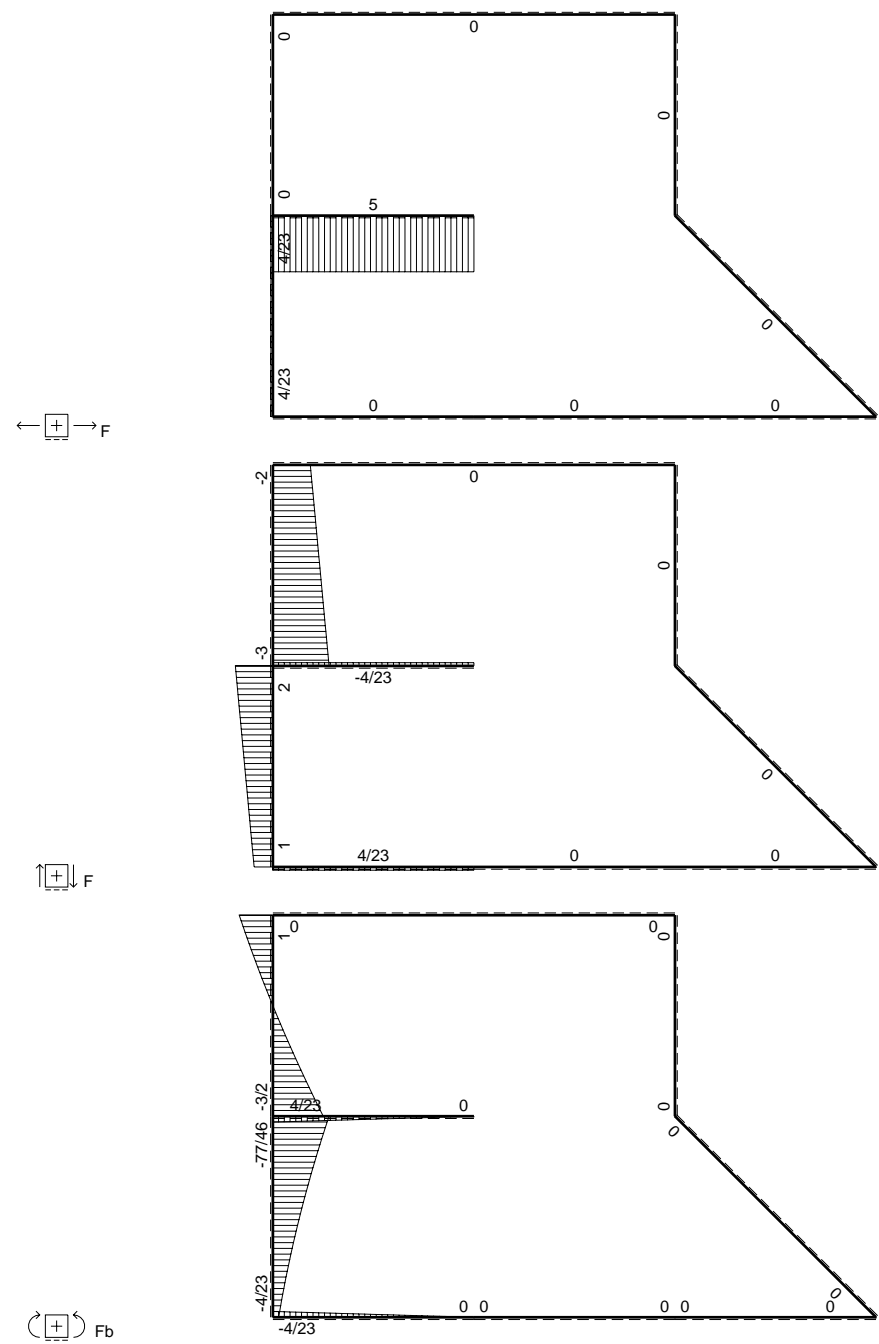
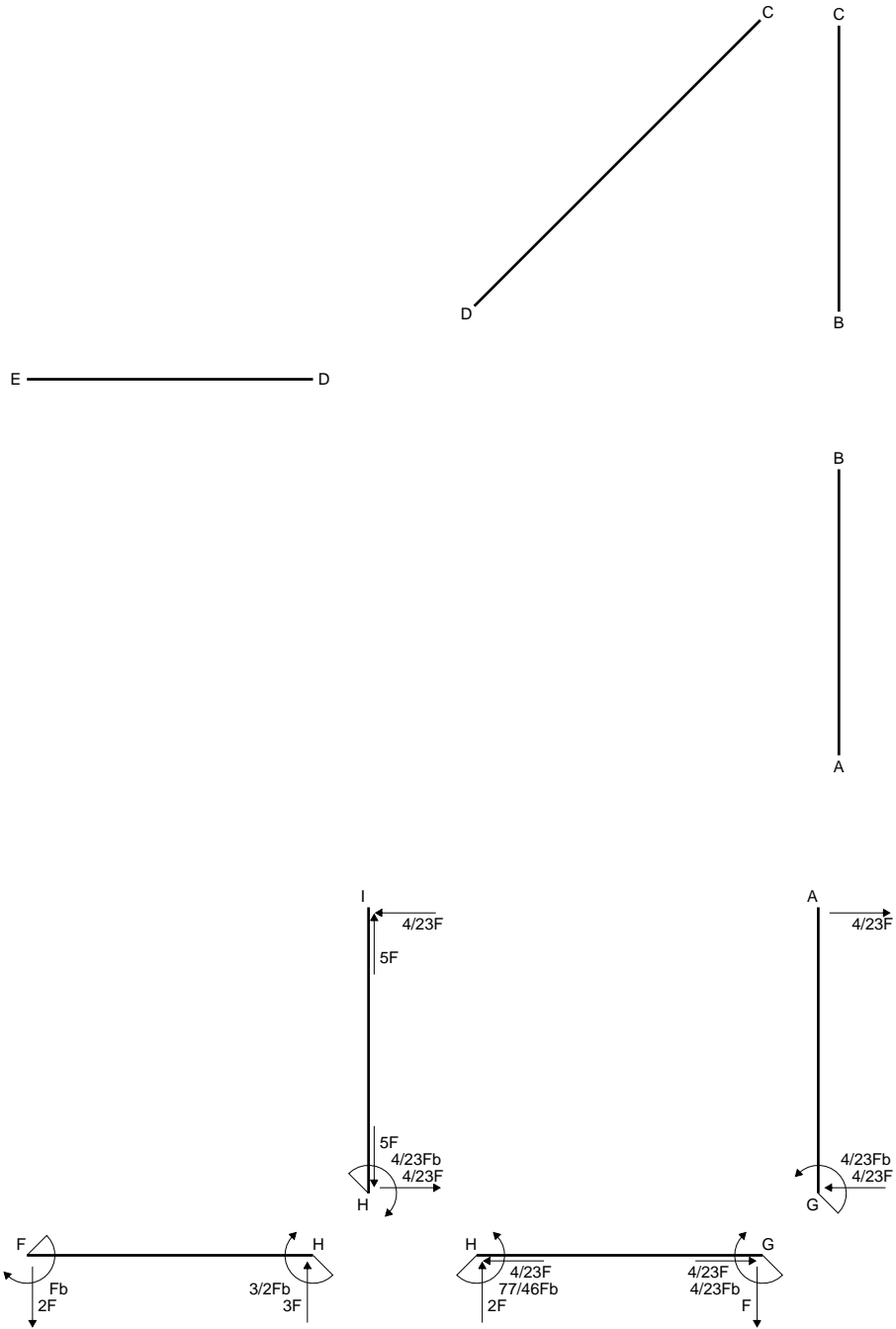
$$= (3/2 b - 3/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/4 Fb^2/EJ$$

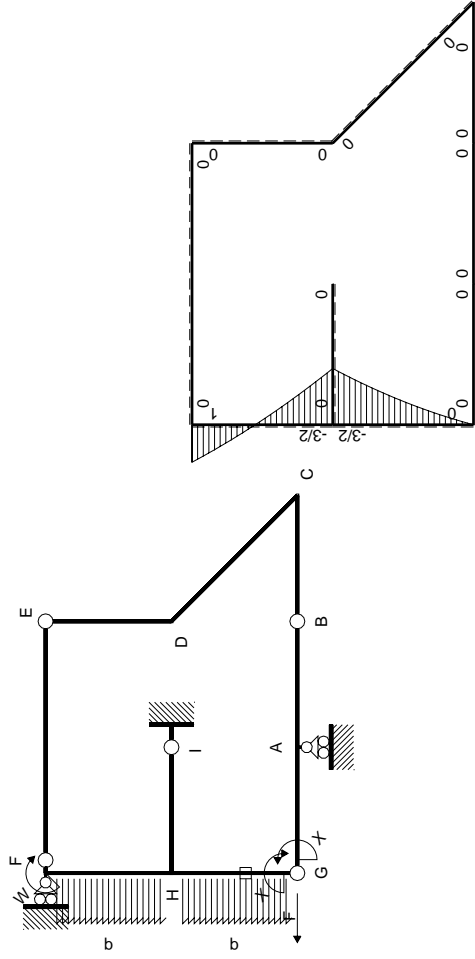
$$L_{GH}^{xo} = \int_0^b (3/2 x/b) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ = [3/4 x^2/b]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (3/4 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/4 Fb^2/EJ$$



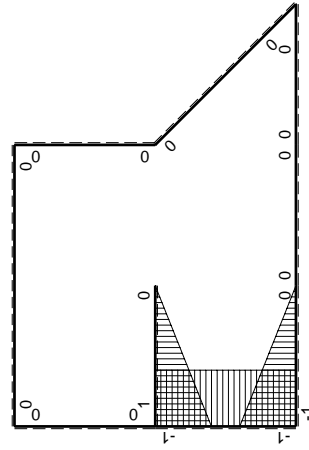
- A = 97.2 mm²
- J_u = 22637. mm⁴
- J_v = 1856. mm⁴
- J_I = 78.1 mm⁴
- y_o = 9.64 mm
- y_g = 21.33 mm
- N = -290. N
- T_y = -580. N
- M_x = -249400. Nmm
- x_m = 11. mm
- v_m = -21.33 mm
- σ_m = N/A-Mv/J_u = -238. N/mm²
- y_c = 3. mm
- u_c = -11. mm
- v_c = -18.33 mm
- σ_c = N/A-Mv/J_u = -238. N/mm²
- τ_c = TS_v/tJ_u = 11.81 N/mm²
- τ_g = TS_v/tJ_u = 11.81 N/mm²
- t_c = 290. mm
- σ_o = √σ²+3τ² = 238.9 N/mm²





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	M _x (x)	M ₀ (x)	M _x M ₀	M _x M ₀	M _x M _x	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$	
AB b	0	0	0	0	0	0	0	
BA b	0	0	0	0	0	0	0	
BC b	0	0	0	0	0	0	0	
CB b	0	0	0	0	0	0	0	
CD $\sqrt{2}b$	0	0	0	0	0	0	0	
DE b	0	0	0	0	0	0	0	
ED b	0	0	0	0	0	0	0	
EF 2b	0	0	0	0	0	0	0	
FE 2b	0	0	0	0	0	0	0	
GA b	-1+x/b	0	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$	
AG b	x/b	0	0	0	x^2/b^2	0	$1/3Xb/EJ$	
FH b	0	$Fb-2Fx-1/2qx^2$	0	0	0	0	0	
HF b	0	$3/2Fb-3Fx+1/2qx^2$	0	0	0	0	0	
HI b	1-x/b	0	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$	
IH b	-x/b	0	0	0	x^2/b^2	0	$1/3Xb/EJ$	
HG b	-1	$-3/2Fb+2Fx-1/2qx^2$	$3/2Fb-2Fx+1/2Fx^2/b$	$3/2Fb-2Fx+1/2Fx^2/b$	1	$2/3Fb^2/EJ$	Xb/EJ	
GH b	1	$Fx+1/2qx^2$	$Fx+1/2Fx^2/b$	$Fx+1/2Fx^2/b$	1	$2/3Fb^2/EJ$	Xb/EJ	
HG	elongazione asta $N_{1HG}^{HG} = HG$							$-Fb^2/EJ$
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$							$1/4Xb/EJ$
	totali							$-1/3Fb^2/EJ$
	iperstatica X=W _{GA}							$4/23Fb$

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = \left[1/3 x^3/b^2 \right]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = \left[x - x^2/b + 1/3 x^3/b^2 \right]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = \left[1/3 x^3/b^2 \right]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = \left[x \right]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = \left[x \right]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{HG}^{x_0} = \int_0^b (3/2 - 2x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

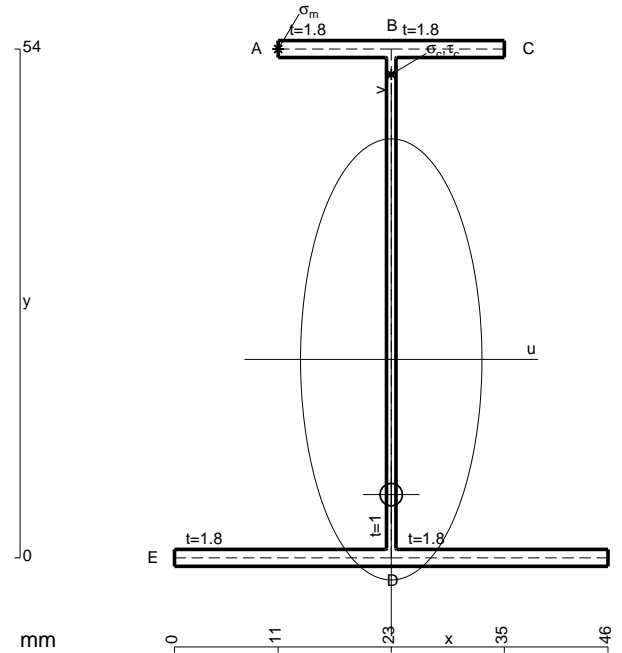
$$= \left[3/2 x - x^2/b + 1/6 x^3/b^2 \right]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (3/2 b - b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/3 Fb^2/EJ$$

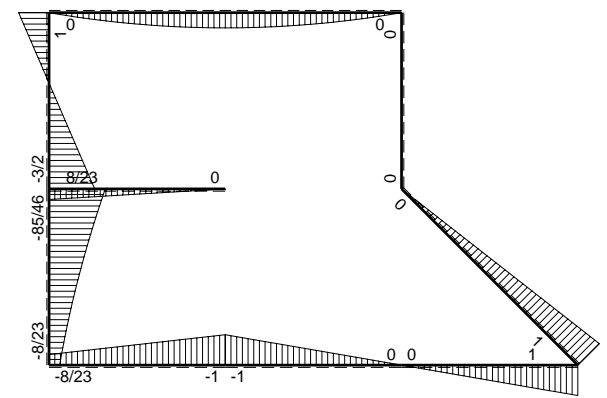
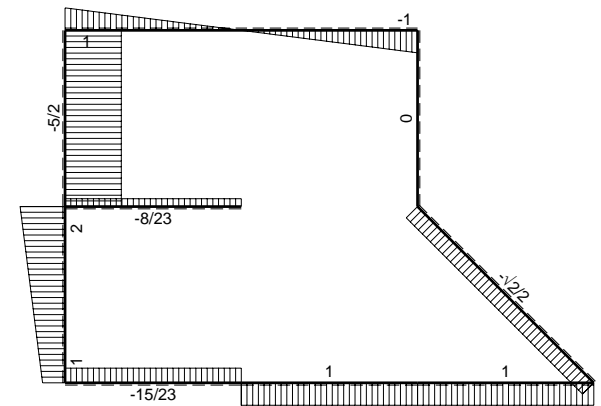
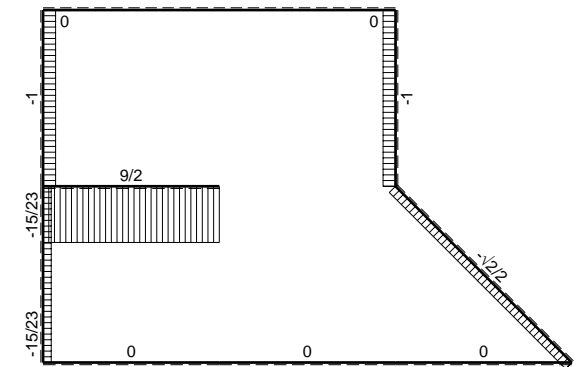
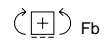
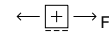
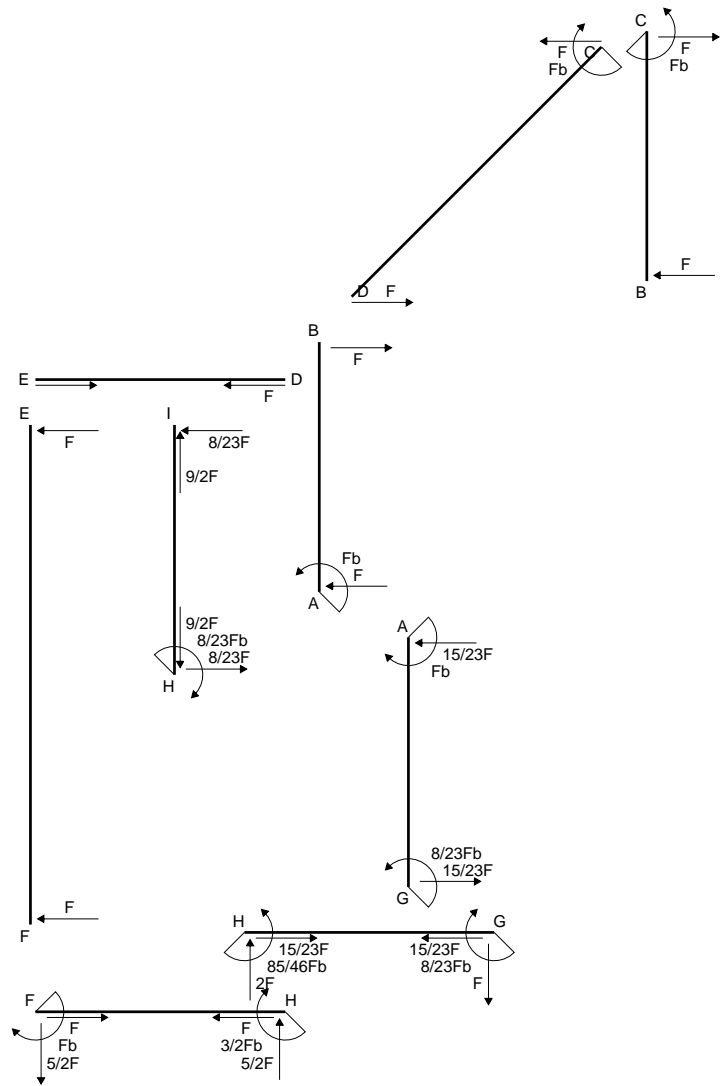
$$L_{GH}^{x_0} = \int_0^b (x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

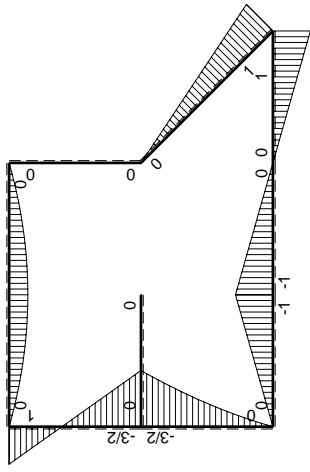
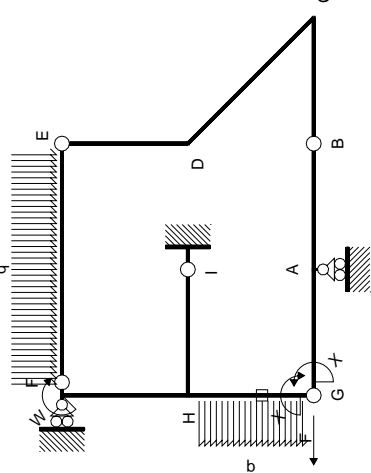
$$= \left[1/2 x^2/b + 1/6 x^3/b^2 \right]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/3 Fb^2/EJ$$



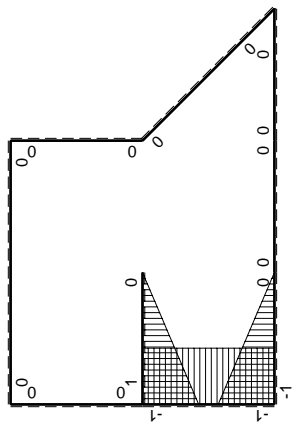
- A = 180. mm²
- J_u = 98625. mm⁴
- J_v = 16674. mm⁴
- J_i = 154.1 mm⁴
- y_o = -14.34 mm
- y_g = 21.06 mm
- T_y = -1710. N
- M_x = -589950. Nmm
- x_m = 11. mm
- y_m = 54. mm
- u_m = -12. mm
- v_m = 32.94 mm
- σ_m = -Mv/J_u = 197. N/mm²
- x_c = 23. mm
- y_c = 54. mm
- v_c = 32.94 mm
- σ_c = -Mv/J_u = 197. N/mm²
- τ_c = TS_y/tJ_u = 24.67 N/mm²
- τ_g = TS_y/tJ_u = 24.67 N/mm²
- t_c = 570. mm
- σ_o = √(σ²+3τ²) = 201.6 N/mm²





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	M _x (x)	M ₀ (x)	M _x M ₀	M _x M _x	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$	
AB b	0	-Fb+Fx	0	0	0	0	
BA b	0	Fx	0	0	0	0	
BC b	0	Fx	0	0	0	0	
CB b	0	-Fb+Fx	0	0	0	0	
CD $\sqrt{2}b$	0	Fb- $\sqrt{2}/2Fx$	0	0	0	0	
DE b	0	0	0	0	0	0	
ED b	0	0	0	0	0	0	
EF 2b	0	-Fx+ $1/2qx^2$	0	0	0	0	
FE 2b	0	Fx- $1/2qx^2$	0	0	0	0	
GA b	-1+x/b	-Fx	Fx-Fx ² /b	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$	
AG b	x/b	Fb-Fx	Fx-Fx ² /b	x^2/b^2	0	0	
FH b	0	Fb- $5/2Fx$	0	0	0	0	
HF b	0	$3/2Fb-5/2Fx$	0	0	0	0	
HI b	1-x/b	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$	
IH b	-x/b	0	0	x^2/b^2	0	0	
HG b	-1	$-3/2Fb+2Fx-1/2qx^2$	$3/2Fb-2Fx+1/2Fx^2/b$	1	$2/3Fb^2/EJ$	Xb/EJ	
GH b	1	Fx+ $1/2qx^2$	Fx+ $1/2Fx^2/b$	1	0	0	
HG	elongazione asta $N_{1HG} = N_{HG} + HG$						
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$						
	totali						
	iperstatica X=W _{GA}						

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{x_0} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{AG}^{x_0} = \int_0^b (x/b - x^2/b^2) Fb 1/EJ dx = [1/2 x^2/b - 1/3 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/2 b - 1/3 b) Fb 1/EJ = 1/6 Fb^2/EJ$$

$$L_{HG}^{x_0} = \int_0^b (3/2 - 2x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

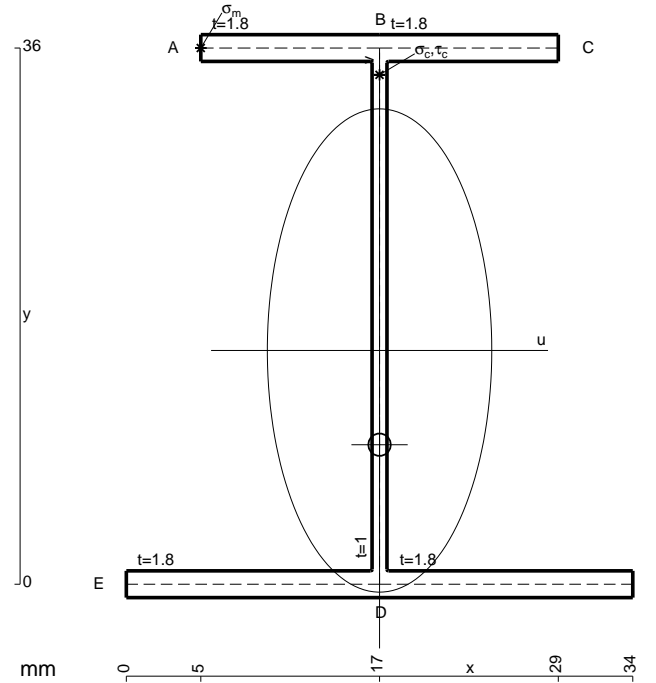
$$= [3/2 x - x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (3/2 b - b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/3 Fb^2/EJ$$

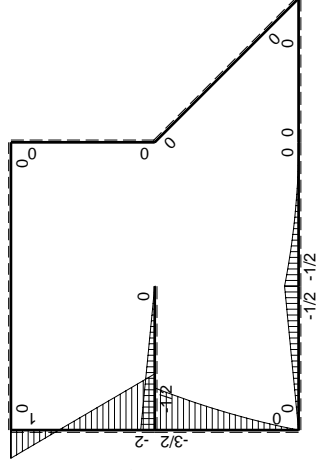
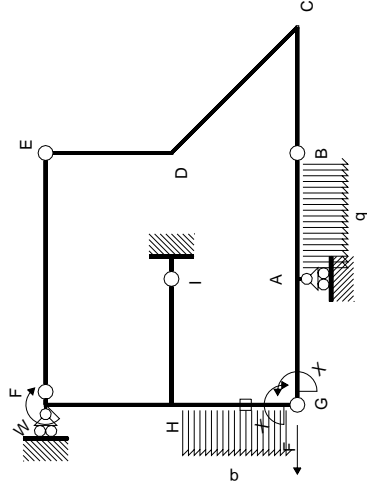
$$L_{GH}^{x_0} = \int_0^b (x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/3 Fb^2/EJ$$

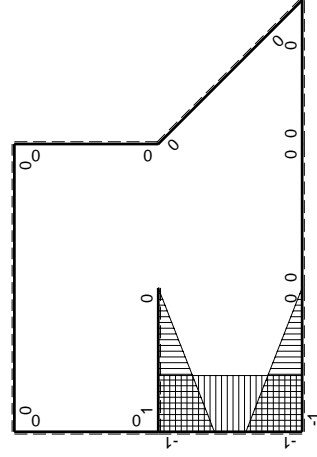


- A = 140.4 mm²
- J_u = 36966. mm⁴
- J_v = 7969. mm⁴
- J_t = 124.8 mm⁴
- y_o = -6.325 mm
- y_g = 15.69 mm
- N = -520. N
- T_y = -1300. N
- M_x = -382200. Nmm
- x_m = 5. mm
- y_m = 36. mm
- u_m = -12. mm
- v_m = 20.31 mm
- σ_m = N/A - Mv/J_u = 206.3 N/mm²
- x_c = 17. mm
- y_c = 36. mm
- v_c = 20.31 mm
- σ_c = N/A - Mv/J_u = 206.3 N/mm²
- τ_c = TS_y/tJ_u = 30.85 N/mm²
- τ_g = TS_y/tJ_u = 30.85 N/mm²
- t_c = 520. mm
- σ_o = √σ² + 3τ² = 213.1 N/mm²



Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$	
AB b	0	$-1/2Fb + Fx - 1/2qx^2$	0	0	0	0	
BA b	0	$1/2qx^2$	0	0	0	0	
BC b	0	0	0	0	0	0	
CB b	0	0	0	0	0	0	
CD $\sqrt{2}b$	0	0	0	0	0	0	
DE b	0	0	0	0	0	0	
ED b	0	0	0	0	0	0	
EF 2b	0	0	0	0	0	0	
FE 2b	0	0	0	0	0	0	
GA b	$-1+x/b$	$-1/2Fx$	$1/2Fx - 1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$	
AG b	x/b	$1/2Fb - 1/2Fx$	$1/2Fx - 1/2Fx^2/b$	x^2/b^2	$1/12Fb^2/EJ$	$1/3Xb/EJ$	
FH b	0	$Fb - 3Fx$	0	0	0	0	
HF b	0	$2Fb - 3Fx$	0	0	0	0	
HI b	$1-x/b$	$-1/2Fb + 1/2Fx$	$-1/2Fb + Fx - 1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$-1/6Fb^2/EJ$	$1/3Xb/EJ$	
IH b	$-x/b$	$1/2Fx$	$-1/2Fx^2/b$	x^2/b^2	$-1/6Fb^2/EJ$	$1/3Xb/EJ$	
HG b	-1	$-3/2Fb + 2Fx - 1/2qx^2$	$3/2Fb - 2Fx + 1/2Fx^2/b$	1	$2/3Fb^2/EJ$	Xb/EJ	
GH b	1	$Fx + 1/2qx^2$	$Fx + 1/2Fx^2/b$	1	$2/3Fb^2/EJ$	Xb/EJ	
HG	elongazione asta $N_{1HG} = N_{HG} - HG$						
A	molla nodo $-V_{1A}(V_{GA} + XV_{1A})/k_A$						
totali						$-Fb^2/EJ$	$1/4Xb/EJ$
iperstatica X=W _{GA}						$-19/24Fb^2/EJ$	$23/12Xb/EJ$
						19/46Fb	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GA}^{x_0} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{AG}^{x_0} = \int_0^b (1/2 x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [1/4 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (1/4 b - 1/6 b) Fb 1/EJ = 1/12 Fb^2/EJ$$

$$L_{HI}^{x_0} = \int_0^b (-1/2 + x/b - 1/2 x^2/b^2) Fb 1/EJ dx = [-1/2 x + 1/2 x^2/b - 1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/2 b + 1/2 b - 1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

$$L_{IH}^{x_0} = \int_0^b (-1/2 x^2/b^2) Fb 1/EJ dx = [-1/6 x^3/b^2]_0^b Fb 1/EJ$$

$$= (-1/6 b) Fb 1/EJ = -1/6 Fb^2/EJ$$

$$L_{HG}^{x_0} = \int_0^b (3/2 - 2x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

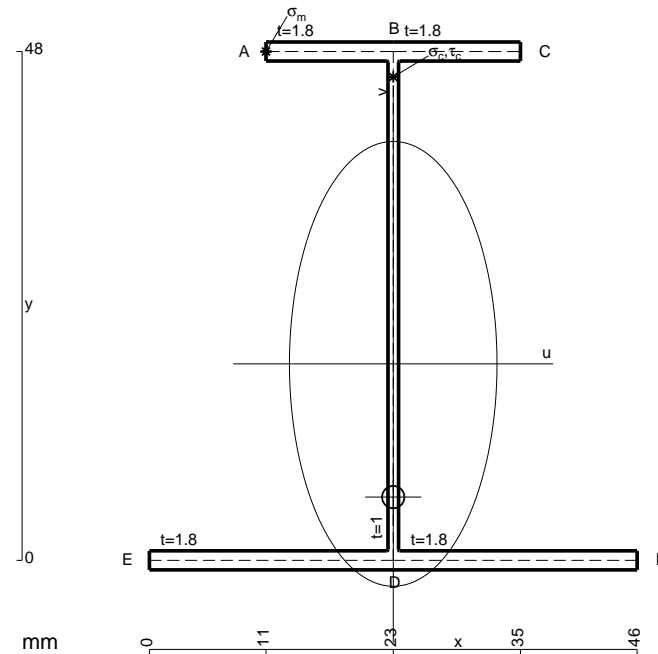
$$= [3/2 x - x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (3/2 b - b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/3 Fb^2/EJ$$

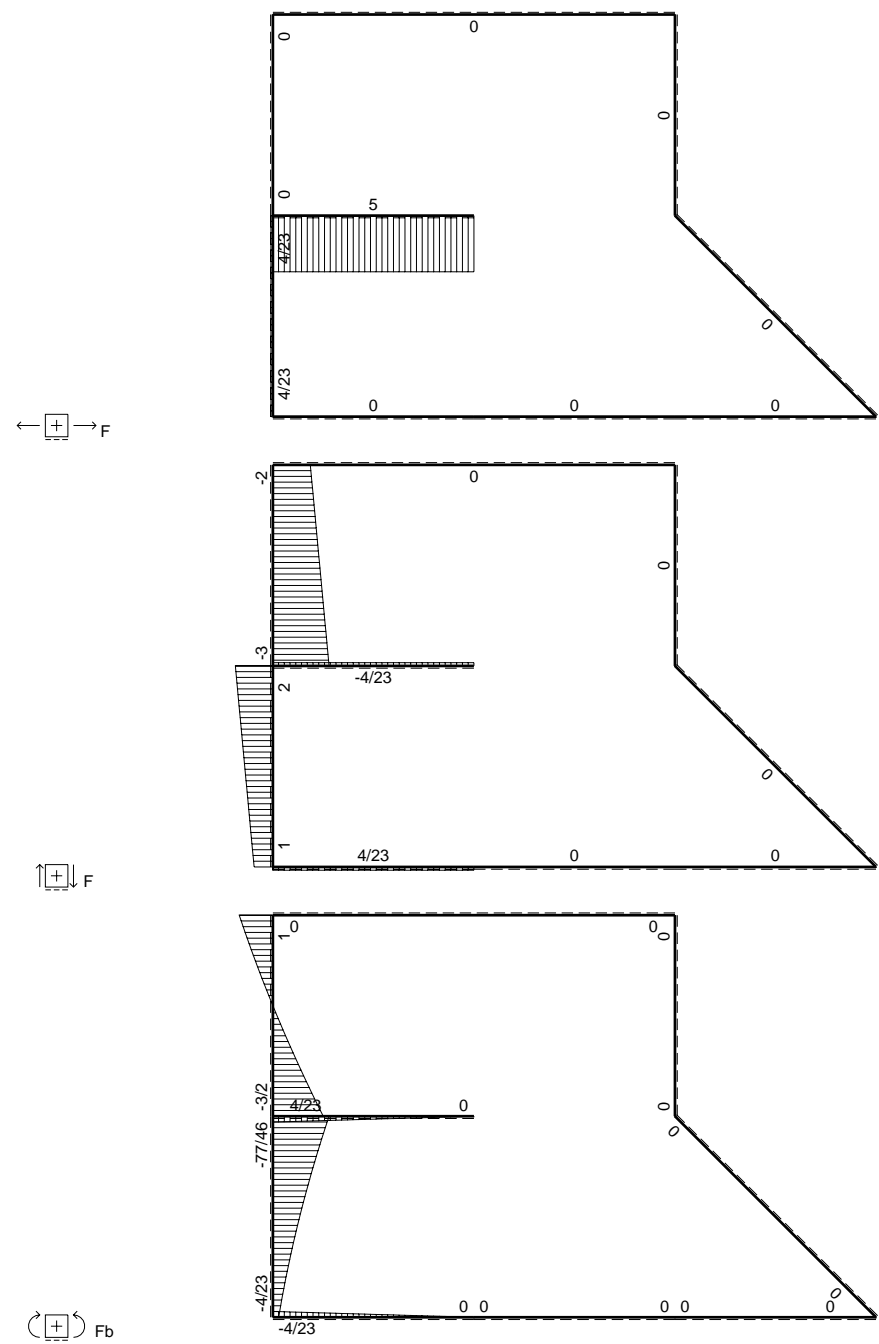
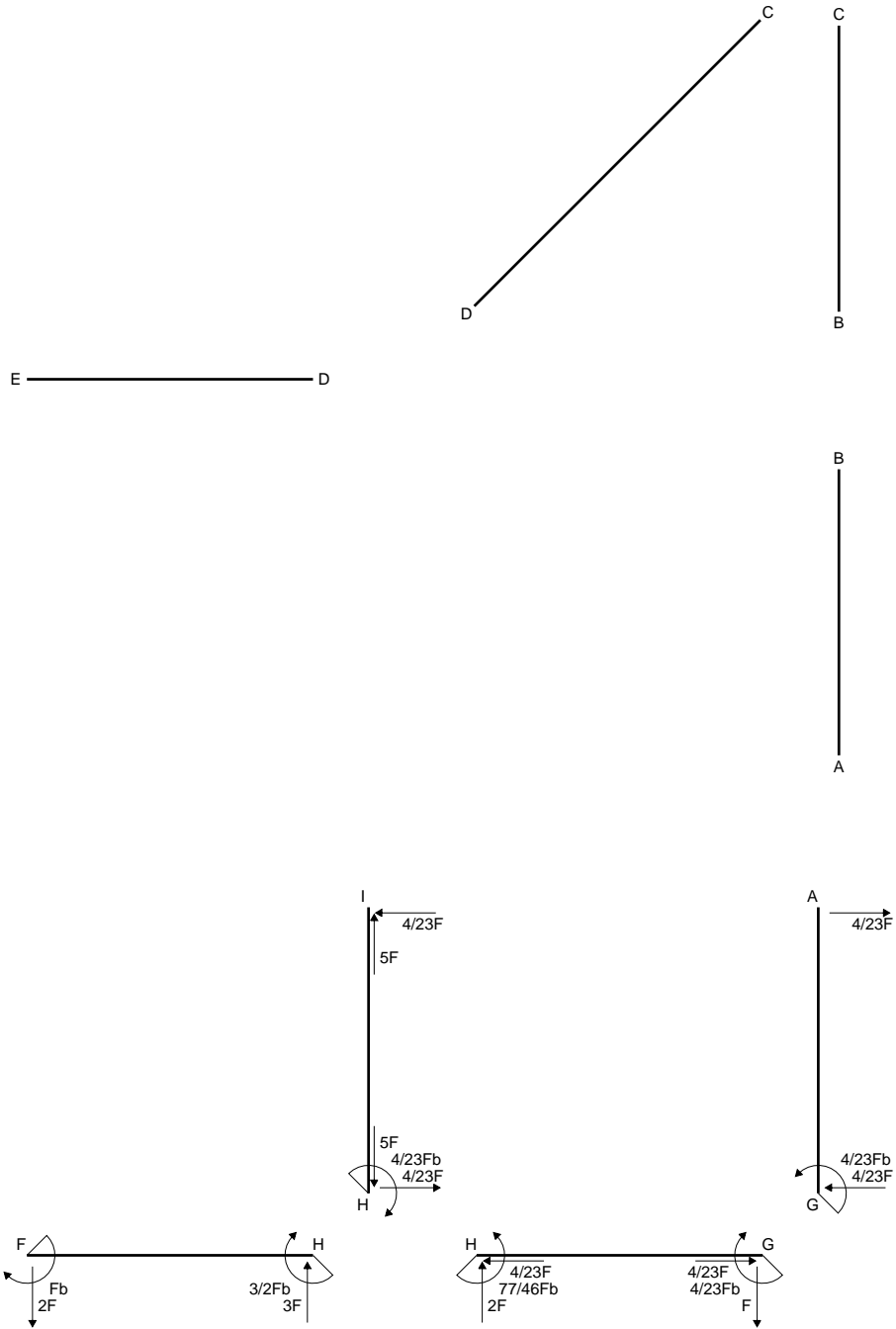
$$L_{GH}^{x_0} = \int_0^b (x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

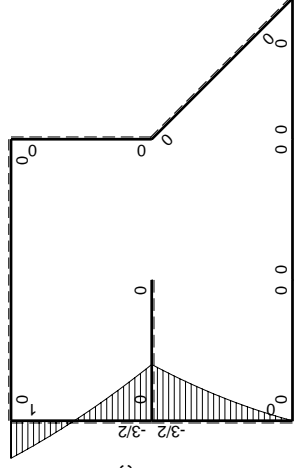
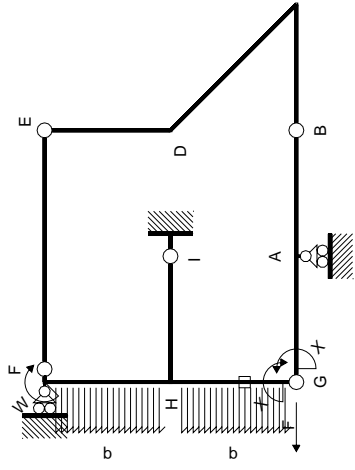
$$= [1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/3 Fb^2/EJ$$



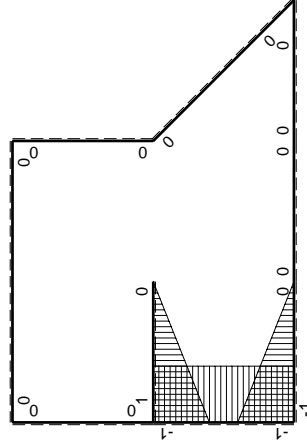
- A = 174. mm²
- J_u = 76601. mm⁴
- J_v = 16674. mm⁴
- J_t = 152.1 mm⁴
- y_o = -12.57 mm
- y_g = 18.54 mm
- T_y = -1230. N
- M_x = -565800. Nmm
- x_m = 11. mm
- y_m = 48. mm
- u_m = -12. mm
- v_m = 29.46 mm
- σ_m = -Mv/J_u = 217.6 N/mm²
- x_c = 23. mm
- y_c = 48. mm
- v_c = 29.46 mm
- σ_c = -Mv/J_u = 217.6 N/mm²
- τ_c = TS^{*}/tJ_u = 20.44 N/mm²
- τ_g = TS^{*}/tJ_u = 20.44 N/mm²
- t_c = 410. mm
- σ_o = √σ²+3τ² = 220.5 N/mm²





Schema di calcolo iperstatico

M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=W_{GA}

→	$M_x(x)$	$M_0(x)$	$M_x M_0$	$M_x M_x$	$\int M_x M_0 / EJ dx$	$\int M_x M_x / EJ dx$
AB b	0	0	0	0	0	0
BA b	0	0	0	0	0	0
BC b	0	0	0	0	0	0
CB b	0	0	0	0	0	0
CD $\sqrt{2}b$	0	0	0	0	0	0
DE b	0	0	0	0	0	0
ED b	0	0	0	0	0	0
EF 2b	0	0	0	0	0	0
FE 2b	0	0	0	0	0	0
GA b	$-1+x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
AG b	x/b	0	0	x^2/b^2	0	$1/3Xb/EJ$
FH b	0	$Fb-2Fx-1/2qx^2$	0	0	0	0
HF b	0	$3/2Fb-3Fx+1/2qx^2$	0	0	0	0
HI b	$1-x/b$	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
IH b	$-x/b$	0	0	x^2/b^2	0	$1/3Xb/EJ$
HG b	-1	$-3/2Fb+2Fx-1/2qx^2$	$3/2Fb-2Fx+1/2Fx^2/b$	1	$2/3Fb^2/EJ$	Xb/EJ
GH b	1	$Fx+1/2qx^2$	$Fx+1/2Fx^2/b$	1	$2/3Fb^2/EJ$	Xb/EJ
HG	elongazione asta $N_{1HG^+HG^-HG}$				$-Fb^2/EJ$	
A	molla nodo $-V_{1A}(V_{GA}+XV_{1A})/k_A$				$1/4Xb/EJ$	
	totali				$-1/3Fb^2/EJ$	$23/12Xb/EJ$
	iperstatica X=W _{GA}				$4/23Fb$	

Sviluppi di calcolo iperstatica

$$L_{GA}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{AG}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HI}^{xx} = \int_0^b (1 - 2x/b + x^2/b^2) 1/EJ dx = [x - x^2/b + 1/3 x^3/b^2]_0^b 1/EJ$$

$$= (b - b + 1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{IH}^{xx} = \int_0^b (x^2/b^2) 1/EJ dx = [1/3 x^3/b^2]_0^b 1/EJ$$

$$= (1/3 b) 1/EJ = 1/3 b/EJ$$

$$L_{HG}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{GH}^{xx} = \int_0^b (1) 1/EJ dx = [x]_0^b 1/EJ$$

$$= (b) 1/EJ = b/EJ$$

$$L_{HG}^{x_0} = \int_0^b (3/2 - 2x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

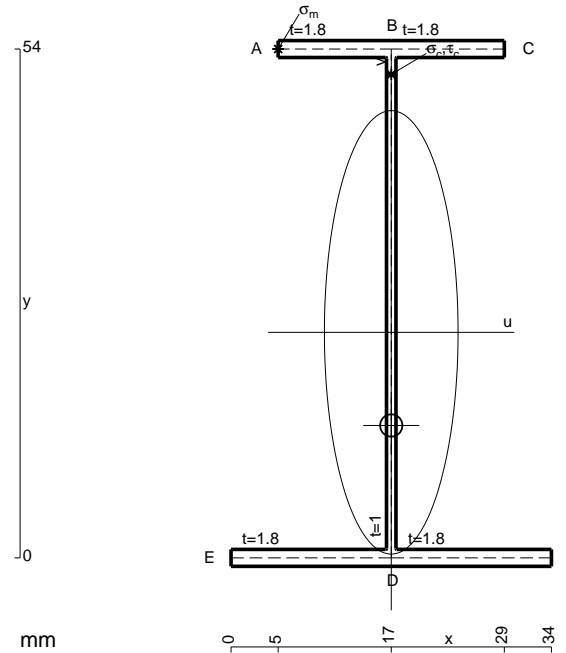
$$= [3/2 x - x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (3/2 b - b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/3 Fb^2/EJ$$

$$L_{GH}^{x_0} = \int_0^b (x/b + 1/2 x^2/b^2) Fb 1/EJ dx - 1 (-1) (-1) Fb^2/EJ$$

$$= [1/2 x^2/b + 1/6 x^3/b^2]_0^b Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ$$

$$= (1/2 b + 1/6 b) Fb 1/EJ - 1 (-1) (-1) Fb^2/EJ = -1/3 Fb^2/EJ$$



- A = 158.4 mm²
- J_u = 87739. mm⁴
- J_v = 7969. mm⁴
- J_i = 130.8 mm⁴
- y_o = -9.881 mm
- y_g = 23.93 mm
- T_y = -1620. N
- M_x = -664200. Nmm
- x_m = 5. mm
- y_m = 54. mm
- u_m = -12. mm
- v_m = 30.07 mm
- σ_m = -M_y/J_u = 227.6 N/mm²
- x_c = 17. mm
- y_c = 54. mm
- v_c = 30.07 mm
- σ_c = -M_y/J_u = 227.6 N/mm²
- τ_c = T_S/t_{J_u} = 23.98 N/mm²
- τ_g = T_S/t_{J_u} = 23.98 N/mm²
- t_c = 540. mm
- σ_o = √(σ²+3τ²) = 231.4 N/mm²

