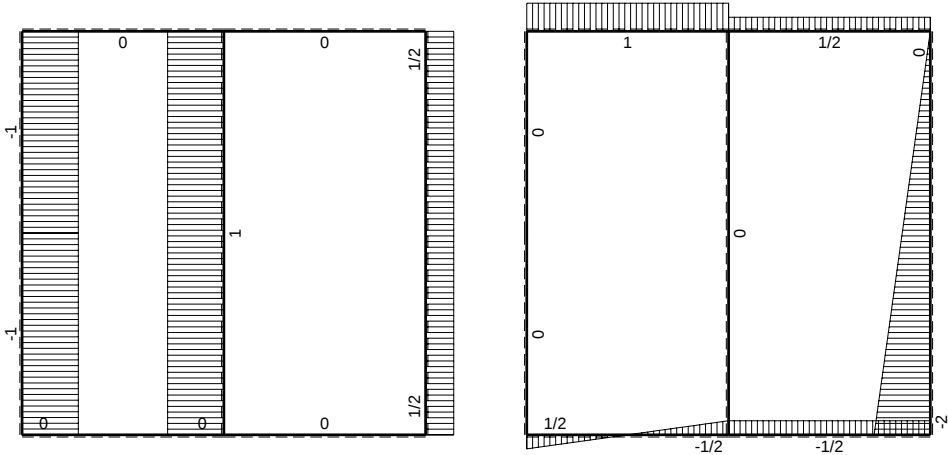
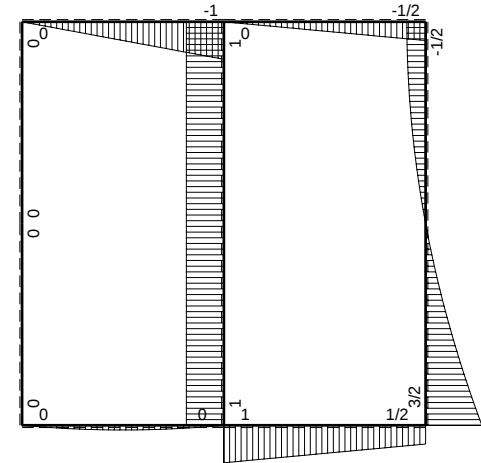


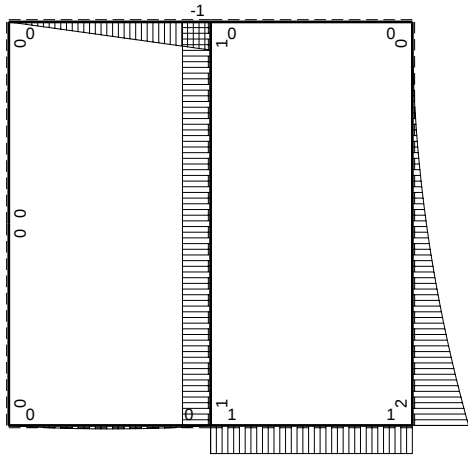
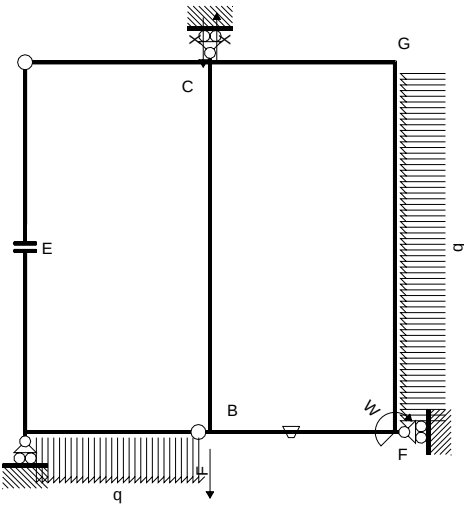


← $\left[\begin{smallmatrix} + \\ - \end{smallmatrix} \right] \rightarrow F$

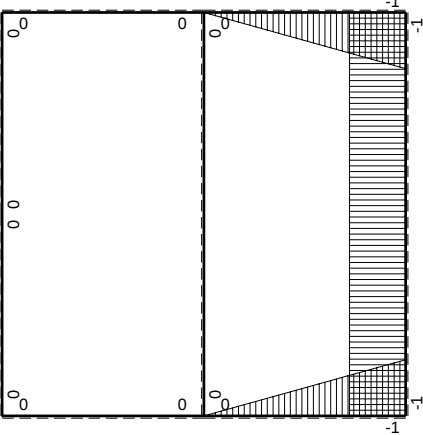
$\uparrow \left[\begin{smallmatrix} + \\ - \end{smallmatrix} \right] \downarrow F$



$\curvearrowright \left[\begin{smallmatrix} + \\ - \end{smallmatrix} \right] \curvearrowleft F_b$



$\curvearrowright \left[\begin{smallmatrix} + \\ - \end{smallmatrix} \right] \curvearrowleft M_o$ flessione da carichi assegnati



$\curvearrowright \left[\begin{smallmatrix} + \\ - \end{smallmatrix} \right] \curvearrowleft M_x$ flessione da iperstatica X=1

Quadro contributi PLV per iperstatica X=V _{CG}									
→	M _x (x)	M ₀ (x)	θ	M _x M ₀	M _x θ	M _x M _x	∫M _x (M ₀ /EJ+θ)dx	∫XM _x M _x /EJdx	
AB b	0	1/2Fx-1/2qx ²	0	0	0	0	0+0	0	
BA b	0	-1/2Fx+1/2qx ²	0	0	0	0	0+0	0	
CD b	0	-Fb+Fx	0	0	0	0	0+0	0	
DC b	0	Fx	0	0	0	0	0+0	0	
DE b	0	0	0	0	0	0	0+0	0	
ED b	0	0	0	0	0	0	0+0	0	
EA b	0	0	0	0	0	0	0+0	0	
AE b	0	0	0	0	0	0	0+0	0	
BF b	-x	Fb	-Fb/EJ	-Fbx	Fxb/EJ	x ²	(-1/2+1/2)Fb ³ /EJ	1/3xb ³ /EJ	
FB b	b-x	-Fb	Fb/EJ	-Fb ² +Fbx	Fb ² /EJ-Fxb/EJ	b ² -2bx+x ²	0+0	1/3xb ³ /EJ	
GC b	-b+x	0	0	0	0	b ² -2bx+x ²	0+0	1/3xb ³ /EJ	
CG b	x	0	0	0	0	x ²	0+0	2xb ³ /EJ	
FG 2b	-b	2Fb-2Fx+1/2qx ²	0	-2Fb ² +2Fbx-1/2Fx ²	0	b ²	(-4/3+0)Fb ³ /EJ	0	
GF 2b	b	-1/2qx ²	0	-1/2Fx ²	0	b ²	0+0	8/3xb ³ /EJ	
CB 2b	0	Fb	0	0	0	0	0+0	0	
BC 2b	0	-Fb	0	0	0	0	-4/3Fb ³ /EJ	0	
	totali						1/2F		
	iperstatica X=V _{CG}								

Sviluppi di calcolo iperstatica

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

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

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

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

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

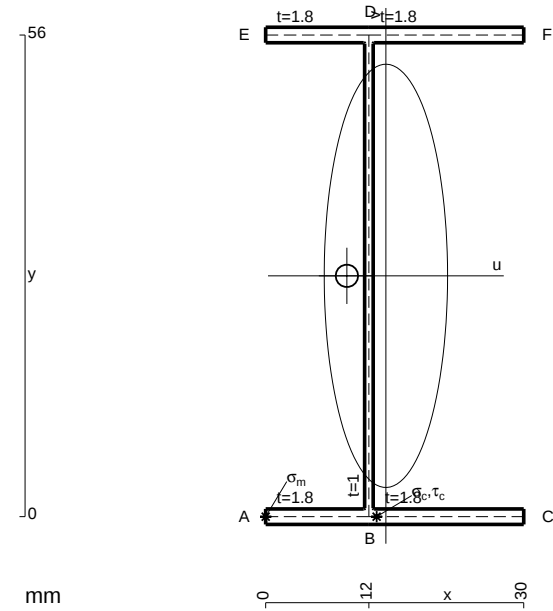
$$L_{GF}^{xx} = \int_0^{2b} \left(1 \right) b^2 1/EJ \, dx = \left[x \right]_0^{2b} b^2 1/EJ$$
$$= (2 b) b^2 1/EJ = 2 b^3/EJ$$

$$L_{BF}^{x0} = \int_0^b \left(-x/b \right) Fb^2 1/EJ \, dx + \int_0^b \left(x/b \right) \theta \, dx = \left[-1/2 x^2/b \right]_0^b Fb^2 1/EJ + \left[1/2 x^2/b \right]_0^b \theta$$
$$= (-1/2 b) Fb^2 1/EJ + (1/2 b) \theta = 0$$

$$L_{FB}^{x0} = \int_0^b \left(-1 + x/b \right) Fb^2 1/EJ \, dx + \int_0^b \left(-1 + x/b \right) \theta \, dx$$
$$= \left[-x + 1/2 x^2/b \right]_0^b Fb^2 1/EJ + \left[-x + 1/2 x^2/b \right]_0^b \theta$$
$$= (-b + 1/2 b) Fb^2 1/EJ + (-b + 1/2 b) \theta = 0$$

$$L_{FG}^{x0} = \int_0^{2b} \left(-2 + 2x/b - 1/2 x^2/b^2 \right) Fb^2 1/EJ \, dx = \left[-2x + x^2/b - 1/6 x^3/b^2 \right]_0^{2b} Fb^2 1/EJ$$
$$= (-4b + 4b - 4/3 b) Fb^2 1/EJ = -4/3 Fb^3/EJ$$

$$L_{GF}^{x0} = \int_0^{2b} \left(-1/2 x^2/b^2 \right) Fb^2 1/EJ \, dx = \left[-1/6 x^3/b^2 \right]_0^{2b} Fb^2 1/EJ$$
$$= (-4/3 b) Fb^2 1/EJ = -4/3 Fb^3/EJ$$



$A = 164. \text{ mm}^2$
 $J_u = 99307. \text{ mm}^4$
 $J_v = 8432. \text{ mm}^4$
 $J_t = 135.3 \text{ mm}^4$
 $x_o = -4.534 \text{ mm}$
 $x_g = 13.98 \text{ mm}$
 $T_y = 1070. \text{ N}$
 $M_x = -706200. \text{ Nmm}$
 $u_m = -13.98 \text{ mm}$
 $v_m = -28. \text{ mm}$
 $\sigma_m = -Mv/J_u = -199.1 \text{ N/mm}^2$
 $x_c = 12. \text{ mm}$
 $u_c = -1.976 \text{ mm}$
 $v_c = -28. \text{ mm}$
 $\sigma_c = -Mv/J_u = -199.1 \text{ N/mm}^2$
 $\tau_c = \tau_g + \tau_{ou} = 69.96 \text{ N/mm}^2$
 $\tau_g = TS/tJ_u = 5.43 \text{ N/mm}^2$
 $\tau_o = Tx_o/tJ_t = 64.53 \text{ N/mm}^2$
 $t_c = 1926. \text{ mm}$
 $\sigma_o = \sqrt{\sigma^2 + 3\tau^2} = 233.1 \text{ N/mm}^2$