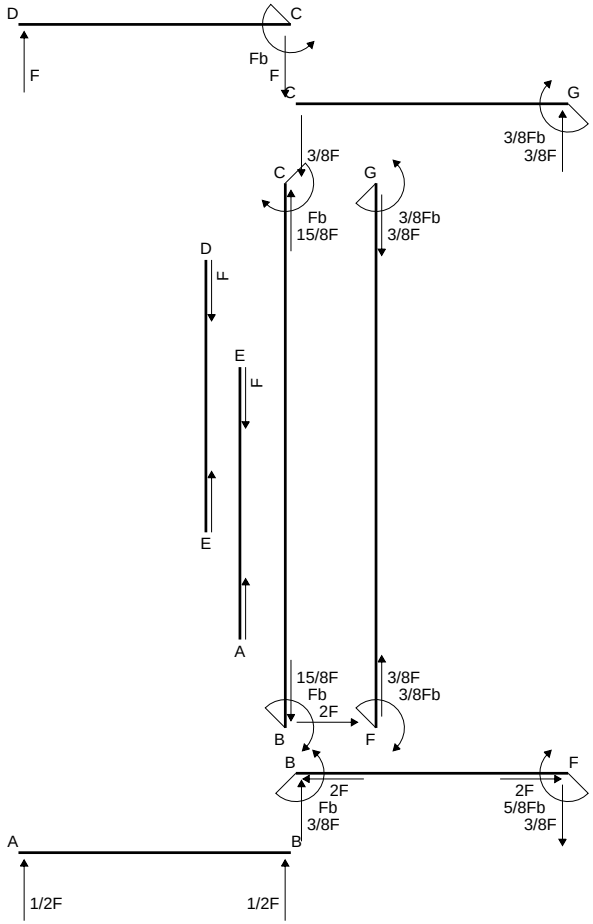
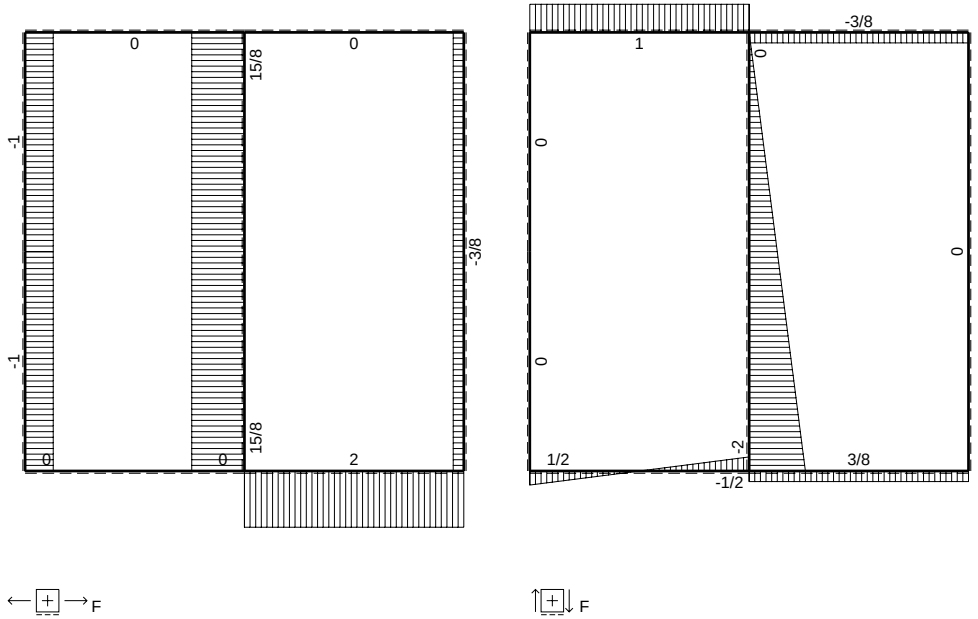

D
C
F
Fb
F
C
G
3/8Fb
3/8F
3/8F
C
G
Fb
15/8F
3/8Fb
3/8F
D
F
E
F
E
A
15/8F
Fb
2F
3/8F
3/8Fb
B
F
B
F
2F
Fb
3/8F
2F
5/8Fb
3/8F
A
B
1/2F
1/2F


0
0
15/8
-1
-1
-3/8
0
0
15/8
0
0
2
F
-3/8
1
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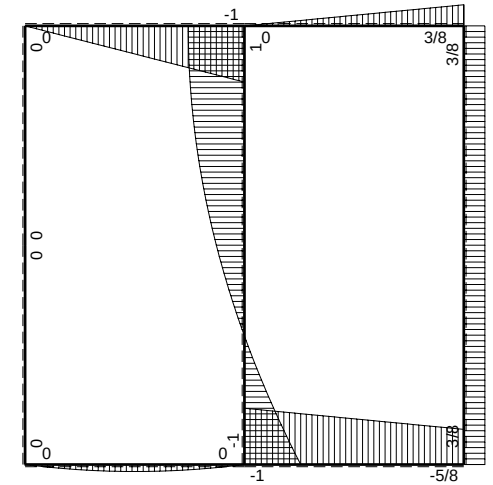
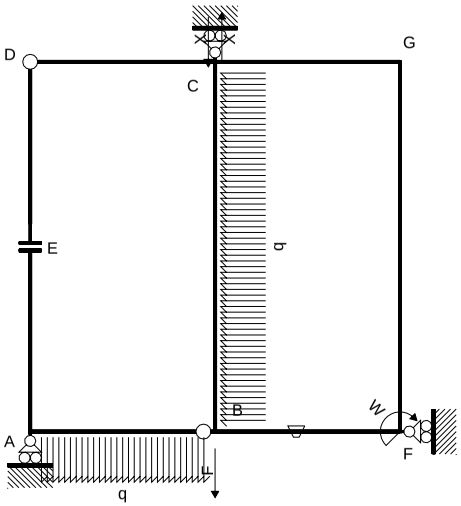
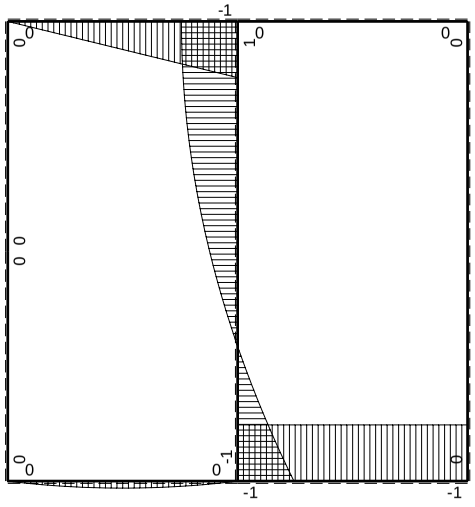
0
0
1/2
-2
3/8
-1/2
F


-1
0
0
1
0
3/8
3/8
0
0
0
0
0
-1
0
-1
3/8
-1
-5/8

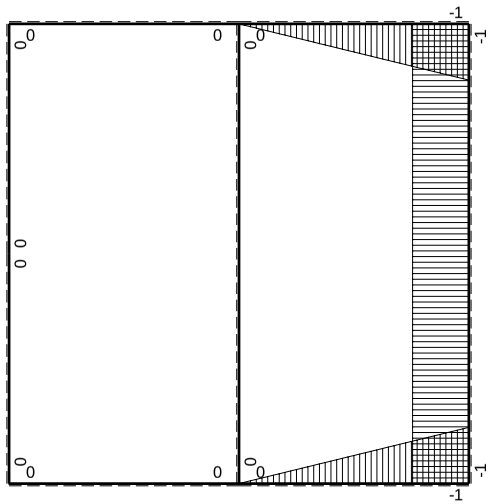
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=V_{CG}$

→	$M_x(x)$	$M_o(x)$	θ	M_xM_o	$M_x\theta$	M_xM_x	$\int M_x(M_o/EJ+\theta)dx$	$\int XM_xM_x/EJdx$
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		
CD b	0	-Fb+Fx	0	0	0	0	0+0	0
DC b	0	Fx	0	0	0	0		
DE b	0	0	0	0	0	0	0+0	0
ED b	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		
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		
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		
FG 2b	-b	0	0	0	0	b^2	0+0	2Xb^3/EJ
GF 2b	b	0	0	0	0	b^2		
CB 2b	0	Fb-1/2qx^2	0	0	0	0	0+0	0
BC 2b	0	Fb-2Fx+1/2qx^2	0	0	0	0		
	totali						Fb^3/EJ	8/3Xb^3/EJ
	iperstatica $X=V_{CG}$						-3/8F	

Sviluppi di calcolo iperstatica

PROCEDIMENTO E RISULTATI 957564 ESΣ8.xxxx.010

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$L^{XX}_{BF} = \int_o^b (x^2/b^2)\, b^2\, 1/EJ\, dx = [1/3\, x^3/b^2]_o^b\, b^2\, 1/EJ$

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

$L^{XX}_{FB} = \int_o^b (1 -2\, x/b + x^2/b^2)\, b^2\, 1/EJ\, dx = [x - x^2/b +1/3\, x^3/b^2]_o^b\, b^2\, 1/EJ$

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

$L^{XX}_{GC} = \int_o^b (1 -2\, x/b + x^2/b^2)\, b^2\, 1/EJ\, dx = [x - x^2/b +1/3\, x^3/b^2]_o^b\, b^2\, 1/EJ$

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

$L^{XX}_{CG} = \int_o^b (x^2/b^2)\, b^2\, 1/EJ\, dx = [1/3\, x^3/b^2]_o^b\, b^2\, 1/EJ$

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

$L^{XX}_{FG} = \int_o^{2b} (1)\, b^2\, 1/EJ\, dx = [x]_o^{2b}\, b^2\, 1/EJ$

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

$L^{XX}_{GF} = \int_o^{2b} (1)\, b^2\, 1/EJ\, dx = [x]_o^{2b}\, b^2\, 1/EJ$

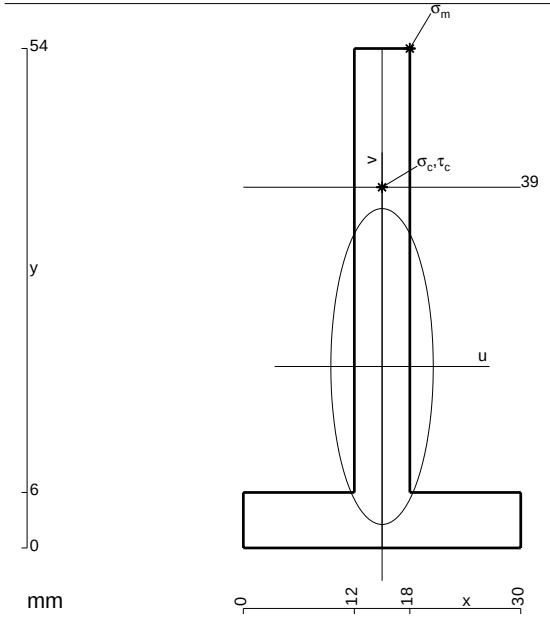
$= (2\, b)\, b^2\, 1/EJ = 2\ b^3/EJ$

$L^{Xo}_{BF} = \int_o^b (x/b)\, Fb^2\, 1/EJ\, dx + \int_o^b (x/b)\, \theta\ dx = [1/2\, x^2/b]_o^b\, Fb^2\, 1/EJ + [1/2\, x^2/b]_o^b\, \theta$

$= (1/2\, b)\, Fb^2\, 1/EJ + (1/2\, b)\, \theta = Fb^3/EJ$

$L^{Xo}_{FB} = \int_o^b (1 - x/b)\, Fb^2\, 1/EJ\, dx + \int_o^b (-1 + x/b)\, \theta\ dx = [x -1/2\, x^2/b]_o^b\, Fb^2\, 1/EJ + [- x +1/2\, x^2/b]_o^b\, \theta$

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



A = 468. mm^2
J_u = 136587. mm^4
J_v = 14364. mm^4
y_g = 19.62 mm
N = 3338. N
T_y = -3560. N
M_x = -765400. Nmm
x_m = 18. mm
y_m = 54. mm
u_m = 3. mm
v_m = 34.38 mm
$\sigma_m = N/A - Mv/J_u$ = 199.8 N/mm^2
x_c = 15. mm
y_c = 39. mm
v_c = 19.38 mm
$\sigma_c = N/A - Mv/J_u$ = 115.8 N/mm^2
τ_c = 10.51 N/mm^2
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 117.2 N/mm^2
S^* = 2420. mm^3

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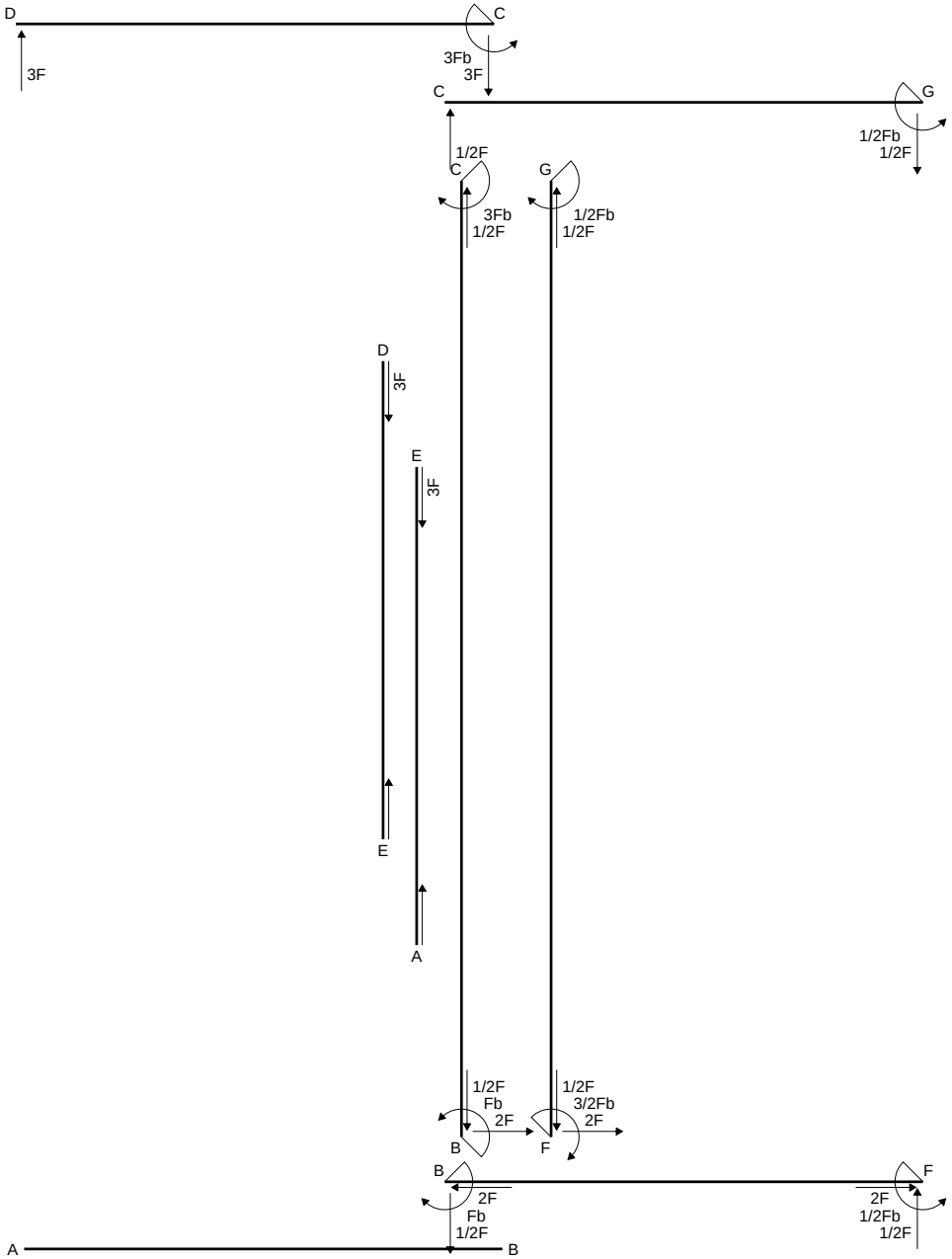
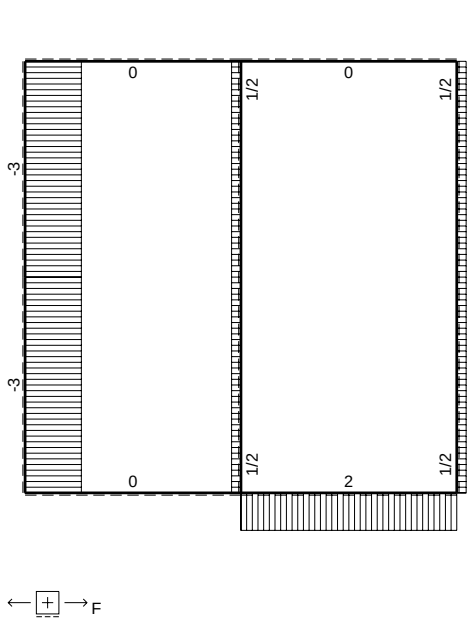
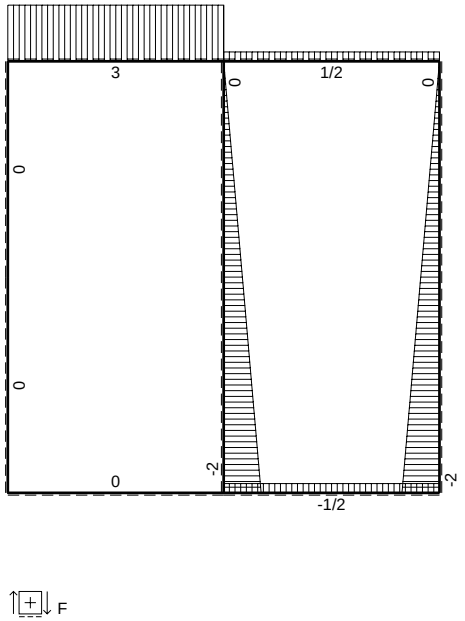
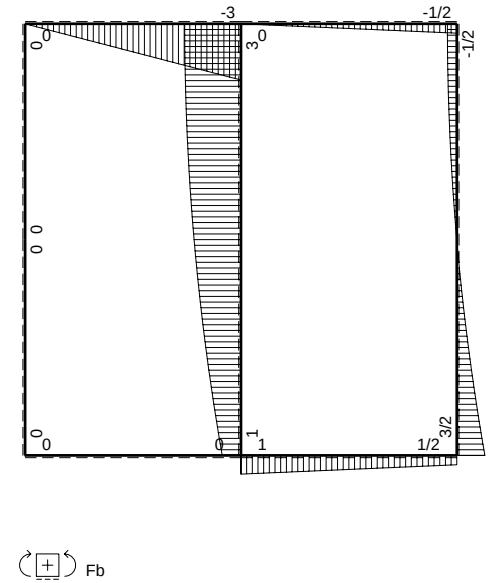
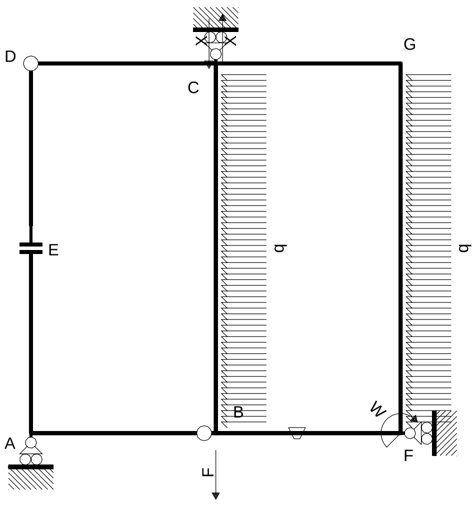
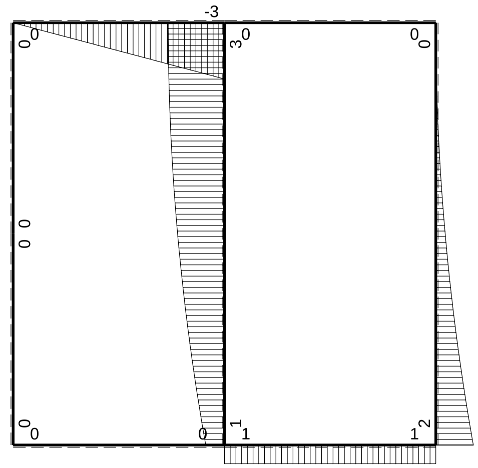

D
C
3F
3Fb
3F
C
G
1/2Fb
1/2F
1/2F
C
G
3Fb
1/2F
1/2Fb
1/2F
D
3F
E
3F
E
A
1/2F
Fb
2F
1/2F
3/2Fb
2F
B
F
B
F
2F
Fb
1/2F
2F
1/2Fb
1/2F
A
B


0
0
1/2
1/2
-3
-3
0
1/2
2
1/2
F

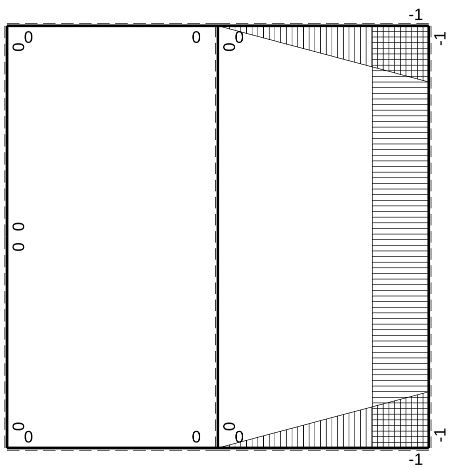

3
0
1/2
0
0
0
-2
-2
-1/2
F


-3
-1/2
0
0
3
0
-1/2
0
0
0
0
0
1
1
1/2
3/2
Fb





M_o flessione da carichi assegnati



M_x flessione da iperstatica X=1

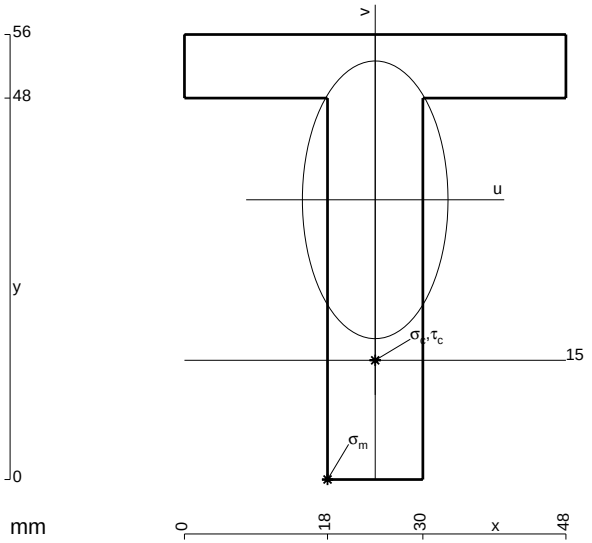
Quadro contributi PLV per iperstatica $X=V_{CG}$

→	$M_x(x)$	$M_o(x)$	θ	M_xM_o	$M_x\theta$	M_xM_x	$\int M_x(M_o/EJ+\theta)dx$	$\int XM_xM_x/EJdx$
AB b	0	0	0	0	0	0	0+0	0
BA b	0	0	0	0	0	0		
CD b	0	$-3Fb+3Fx$	0	0	0	0	0+0	0
DC b	0	$3Fx$	0	0	0	0		
DE b	0	0	0	0	0	0	0+0	0
ED b	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		
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	$-Fb^2+Fbx$	$Fb^2/EJ-Fxb/EJ$	$b^2-2bx+x^2$		
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		
FG 2b	$-b$	$2Fb-2Fx+1/2qx^2$	0	$-2Fb^2+2Fbx-1/2Fx^2$	0	b^2	$(-4/3+0)Fb^3/EJ$	$2Xb^3/EJ$
GF 2b	b	$-1/2qx^2$	0	$-1/2Fx^2$	0	b^2		
CB 2b	0	$3Fb-1/2qx^2$	0	0	0	0	0+0	0
BC 2b	0	$-Fb-2Fx+1/2qx^2$	0	0	0	0		
totali							$-4/3Fb^3/EJ$	$8/3Xb^3/EJ$
iperstatica $X=V_{CG}$							$1/2F$	

Sviluppi di calcolo iperstatica

$$L^{XX}_{BF} = \int_o^b \left(x^2/b^2 \right) b^2\ 1/EJ\ dx = \left[1/3\ x^3/b^2 \right]_o^b b^2\ 1/EJ$$
$$= \left(1/3\ b \right) b^2\ 1/EJ\ = 1/3\ \ b^3/EJ$$
$$L^{XX}_{FB} = \int_o^b \left(1 -2\ x/b + x^2/b^2 \right) b^2\ 1/EJ\ dx = \left[x - x^2/b + 1/3\ x^3/b^2 \right]_o^b b^2\ 1/EJ$$
$$= \left(b - b + 1/3\ b \right) b^2\ 1/EJ\ = 1/3\ \ b^3/EJ$$
$$L^{XX}_{GC} = \int_o^b \left(1 -2\ x/b + x^2/b^2 \right) b^2\ 1/EJ\ dx = \left[x - x^2/b + 1/3\ x^3/b^2 \right]_o^b b^2\ 1/EJ$$
$$= \left(b - b + 1/3\ b \right) b^2\ 1/EJ\ = 1/3\ \ b^3/EJ$$
$$L^{XX}_{CG} = \int_o^b \left(x^2/b^2 \right) b^2\ 1/EJ\ dx = \left[1/3\ x^3/b^2 \right]_o^b b^2\ 1/EJ$$
$$= \left(1/3\ b \right) b^2\ 1/EJ\ = 1/3\ \ b^3/EJ$$
$$L^{XX}_{FG} = \int_o^{2b} \left(1 \right) b^2\ 1/EJ\ dx = \left[x \right]_o^{2b} b^2\ 1/EJ$$
$$= \left(2\ b \right) b^2\ 1/EJ\ = 2\ \ b^3/EJ$$
$$L^{XX}_{GF} = \int_o^{2b} \left(1 \right) b^2\ 1/EJ\ dx = \left[x \right]_o^{2b} b^2\ 1/EJ$$
$$= \left(2\ b \right) b^2\ 1/EJ\ = 2\ \ b^3/EJ$$
$$L^{Xo}_{BF} = \int_o^b \left(- x/b \right) Fb^2\ 1/EJ\ dx + \int_o^b \left(x/b \right) \theta\ \ dx = \left[-1/2\ x^2/b \right]_o^b Fb^2\ 1/EJ\ + \left[1/2\ x^2/b \right]_o^b \theta$$
$$= \left(-1/2\ b \right) Fb^2\ 1/EJ\ + \left(1/2\ b \right) \theta\ \ = 0$$
$$L^{Xo}_{FB} = \int_o^b \left(-1 + x/b \right) Fb^2\ 1/EJ\ dx + \int_o^b \left(-1 + x/b \right) \theta\ \ dx$$
$$= \left[- x + 1/2\ x^2/b \right]_o^b Fb^2\ 1/EJ\ + \left[- x + 1/2\ x^2/b \right]_o^b \theta$$
$$= \left(- b + 1/2\ b \right) Fb^2\ 1/EJ\ + \left(- b + 1/2\ b \right) \theta\ \ = 0$$
$$L^{Xo}_{FG} = \int_o^{2b} \left(-2 + 2\ x/b - 1/2\ x^2/b^2 \right) Fb^2\ 1/EJ\ dx = \left[-2\ x + x^2/b - 1/6\ x^3/b^2 \right]_o^{2b} Fb^2\ 1/EJ$$
$$= \left(-4\ b + 4\ b - 4/3\ b \right) Fb^2\ 1/EJ\ = -4/3\ \ Fb^3/EJ$$
$$L^{Xo}_{GF} = \int_o^{2b} \left(-1/2\ x^2/b^2 \right) Fb^2\ 1/EJ\ dx = \left[-1/6\ x^3/b^2 \right]_o^{2b} Fb^2\ 1/EJ$$
$$= \left(-4/3\ b \right) Fb^2\ 1/EJ\ = -4/3\ \ Fb^3/EJ$$

PROCEDIMENTO E RISULTATI 981482 ESΣ8.xxxx.067



$A = 960.\ mm^2$
$J_u = 293274.\ mm^4$
$J_v = 80640.\ mm^4$
$y_g = 35.2\ mm$
$T_y = 2460.\ N$
$M_x = -1820400.\ Nmm$
$x_m = 18.\ mm$
$u_m = -6.\ mm$
$v_m = -35.2\ mm$
$\sigma_m = -Mv/J_u = -218.5\ N/mm^2$
$x_c = 24.\ mm$
$y_c = 15.\ mm$
$v_c = -20.2\ mm$
$\sigma_c = -Mv/J_u = -125.4\ N/mm^2$
$\tau_c = 3.485\ N/mm^2$
$\sigma_o = \sqrt{\sigma^2 + 3\tau^2} = 125.5\ N/mm^2$
$S^* = 4986.\ mm^3$

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