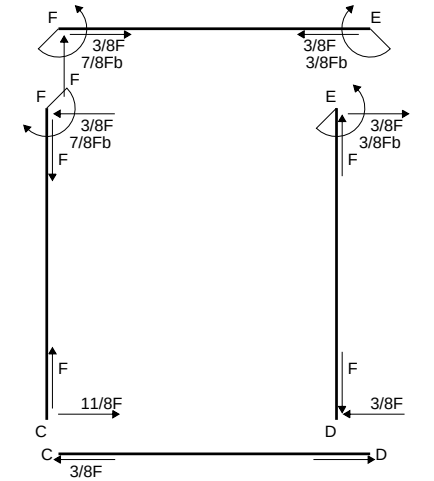
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7/8Fb
3/8F
3/8Fb
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F
E
3/8F
7/8Fb
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3/8F
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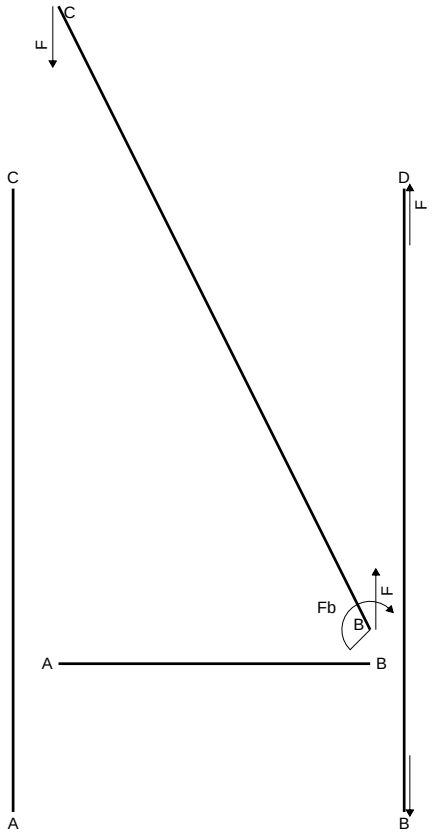
D
C
D
3/8F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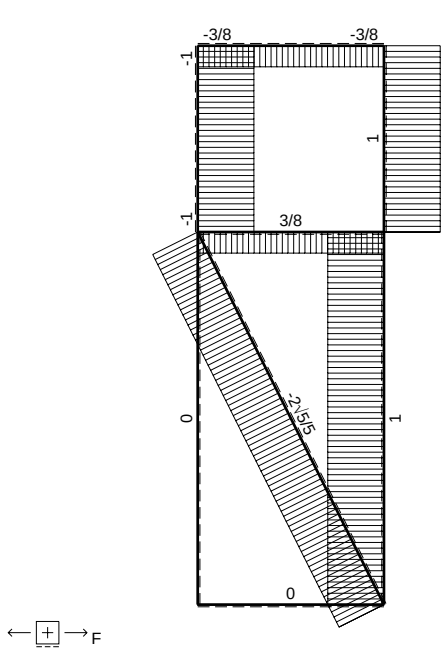
A
B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3/8
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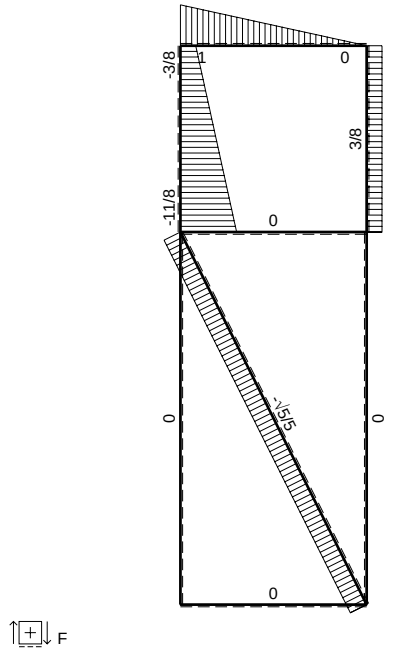
F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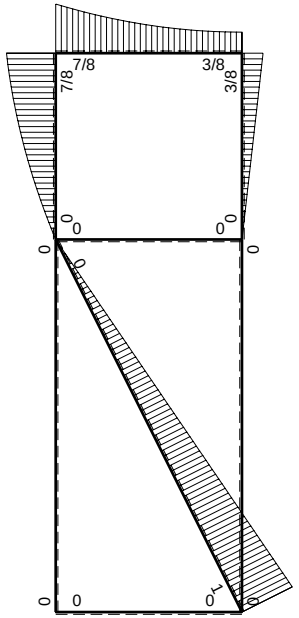
3/8
-11/8
0
-√5/5
0
0
F


7/8
7/8
3/8
3/8
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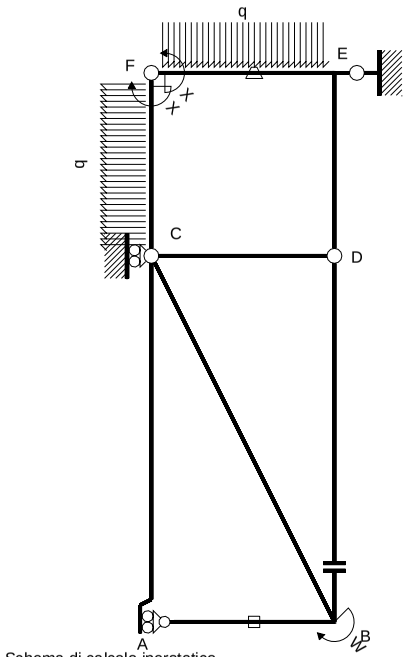
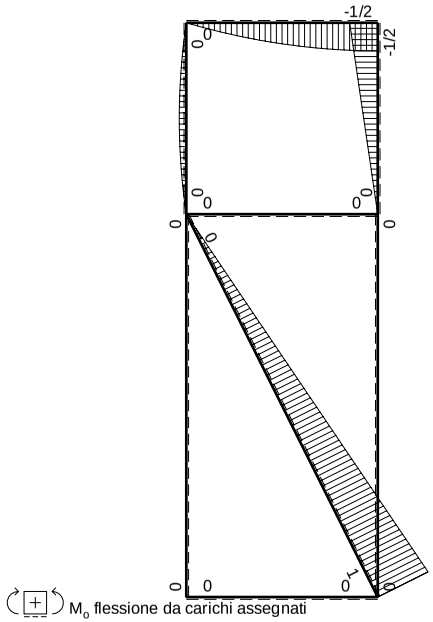
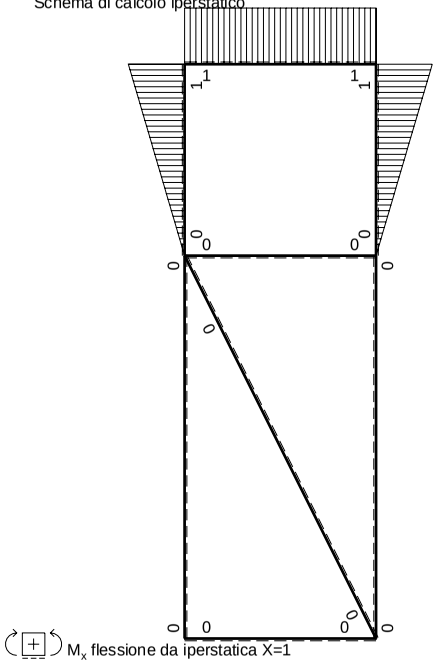
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_o(x)$	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		
BC $\sqrt{5}$b	0	Fb-$\sqrt{5}$/5Fx	0	0	0	0	0	0
AC 2b	0	0	0	0	0	0	0+0	0
CA 2b	0	0	0	0	0	0		
DB 2b	0	0	0	0	0	0	0+0	0
BD 2b	0	0	0	0	0	0		
DE b	x/b	-1/2Fx	0	-1/2Fx^2/b	0	x^2/b^2	(-1/6+0)Fb^2/EJ	1/3Xb/EJ
ED b	-1+x/b	1/2Fb-1/2Fx	0	-1/2Fb+Fx-1/2Fx^2/b	0	1-2x/b+x^2/b^2		
CD b	0	0	0	0	0	0	0+0	0
DC b	0	0	0	0	0	0		
EF b	1	-1/2Fb+1/2qx^2	-Fb/EJ	-1/2Fb+1/2Fx^2/b	-Fb/EJ	1	(-1/3-1)Fb^2/EJ	Xb/EJ
FE b	-1	Fx-1/2qx^2	Fb/EJ	-Fx+1/2Fx^2/b	-Fb/EJ	1		
FC b	1-x/b	1/2Fx-1/2qx^2	0	1/2Fx-Fx^2/b+1/2qx^3/b	0	1-2x/b+x^2/b^2	(1/24+0)Fb^2/EJ	1/3Xb/EJ
CF b	-x/b	-1/2Fx+1/2qx^2	0	1/2Fx^2/b-1/2qx^3/b	0	x^2/b^2		
	totali						-35/24Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{FE}$						7/8Fb	

Sviluppi di calcolo iperstatica

PROCEDIMENTO E RISULTATI 983692 ESΣ9.xxxx.001

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

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

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

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

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

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

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

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

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

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

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

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

$L^{Xo}_{DE} = \int_o^b (-1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

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

$L^{Xo}_{ED} = \int_o^b (-1/2 + x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x +1/2\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

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

$L^{Xo}_{EF} = \int_o^b (-1/2 +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx + \int_o^b (-1)\ \theta\ dx = [-1/2\ x +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + [-\ x\ ]_o^b\ \theta$

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

$L^{Xo}_{FE} = \int_o^b (-\ x/b +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx + \int_o^b (1)\ \theta\ dx = [-1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + [\ x\ ]_o^b\ \theta$

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

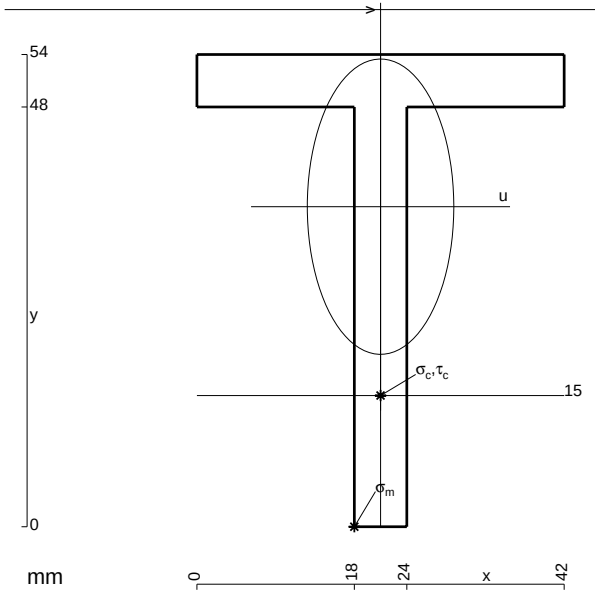
$L^{Xo}_{FC} = \int_o^b (1/2\ x/b - x^2/b^2 +1/2\ x^3/b^3)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/3\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

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

$L^{Xo}_{CF} = \int_o^b (1/2\ x^2/b^2 -1/2\ x^3/b^3)\ Fb\ 1/EJ\ dx = [1/6\ x^3/b^2 -1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

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

PROCEDIMENTO E RISULTATI 983692 ESΣ9.xxxx.001



A = 540. mm^2
J_u = 154030. mm^4
J_v = 37908. mm^4
y_g = 36.6 mm
N = -1959. N
T_y = -979.4 N
M_x = 897900. Nmm
x_m = 18. mm
u_m = -3. mm
v_m = -36.6 mm
σ_m = N/A-Mv/J_u = 209.7 N/mm^2
x_c = 21. mm
y_c = 15. mm
v_c = -21.6 mm
σ_c = N/A-Mv/J_u = 122.3 N/mm^2
τ_c = 2.775 N/mm^2
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 122.4 N/mm^2
S^* = 2619. mm^3

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ESΣ9.xxxx.001

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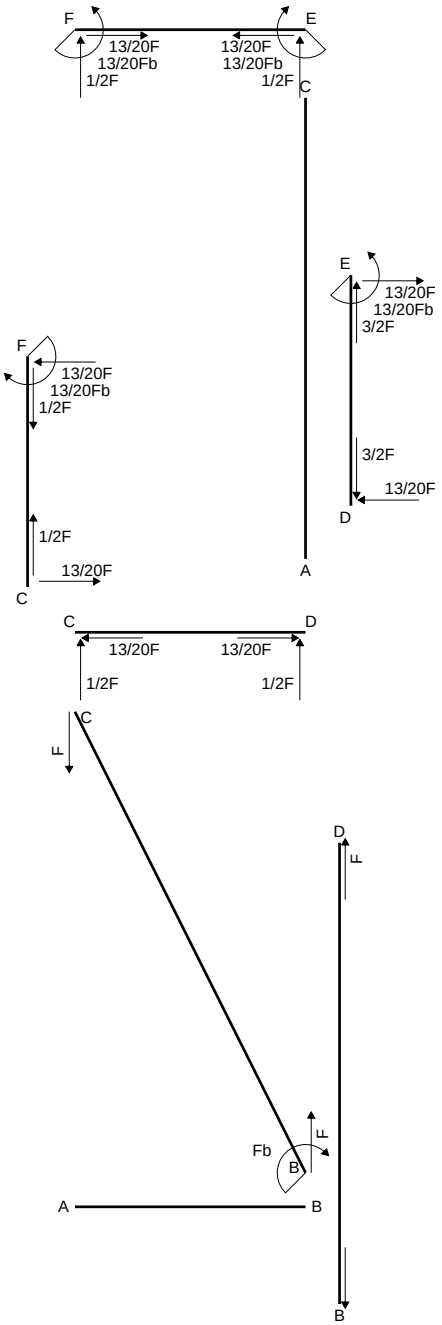
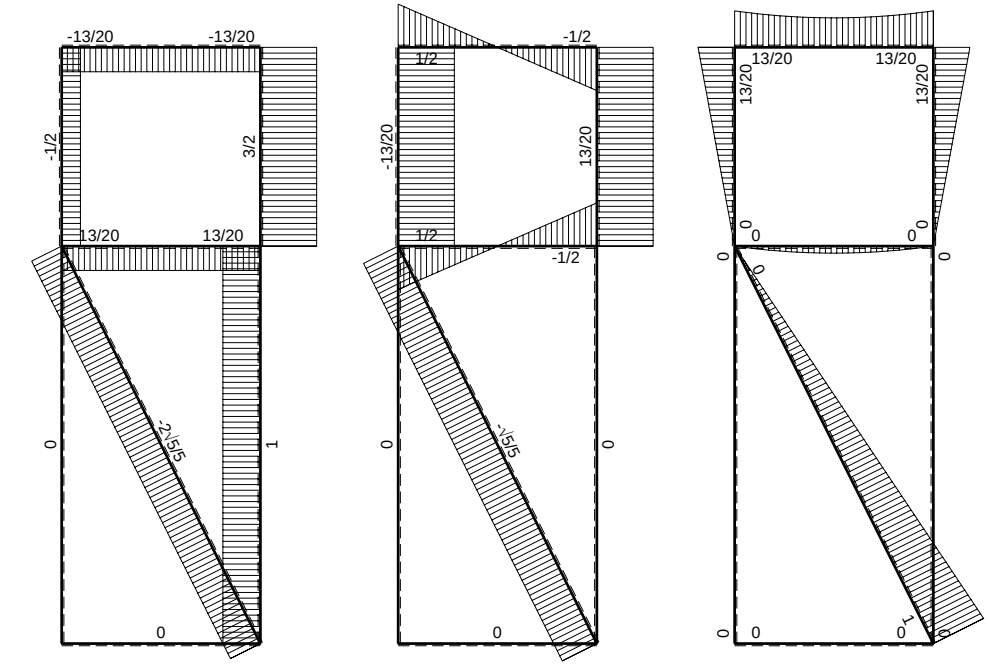
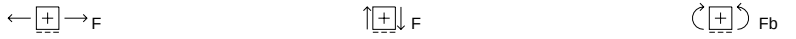

F
E
13/20F
13/20Fb
1/2F
C
A
D
3/2F
B
Fb


-13/20
-1/2
3/2
13/20
1/2
0
1
-2√5/5
-√5/5


F
F
Fb

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

→	$M_x(x)$	$M_0(x)$	θ	M_xM_0	$M_x\theta$	M_xM_x	$\int M_x(M_0/EJ+\theta)dx$	$\int XM_xM_x/EJdx$
AB b	0	0	0	0	0	0	0+0	0
BA b	0	0	0	0	0	0		
BC √5b	0	Fb-√5/5Fx	0	0	0	0	0	0
AC 2b	0	0	0	0	0	0	0+0	0
CA 2b	0	0	0	0	0	0		
DB 2b	0	0	0	0	0	0	0+0	0
BD 2b	0	0	0	0	0	0		
DE b	x/b	0	0	0	0	x^2/b^2	0+0	1/3Xb/EJ
ED b	-1+x/b	0	0	0	0	$1-2x/b+x^2/b^2$		
CD b	0	$1/2Fx-1/2qx^2$	0	0	0	0	0+0	0
DC b	0	$-1/2Fx+1/2qx^2$	0	0	0	0		
EF b	1	$-1/2Fx+1/2qx^2$	-Fb/EJ	$-1/2Fx+1/2Fx^2/b$	-Fb/EJ	1	$(-1/12-1)Fb^2/EJ$	Xb/EJ
FE b	-1	$1/2Fx-1/2qx^2$	Fb/EJ	$-1/2Fx+1/2Fx^2/b$	-Fb/EJ	1		
FC b	1-x/b	0	0	0	0	$1-2x/b+x^2/b^2$	0+0	1/3Xb/EJ
CF b	-x/b	0	0	0	0	x^2/b^2		
	totali						$-13/12Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{FE}$						13/20Fb	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

$L^{Xo}_{EF} = \int_o^b (-1/2\ x/b +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx + \int_o^b (-1)\ \theta\ dx$

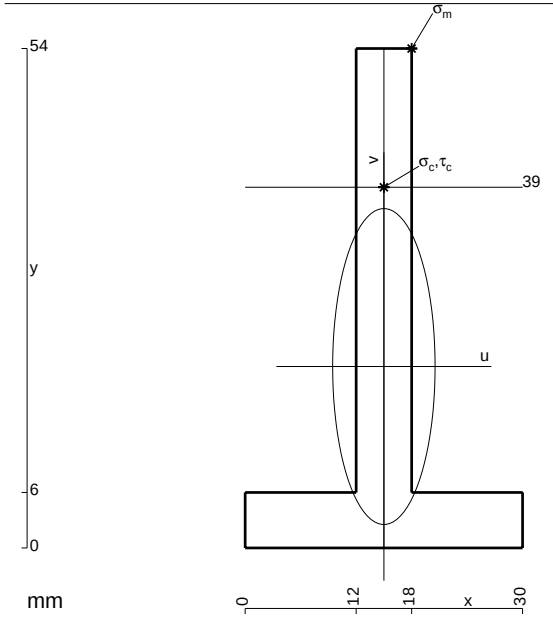
$= [-1/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + [-\ x\ ]_o^b\ \theta$

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

$L^{Xo}_{FE} = \int_o^b (-1/2\ x/b +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx + \int_o^b (1)\ \theta\ dx$

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

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



A = 468. mm^2
J_u = 136587. mm^4
J_v = 14364. mm^4
y_g = 19.62 mm
N = -1825. N
T_y = -912.3 N
M_x = 775200. 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. N/mm^2
x_c = 15. mm
y_c = 39. mm
v_c = 19.38 mm
$\sigma_c = N/A - Mv/J_u$ = -113.9 N/mm^2
τ_c = 2.694 N/mm^2
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 114. N/mm^2
S^* = 2420. mm^3

ESΣ9.xxxx.010

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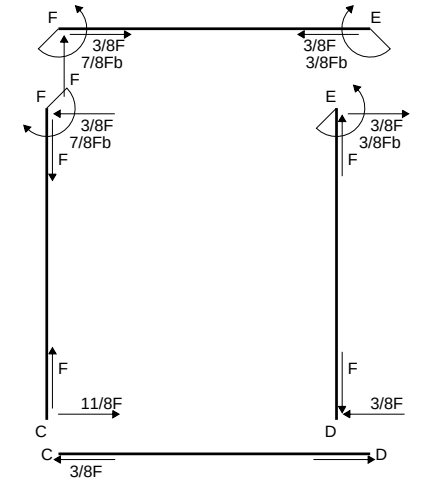
F
E
3/8F
7/8Fb
3/8F
3/8Fb
F
F
E
3/8F
7/8Fb
3/8F
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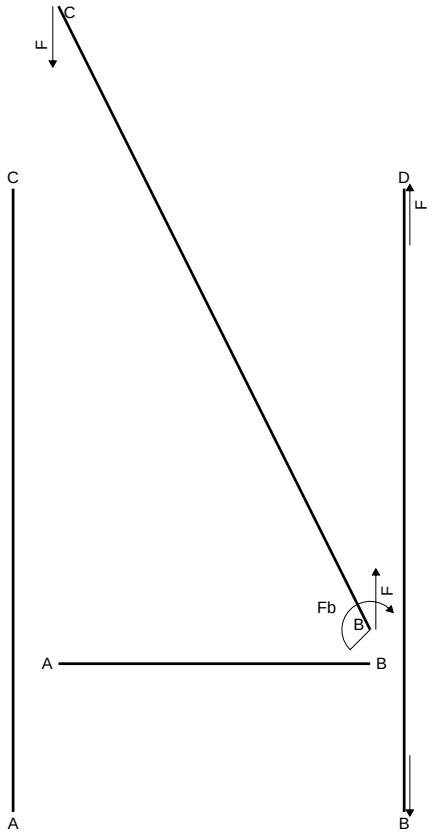
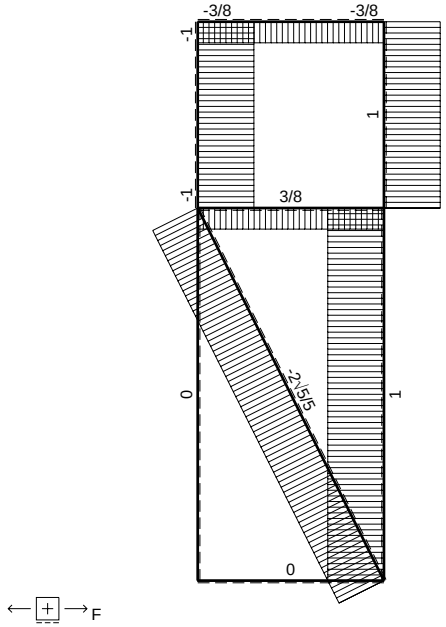
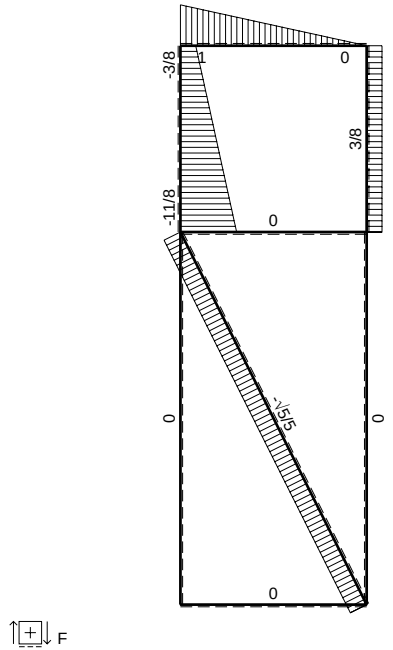
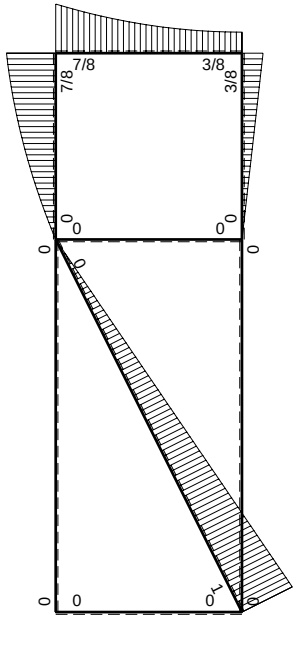
11/8F
3/8F
C
D
C
D
3/8F


C
F
C
D
F
Fb
B
F
A
B
A
B


-3/8
-3/8
-1
-1
1
3/8
0
1
0
1
-2√5/5
0
F


-3/8
1
0
3/8
-11/8
0
0
-√5/5
0
0
F


7/8
7/8
3/8
3/8
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0
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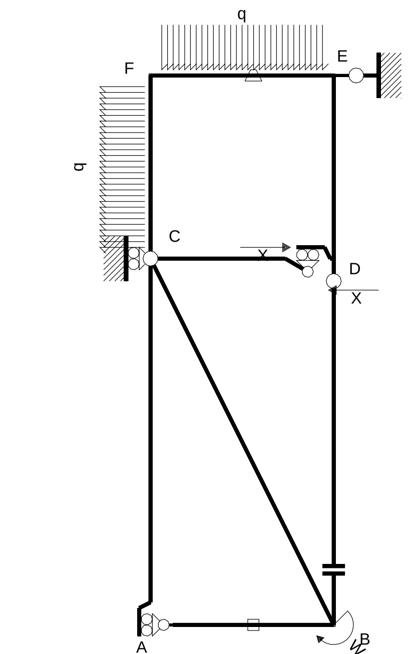
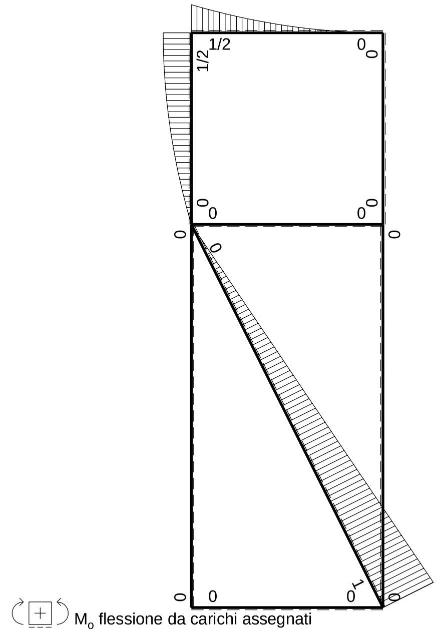
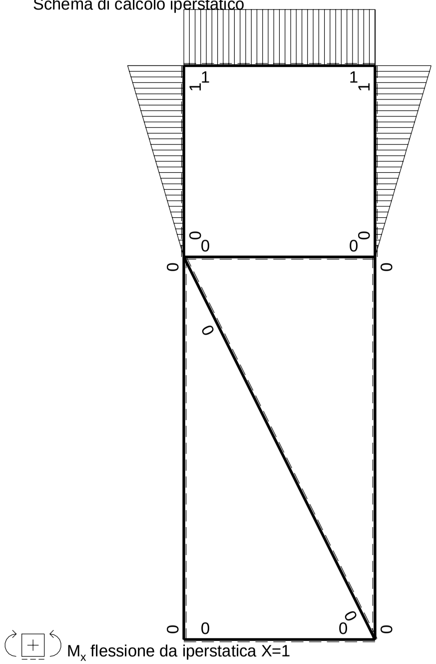
0
0
0
0
0
0
0
0
Fb



Schema di calcolo iperstatico



M_o flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=H_{DC}$

→	$M_x(x)$	$M_o(x)$	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		
BC √5b	0	Fb-√5/5Fx	0	0	0	0	0	0
AC 2b	0	0	0	0	0	0	0+0	0
CA 2b	0	0	0	0	0	0		
DB 2b	0	0	0	0	0	0	0+0	0
BD 2b	0	0	0	0	0	0		
DE b	x	0	0	0	0	x^2	0+0	$1/3Xb^3/EJ$
ED b	-b+x	0	0	0	0	$b^2-2bx+x^2$		
CD b	0	0	0	0	0	0	0+0	0
DC b	0	0	0	0	0	0		
EF b	b	$1/2qx^2$	-Fb/EJ	$1/2Fx^2$	$-Fb^2/EJ$	b^2	$(1/6-1)Fb^3/EJ$	Xb^3/EJ
FE b	-b	$-1/2Fb+Fx-1/2qx^2$	Fb/EJ	$1/2Fb^2-Fbx+1/2Fx^2$	$-Fb^2/EJ$	b^2		
FC b	b-x	$1/2Fb-1/2qx^2$	0	$1/2Fb^2-1/2Fbx-1/2Fx^2+1/2qx^3$	0	$b^2-2bx+x^2$	$(5/24+0)Fb^3/EJ$	$1/3Xb^3/EJ$
CF b	-x	$-Fx+1/2qx^2$	0	$Fx^2-1/2qx^3$	0	x^2		
	totali						$-5/8Fb^3/EJ$	$5/3Xb^3/EJ$
	iperstatica $X=H_{DC}$						3/8F	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

$L^{Xo}_{EF} = \int_o^b (1/2\, x^2/b^2)\, Fb^2\, 1/EJ\, dx + \int_o^b (-1)\, \theta\ dx = [1/6\, x^3/b^2]_o^b\, Fb^2\, 1/EJ + [- x]_o^b\, \theta$

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

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

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

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

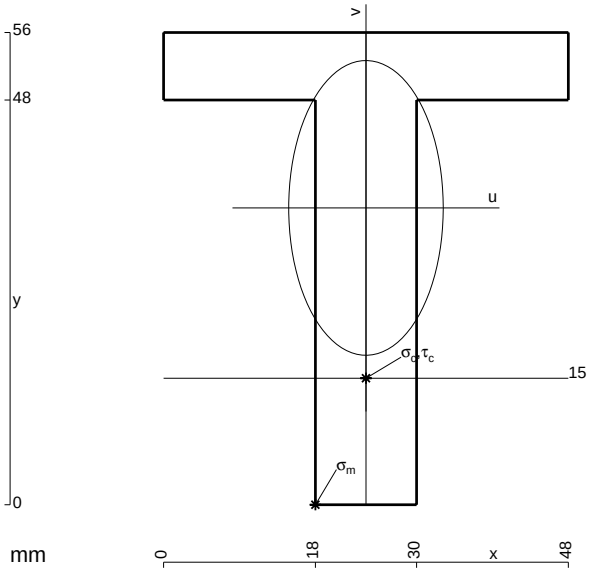
$L^{Xo}_{FC} = \int_o^b (1/2 -1/2\, x/b -1/2\, x^2/b^2 +1/2\, x^3/b^3)\, Fb^2\, 1/EJ\, dx$

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

$= (1/2\, b -1/4\, b -1/6\, b +1/8\, b)\, Fb^2\, 1/EJ = 5/24\ Fb^3/EJ$

$L^{Xo}_{CF} = \int_o^b (x^2/b^2 -1/2\, x^3/b^3)\, Fb^2\, 1/EJ\, dx = [1/3\, x^3/b^2 -1/8\, x^4/b^3]_o^b\, Fb^2\, 1/EJ$

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



A = 960. mm^2
J_u = 293274. mm^4
J_v = 80640. mm^4
y_g = 35.2 mm
N = -2513. N
T_y = -1257. N
M_x = 1854600. Nmm
x_m = 18. mm
u_m = -6. mm
v_m = -35.2 mm
$\sigma_m = N/A - Mv/J_u$ = 220. N/mm^2
x_c = 24. mm
y_c = 15. mm
v_c = -20.2 mm
$\sigma_c = N/A - Mv/J_u$ = 125.1 N/mm^2
τ_c = 1.78 N/mm^2
$\sigma_o = \sqrt{\sigma^2 + 3\tau^2}$ = 125.2 N/mm^2
S^* = 4986. mm^3

ESΣ9.xxxx.067

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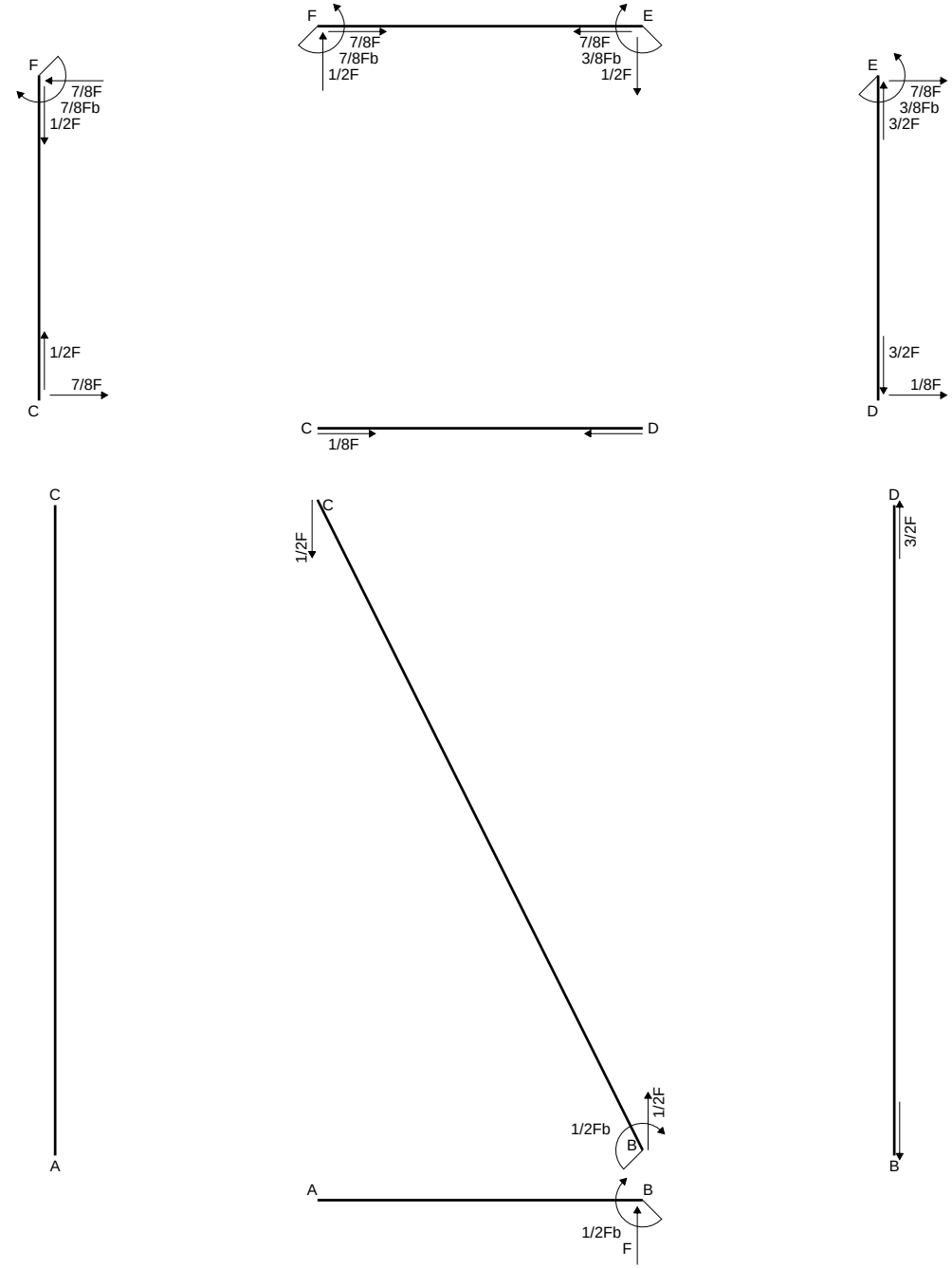
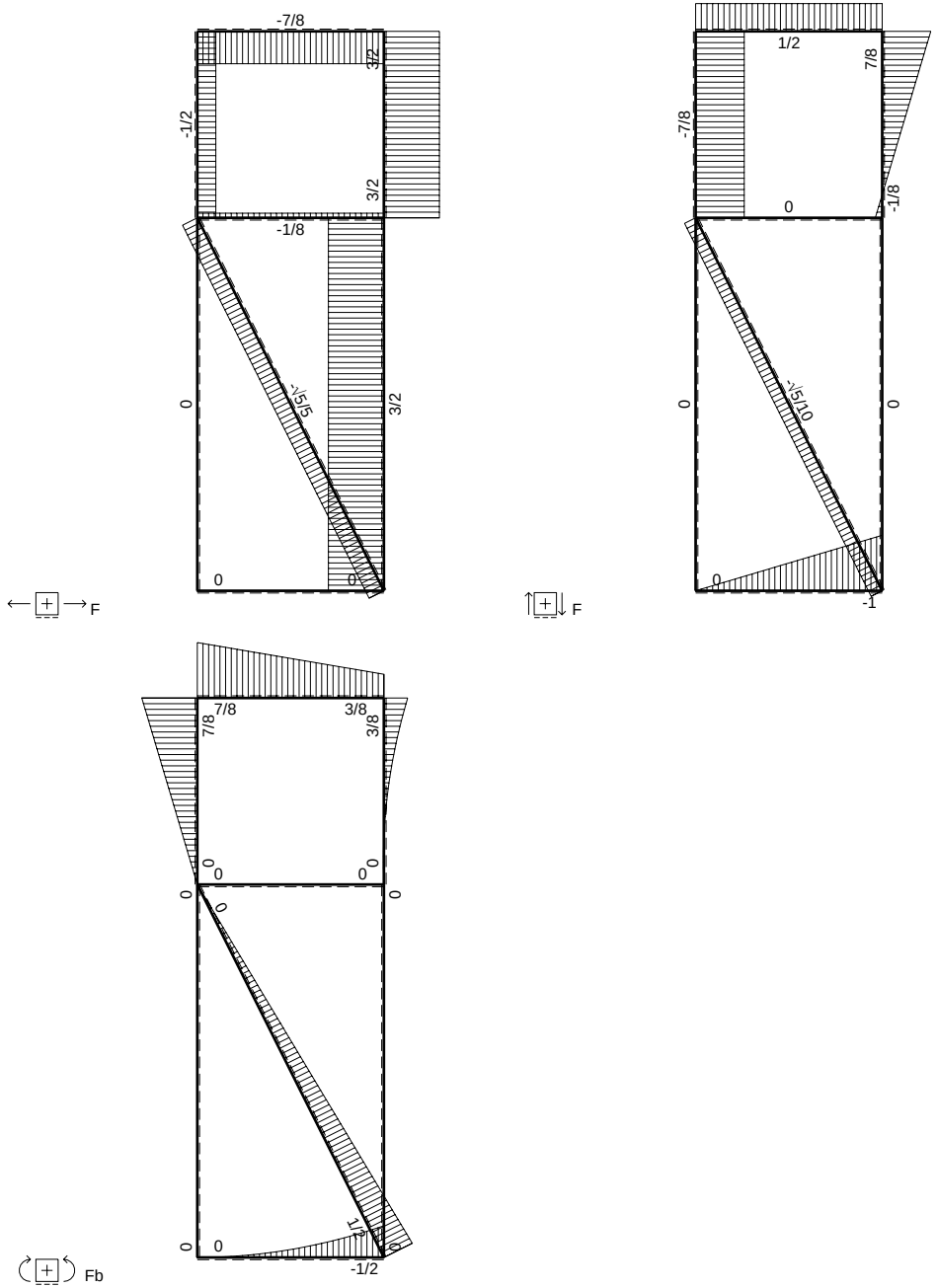
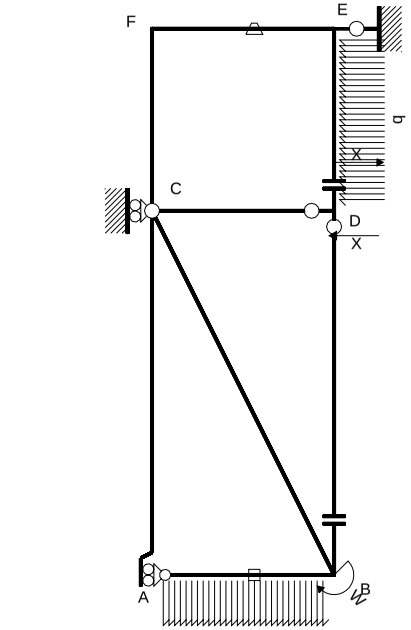
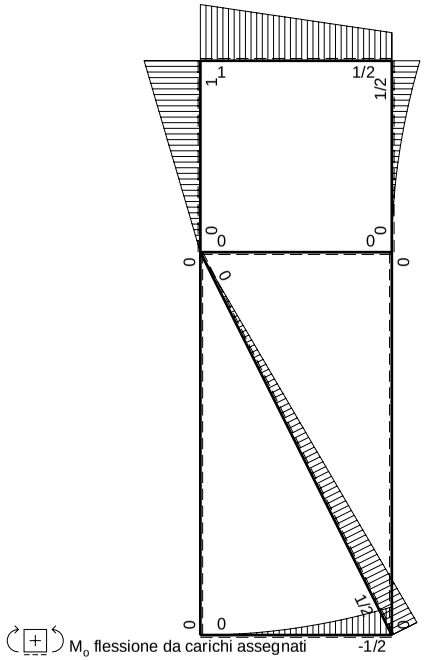

F
7/8F
7/8Fb
1/2F
E
7/8F
3/8Fb
1/2F
1/2F
7/8F
C
3/2F
1/8F
D
1/8F
A
1/2Fb
B

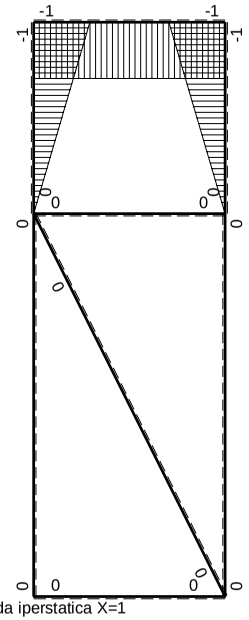

-7/8
3/2
-1/2
-1/8
-√5/5
0
1/2
7/8
-1/8
-√5/10
F
7/8
3/8
Fb
-1/2



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=H_{DE}$

→	$M_x(x)$	$M_o(x)$	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	$-1/2qx^2$	0	0	0	0	0+0	0
BA b	0	$1/2Fb-Fx+1/2qx^2$	0	0	0	0		
BC $\sqrt{5}$b	0	$1/2Fb-\sqrt{5}/10Fx$	0	0	0	0	0	0
AC 2b	0	0	0	0	0	0	0+0	0
CA 2b	0	0	0	0	0	0		
DB 2b	0	0	0	0	0	0	0+0	0
BD 2b	0	0	0	0	0	0		
DE b	-x	$1/2qx^2$	0	$-1/2qx^3$	0	x^2	$(-1/8+0)Fb^3/EJ$	$1/3Xb^3/EJ$
ED b	b-x	$-1/2Fb+Fx-1/2qx^2$	0	$-1/2Fb^2+3/2Fbx-3/2Fx^2+1/2qx^3$	0	$b^2-2bx+x^2$		
CD b	0	0	0	0	0	0	0+0	0
DC b	0	0	0	0	0	0		
EF b	-b	$1/2Fb+1/2Fx$	-Fb/EJ	$-1/2Fb^2-1/2Fbx$	Fb^2/EJ	b^2	$(-3/4+1)Fb^3/EJ$	Xb^3/EJ
FE b	b	$-Fb+1/2Fx$	Fb/EJ	$-Fb^2+1/2Fbx$	Fb^2/EJ	b^2		
FC b	-b+x	Fb-Fx	0	$-Fb^2+2Fbx-Fx^2$	0	$b^2-2bx+x^2$	$(-1/3+0)Fb^3/EJ$	$1/3Xb^3/EJ$
CF b	x	-Fx	0	$-Fx^2$	0	x^2		
	totali						$-5/24Fb^3/EJ$	$5/3Xb^3/EJ$
	iperstatica $X=H_{DE}$						1/8F	

Sviluppi di calcolo iperstatica

PROCEDIMENTO E RISULTATI 955930 ESΣ9.xxxx.084

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

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

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

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

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

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

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

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

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

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

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

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

$L^{Xo}_{DE} = \int_o^b (-1/2\, x^3/b^3)\, Fb^2\, 1/EJ\, dx = [-1/8\, x^4/b^3]_o^b\, Fb^2\, 1/EJ$

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

$L^{Xo}_{ED} = \int_o^b (-1/2 + 3/2\, x/b - 3/2\, x^2/b^2 + 1/2\, x^3/b^3)\, Fb^2\, 1/EJ\, dx$

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

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

$L^{Xo}_{EF} = \int_o^b (-1/2 - 1/2\, x/b)\, Fb^2\, 1/EJ\, dx + \int_o^b (1)\, \theta\, dx = [-1/2\, x - 1/4\, x^2/b]_o^b\, Fb^2\, 1/EJ + [\, x]_o^b\, \theta$

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

$L^{Xo}_{FE} = \int_o^b (-1 + 1/2\, x/b)\, Fb^2\, 1/EJ\, dx + \int_o^b (-1)\, \theta\, dx = [-\, x + 1/4\, x^2/b]_o^b\, Fb^2\, 1/EJ + [-\, x]_o^b\, \theta$

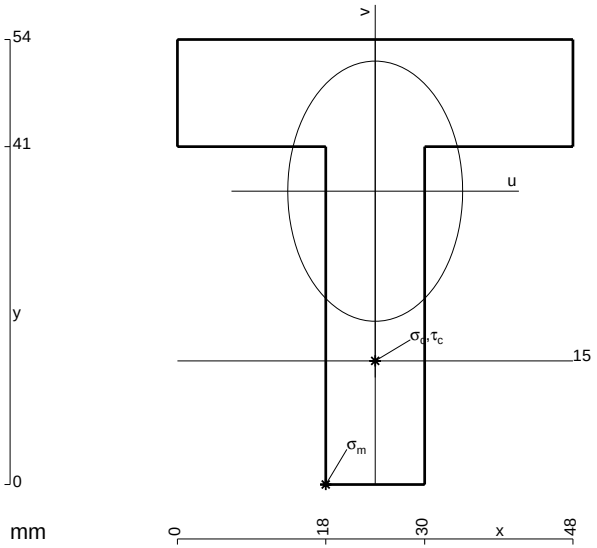
$= (-\, b + 1/4\, b)\, Fb^2\, 1/EJ + (-\, b)\, \theta = 1/4\ Fb^3/EJ$

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

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

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

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



A = 1116. mm^2
J_u = 278254. mm^4
J_v = 125712. mm^4
y_g = 35.6 mm
T_y = -7070. N
M_x = -1873550. Nmm
x_m = 18. mm
u_m = -6. mm
v_m = -35.6 mm
$\sigma_m = -Mv/J_u$ = -239.7 N/mm^2
x_c = 24. mm
y_c = 15. mm
v_c = -20.6 mm
$\sigma_c = -Mv/J_u$ = -138.7 N/mm^2
τ_c = 10.71 N/mm^2
$\sigma_0 = \sqrt{\sigma^2 + 3\tau^2}$ = 139.9 N/mm^2
S^* = 5057. mm^3

ESΣ9.xxxx.084

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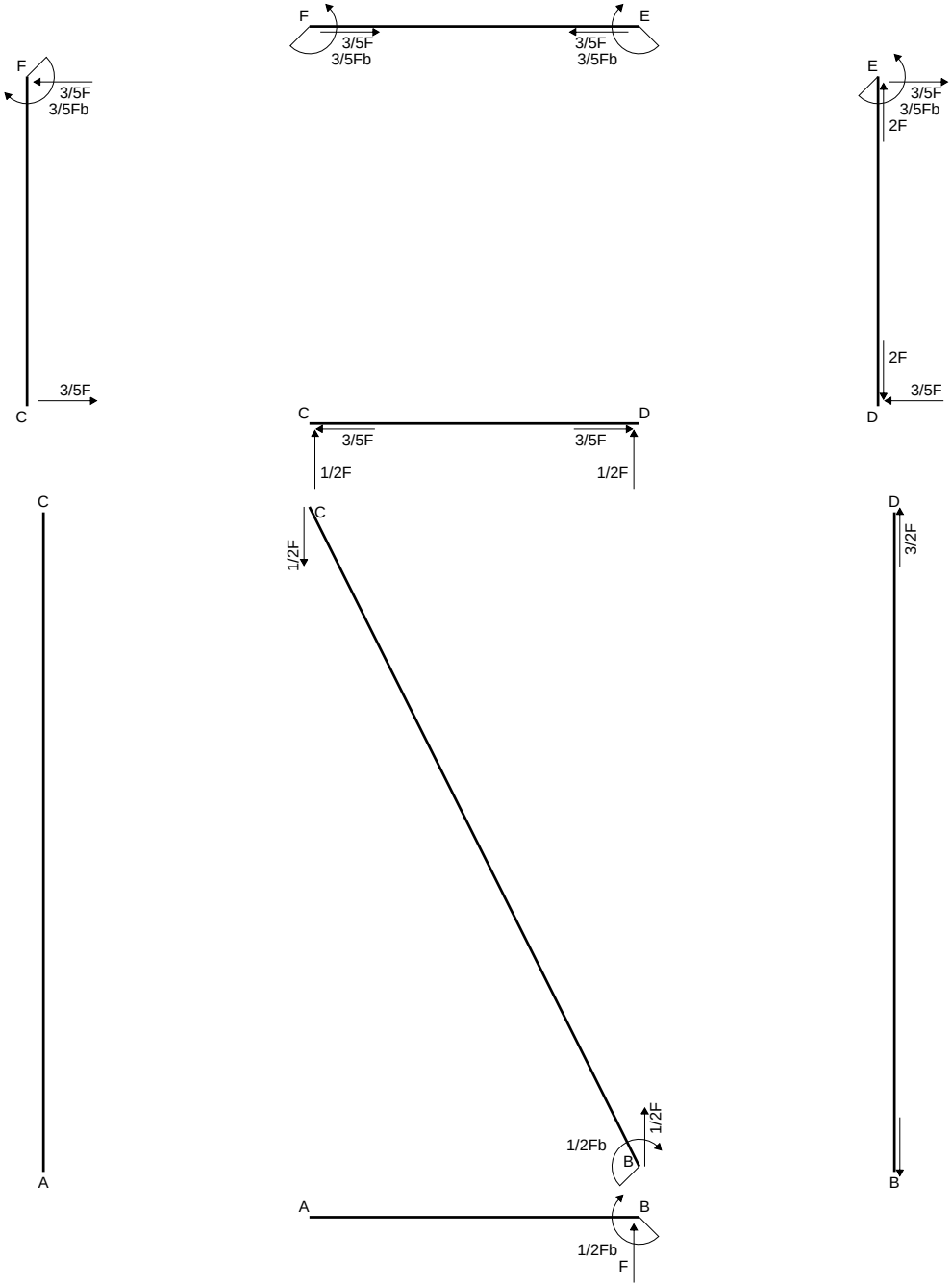
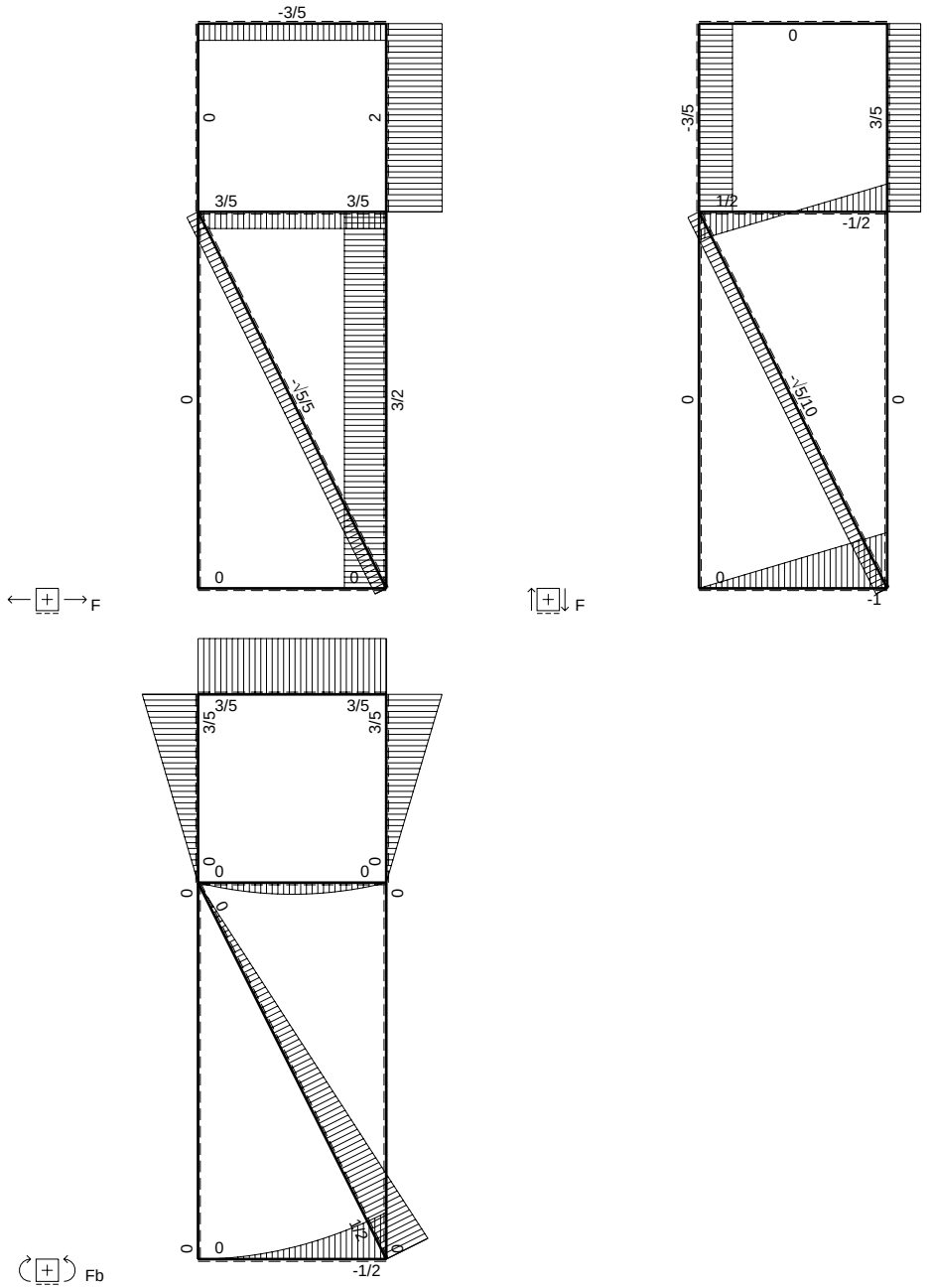

F
E
3/5F
3/5Fb
3/5F
3/5Fb
F
3/5F
3/5Fb
E
3/5F
3/5Fb
2F
C
3/5F
2F
D
3/5F
C
D
3/5F
3/5F
1/2F
1/2F
C
D
1/2F
3/2F
1/2F
1/2Fb
B
A
B
1/2Fb
F


-3/5
0
2
3/5
3/5
0
3/2
-3/5
0
0
F
0
-3/5
3/5
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-1/2
0
-3/10
0
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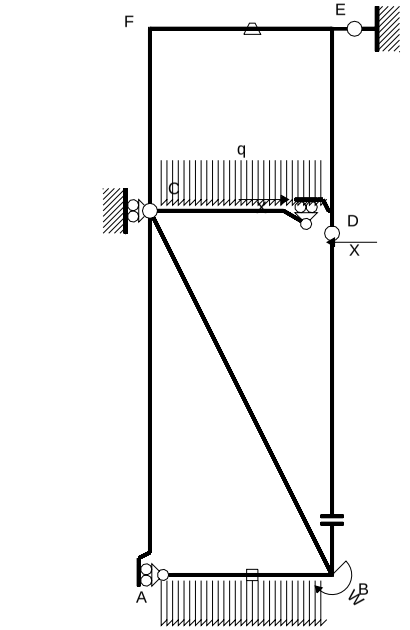
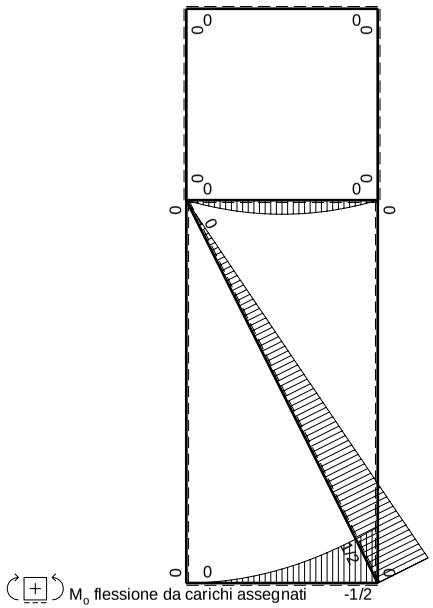
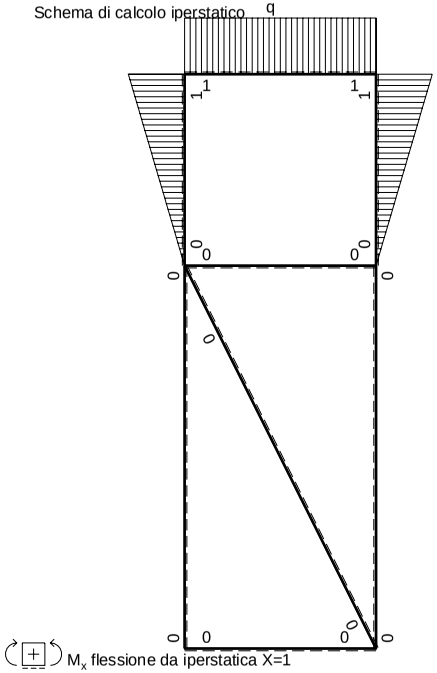
0
0
0
0
0
0
-1/2
Fb







Quadro contributi PLV per iperstatica $X=H_{DC}$

→	$M_x(x)$	$M_o(x)$	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	$-1/2qx^2$	0	0	0	0	0+0	0
BA b	0	$1/2Fb-Fx+1/2qx^2$	0	0	0	0		
BC $\sqrt{5}$b	0	$1/2Fb-\sqrt{5}/10Fx$	0	0	0	0	0	0
AC 2b	0	0	0	0	0	0	0+0	0
CA 2b	0	0	0	0	0	0		
DB 2b	0	0	0	0	0	0	0+0	0
BD 2b	0	0	0	0	0	0		
DE b	x	0	0	0	0	x^2	0+0	$1/3Xb^3/EJ$
ED b	-b+x	0	0	0	0	$b^2-2bx+x^2$		
CD b	0	$1/2Fx-1/2qx^2$	0	0	0	0	0+0	0
DC b	0	$-1/2Fx+1/2qx^2$	0	0	0	0		
EF b	b	0	-Fb/EJ	0	$-Fb^2/EJ$	b^2	$(0-1)Fb^3/EJ$	Xb^3/EJ
FE b	-b	0	Fb/EJ	0	$-Fb^2/EJ$	b^2		
FC b	b-x	0	0	0	0	$b^2-2bx+x^2$	0+0	$1/3Xb^3/EJ$
CF b	-x	0	0	0	0	x^2		
	totali						$-Fb^3/EJ$	$5/3Xb^3/EJ$
	iperstatica $X=H_{DC}$						3/5F	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

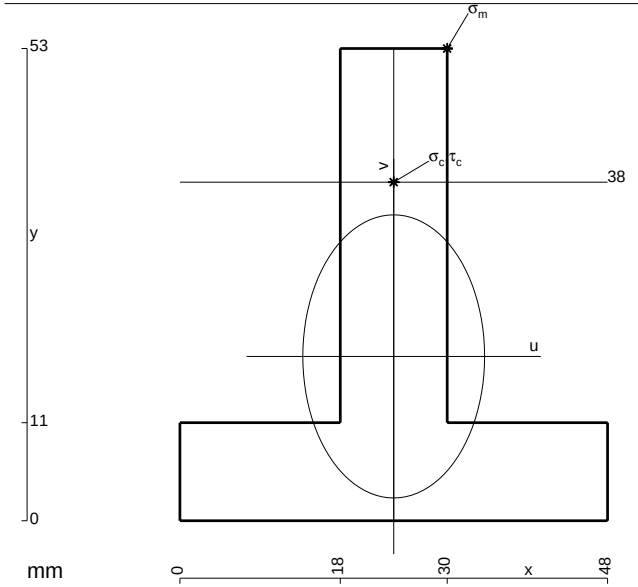
$$L^{Xo}_{EF} = \int_o^b \left(-1 \right) \theta\ dx = \left[- x \right]_o^b \theta$$

$$= \left(- b \right) \theta = - Fb^3/EJ$$

$$L^{Xo}_{FE} = \int_o^b \left(1 \right) \theta\ dx = \left[x \right]_o^b \theta$$

$$= \left(b \right) \theta = - Fb^3/EJ$$

PROCEDIMENTO E RISULTATI 983213 ESΣ9.xxxx.111



A = 1032. mm^2
J_u = 260495. mm^4
J_v = 107424. mm^4
y_g = 18.44 mm
T_y = -7910. N
M_x = -1582000. Nmm
x_m = 30. mm
y_m = 53. mm
u_m = 6. mm
v_m = 34.56 mm
$\sigma_m = -Mv/J_u$ = 209.9 N/mm^2
x_c = 24. mm
y_c = 38. mm
v_c = 19.56 mm
$\sigma_c = -Mv/J_u$ = 118.8 N/mm^2
τ_c = 12.32 N/mm^2
$\sigma_o = \sqrt{\sigma^2 + 3\tau^2}$ = 120.7 N/mm^2
S^* = 4870. mm^3

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ESΣ9.xxxx.111

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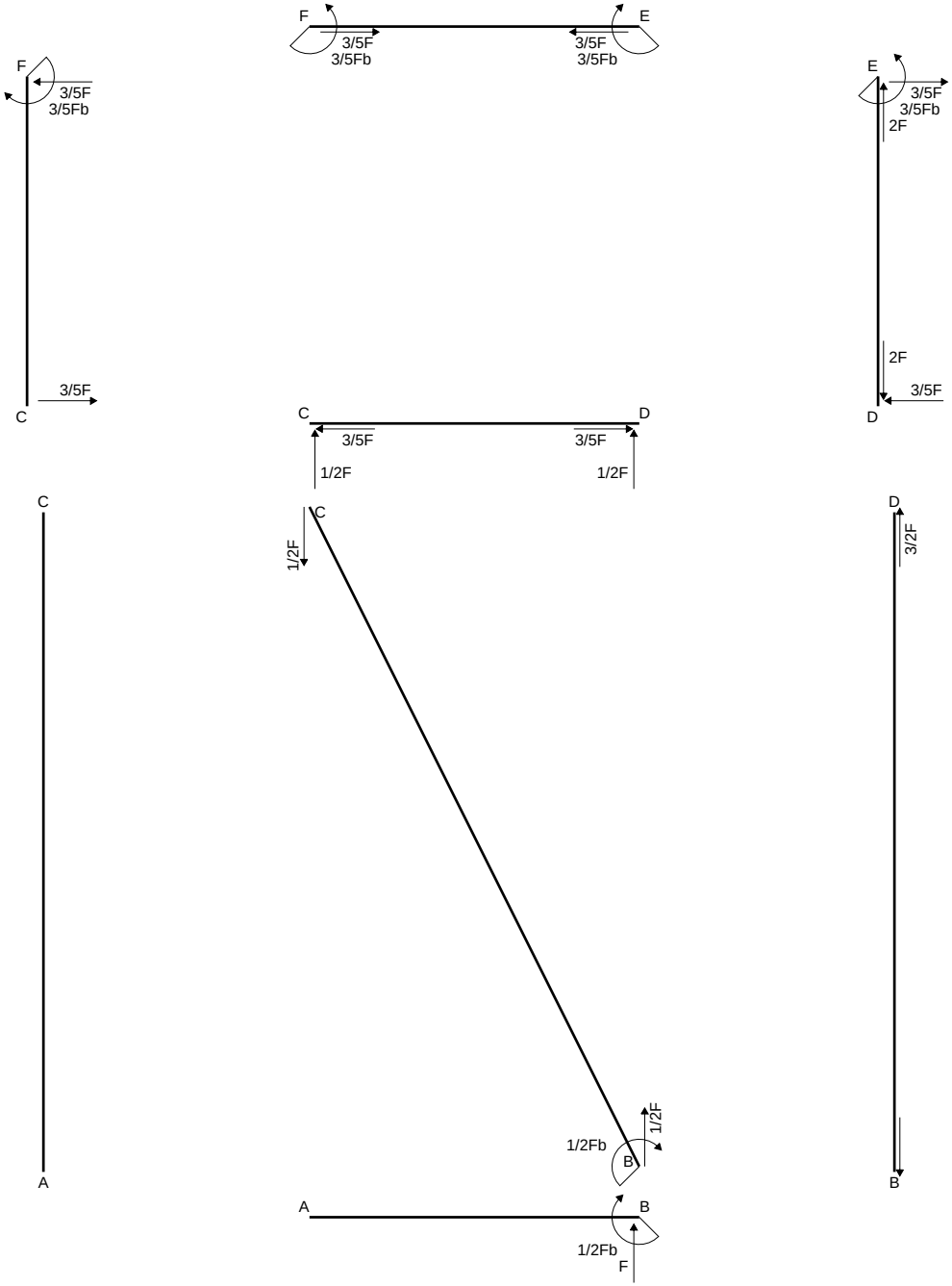
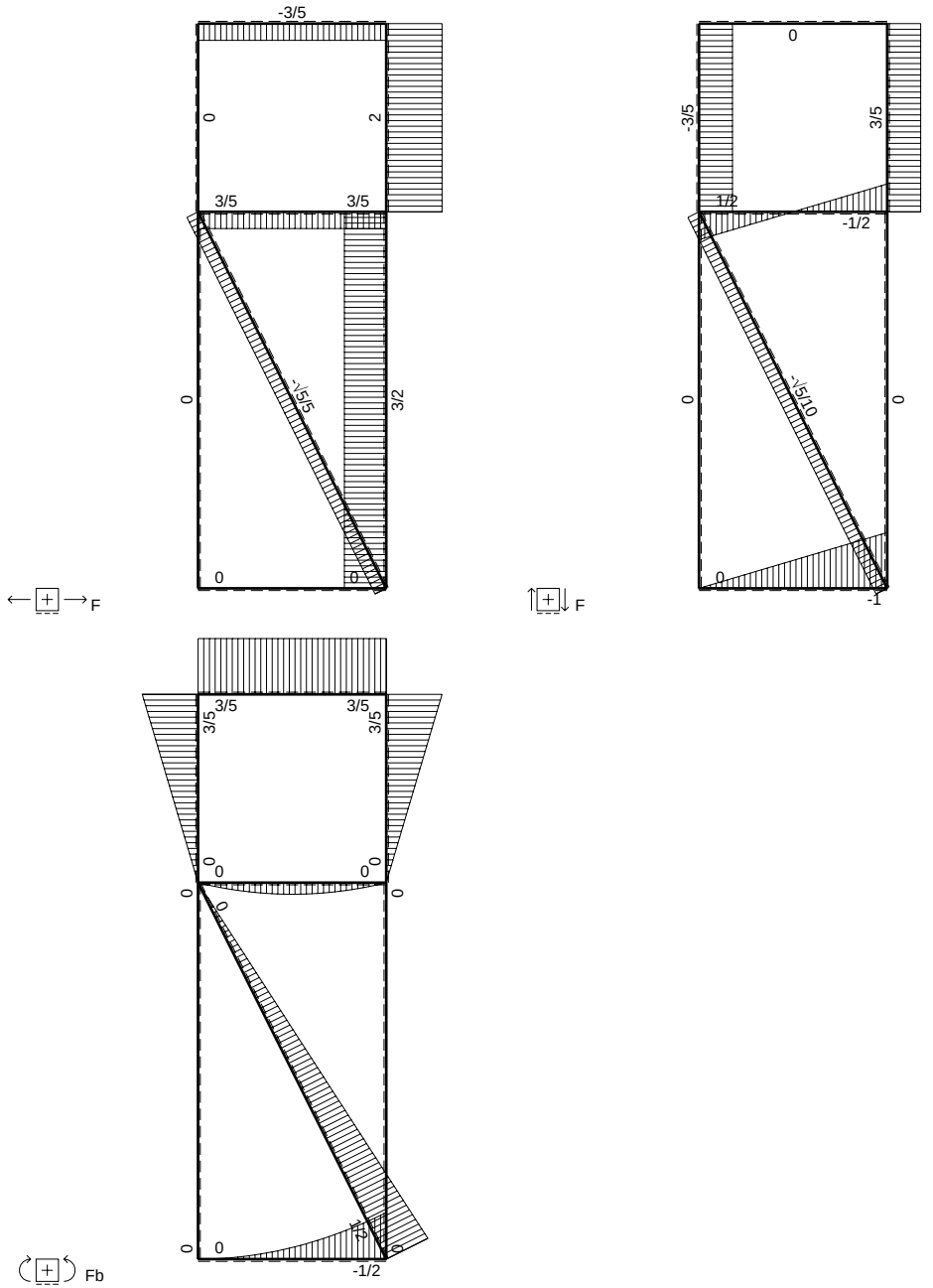

F
E
3/5F
3/5Fb
3/5F
3/5Fb
F
3/5F
3/5Fb
E
3/5F
3/5Fb
2F
C
3/5F
2F
D
3/5F
C
D
3/5F
3/5F
1/2F
1/2F
C
D
1/2F
3/2F
1/2F
1/2Fb
B
A
B
1/2Fb
F


-3/5
0
2
3/5
3/5
0
3/2
-√5/5
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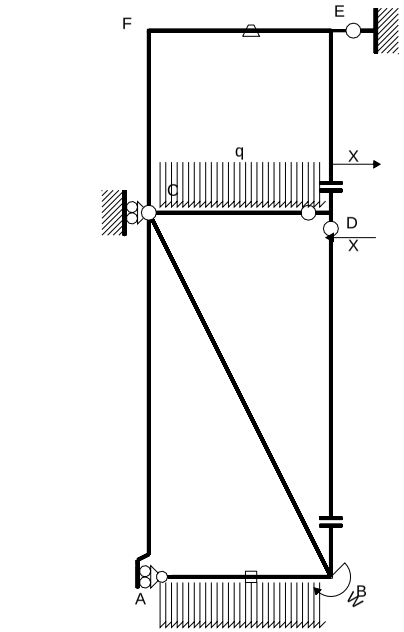
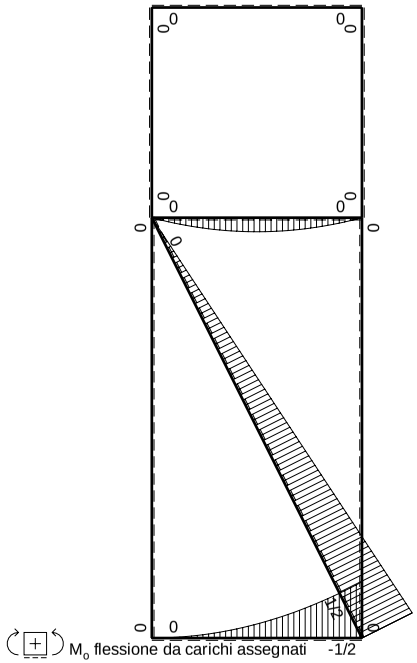
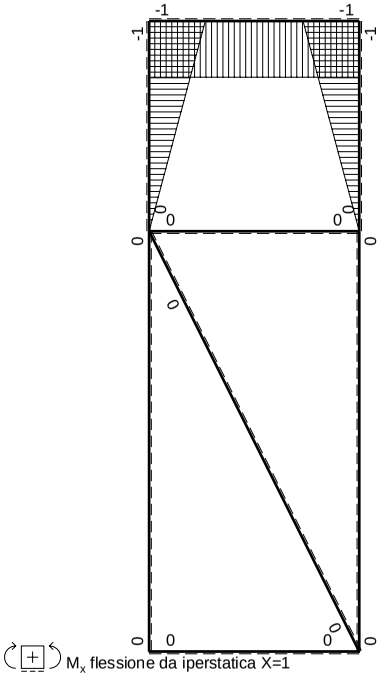
0
F
0
-3/5
3/5
1/2
-1/2
0
-√5/10
0
0
-1
F
3/5
3/5
3/5
3/5
0
0
0
0
0
0
0
-√2
0
-1/2
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=H_{DE}$

→	$M_x(x)$	$M_o(x)$	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	$-1/2qx^2$	0	0	0	0	0+0	0
BA b	0	$1/2Fb-Fx+1/2qx^2$	0	0	0	0		
BC √5b	0	$1/2Fb-\sqrt{5}/10Fx$	0	0	0	0	0	0
AC 2b	0	0	0	0	0	0	0+0	0
CA 2b	0	0	0	0	0	0		
DB 2b	0	0	0	0	0	0	0+0	0
BD 2b	0	0	0	0	0	0		
DE b	-x	0	0	0	0	x^2	0+0	$1/3Xb^3/EJ$
ED b	b-x	0	0	0	0	$b^2-2bx+x^2$		
CD b	0	$1/2Fx-1/2qx^2$	0	0	0	0	0+0	0
DC b	0	$-1/2Fx+1/2qx^2$	0	0	0	0		
EF b	-b	0	$-Fb/EJ$	0	Fb^2/EJ	b^2	$(0+1)Fb^3/EJ$	Xb^3/EJ
FE b	b	0	Fb/EJ	0	Fb^2/EJ	b^2		
FC b	-b+x	0	0	0	0	$b^2-2bx+x^2$	0+0	$1/3Xb^3/EJ$
CF b	x	0	0	0	0	x^2		
	totali						Fb^3/EJ	$5/3Xb^3/EJ$
	iperstatica $X=H_{DE}$						-3/5F	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

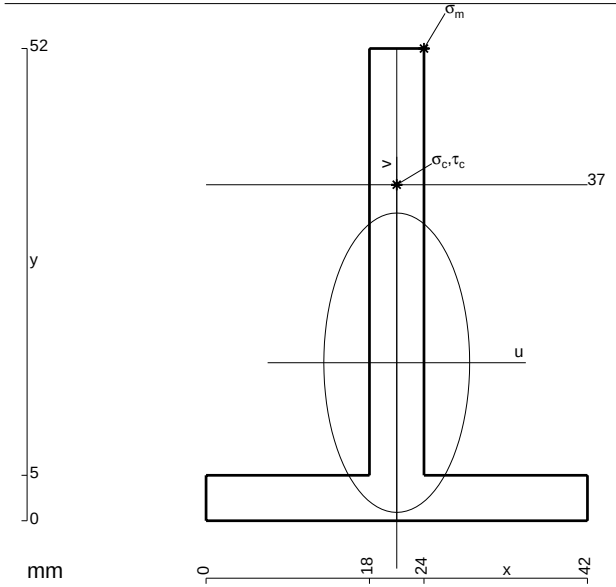
$L^{Xo}_{EF} = \int_o^b (1)\, \theta\ dx = [x]_o^b\, \theta$

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

$L^{Xo}_{FE} = \int_o^b (-1)\, \theta\ dx = [- x]_o^b\, \theta$

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

PROCEDIMENTO E RISULTATI 955914 ESΣ9.xxxx.144



A = 492. mm^2
J_u = 133716. mm^4
J_v = 31716. mm^4
y_g = 17.4 mm
T_y = -3630. N
M_x = -925650. Nmm
x_m = 24. mm
y_m = 52. mm
u_m = 3. mm
v_m = 34.6 mm
$\sigma_m = -Mv/J_u$ = 239.5 N/mm^2
x_c = 21. mm
y_c = 37. mm
v_c = 19.6 mm
$\sigma_c = -Mv/J_u$ = 135.7 N/mm^2
τ_c = 11.03 N/mm^2
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 137. N/mm^2
S^* = 2439. mm^3

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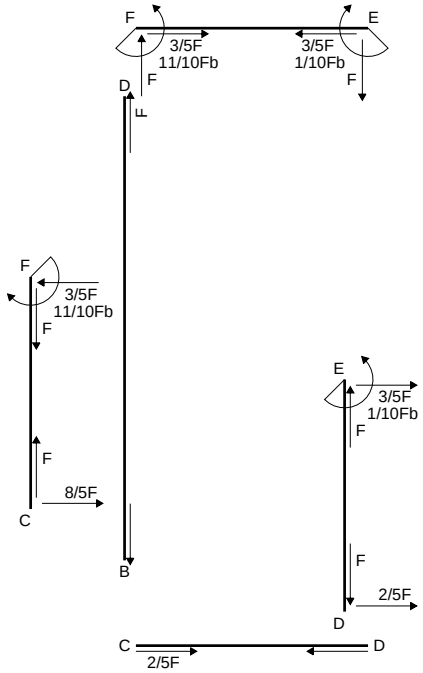
F
E
3/5F
11/10Fb
3/5F
1/10Fb
D
F
F
F
3/5F
11/10Fb
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E
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1/10Fb
F
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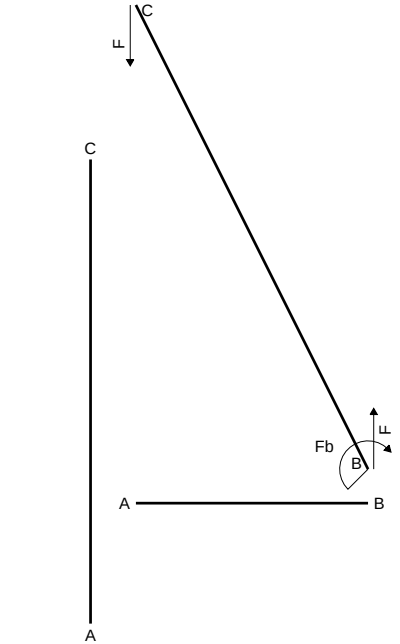
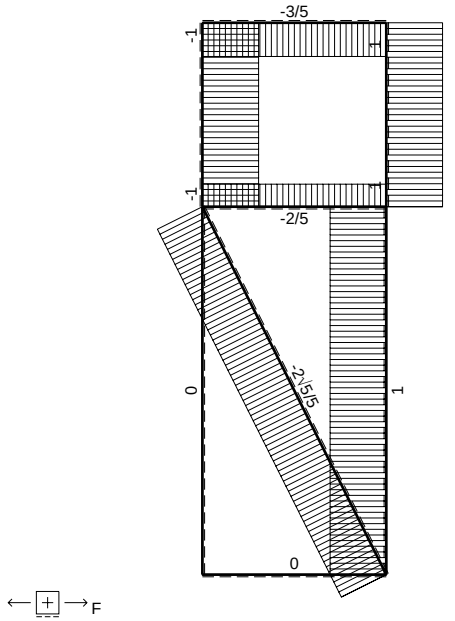
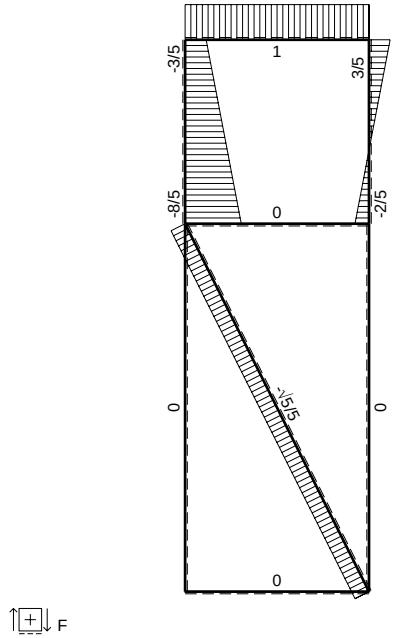
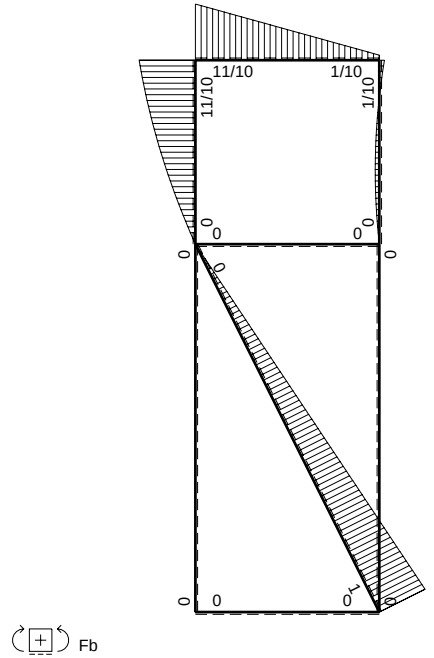
C
B
F
2/5F
D
C
2/5F
D


C
F
C
Fb
F
B
A
B
A


-3/5
-1
1
-1
1
-2/5
0
-2/5/5
1
0
F


-3/5
1
3/5
-8/5
0
-2/5
0
-2/5/5
0
0
F


11/10
1/10
11/10
1/10
0
0
0
0
0
0
0
0
0
0
Fb

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

→	$M_x(x)$	$M_o(x)$	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		
BC √5b	0	Fb-√5/5Fx	0	0	0	0	0	0
AC 2b	0	0	0	0	0	0	0+0	0
CA 2b	0	0	0	0	0	0		
DB 2b	0	0	0	0	0	0	0+0	0
BD 2b	0	0	0	0	0	0		
DE b	-x/b	-3/2Fx+1/2qx²	0	3/2Fx²/b-1/2qx³/b	0	x²/b²	(3/8+0)Fb²/EJ	1/3Xb/EJ
ED b	1-x/b	Fb-1/2Fx-1/2qx²	0	Fb-3/2Fx+1/2qx³/b	0	1-2x/b+x²/b²		
CD b	0	0	0	0	0	0	0+0	0
DC b	0	0	0	0	0	0		
EF b	-1	-Fb+Fx	-Fb/EJ	Fb-Fx	Fb/EJ	1	(1/2+1)Fb²/EJ	Xb/EJ
FE b	1	Fx	Fb/EJ	Fx	Fb/EJ	1		
FC b	-1+x/b	1/2Fx-1/2qx²	0	-1/2Fx²/b-1/2qx³/b	0	1-2x/b+x²/b²	(-1/24+0)Fb²/EJ	1/3Xb/EJ
CF b	x/b	-1/2Fx+1/2qx²	0	-1/2Fx²/b+1/2qx³/b	0	x²/b²		
	totali						11/6Fb²/EJ	5/3Xb/EJ
	iperstatica $X=W_{FC}$						-11/10Fb	

Sviluppi di calcolo iperstatica

PROCEDIMENTO E RISULTATI 980904 ESΣ9.xxxx.153

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

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

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

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

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

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

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

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

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

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

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

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

$L^{Xo}_{DE} = \int_o^b (3/2\ x^2/b^2 -1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [1/2\ x^3/b^2 -1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

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

$L^{Xo}_{ED} = \int_o^b (1 -3/2\ x/b +1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [\ x -3/4\ x^2/b +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

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

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

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

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

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

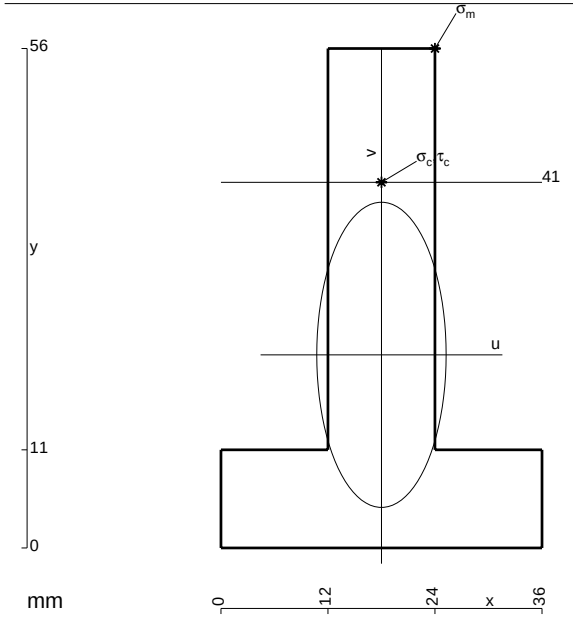
$L^{Xo}_{FC} = \int_o^b (-1/2\ x/b + x^2/b^2 -1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [-1/4\ x^2/b +1/3\ x^3/b^2 -1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

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

$L^{Xo}_{CF} = \int_o^b (-1/2\ x^2/b^2 +1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [-1/6\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

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

PROCEDIMENTO E RISULTATI 980904 ESΣ9.xxxx.153



A = 936. mm^2
J_u = 274232. mm^4
J_v = 49248. mm^4
y_g = 21.65 mm
N = -3229. N
T_y = -1614. N
M_x = 1805000. Nmm
x_m = 24. mm
y_m = 56. mm
u_m = 6. mm
v_m = 34.35 mm
$\sigma_m = N/A - Mv/J_u$ = -229.5 N/mm^2
x_c = 18. mm
y_c = 41. mm
v_c = 19.35 mm
$\sigma_c = N/A - Mv/J_u$ = -130.8 N/mm^2
τ_c = 2.371 N/mm^2
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 130.9 N/mm^2
S^* = 4832. mm^3

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