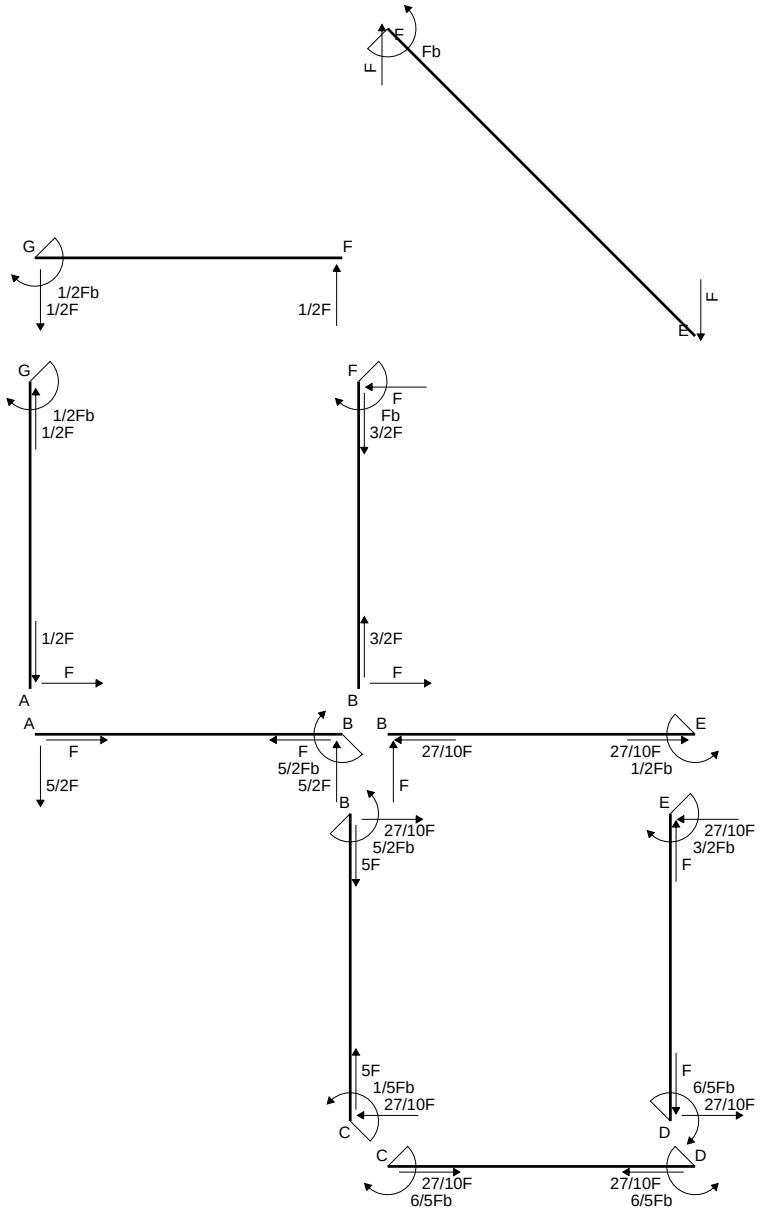
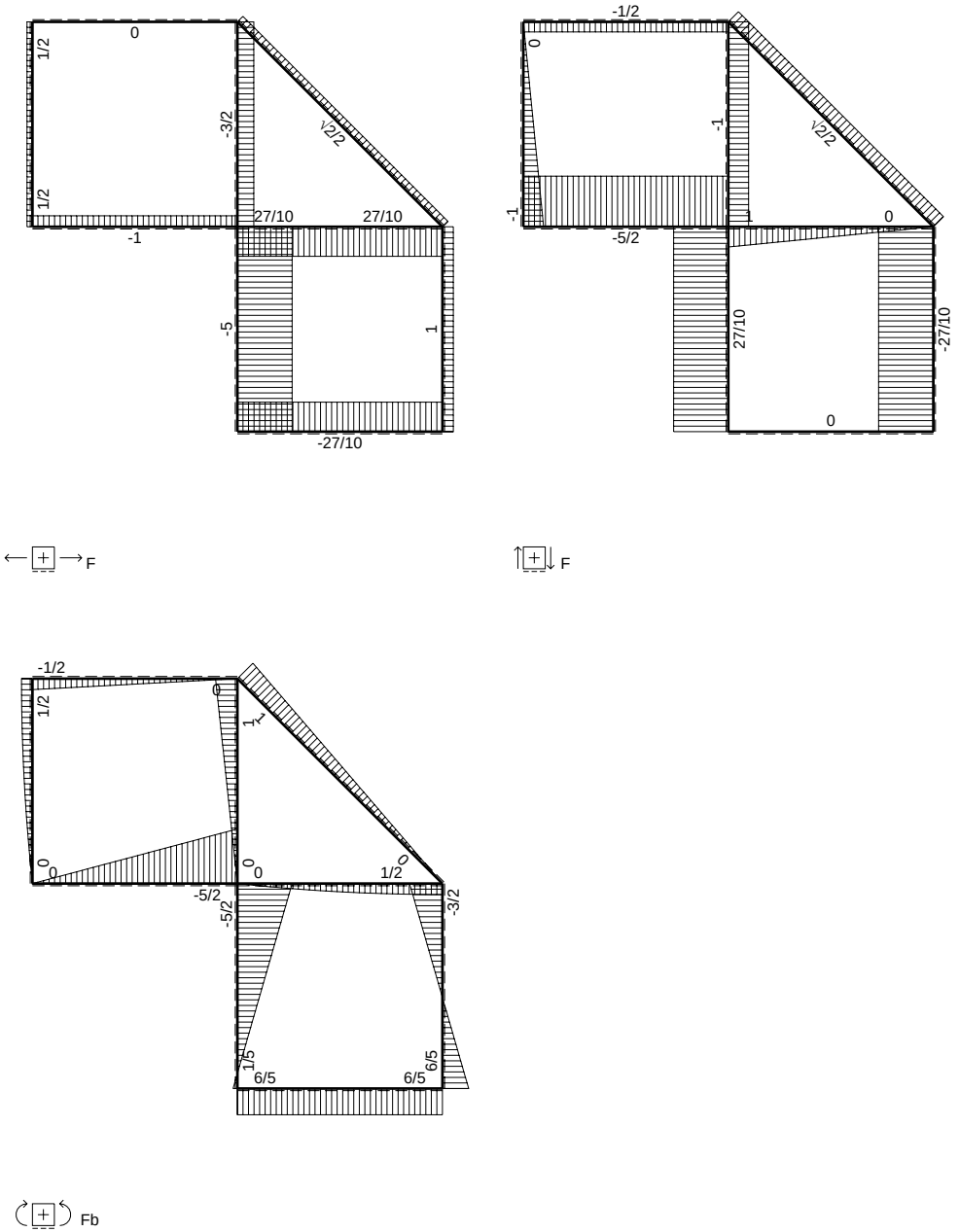
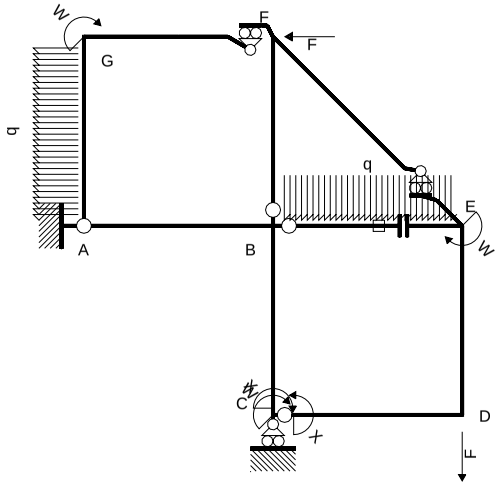
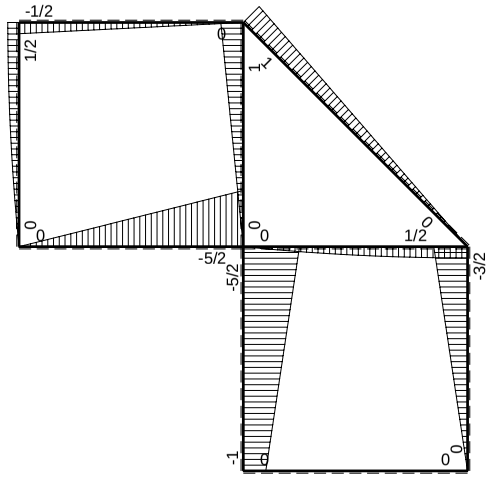

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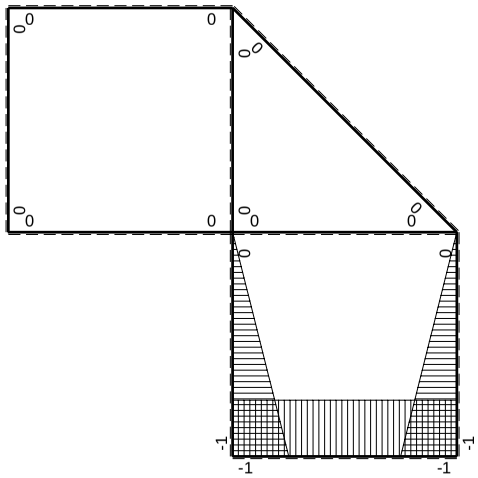

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Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0		
BC b	-x/b	-5/2Fb+3/2Fx	$5/2Fx-3/2Fx^2/b$	x^2/b^2	$3/4Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	$Fb+1/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE 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
ED b	x/b	3/2Fb-3/2Fx	$3/2Fx-3/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-1/2Fx	0	0	0	0
GF b	0	1/2Fb-1/2Fx	0	0		
GA b	0	$1/2Fb-1/2qx^2$	0	0	0	0
AG b	0	$-Fx+1/2qx^2$	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	$Fx-1/2qx^2$	0	0	0	0
EB b	0	$-1/2Fb+1/2qx^2$	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$2Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-6/5Fb	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ \ Fb^2/EJ$

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

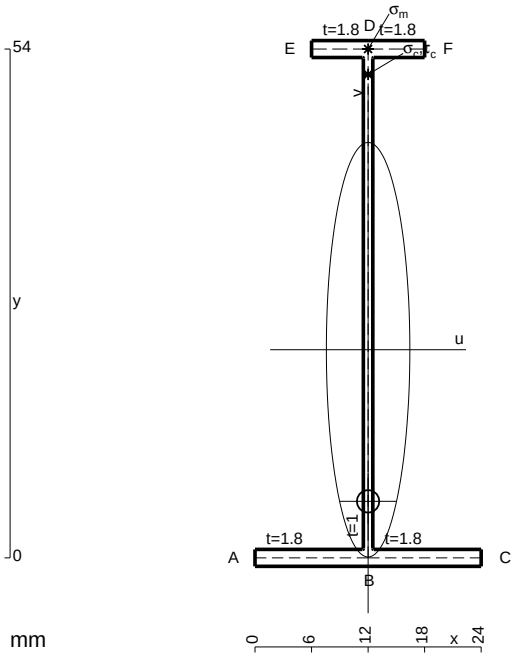
$= (\ b +1/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ \ Fb^2/EJ$

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

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

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

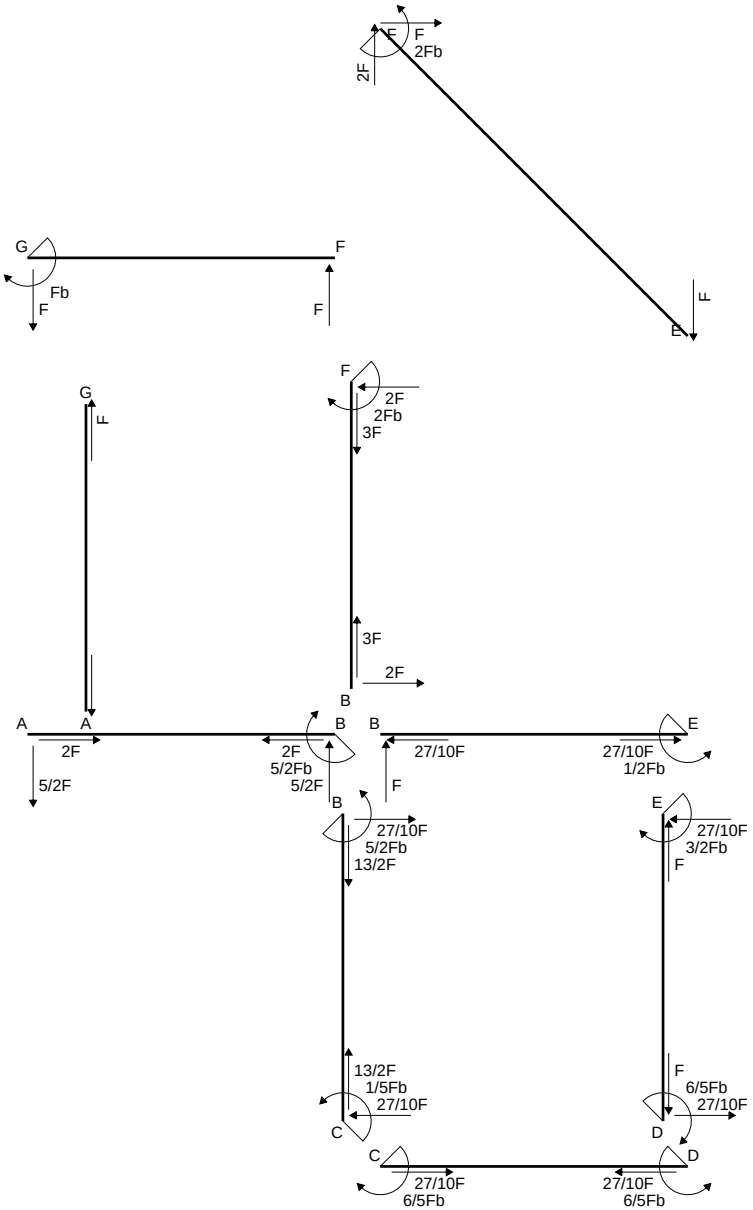
$= (3/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 1/4\ \ Fb^2/EJ$

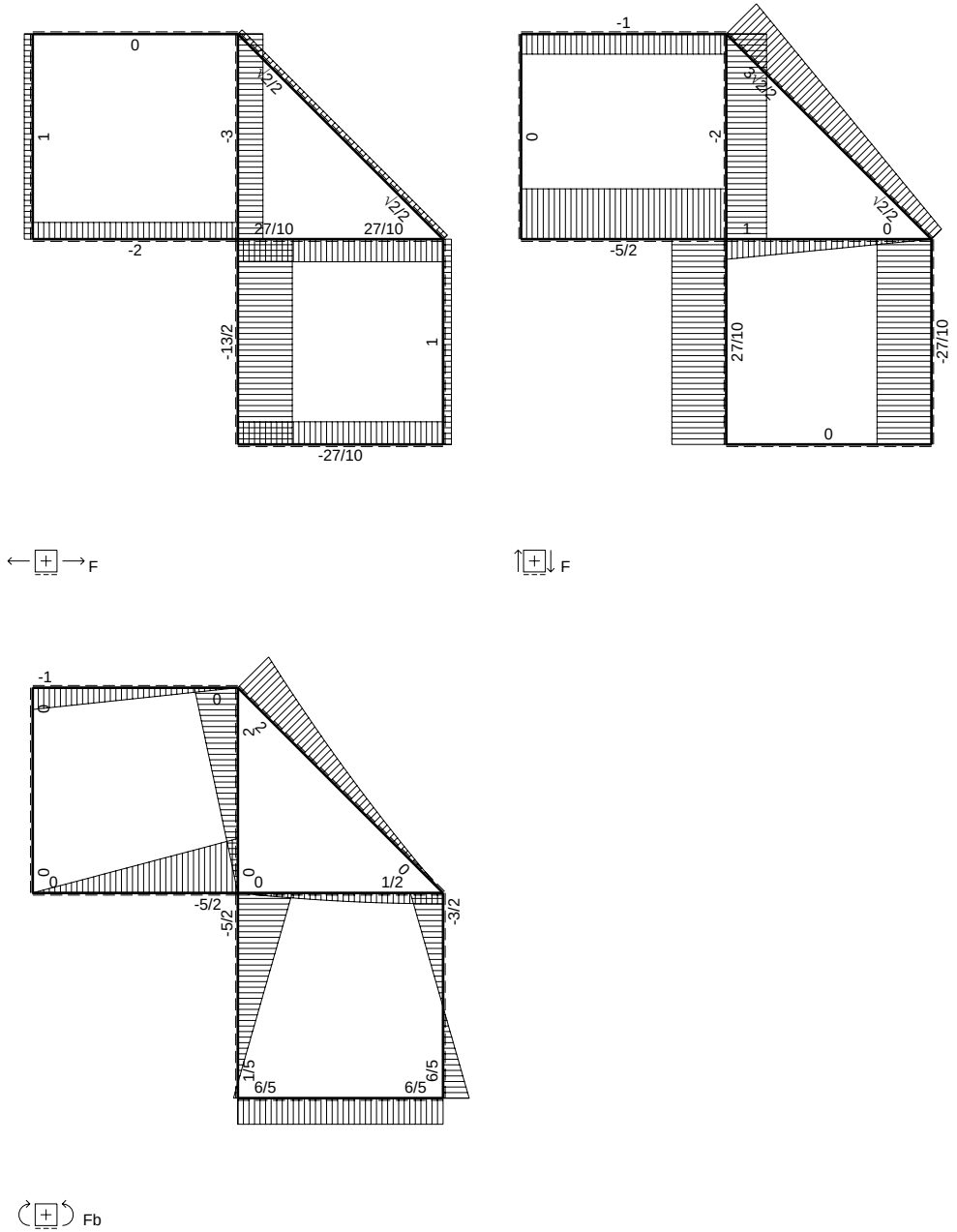


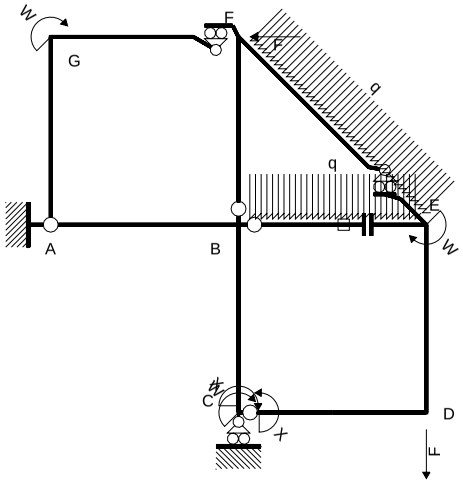
A = 118.8 mm^2
J_u = 57498. mm^4
J_v = 2333. mm^4
J_t = 87.98 mm^4
y_o = -16.09 mm
y_g = 22.09 mm
N = -270. N
T_y = -675. N
M_x = -378000. Nmm
x_m = 12. mm
y_m = 54. mm
v_m = 31.91 mm
$\sigma_m = N/A - Mv/J_u$ = 207.5 N/mm^2
y_c = 2. mm
u_c = -12. mm
v_c = -20.09 mm
$\sigma_c = N/A - Mv/J_u$ = 207.5 N/mm^2
$\tau_c = TS^*/tJ_u$ = 8.091 N/mm^2
$\tau_g = TS^*/tJ_u$ = 8.091 N/mm^2
t_c = 270. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 208. N/mm^2

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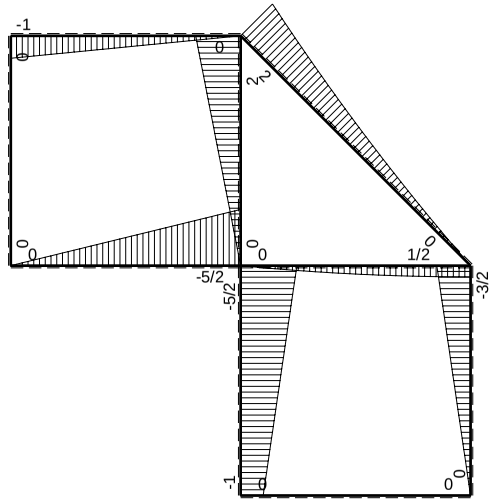
@ Adolfo Zavelani Rossi, Politecnico di Milano, vers.27.03.13 16.04.26


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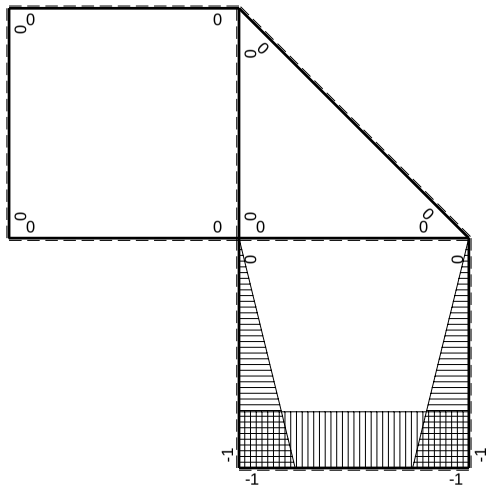

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Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0		
BC b	-x/b	-5/2Fb+3/2Fx	5/2Fx-3/2Fx^2/b	x^2/b^2	3/4Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	Fb+1/2Fx-3/2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE 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
ED b	x/b	3/2Fb-3/2Fx	3/2Fx-3/2Fx^2/b	x^2/b^2		
EF √2b	0	√2/2Fx+1/2qx^2	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	Fx-1/2qx^2	0	0	0	0
EB b	0	-1/2Fb+1/2qx^2	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				2Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-6/5Fb	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ \ Fb^2/EJ$

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

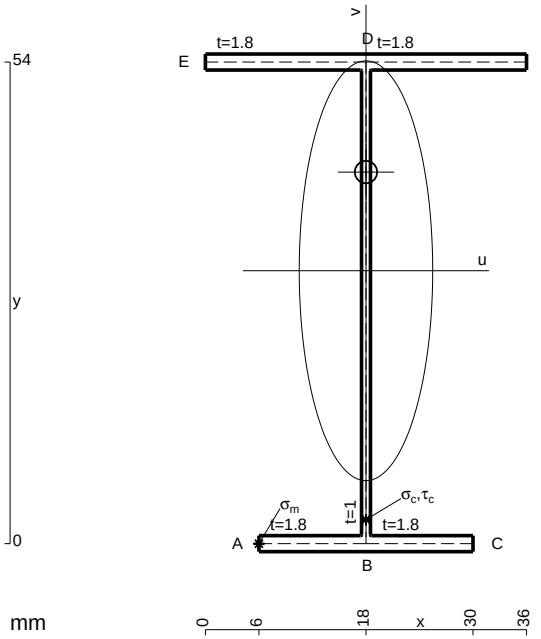
$= (\ b +1/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ \ Fb^2/EJ$

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

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

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

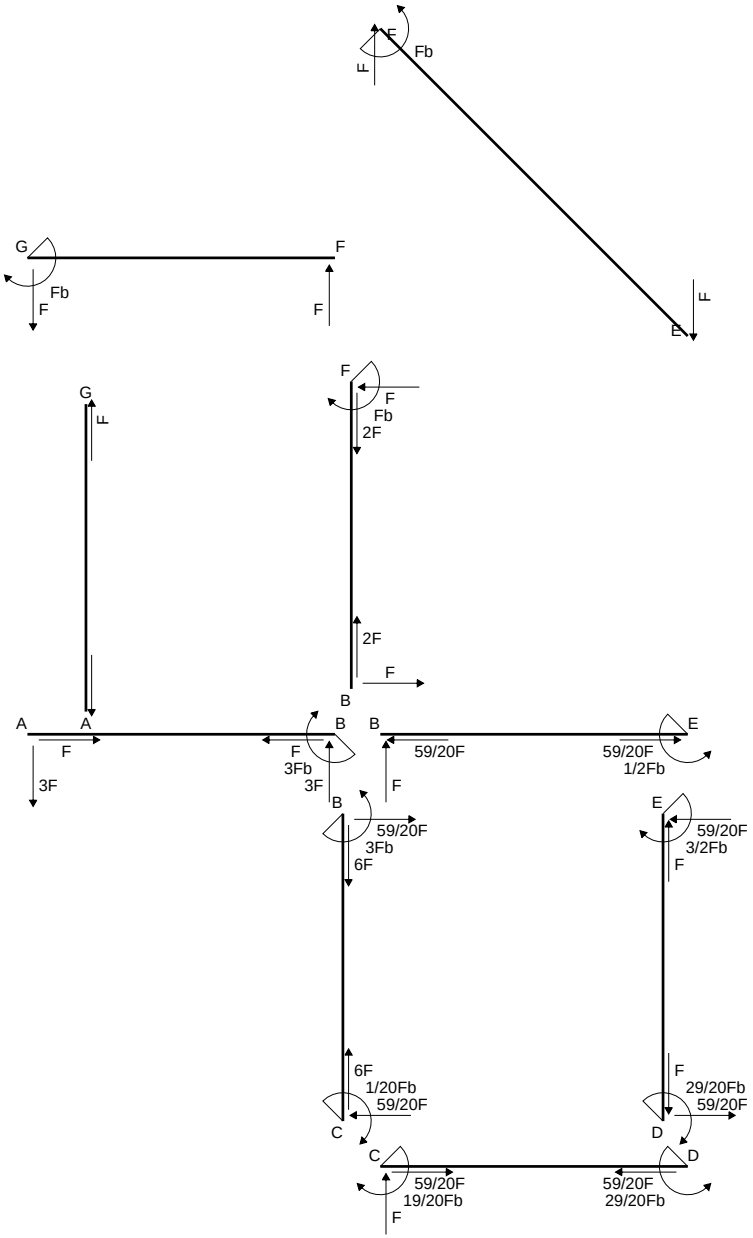
$= (3/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 1/4\ \ Fb^2/EJ$

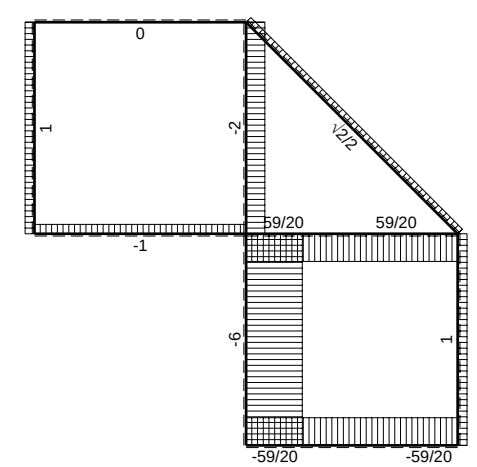


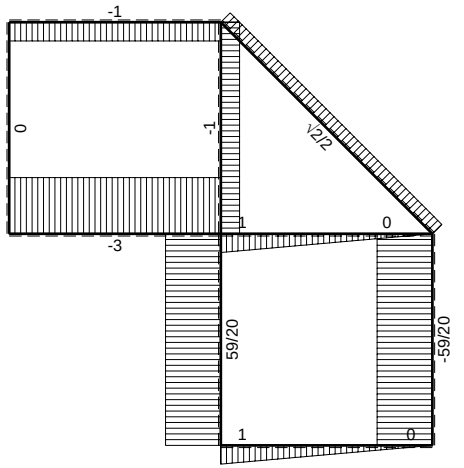
A = 162. mm^2
J_u = 89755. mm^4
J_v = 9072. mm^4
J_t = 134.6 mm^4
y_o = 11.06 mm
y_g = 30.6 mm
N = -820. N
T_y = -1025. N
M_x = -625250. Nmm
x_m = 6. mm
u_m = -12. mm
v_m = -30.6 mm
$\sigma_m = N/A - Mv/J_u$ = -218.2 N/mm^2
x_c = 18. mm
v_c = -30.6 mm
$\sigma_c = N/A - Mv/J_u$ = -218.2 N/mm^2
$\tau_c = TS^*/tJ_u$ = 15.1 N/mm^2
$\tau_g = TS^*/tJ_u$ = 15.1 N/mm^2
t_c = 410. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 219.8 N/mm^2

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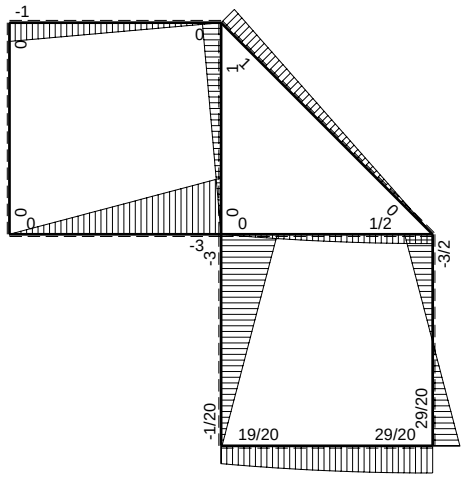

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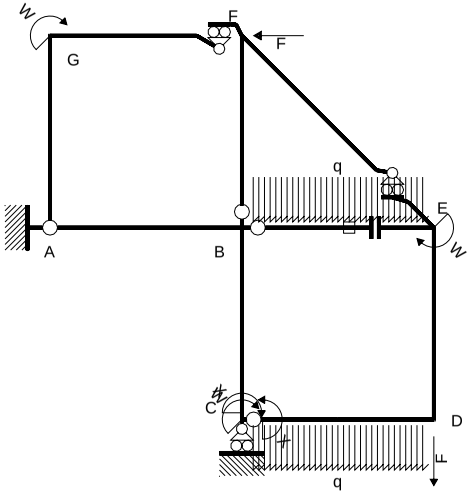

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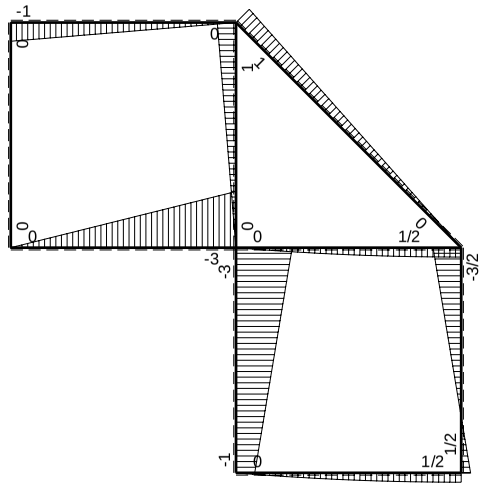
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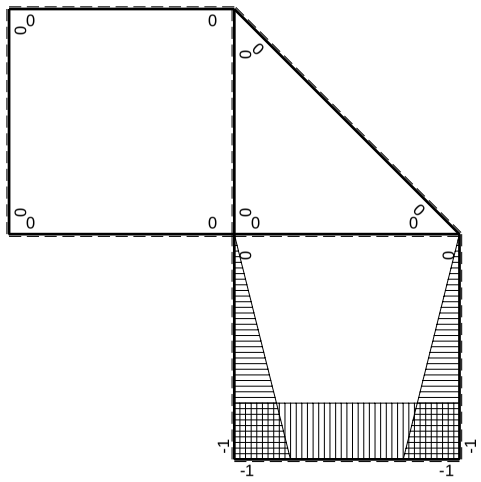
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3Fx	0	0	0	0
BA b	0	3Fb-3Fx	0	0		
BC b	-x/b	-3Fb+2Fx	$3Fx-2Fx^2/b$	x^2/b^2	$5/6Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+2Fx	$Fb+Fx-2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	$Fx-1/2qx^2$	$-Fx+1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fb+1/2qx^2$	$-1/2Fb+1/2Fx^2/b$	1		
DE b	-1+x/b	1/2Fb-2Fx	$-1/2Fb+5/2Fx-2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	3/2Fb-2Fx	$3/2Fx-2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	$Fx-1/2qx^2$	0	0	0	0
EB b	0	$-1/2Fb+1/2qx^2$	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$19/12Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				-19/20Fb	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

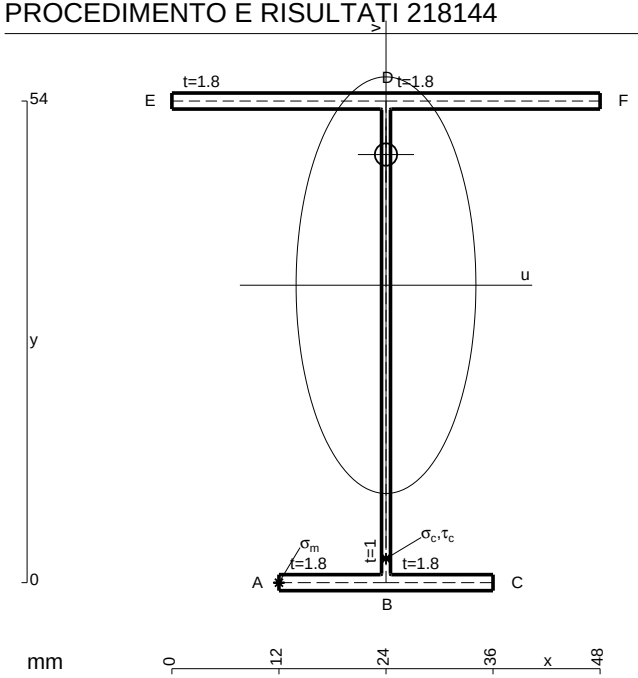
$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/3\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (-1/2 +5/2\ x/b -2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/2\ x +5/4\ x^2/b -2/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +5/4\ b -2/3\ b\ )\ Fb\ 1/EJ\ = 1/12\ \ Fb^2/EJ$

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

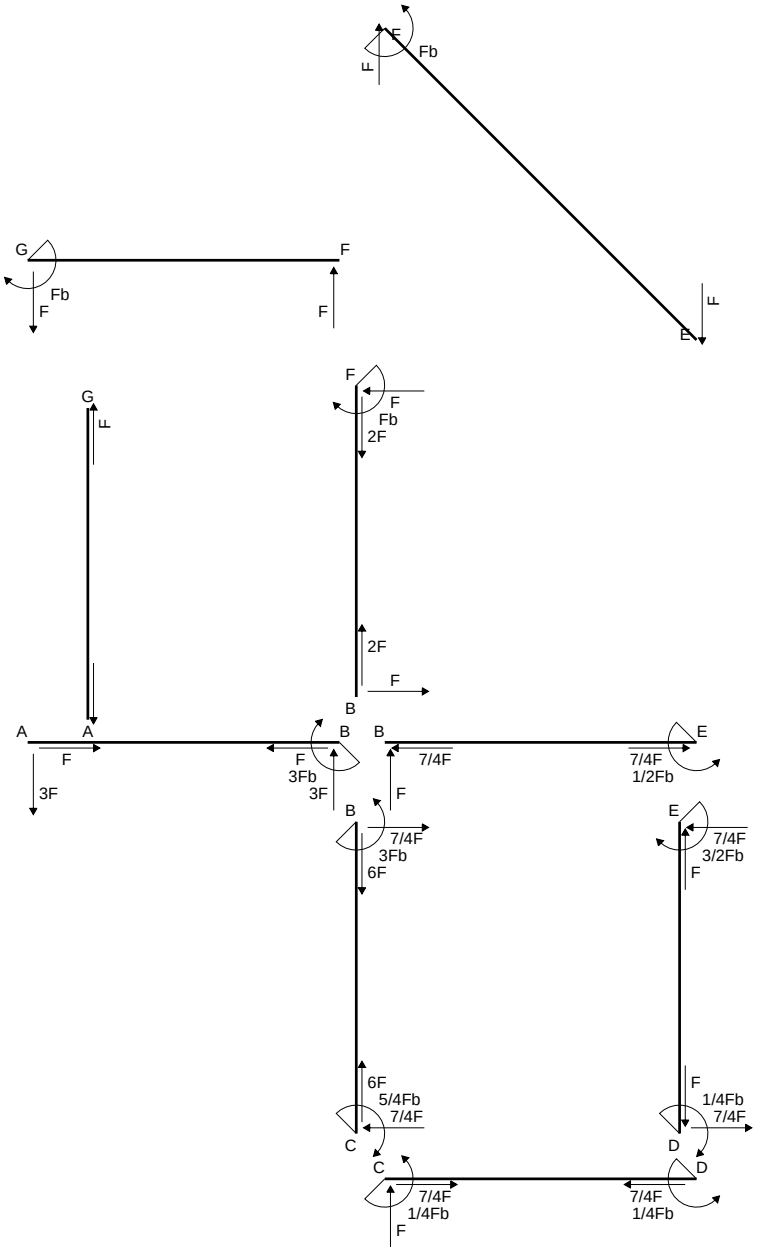
$= (3/4\ b -2/3\ b\ )\ Fb\ 1/EJ\ = 1/12\ \ Fb^2/EJ$

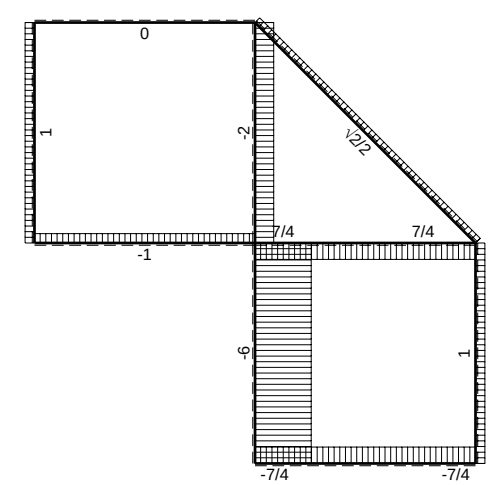


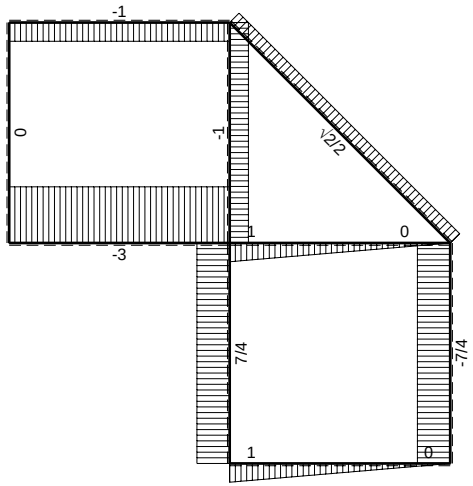
A = 183.6 mm^2
J_u = 100190. mm^4
J_v = 18662. mm^4
J_t = 158. mm^4
y_o = 14.65 mm
y_g = 33.35 mm
N = -340. N
T_y = -1020. N
M_x = -673200. Nmm
x_m = 12. mm
u_m = -12. mm
v_m = -33.35 mm
$\sigma_m = N/A - Mv/J_u$ = -226. N/mm^2
x_c = 24. mm
v_c = -33.35 mm
$\sigma_c = N/A - Mv/J_u$ = -226. N/mm^2
$\tau_c = TS^*/tJ_u$ = 14.67 N/mm^2
$\tau_g = TS^*/tJ_u$ = 14.67 N/mm^2
t_c = 340. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 227.4 N/mm^2

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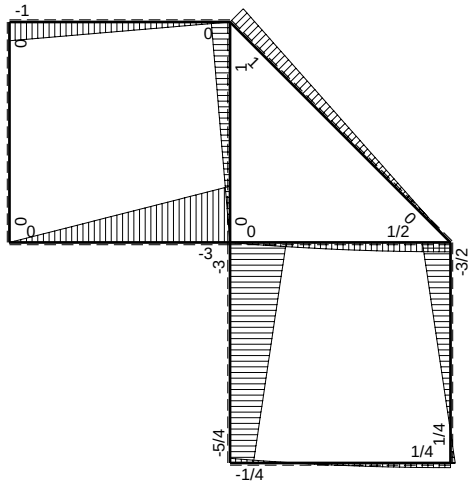

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-7/4

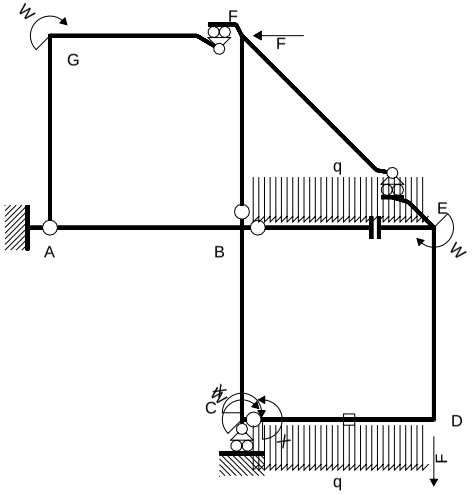

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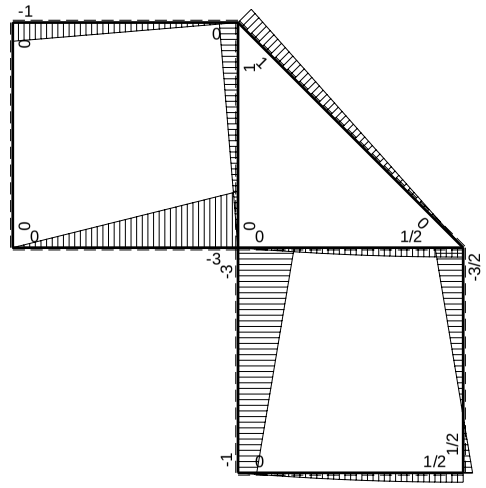
F


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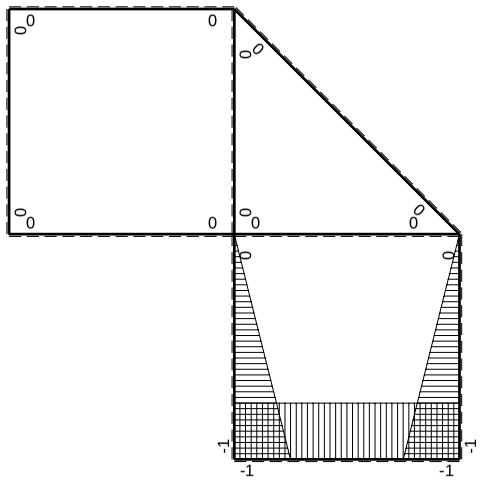
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3Fx	0	0	0	0
BA b	0	3Fb-3Fx	0	0		
BC b	-x/b	-3Fb+2Fx	$3Fx-2Fx^2/b$	x^2/b^2	$5/6Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+2Fx	$Fb+Fx-2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	$Fx-1/2qx^2$	$-Fx+1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fb+1/2qx^2$	$-1/2Fb+1/2Fx^2/b$	1		
DE b	-1+x/b	1/2Fb-2Fx	$-1/2Fb+5/2Fx-2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	3/2Fb-2Fx	$3/2Fx-2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	$Fx-1/2qx^2$	0	0	0	0
EB b	0	$-1/2Fb+1/2qx^2$	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-5/12Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				1/4Fb	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

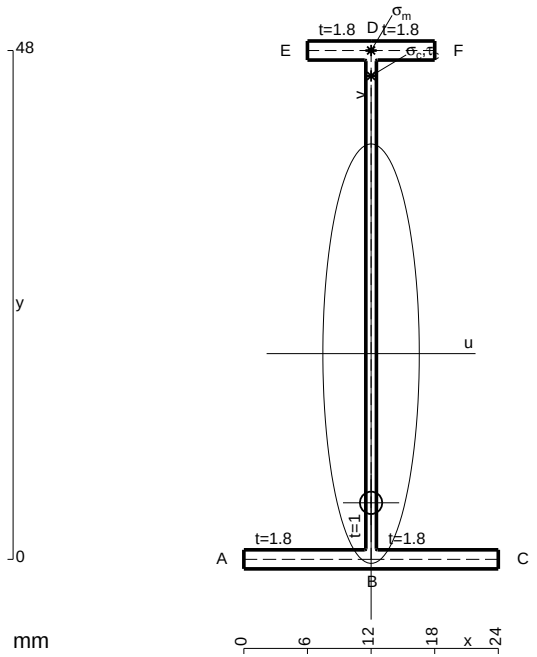
$= (-1/2\ b +1/6\ b)\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -4/3\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (-1/2 +5/2\ x/b -2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x +5/4\ x^2/b -2/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +5/4\ b -2/3\ b)\ Fb\ 1/EJ\ = 1/12\ \ Fb^2/EJ$

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

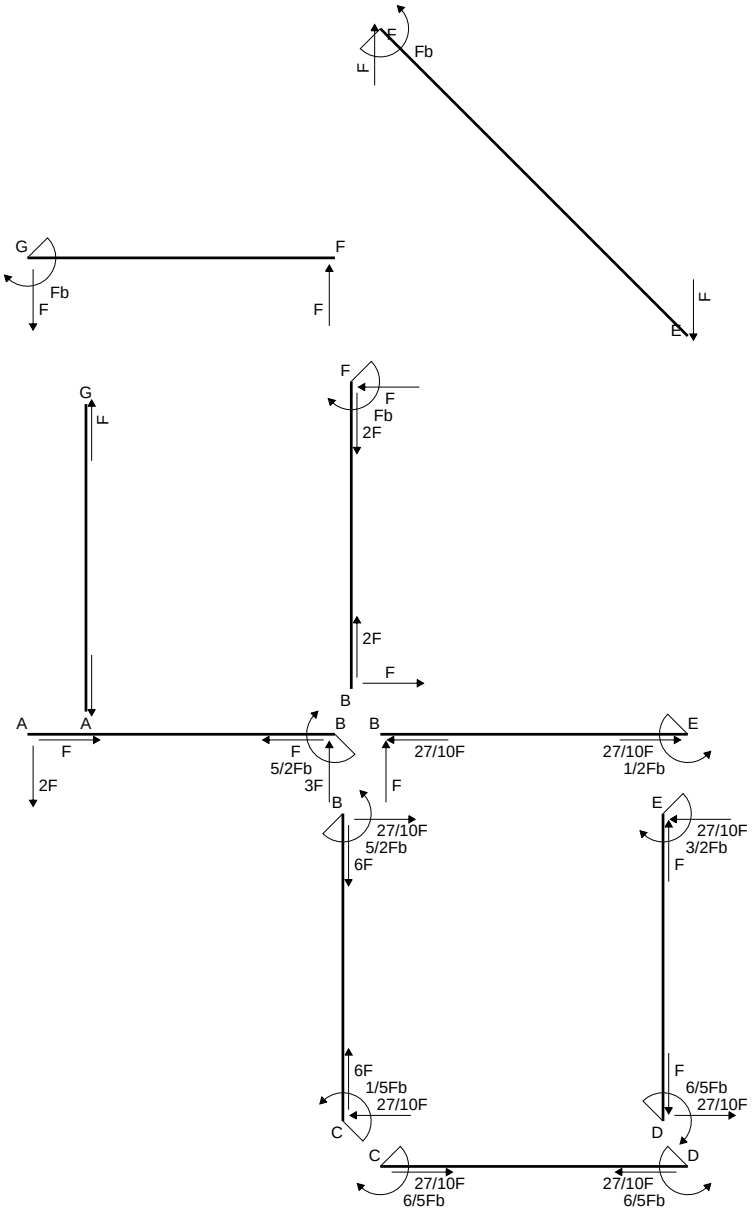
$= (3/4\ b -2/3\ b)\ Fb\ 1/EJ\ = 1/12\ \ Fb^2/EJ$

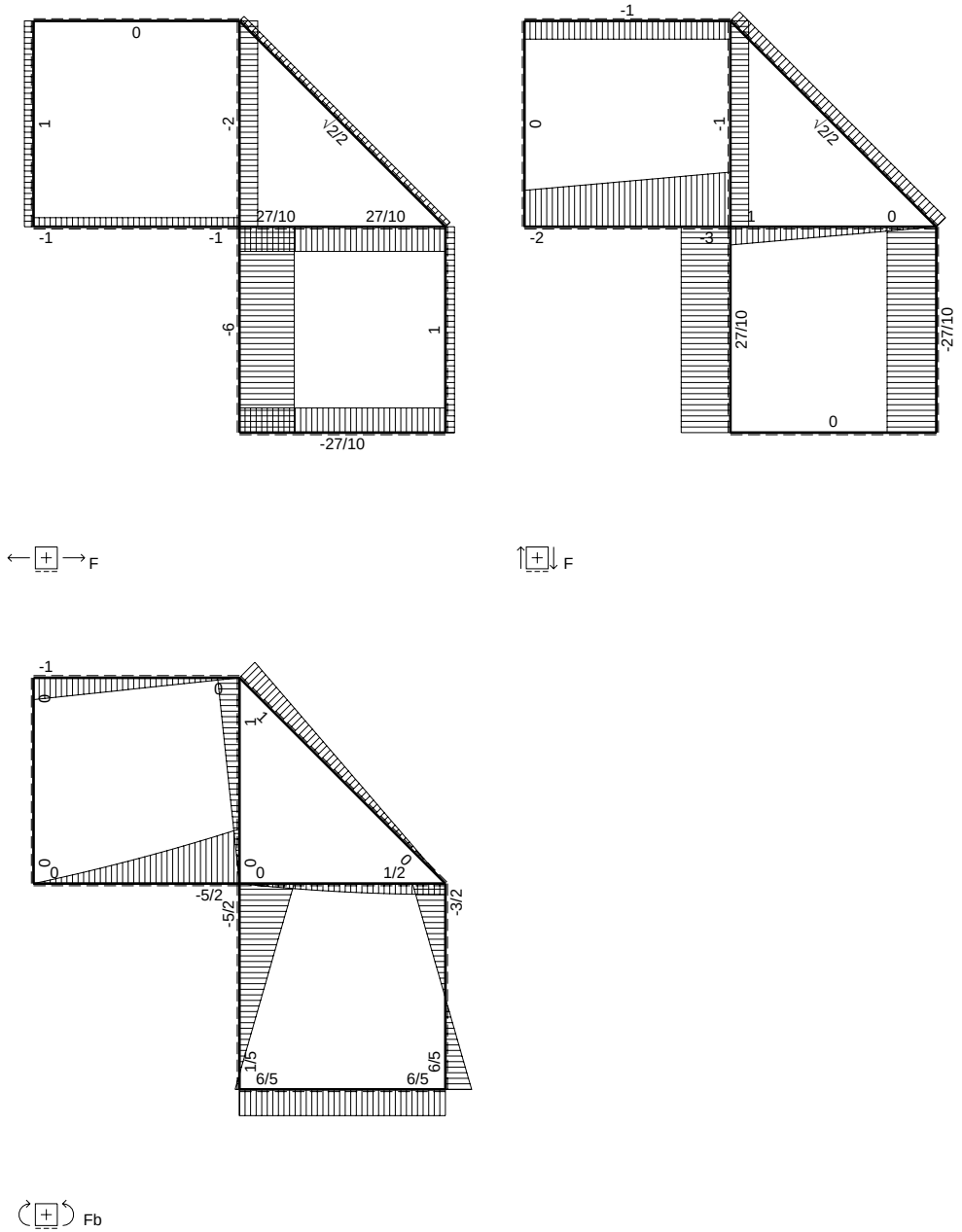


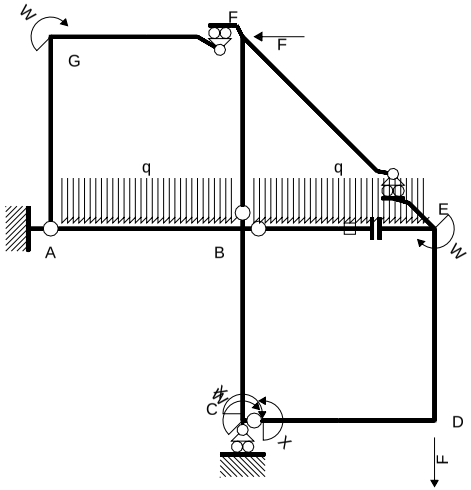
A = 112.8 mm^2
J_u = 44158. mm^4
J_v = 2333. mm^4
J_t = 85.98 mm^4
y_o = -14.07 mm
y_g = 19.4 mm
N = -190. N
T_y = -570. N
M_x = -359100. Nmm
x_m = 12. mm
y_m = 48. mm
v_m = 28.6 mm
$\sigma_m = N/A - Mv/J_u$ = 230.9 N/mm^2
y_c = 2. mm
u_c = -12. mm
v_c = -17.4 mm
$\sigma_c = N/A - Mv/J_u$ = 230.9 N/mm^2
$\tau_c = TS^*/tJ_u$ = 7.973 N/mm^2
$\tau_g = TS^*/tJ_u$ = 7.973 N/mm^2
t_c = 190. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 231.3 N/mm^2

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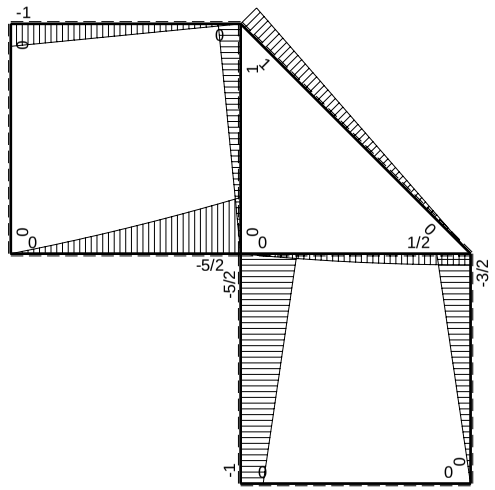
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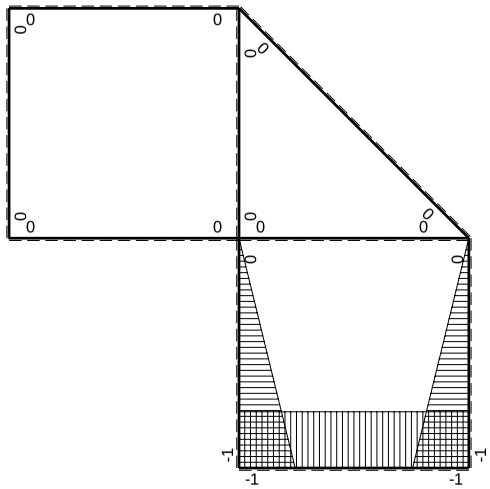

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-5/2
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6/5
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-2Fx-1/2qx^2$	0	0	0	0
BA b	0	$5/2Fb-3Fx+1/2qx^2$	0	0		
BC b	-x/b	$-5/2Fb+3/2Fx$	$5/2Fx-3/2Fx^2/b$	x^2/b^2	$3/4Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	$Fb+3/2Fx$	$Fb+1/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE 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
ED b	x/b	3/2Fb-3/2Fx	$3/2Fx-3/2Fx^2/b$	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	$Fx-1/2qx^2$	0	0	0	0
EB b	0	$-1/2Fb+1/2qx^2$	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$2Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-6/5Fb	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ Fb^2/EJ$

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

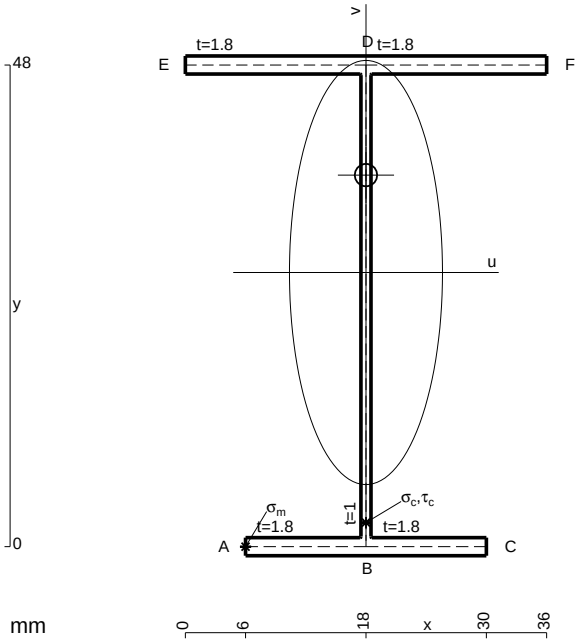
$= (\ b +1/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ Fb^2/EJ$

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

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

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

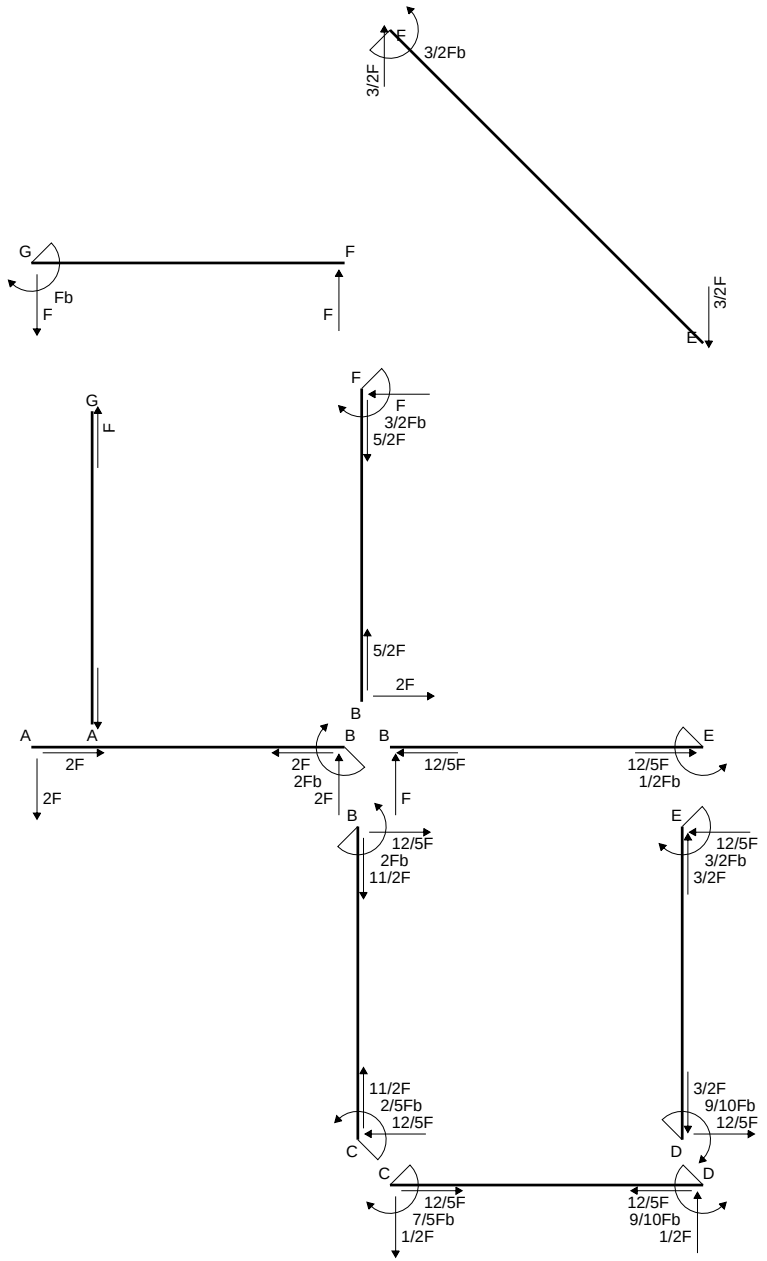
$= (3/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

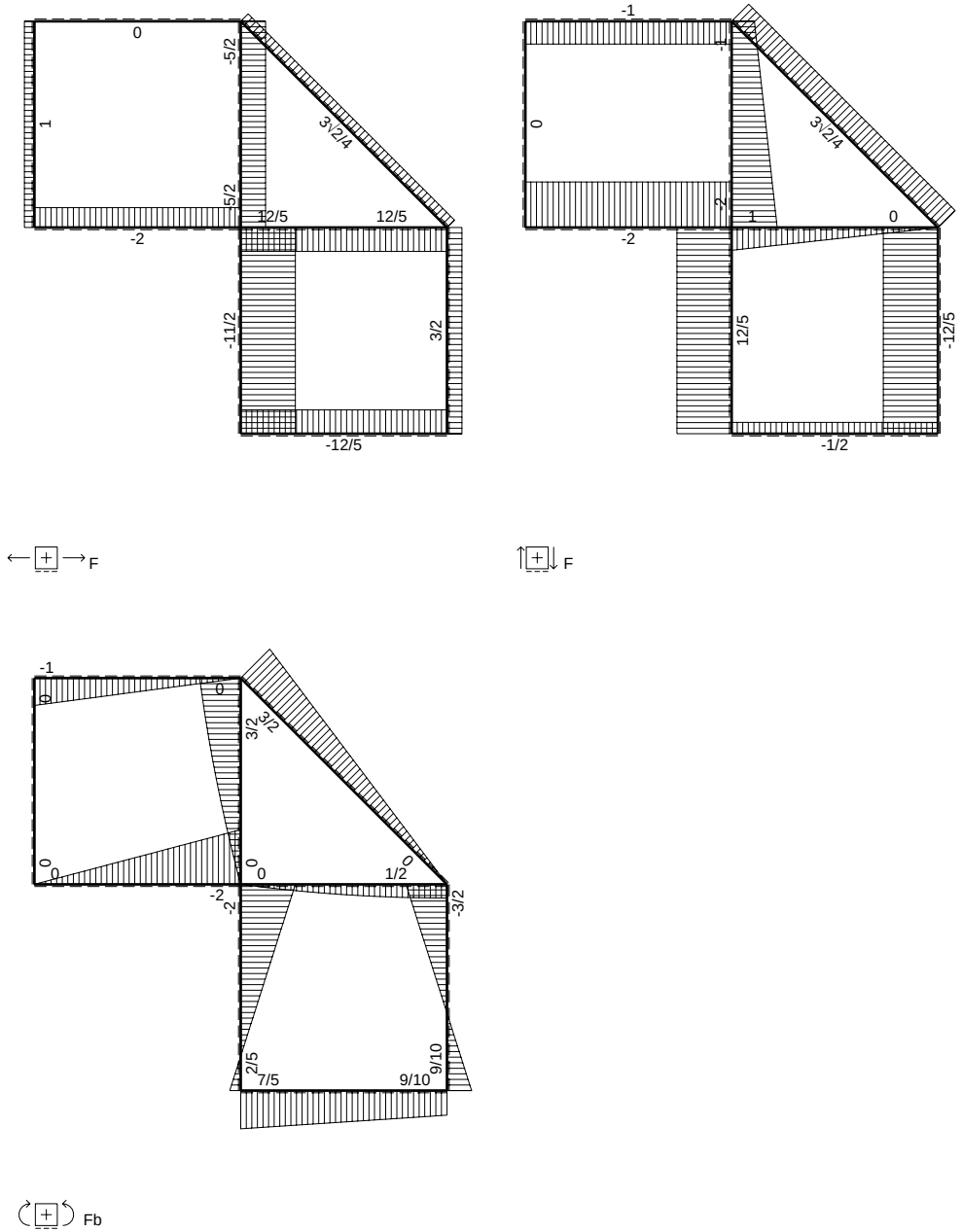


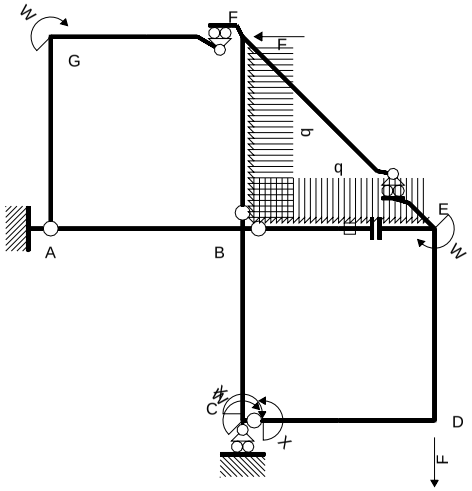
A = 156. mm^2
J_u = 69701. mm^4
J_v = 9072. mm^4
J_t = 132.6 mm^4
y_o = 9.705 mm
y_g = 27.32 mm
N = -300. N
T_y = -900. N
M_x = -502500. Nmm
x_m = 6. mm
u_m = -12. mm
v_m = -27.32 mm
$\sigma_m = N/A - Mv/J_u$ = -198.9 N/mm^2
x_c = 18. mm
v_c = -27.32 mm
$\sigma_c = N/A - Mv/J_u$ = -198.9 N/mm^2
$\tau_c = TS^*/tJ_u$ = 15.24 N/mm^2
$\tau_g = TS^*/tJ_u$ = 15.24 N/mm^2
t_c = 300. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 200.6 N/mm^2

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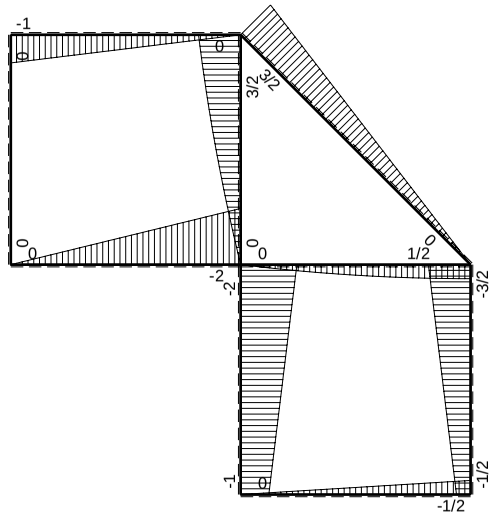
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11/2F
2/5Fb
12/5F
C
3/2F
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9/10Fb
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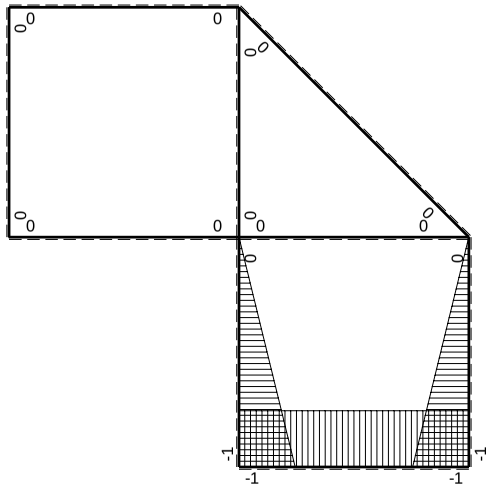

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7/5
9/10
9/10
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0		
BC b	-x/b	-2Fb+Fx	2Fx-Fx^2/b	x^2/b^2	$2/3Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	-1/2Fx	1/2Fx	1	$1/4Fb^2/EJ$	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE b	-1+x/b	-1/2Fb-Fx	1/2Fb+1/2Fx-Fx^2/b	1-2x/b+x^2/b^2	$5/12Fb^2/EJ$	1/3Xb/EJ
ED b	x/b	3/2Fb-Fx	3/2Fx-Fx^2/b	x^2/b^2		
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	3/2Fb-Fx-1/2qx^2	0	0	0	0
BF b	0	-2Fx+1/2qx^2	0	0		
BE b	0	Fx-1/2qx^2	0	0	0	0
EB b	0	-1/2Fb+1/2qx^2	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$7/3Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-7/5Fb	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

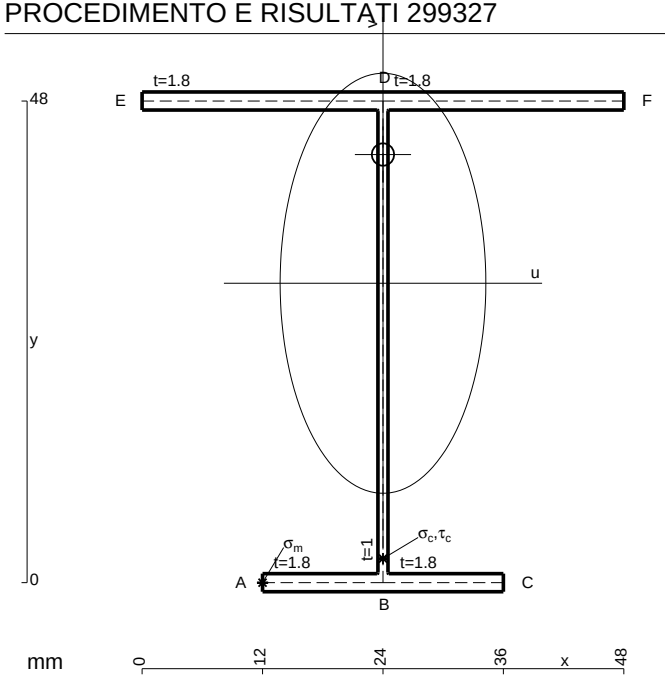
$= (1/2\ b -1/4\ b\ )\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

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

$= (1/2\ b +1/4\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 5/12\ Fb^2/EJ$

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

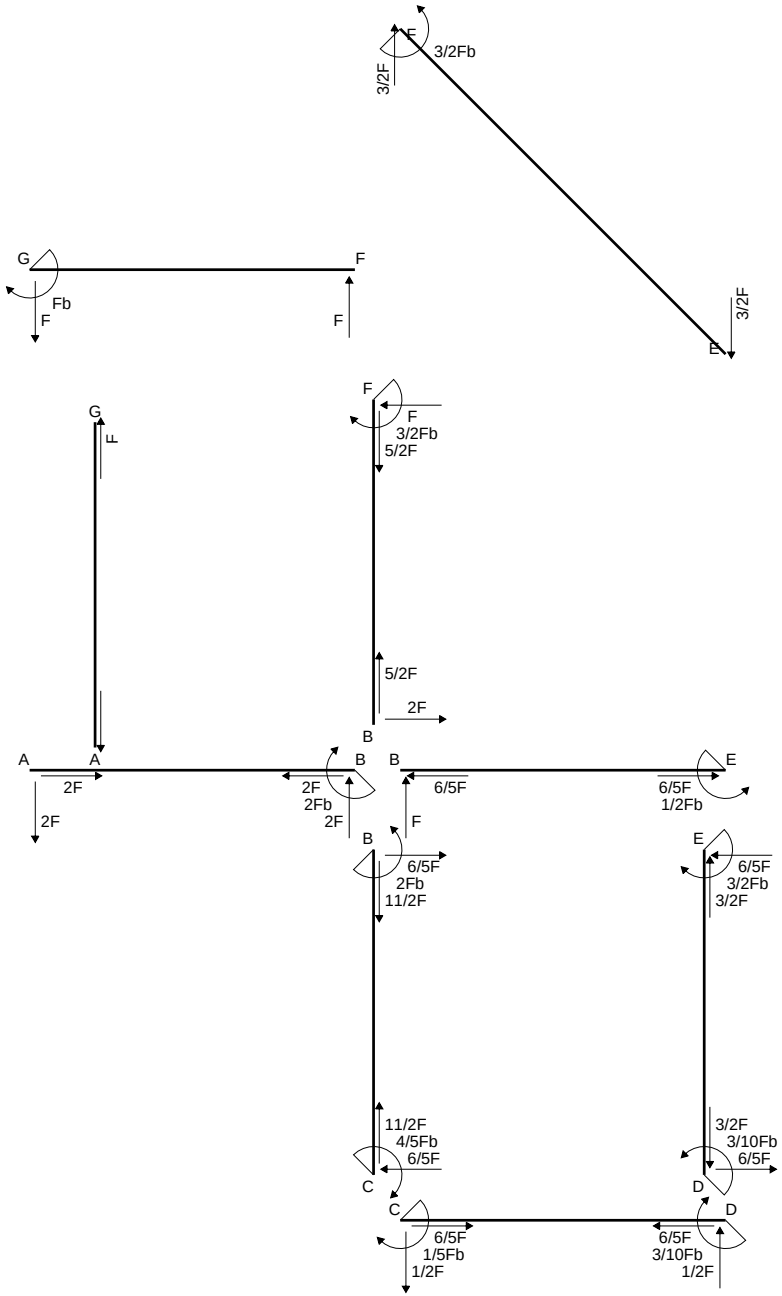
$= (3/4\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 5/12\ Fb^2/EJ$

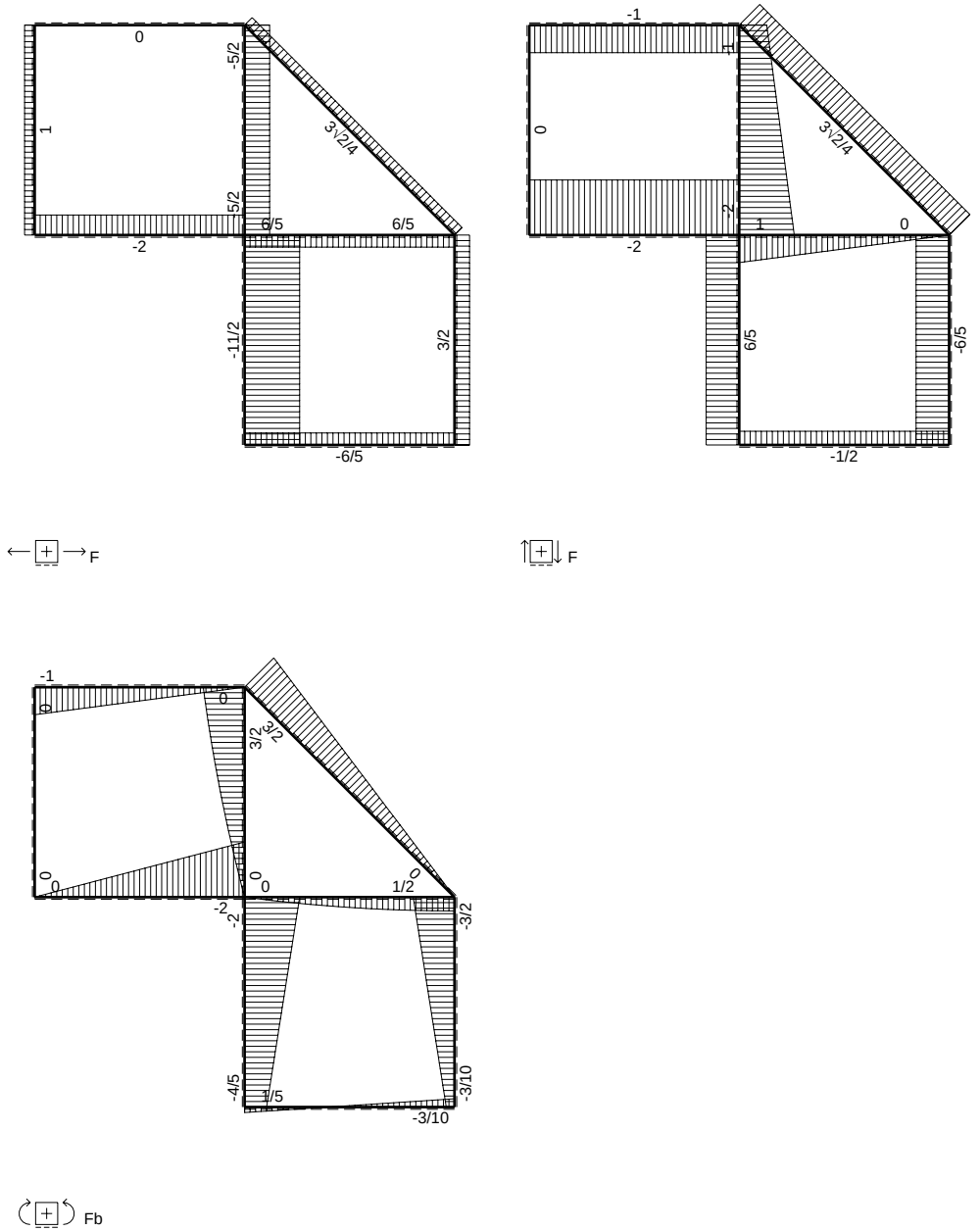


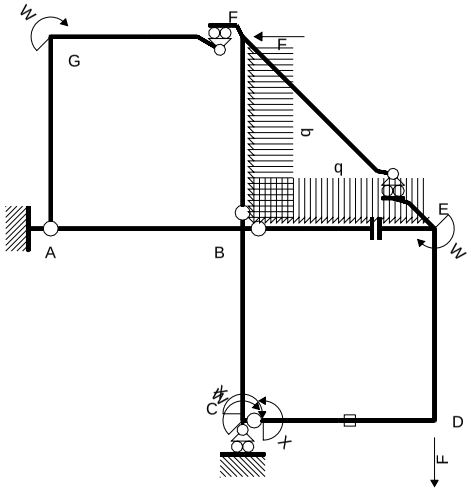
A = 177.6 mm^2
J_u = 77813. mm^4
J_v = 18662. mm^4
J_t = 156. mm^4
y_o = 12.83 mm
y_g = 29.84 mm
N = -740. N
T_y = -740. N
M_x = -532800. Nmm
x_m = 12. mm
u_m = -12. mm
v_m = -29.84 mm
$\sigma_m = N/A - Mv/J_u$ = -208.5 N/mm^2
x_c = 24. mm
v_c = -29.84 mm
$\sigma_c = N/A - Mv/J_u$ = -208.5 N/mm^2
$\tau_c = TS^*/tJ_u$ = 12.26 N/mm^2
$\tau_g = TS^*/tJ_u$ = 12.26 N/mm^2
t_c = 370. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 209.6 N/mm^2

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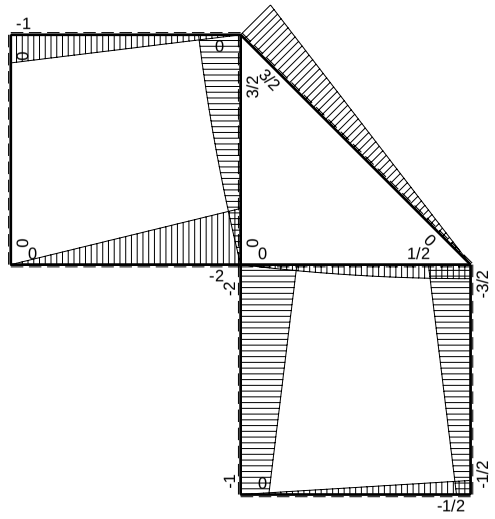
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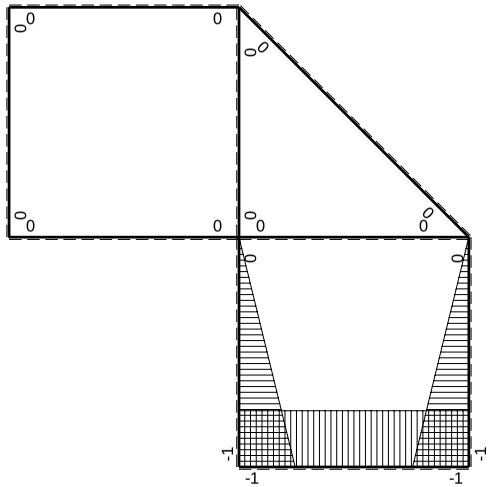

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-2
-3/2
-4/5
1/5
-3/10
-3/10
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0		
BC b	-x/b	-2Fb+Fx	2Fx-Fx^2/b	x^2/b^2	$2/3Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	-1/2Fx	1/2Fx	1	$1/4Fb^2/EJ$	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE b	-1+x/b	-1/2Fb-Fx	1/2Fb+1/2Fx-Fx^2/b	1-2x/b+x^2/b^2	$5/12Fb^2/EJ$	1/3Xb/EJ
ED b	x/b	3/2Fb-Fx	3/2Fx-Fx^2/b	x^2/b^2		
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	3/2Fb-Fx-1/2qx^2	0	0	0	0
BF b	0	-2Fx+1/2qx^2	0	0		
BE b	0	Fx-1/2qx^2	0	0	0	0
EB b	0	-1/2Fb+1/2qx^2	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$1/3Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-1/5Fb	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

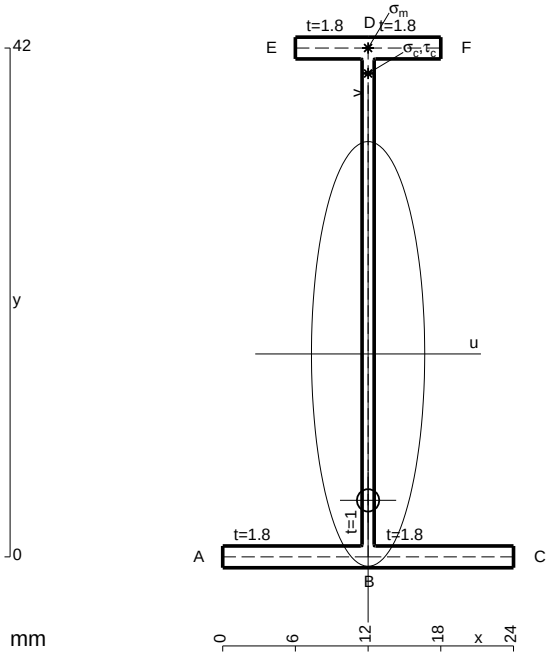
$= (1/2\ b -1/4\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -3/4\ \ Fb^2/EJ$

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

$= (1/2\ b +1/4\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 5/12\ \ Fb^2/EJ$

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

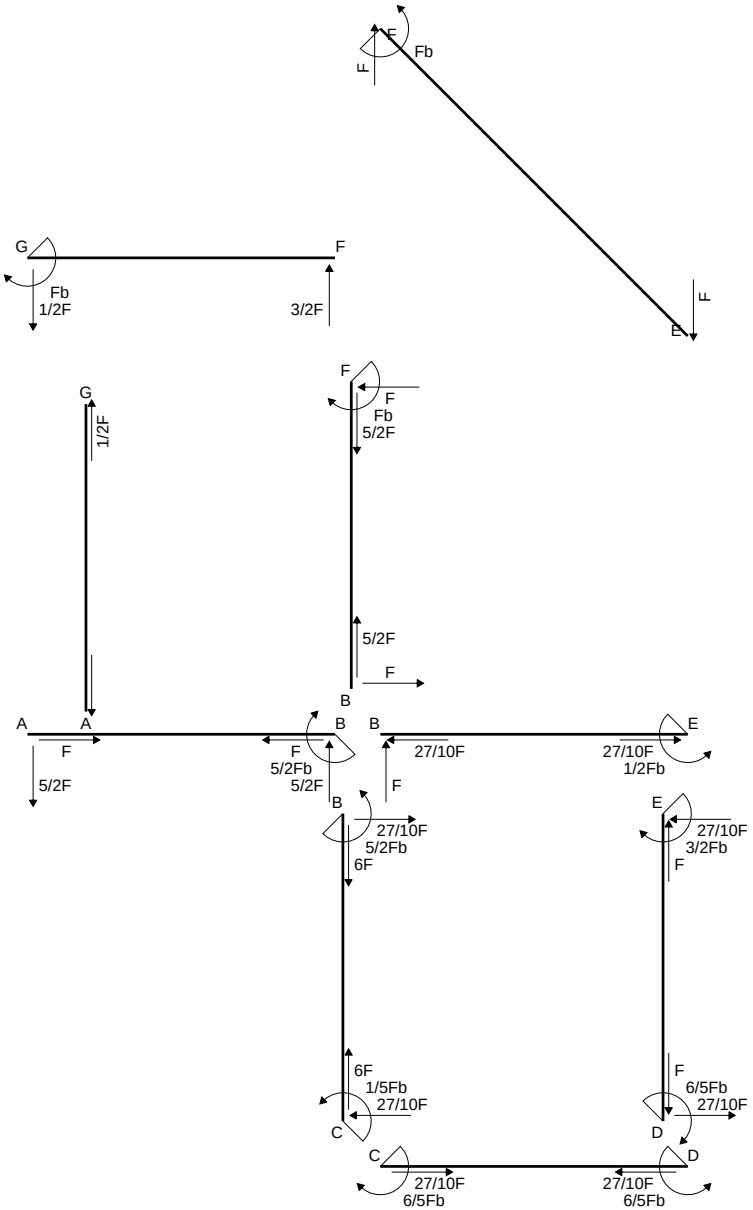
$= (3/4\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 5/12\ \ Fb^2/EJ$

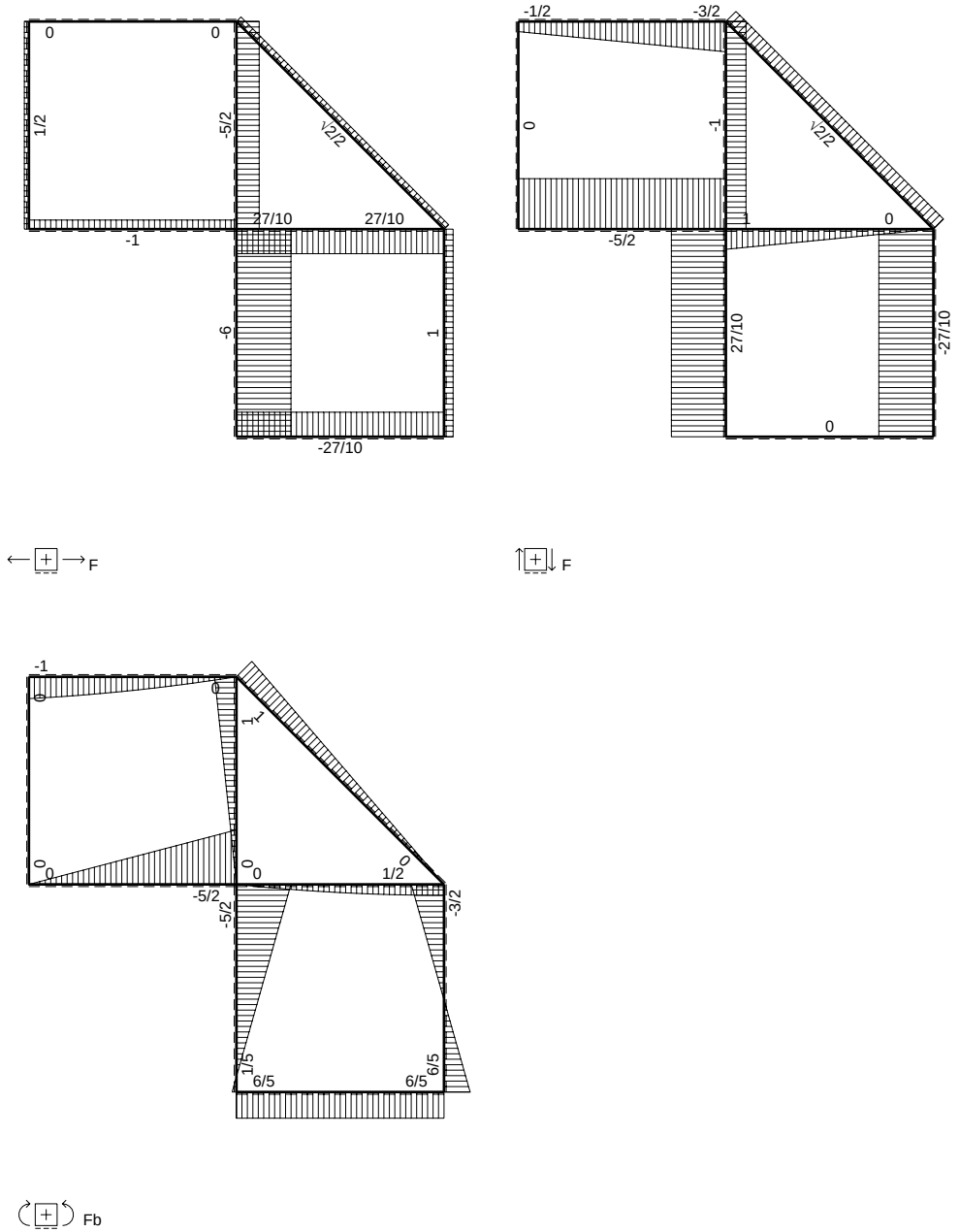


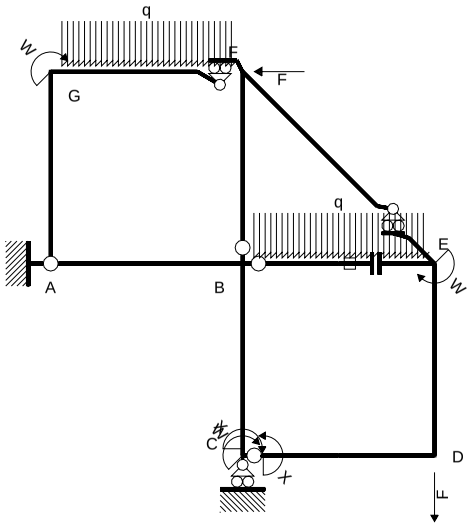
A = 106.8 mm^2
J_u = 32824. mm^4
J_v = 2333. mm^4
J_t = 83.98 mm^4
y_o = -12.09 mm
y_g = 16.75 mm
N = -420. N
T_y = -420. N
M_x = -285600. Nmm
x_m = 12. mm
y_m = 42. mm
v_m = 25.25 mm
$\sigma_m = N/A - Mv/J_u$ = 215.7 N/mm^2
y_c = 2. mm
u_c = -12. mm
v_c = -14.75 mm
$\sigma_c = N/A - Mv/J_u$ = 215.7 N/mm^2
$\tau_c = TS^*/tJ_u$ = 6.978 N/mm^2
$\tau_g = TS^*/tJ_u$ = 6.978 N/mm^2
t_c = 210. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 216.1 N/mm^2

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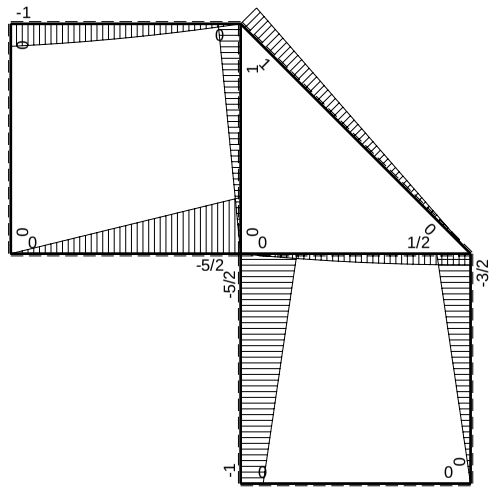
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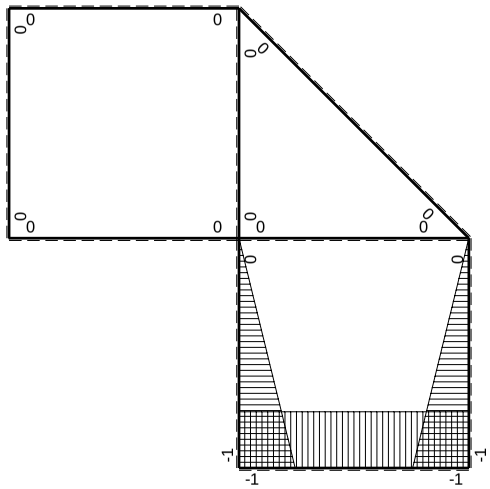

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Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0		
BC b	-x/b	-5/2Fb+3/2Fx	5/2Fx-3/2Fx^2/b	x^2/b^2	3/4Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	Fb+1/2Fx-3/2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE 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
ED b	x/b	3/2Fb-3/2Fx	3/2Fx-3/2Fx^2/b	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-3/2Fx+1/2qx^2	0	0	0	0
GF b	0	Fb-1/2Fx-1/2qx^2	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	Fx-1/2qx^2	0	0	0	0
EB b	0	-1/2Fb+1/2qx^2	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				2Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-6/5Fb	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ Fb^2/EJ$

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

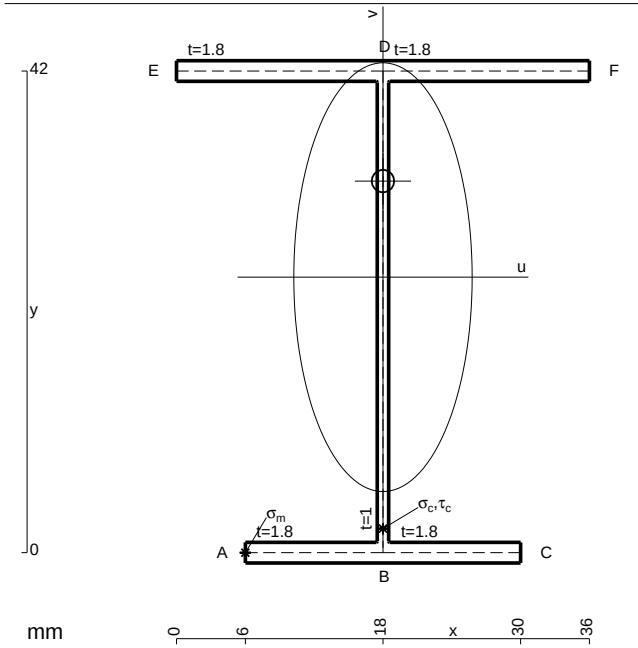
$= (\ b +1/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ Fb^2/EJ$

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

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

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

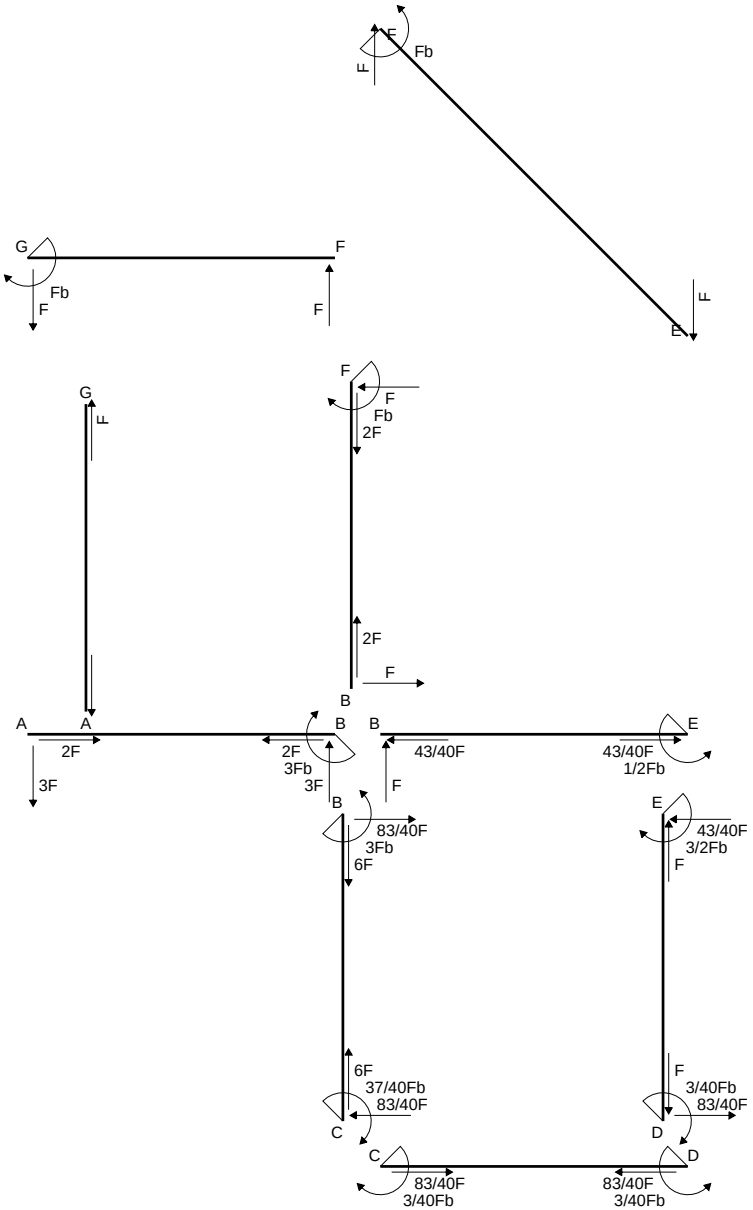
$= (3/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

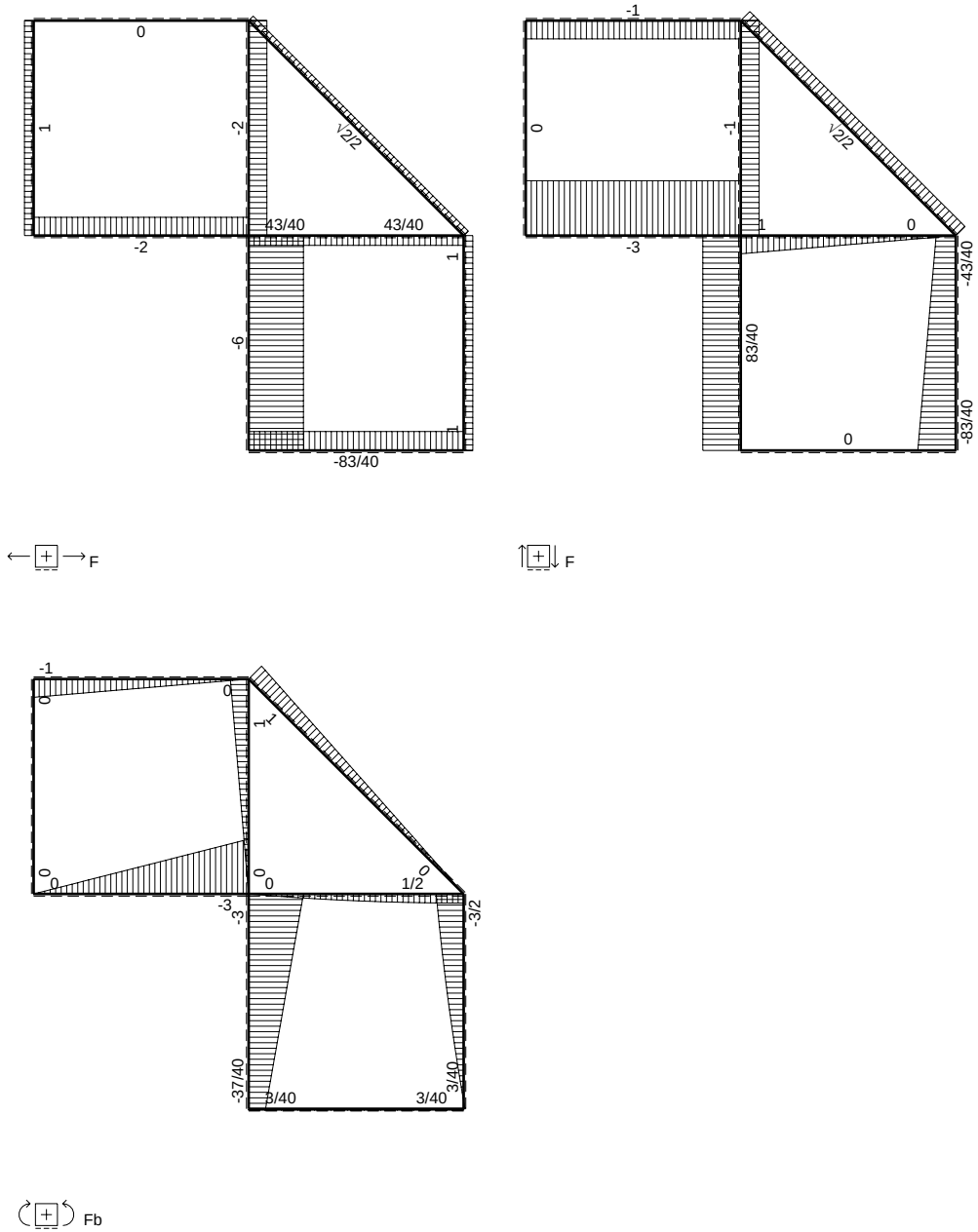


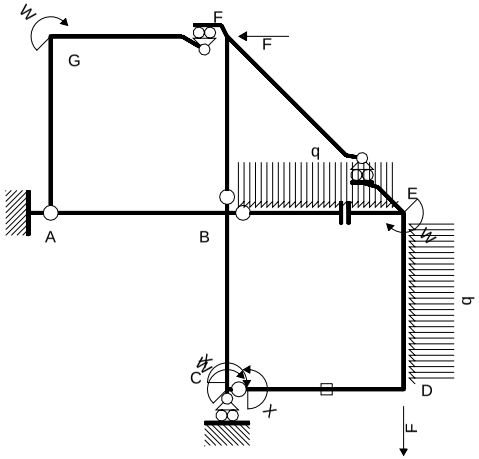
A = 150. mm^2
J_u = 52430. mm^4
J_v = 9072. mm^4
J_t = 130.6 mm^4
y_o = 8.376 mm
y_g = 24.02 mm
N = -270. N
T_y = -675. N
M_x = -486000. Nmm
x_m = 6. mm
u_m = -12. mm
v_m = -24.02 mm
$\sigma_m = N/A - Mv/J_u$ = -224.5 N/mm^2
x_c = 18. mm
v_c = -24.02 mm
$\sigma_c = N/A - Mv/J_u$ = -224.5 N/mm^2
$\tau_c = TS^*/tJ_u$ = 13.36 N/mm^2
$\tau_g = TS^*/tJ_u$ = 13.36 N/mm^2
t_c = 270. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 225.7 N/mm^2

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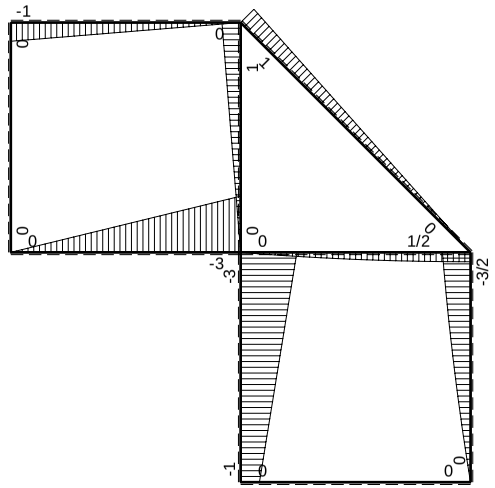
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6F
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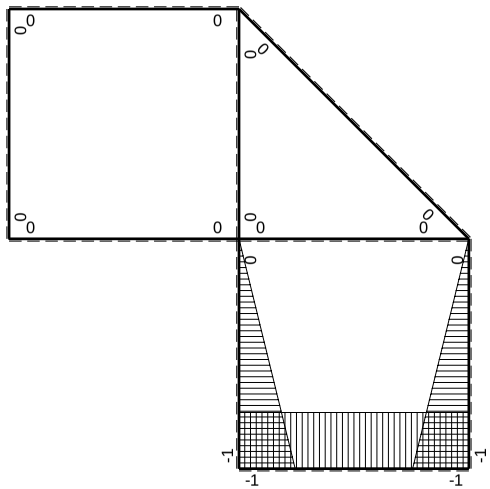

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Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3Fx	0	0	0	0
BA b	0	3Fb-3Fx	0	0		
BC b	-x/b	-3Fb+2Fx	$3Fx-2Fx^2/b$	x^2/b^2	$5/6Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+2Fx	$Fb+Fx-2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	$-2Fx+1/2qx^2$	$2Fx-5/2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$7/24Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$3/2Fb-Fx-1/2qx^2$	$3/2Fx-Fx^2/b-1/2qx^3/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	$Fx-1/2qx^2$	0	0	0	0
EB b	0	$-1/2Fb+1/2qx^2$	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$1/8Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				-3/40Fb	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

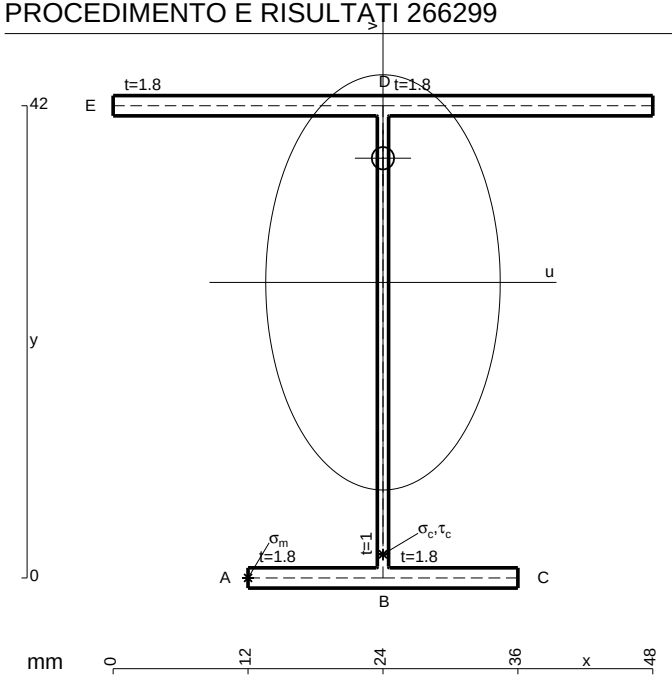
$= (\ b +1/2\ b -2/3\ b\ )\ Fb\ 1/EJ\ = 5/6\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (2\ x/b -5/2\ x^2/b^2 +1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [\ x^2/b -5/6\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

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

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

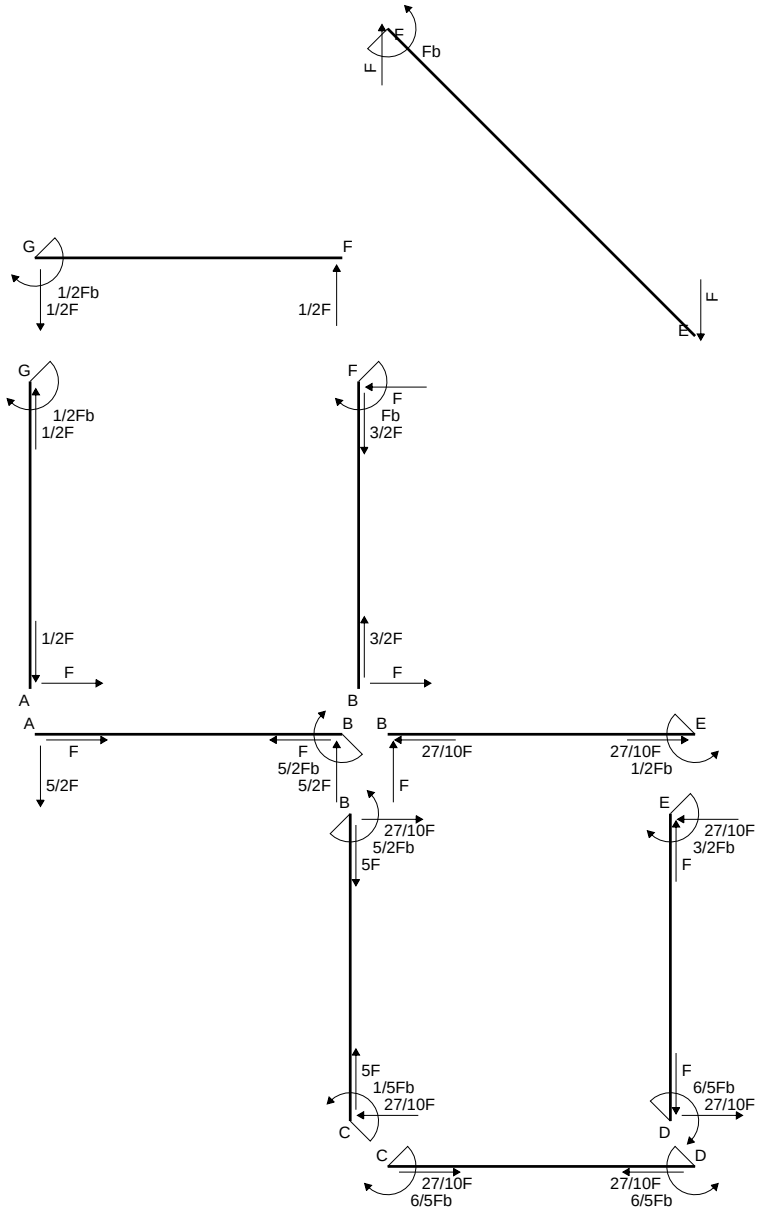
$= (3/4\ b -1/3\ b -1/8\ b\ )\ Fb\ 1/EJ\ = 7/24\ \ Fb^2/EJ$

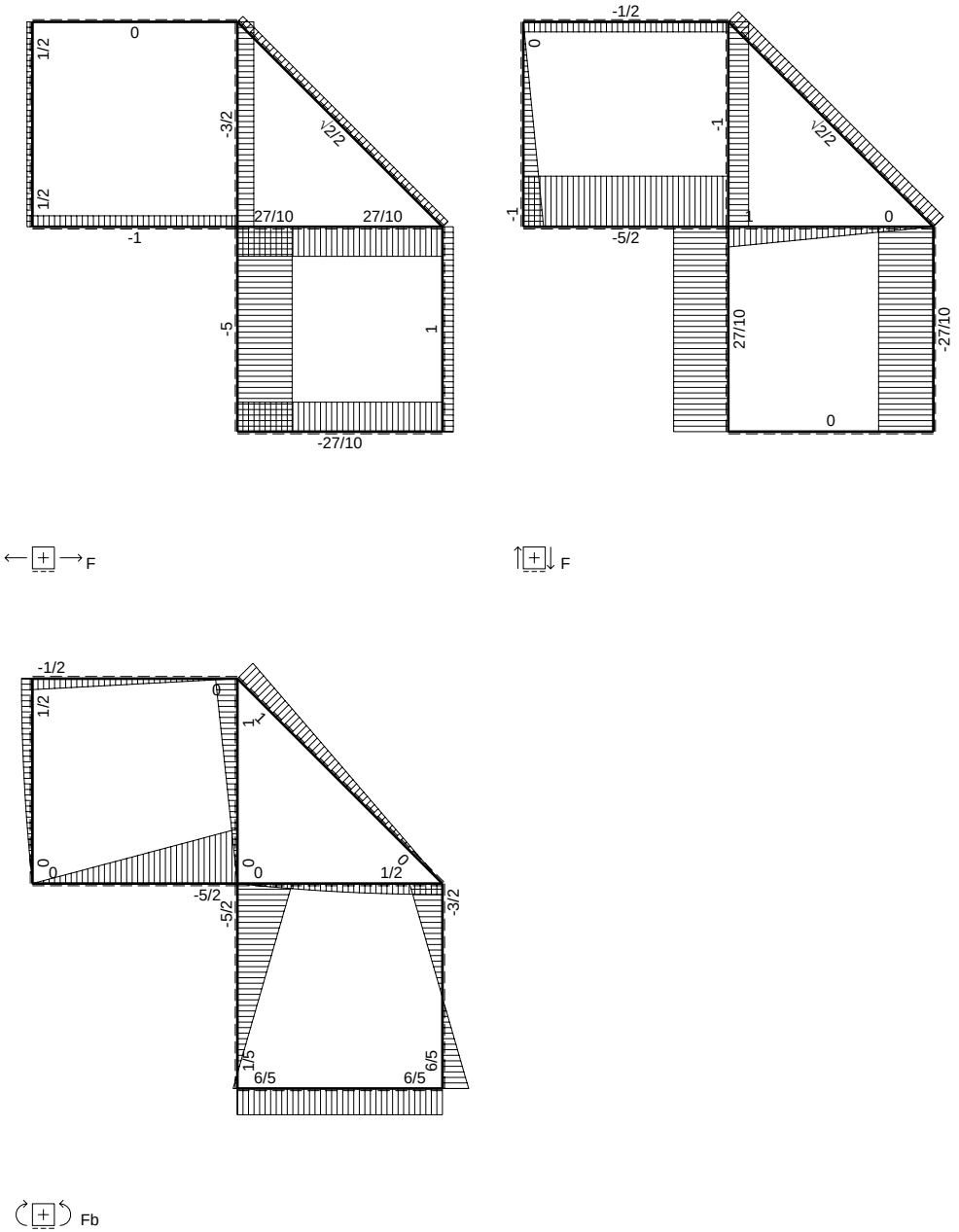


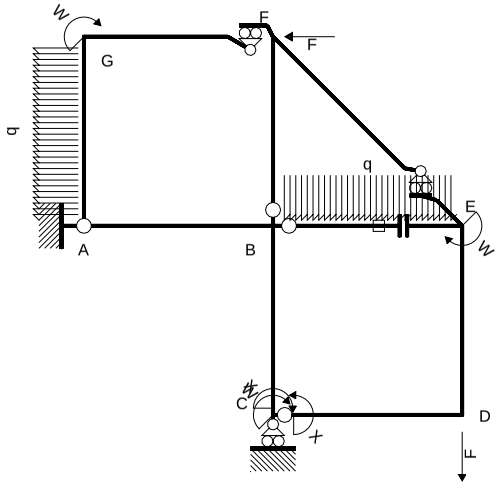
A = 171.6 mm^2
J_u = 58532. mm^4
J_v = 18662. mm^4
J_t = 154. mm^4
y_o = 11.05 mm
y_g = 26.29 mm
N = -460. N
T_y = -690. N
M_x = -524400. Nmm
x_m = 12. mm
u_m = -12. mm
v_m = -26.29 mm
$\sigma_m = N/A - Mv/J_u$ = -238.2 N/mm^2
x_c = 24. mm
v_c = -26.29 mm
$\sigma_c = N/A - Mv/J_u$ = -238.2 N/mm^2
$\tau_c = TS^*/tJ_u$ = 13.39 N/mm^2
$\tau_g = TS^*/tJ_u$ = 13.39 N/mm^2
t_c = 230. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 239.3 N/mm^2

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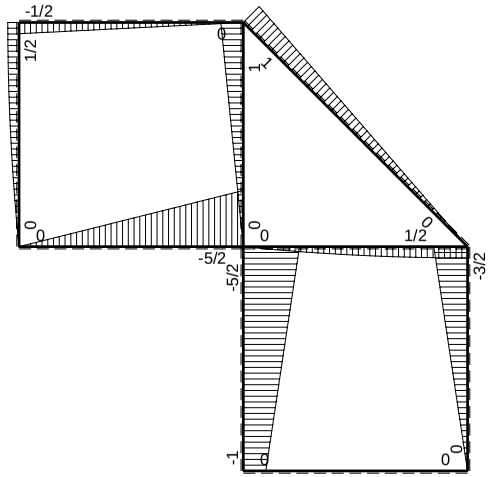
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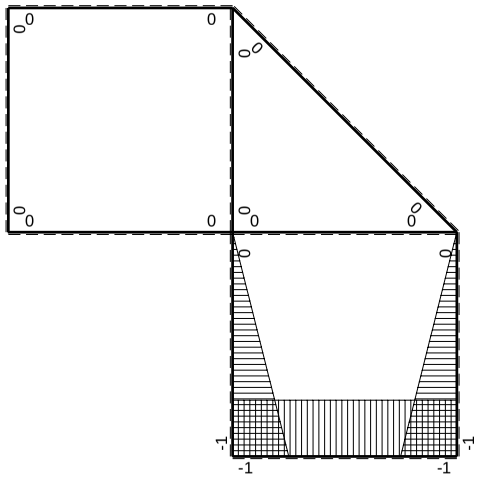

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-27/10
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Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0		
BC b	-x/b	-5/2Fb+3/2Fx	$5/2Fx-3/2Fx^2/b$	x^2/b^2	$3/4Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	$Fb+1/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE 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
ED b	x/b	3/2Fb-3/2Fx	$3/2Fx-3/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-1/2Fx	0	0	0	0
GF b	0	1/2Fb-1/2Fx	0	0		
GA b	0	$1/2Fb-1/2qx^2$	0	0	0	0
AG b	0	$-Fx+1/2qx^2$	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	$Fx-1/2qx^2$	0	0	0	0
EB b	0	$-1/2Fb+1/2qx^2$	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$2Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-6/5Fb	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ \ Fb^2/EJ$

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

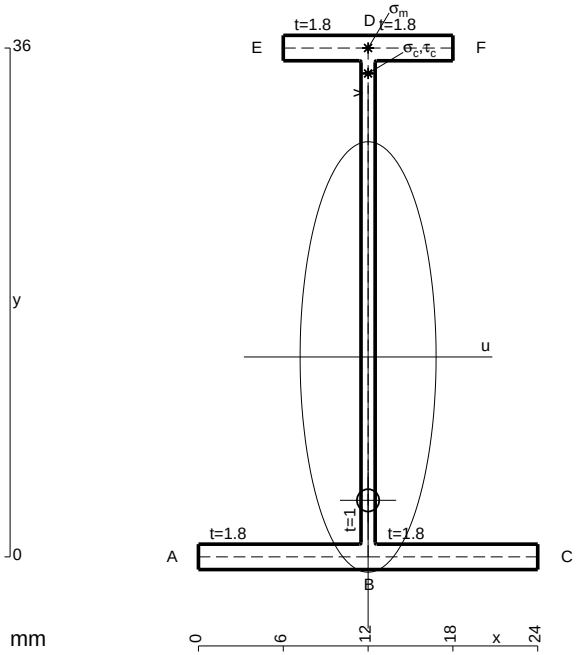
$= (\ b +1/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ \ Fb^2/EJ$

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

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

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

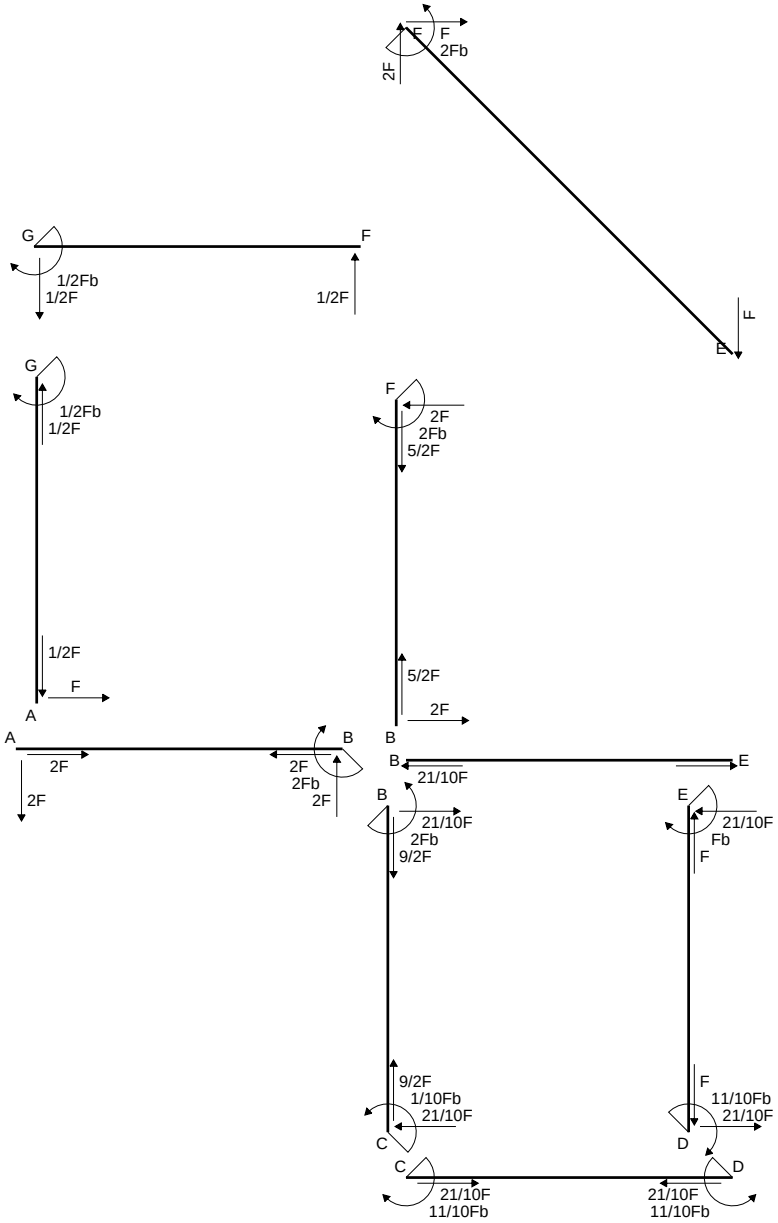
$= (3/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 1/4\ \ Fb^2/EJ$

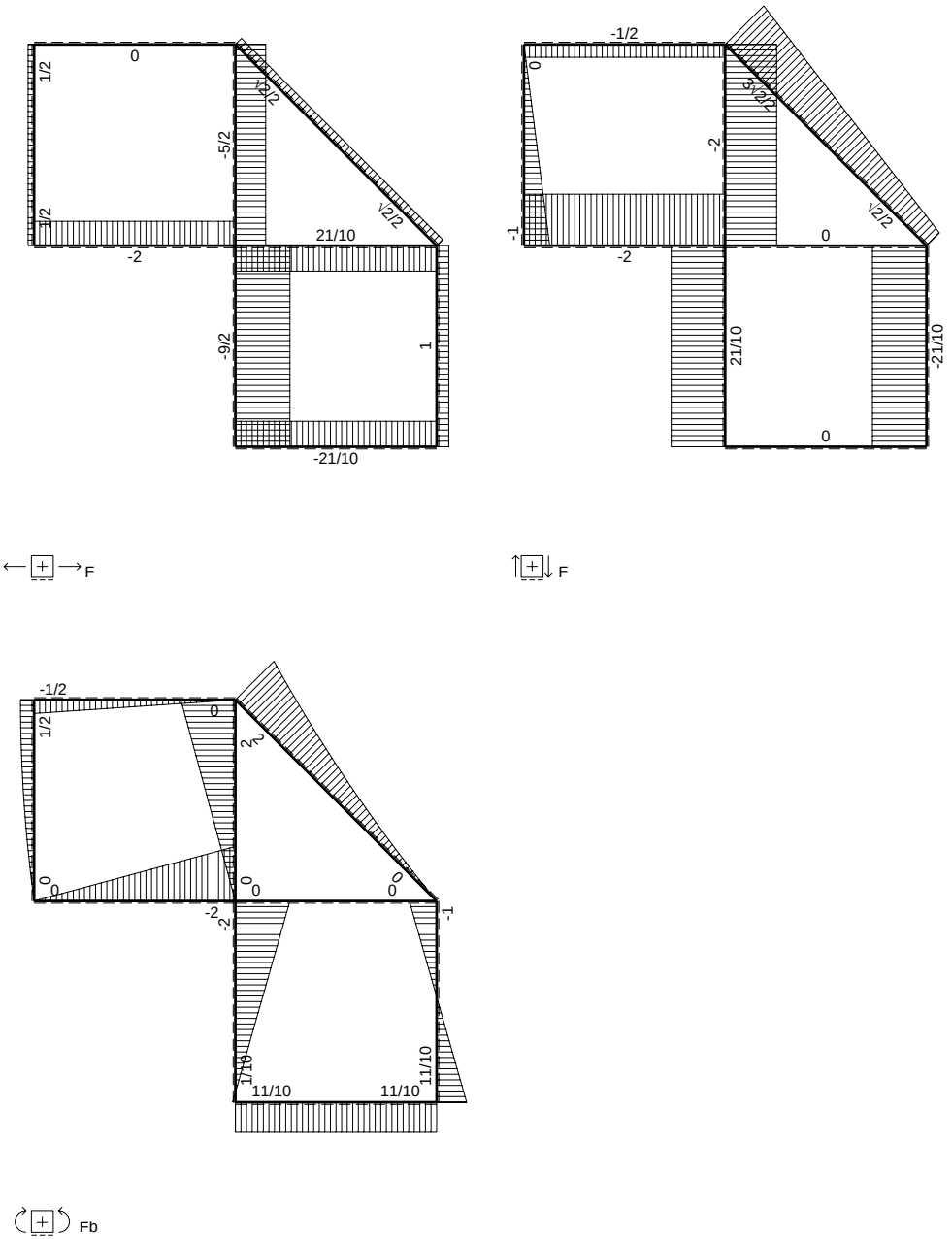


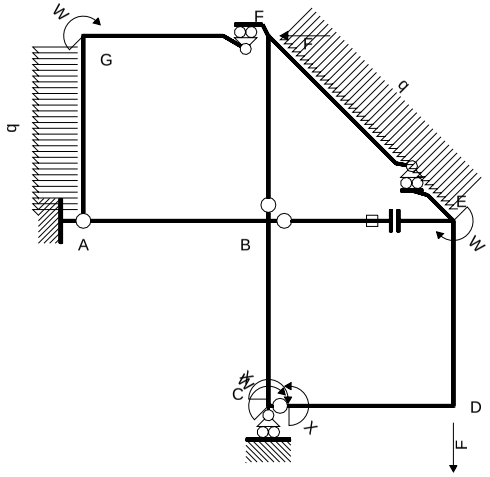
A = 100.8 mm^2
J_u = 23384. mm^4
J_v = 2333. mm^4
J_t = 81.98 mm^4
y_o = -10.14 mm
y_g = 14.14 mm
N = -250. N
T_y = -625. N
M_x = -212500. Nmm
x_m = 12. mm
y_m = 36. mm
v_m = 21.86 mm
$\sigma_m = N/A - Mv/J_u$ = 196.1 N/mm^2
y_c = 2. mm
u_c = -12. mm
v_c = -12.14 mm
$\sigma_c = N/A - Mv/J_u$ = 196.1 N/mm^2
$\tau_c = TS^*/tJ_u$ = 12.62 N/mm^2
$\tau_g = TS^*/tJ_u$ = 12.62 N/mm^2
t_c = 250. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 197.4 N/mm^2

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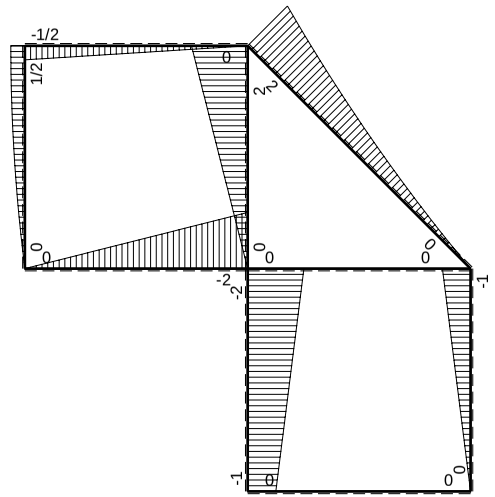
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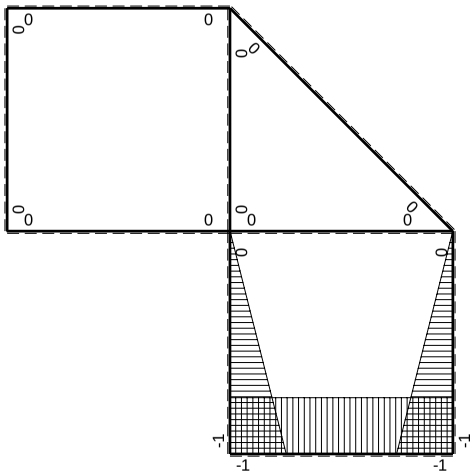

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0
-2
-1
11/10
11/10
11/10
11/10
Fb



Schema di calcolo iperstatico



M_o flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0		
BC b	-x/b	-2Fb+Fx	2Fx-Fx^2/b	x^2/b^2	$2/3Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+Fx	Fb-Fx^2/b	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	-Fx	Fx-Fx^2/b	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	Fb-Fx	Fx-Fx^2/b	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}$/2Fx+1/2qx^2	0	0	0	0
FG b	0	-1/2Fx	0	0	0	0
GF b	0	1/2Fb-1/2Fx	0	0		
GA b	0	1/2Fb-1/2qx^2	0	0	0	0
AG b	0	-Fx+1/2qx^2	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$11/6Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				$-11/10Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

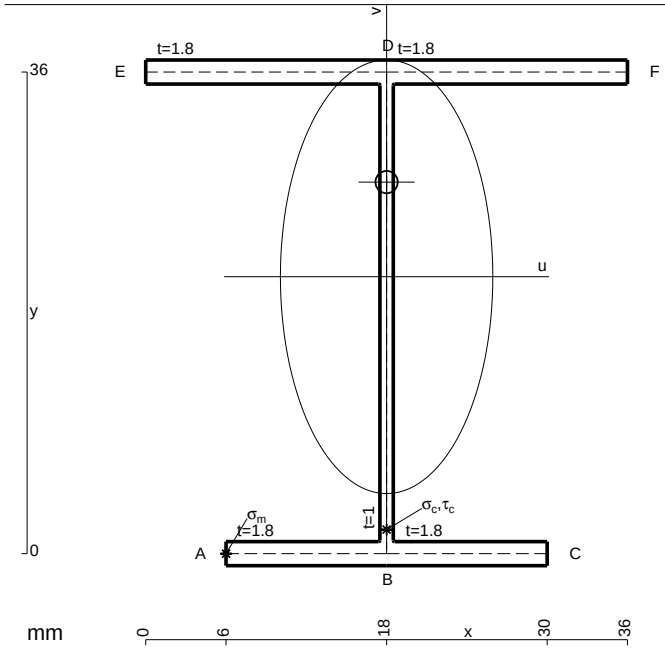
$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ \ Fb^2/EJ$

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

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

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

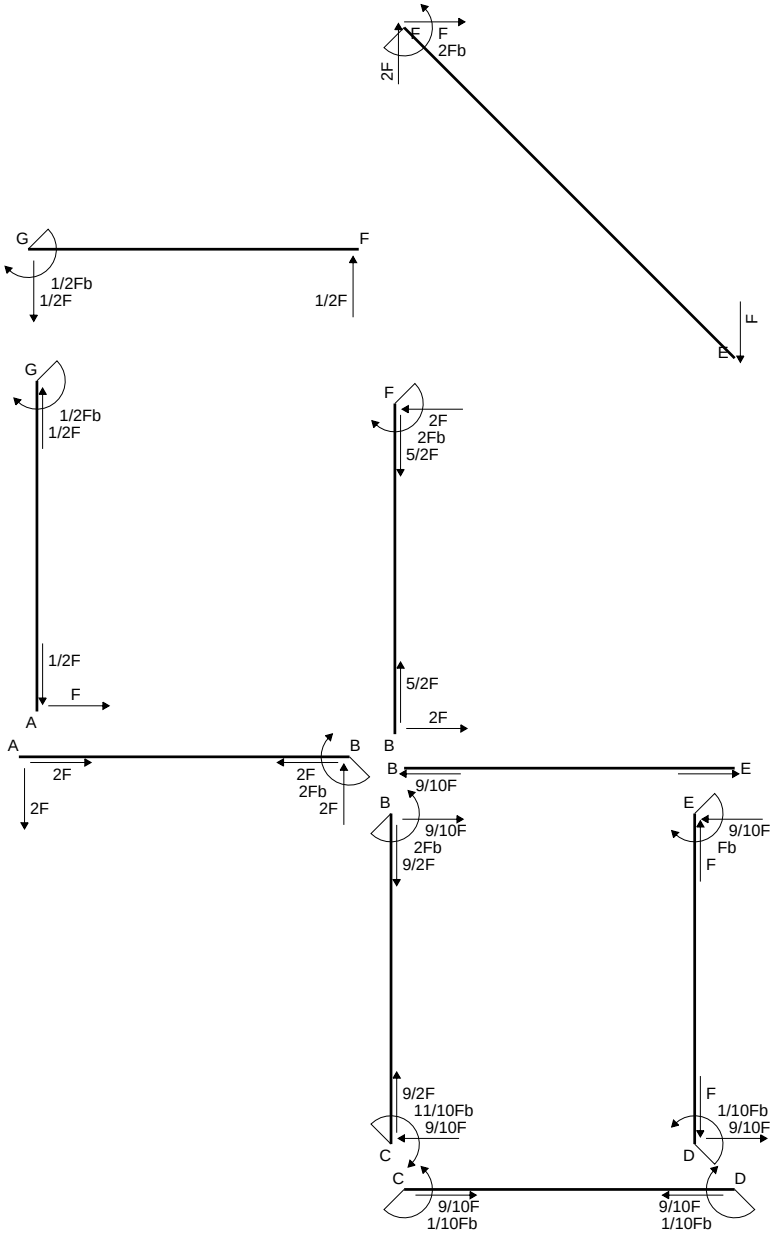
$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ \ Fb^2/EJ$

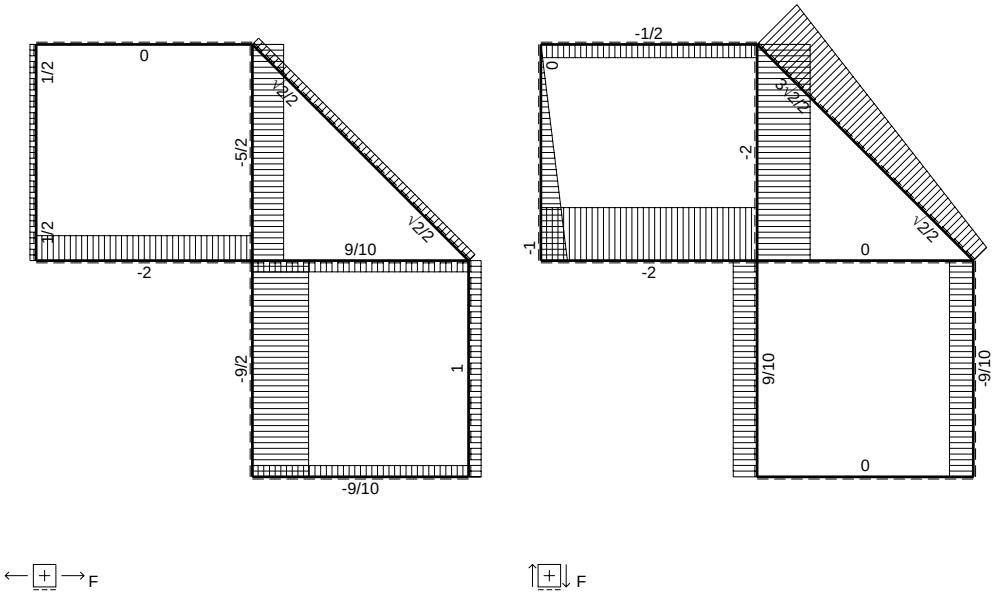


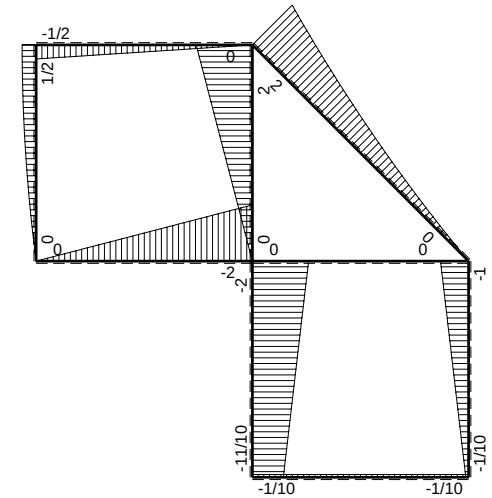
A = 144. mm^2
J_u = 37830. mm^4
J_v = 9072. mm^4
J_t = 128.6 mm^4
y_o = 7.071 mm
y_g = 20.7 mm
N = 360.6 N
T_y = 1082. N
M_x = 377400. Nmm
x_m = 6. mm
u_m = -12. mm
v_m = -20.7 mm
$\sigma_m = N/A - Mv/J_u$ = 209. N/mm^2
x_c = 18. mm
v_c = -20.7 mm
$\sigma_c = N/A - Mv/J_u$ = 209. N/mm^2
$\tau_c = TS^*/tJ_u$ = 25.57 N/mm^2
$\tau_g = TS^*/tJ_u$ = 25.57 N/mm^2
t_c = 510. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 213.7 N/mm^2

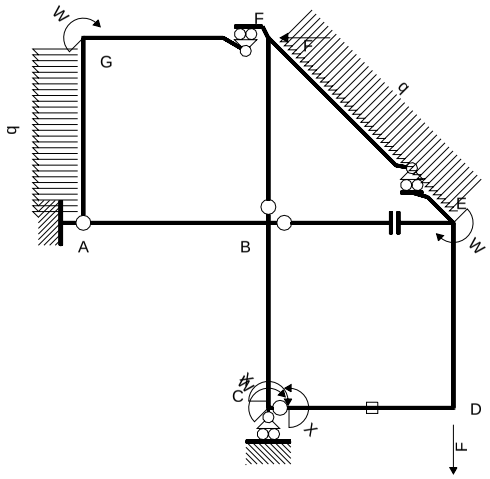
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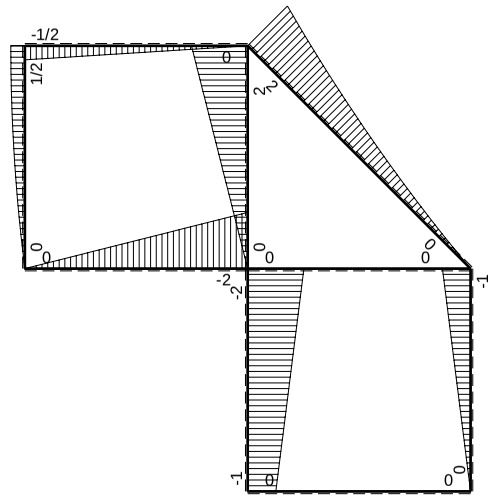

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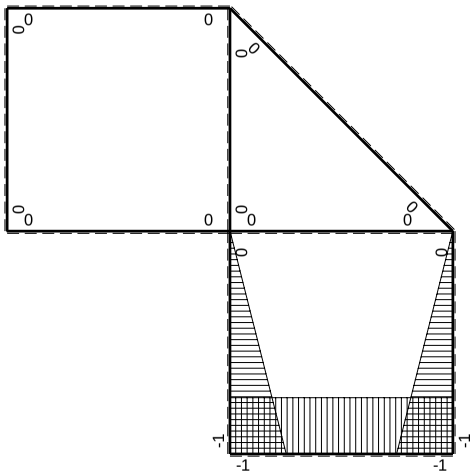

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Schema di calcolo iperstatico



M_o flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0		
BC b	-x/b	-2Fb+Fx	2Fx-Fx^2/b	x^2/b^2	$2/3Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+Fx	Fb-Fx^2/b	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	-Fx	Fx-Fx^2/b	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	Fb-Fx	Fx-Fx^2/b	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}$/2Fx+1/2qx^2	0	0	0	0
FG b	0	-1/2Fx	0	0	0	0
GF b	0	1/2Fb-1/2Fx	0	0		
GA b	0	1/2Fb-1/2qx^2	0	0	0	0
AG b	0	-Fx+1/2qx^2	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/6Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				$1/10Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

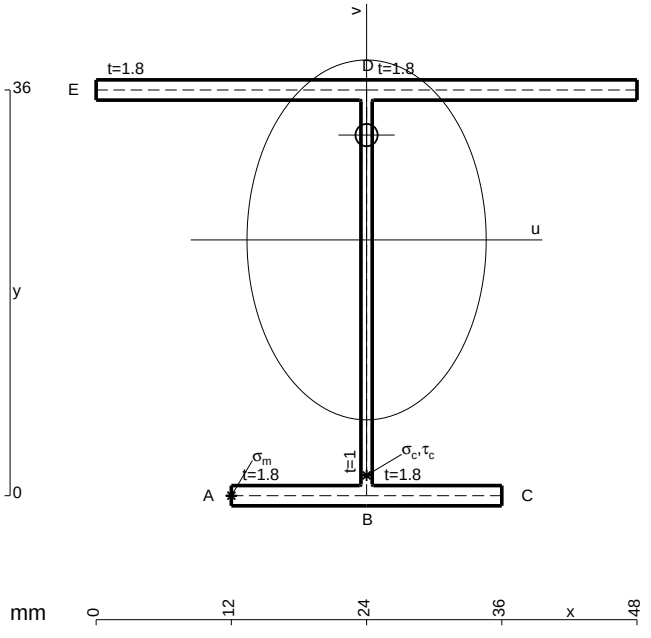
$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

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

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

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

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



$A = 165.6\ mm^2$

$J_u = 42227.\ mm^4$

$J_v = 18662.\ mm^4$

$J_t = 152.\ mm^4$

$y_o = 9.304\ mm$

$y_g = 22.7\ mm$

$N = 353.6\ N$

$T_y = 1061.\ N$

$M_x = 400000.\ Nmm$

$x_m = 12.\ mm$

$u_m = -12.\ mm$

$v_m = -22.7\ mm$

$\sigma_m = N/A - Mv/J_u = 217.1\ N/mm^2$

$x_c = 24.\ mm$

$v_c = -22.7\ mm$

$\sigma_c = N/A - Mv/J_u = 217.1\ N/mm^2$

$\tau_c = TS^*/tJ_u = 24.63\ N/mm^2$

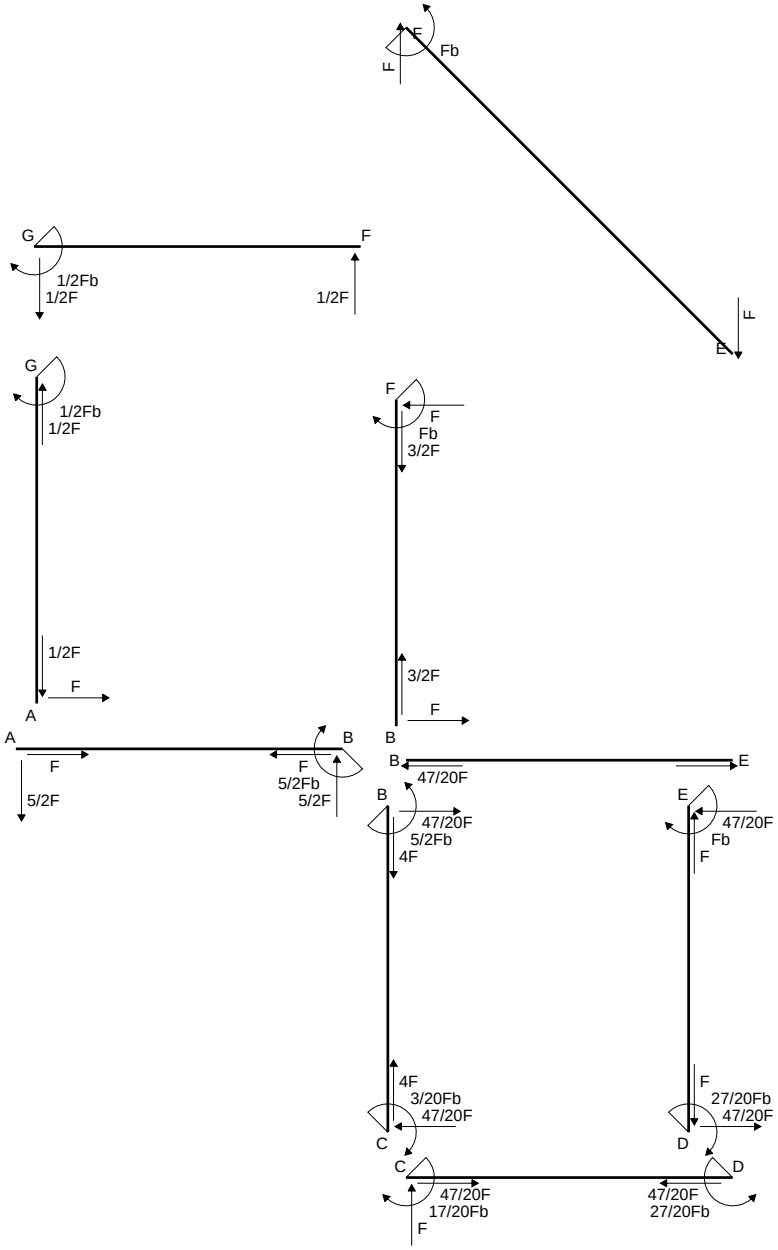
$\tau_g = TS^*/tJ_u = 24.63\ N/mm^2$

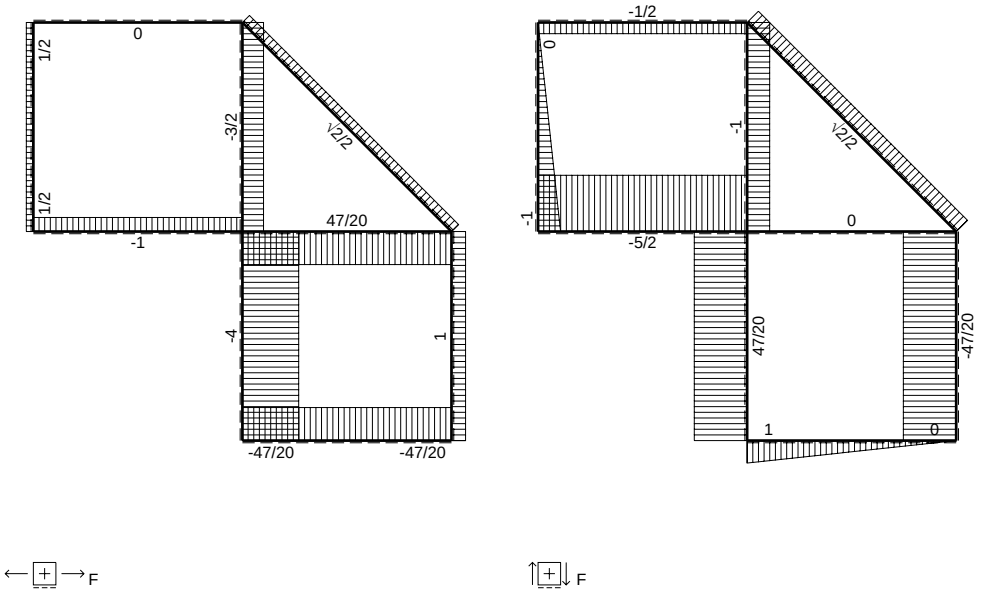
$t_c = 500.\ mm$

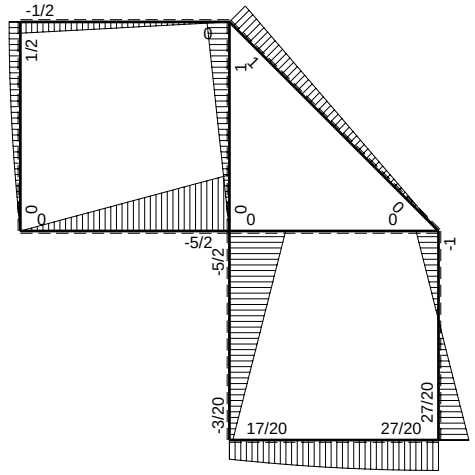
$\sigma_o = \sqrt{\sigma^2+3\tau^2} = 221.3\ N/mm^2$

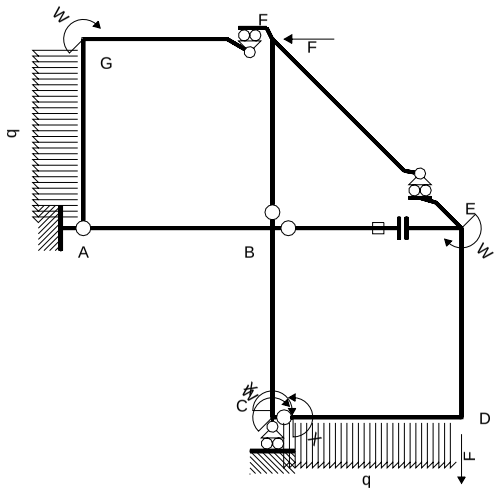
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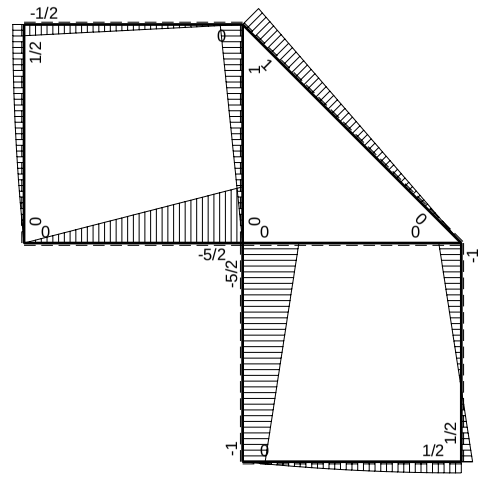

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F


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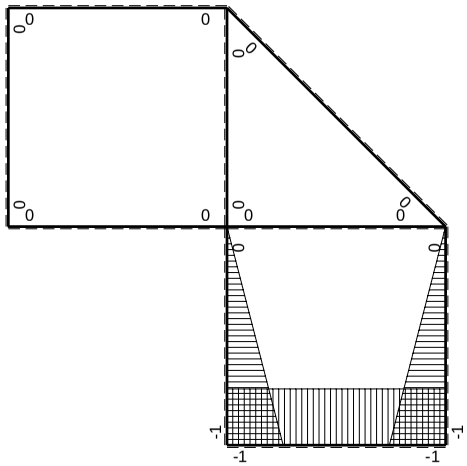

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-3/20
17/20
27/20
27/20
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0		
BC b	-x/b	-5/2Fb+3/2Fx	5/2Fx-3/2Fx^2/b	x^2/b^2	3/4Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	Fb+1/2Fx-3/2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	Fx-1/2qx^2	-Fx+1/2Fx^2/b	1	-1/3Fb^2/EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx^2	-1/2Fb+1/2Fx^2/b	1		
DE b	-1+x/b	1/2Fb-3/2Fx	-1/2Fb+2Fx-3/2Fx^2/b	1-2x/b+x^2/b^2	0	1/3Xb/EJ
ED b	x/b	Fb-3/2Fx	Fx-3/2Fx^2/b	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-1/2Fx	0	0	0	0
GF b	0	1/2Fb-1/2Fx	0	0		
GA b	0	1/2Fb-1/2qx^2	0	0	0	0
AG b	0	-Fx+1/2qx^2	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				17/12Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-17/20Fb	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ Fb^2/EJ$

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

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

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

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

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

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

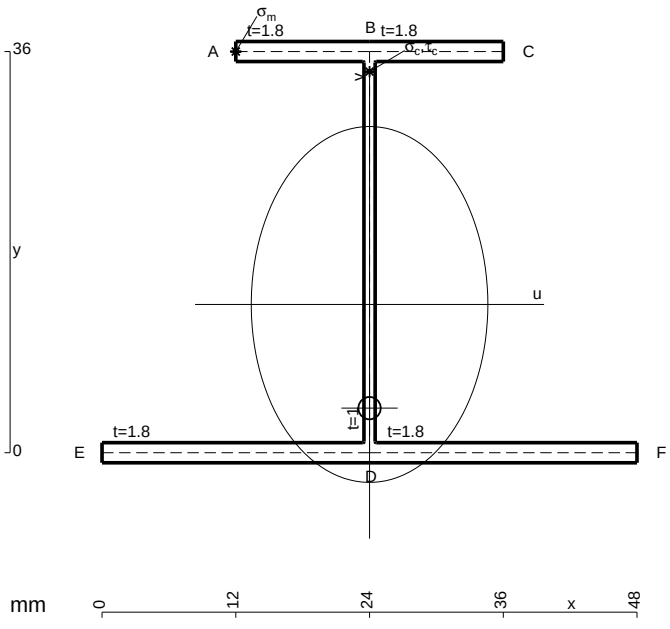
$L^{Xo}_{DE} = \int_o^b (-1/2 +2\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/2\ x + x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b + b -1/2\ b\ )\ Fb\ 1/EJ\ = 0$

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

$= (1/2\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 0$

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$A = 165.6\ mm^2$

$J_u = 42227.\ mm^4$

$J_v = 18662.\ mm^4$

$J_t = 152.\ mm^4$

$y_o = -9.304\ mm$

$y_g = 13.3\ mm$

$N = -390.\ N$

$T_y = -975.\ N$

$M_x = -429000.\ Nmm$

$x_m = 12.\ mm$

$y_m = 36.\ mm$

$u_m = -12.\ mm$

$v_m = 22.7\ mm$

$\sigma_m = N/A - Mv/J_u = 228.2\ N/mm^2$

$x_c = 24.\ mm$

$y_c = 36.\ mm$

$v_c = 22.7\ mm$

$\sigma_c = N/A - Mv/J_u = 228.2\ N/mm^2$

$\tau_c = TS^*/tJ_u = 22.64\ N/mm^2$

$\tau_g = TS^*/tJ_u = 22.64\ N/mm^2$

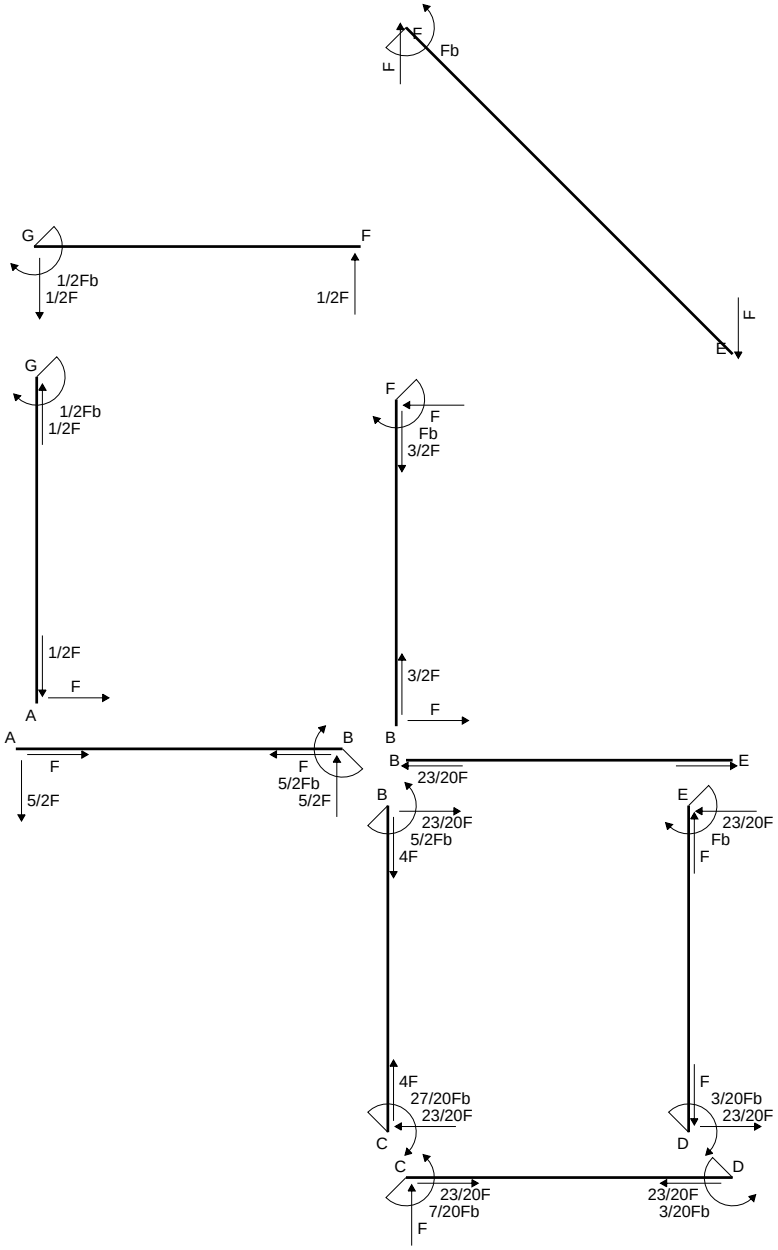
$t_c = 390.\ mm$

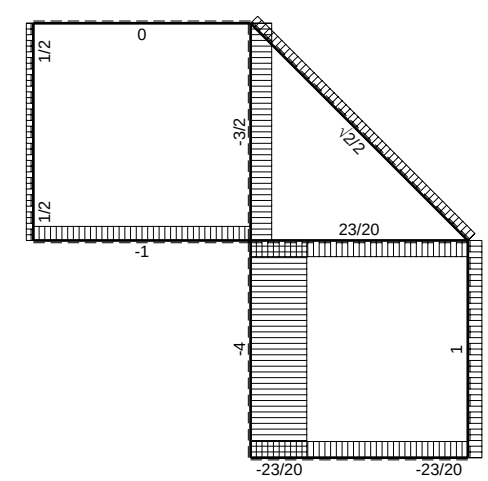
$\sigma_o = \sqrt{\sigma^2 + 3\tau^2} = 231.6\ N/mm^2$

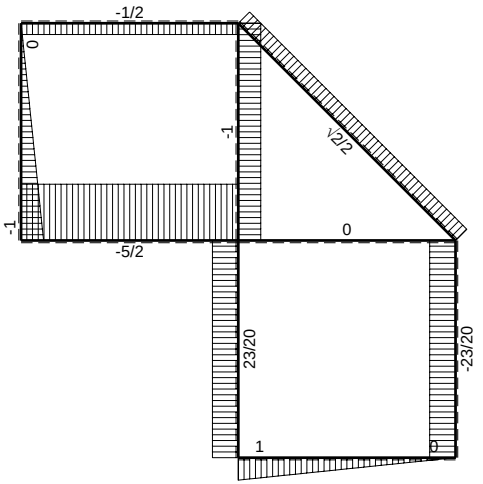
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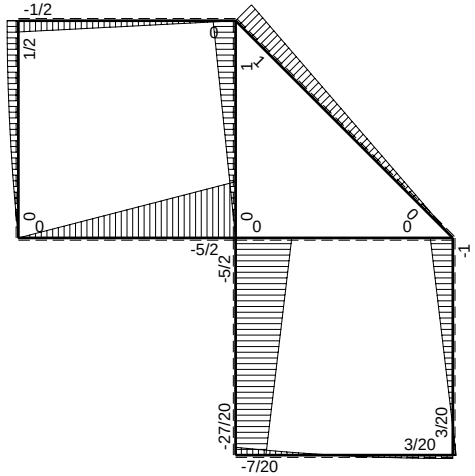

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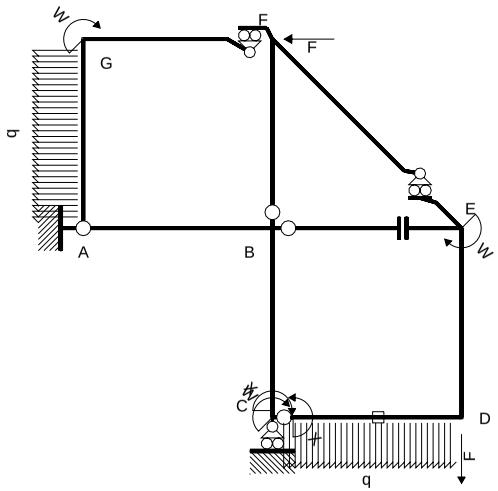

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23/20
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0

←□→ F

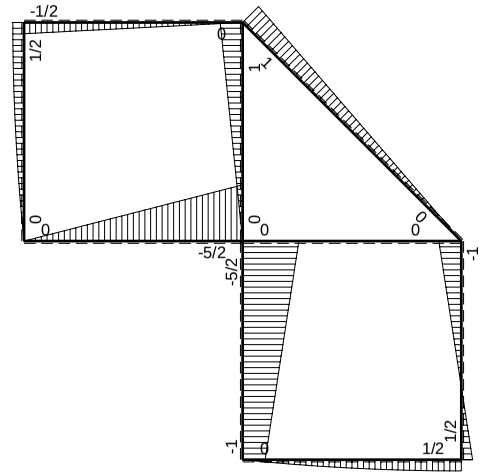
↑□↓ F


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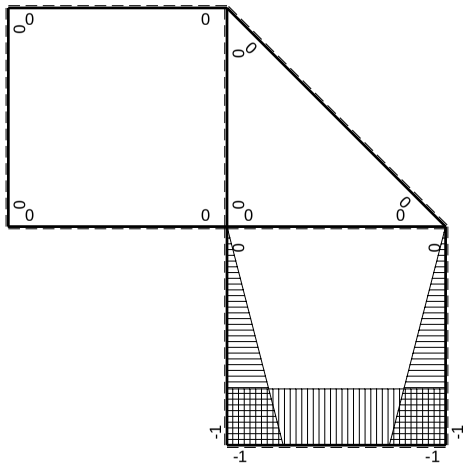
↻□↺ Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0		
BC b	-x/b	-5/2Fb+3/2Fx	5/2Fx-3/2Fx^2/b	x^2/b^2	3/4Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	Fb+1/2Fx-3/2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	Fx-1/2qx^2	-Fx+1/2Fx^2/b	1	-1/3Fb^2/EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx^2	-1/2Fb+1/2Fx^2/b	1		
DE b	-1+x/b	1/2Fb-3/2Fx	-1/2Fb+2Fx-3/2Fx^2/b	1-2x/b+x^2/b^2	0	1/3Xb/EJ
ED b	x/b	Fb-3/2Fx	Fx-3/2Fx^2/b	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-1/2Fx	0	0	0	0
GF b	0	1/2Fb-1/2Fx	0	0		
GA b	0	1/2Fb-1/2qx^2	0	0	0	0
AG b	0	-Fx+1/2qx^2	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				-Fb^2/EJ	
	totali				-7/12Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				7/20Fb	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ Fb^2/EJ$

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

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

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

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

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

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

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

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

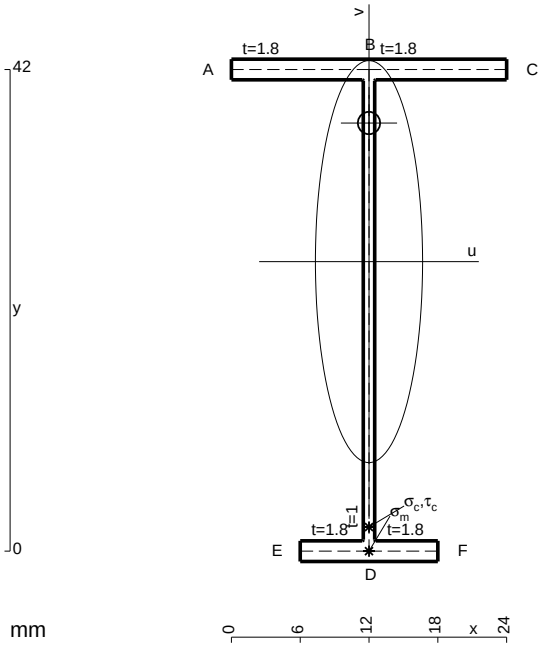
$L^{Xo}_{DE} = \int_o^b (-1/2 +2\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/2\ x + x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b + b -1/2\ b\ )\ Fb\ 1/EJ\ = 0$

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

$= (1/2\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 0$

PROCEDIMENTO E RISULTATI 265578 CI02.xxxx.014

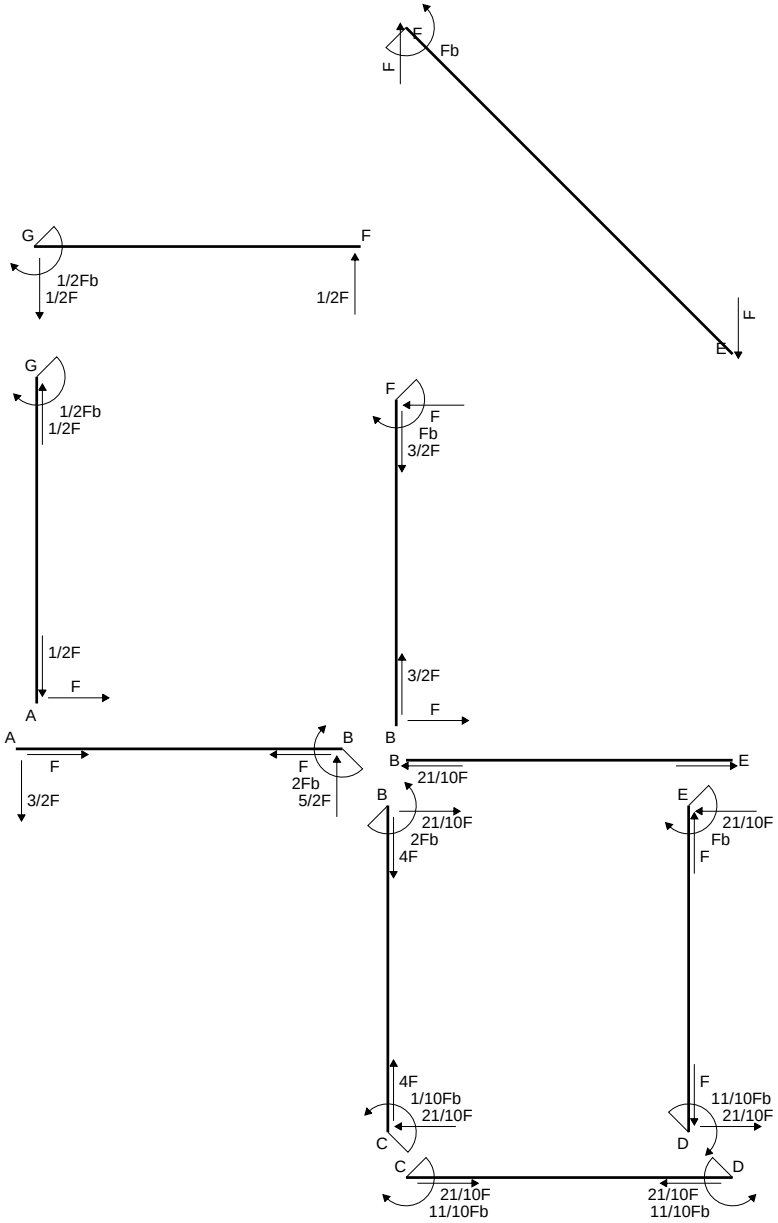


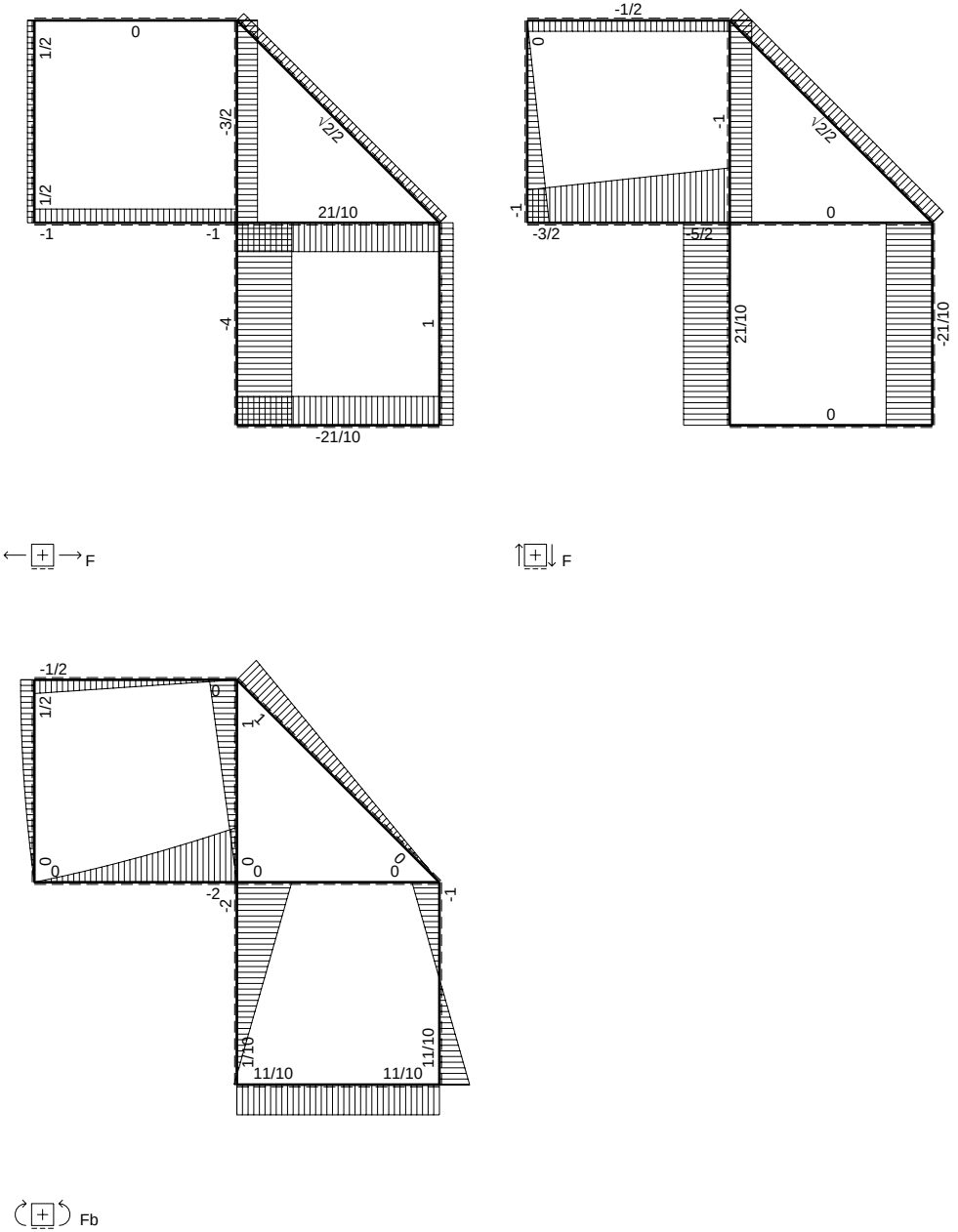
A = 106.8 mm^2
J_u = 32824. mm^4
J_v = 2333. mm^4
J_t = 83.98 mm^4
y_o = 12.09 mm
y_g = 25.25 mm
N = -220. N
T_y = -550. N
M_x = -308000. Nmm
x_m = 12. mm
v_m = -25.25 mm
$\sigma_m = N/A - Mv/J_u$ = -239. N/mm^2
y_c = 3. mm
u_c = -12. mm
v_c = -22.25 mm
$\sigma_c = N/A - Mv/J_u$ = -239. N/mm^2
$\tau_c = TS^*/tJ_u$ = 9.138 N/mm^2
$\tau_g = TS^*/tJ_u$ = 9.138 N/mm^2
t_c = 220. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 239.5 N/mm^2

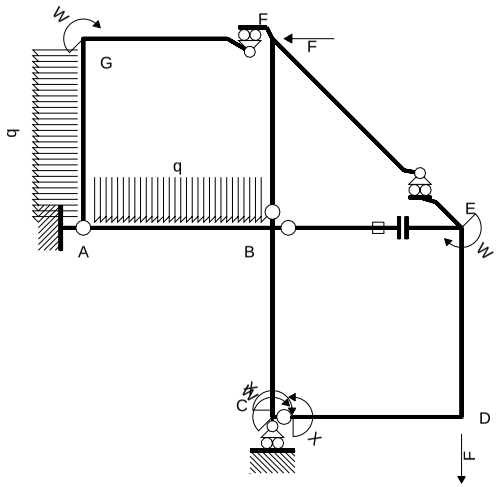
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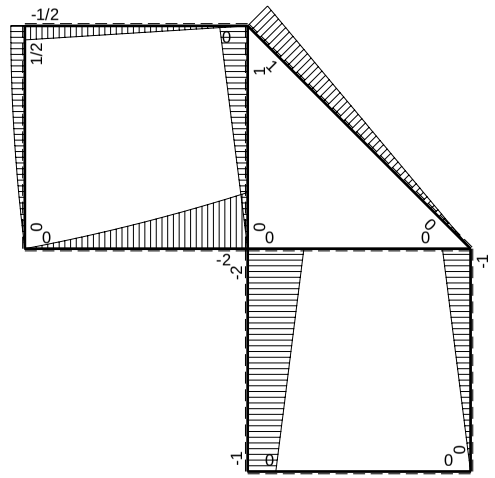
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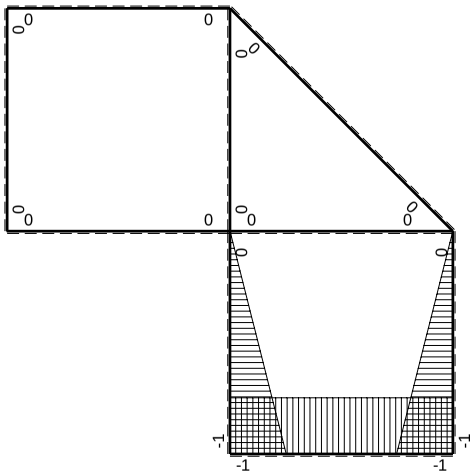

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Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-3/2Fx-1/2qx^2$	0	0	0	0
BA b	0	$2Fb-5/2Fx+1/2qx^2$	0	0		
BC b	-x/b	-2Fb+Fx	$2Fx-Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+Fx	$Fb-Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-1/2Fx	0	0	0	0
GF b	0	1/2Fb-1/2Fx	0	0		
GA b	0	$1/2Fb-1/2qx^2$	0	0	0	0
AG b	0	$-Fx+1/2qx^2$	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$11/6Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				-11/10Fb	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

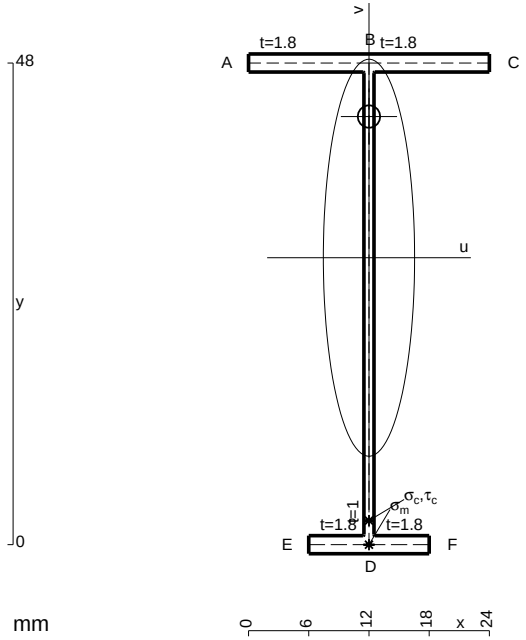
$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

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

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

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

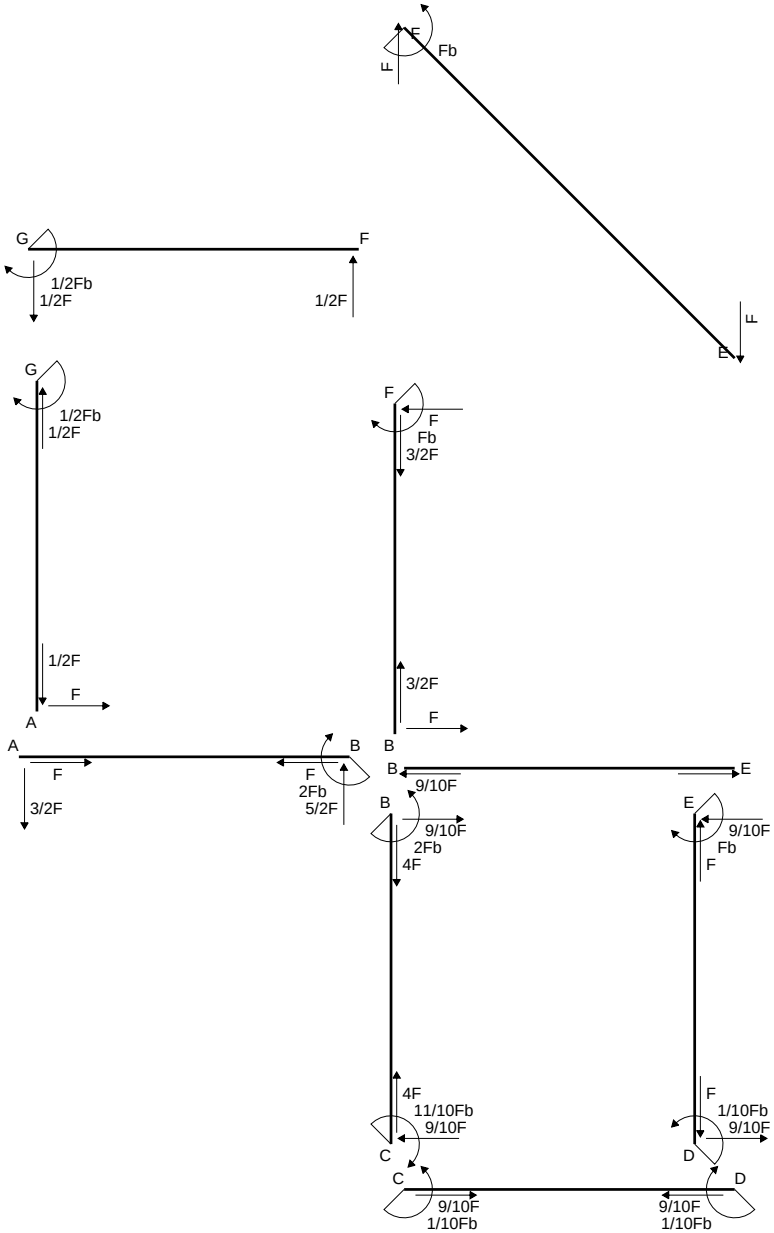
$= (1/2\ b -1/3\ b)\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

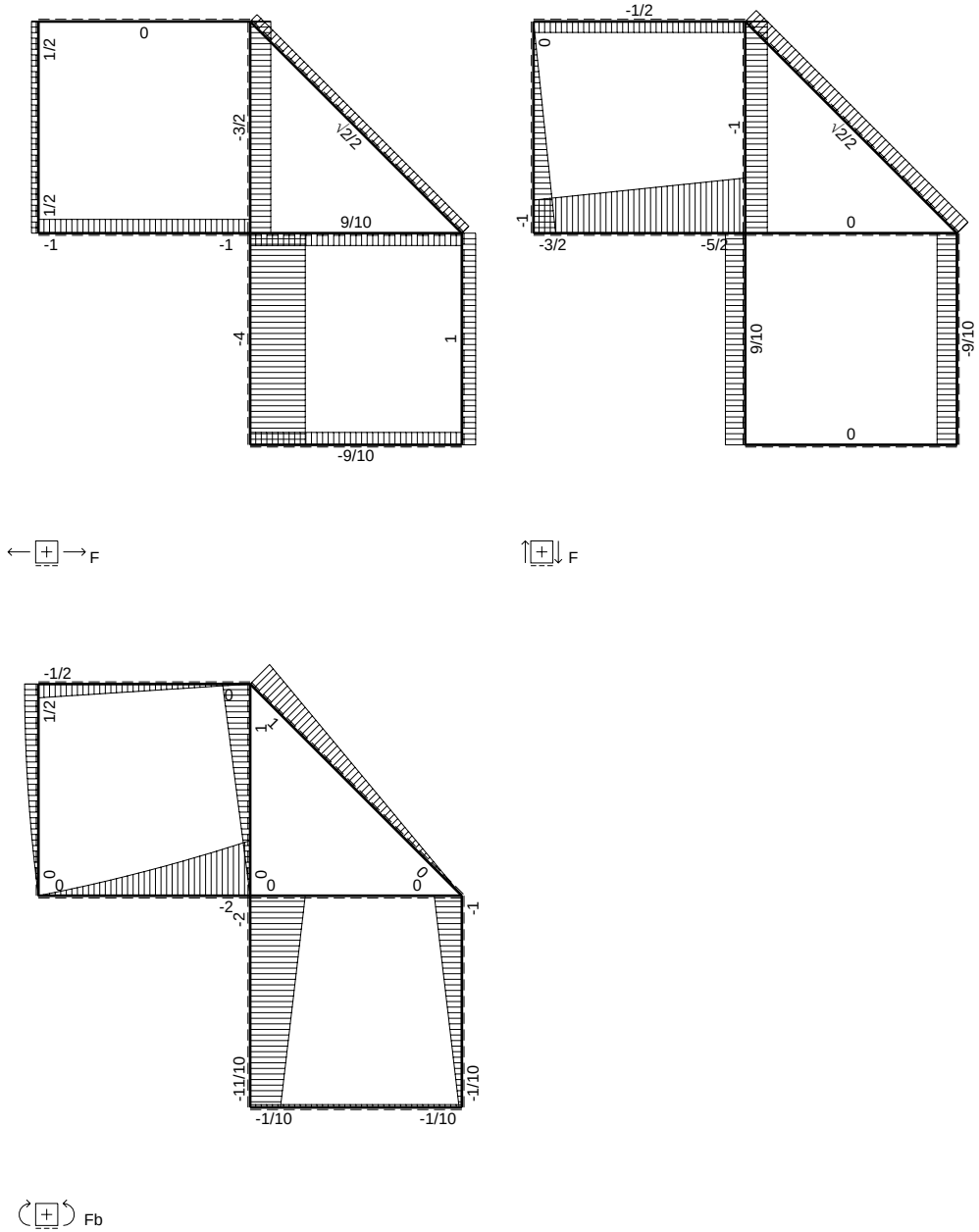


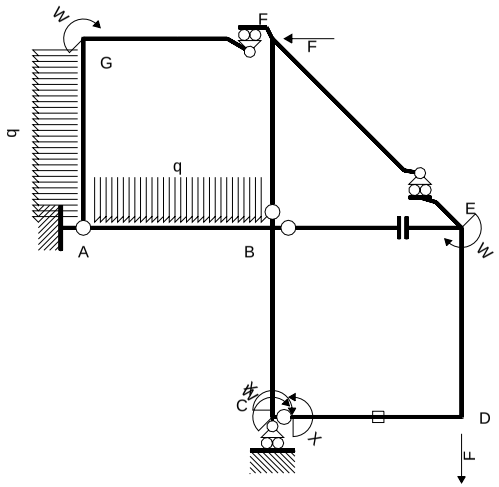
A = 112.8 mm^2
J_u = 44158. mm^4
J_v = 2333. mm^4
J_t = 85.98 mm^4
y_o = 14.07 mm
y_g = 28.6 mm
N = -220. N
T_y = -550. N
M_x = -294800. Nmm
x_m = 12. mm
v_m = -28.6 mm
$\sigma_m = N/A - Mv/J_u$ = -192.9 N/mm^2
y_c = 3. mm
u_c = -12. mm
v_c = -25.6 mm
$\sigma_c = N/A - Mv/J_u$ = -192.9 N/mm^2
$\tau_c = TS^*/tJ_u$ = 7.693 N/mm^2
$\tau_g = TS^*/tJ_u$ = 7.693 N/mm^2
t_c = 220. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 193.3 N/mm^2

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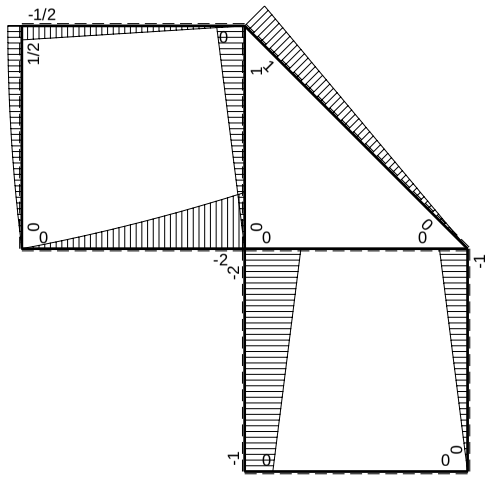
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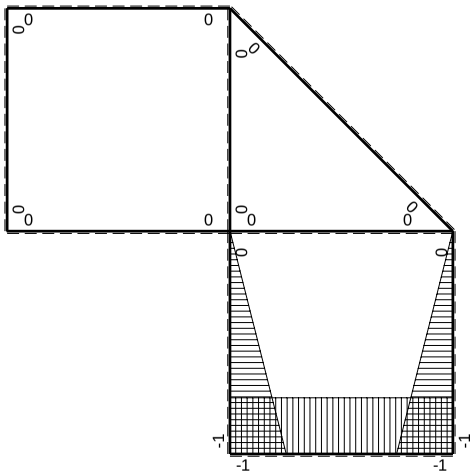

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Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-3/2Fx-1/2qx^2$	0	0	0	0
BA b	0	$2Fb-5/2Fx+1/2qx^2$	0	0		
BC b	-x/b	-2Fb+Fx	$2Fx-Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	$Fb-Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	1/3Xb/EJ
ED b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-1/2Fx	0	0	0	0
GF b	0	1/2Fb-1/2Fx	0	0		
GA b	0	$1/2Fb-1/2qx^2$	0	0	0	0
AG b	0	$-Fx+1/2qx^2$	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/6Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				1/10Fb	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

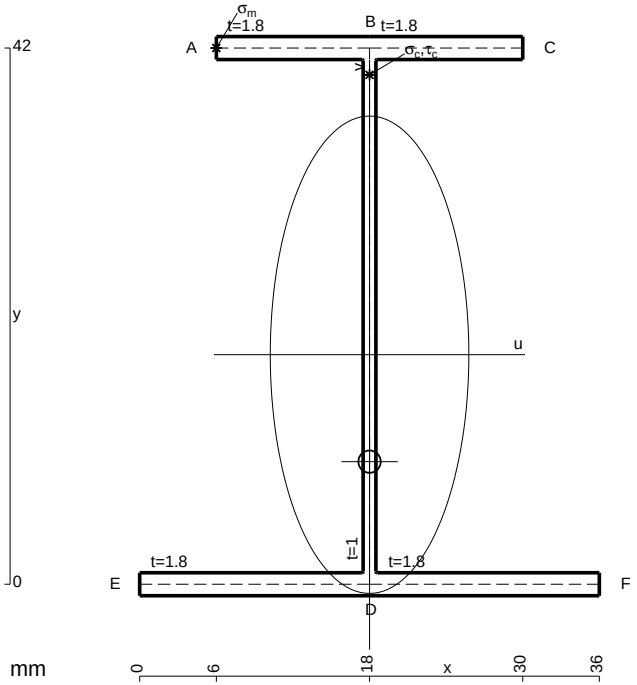
$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

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

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

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

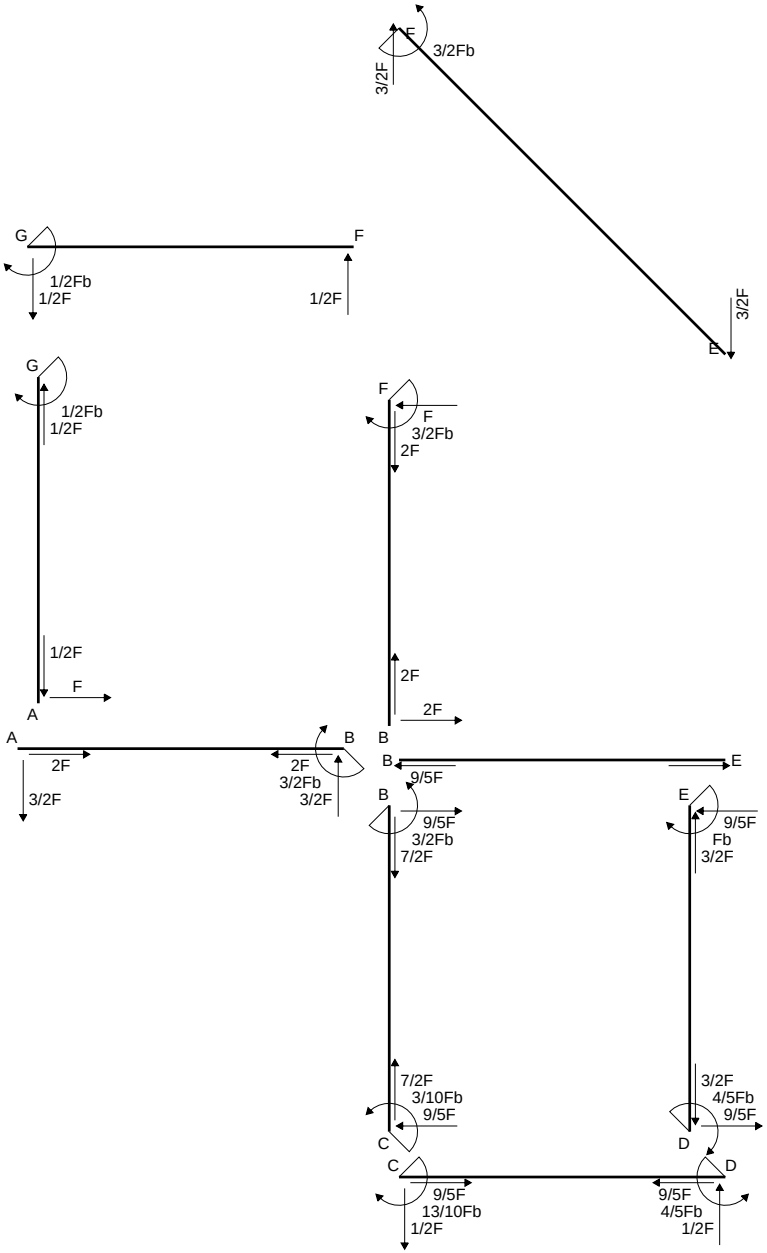
$= (1/2\ b -1/3\ b)\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

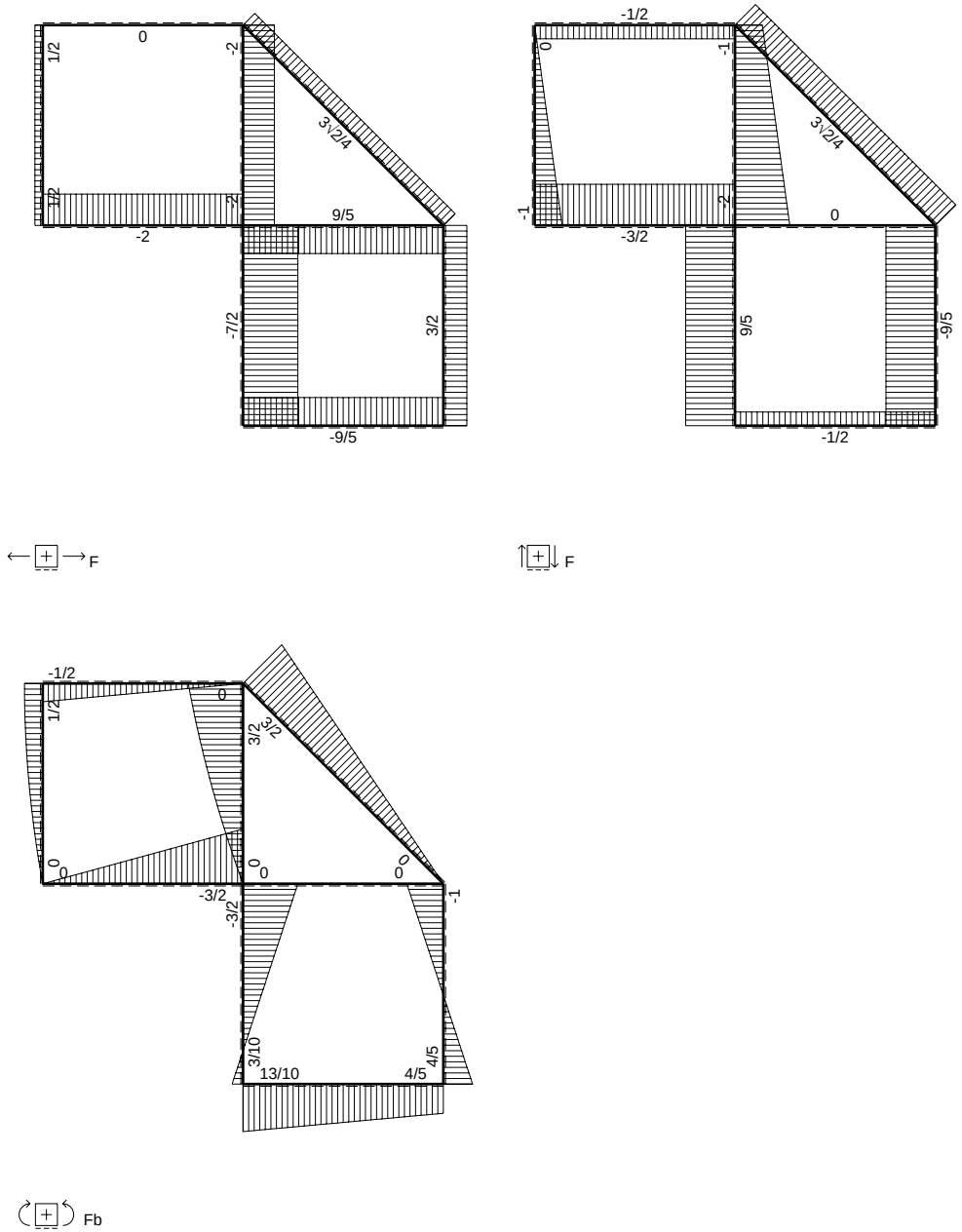


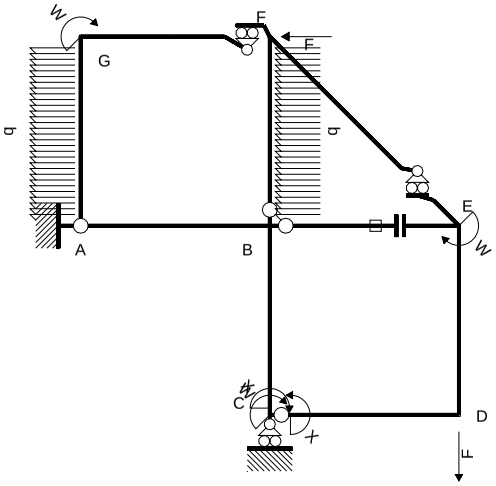
A = 150. mm^2
J_u = 52430. mm^4
J_v = 9072. mm^4
J_t = 130.6 mm^4
y_o = -8.376 mm
y_g = 17.98 mm
N = -360. N
T_y = -900. N
M_x = -460800. Nmm
x_m = 6. mm
y_m = 42. mm
u_m = -12. mm
v_m = 24.02 mm
$\sigma_m = N/A - Mv/J_u$ = 208.7 N/mm^2
x_c = 18. mm
y_c = 42. mm
v_c = 24.02 mm
$\sigma_c = N/A - Mv/J_u$ = 208.7 N/mm^2
$\tau_c = TS^*/tJ_u$ = 17.82 N/mm^2
$\tau_g = TS^*/tJ_u$ = 17.82 N/mm^2
t_c = 360. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 211. N/mm^2

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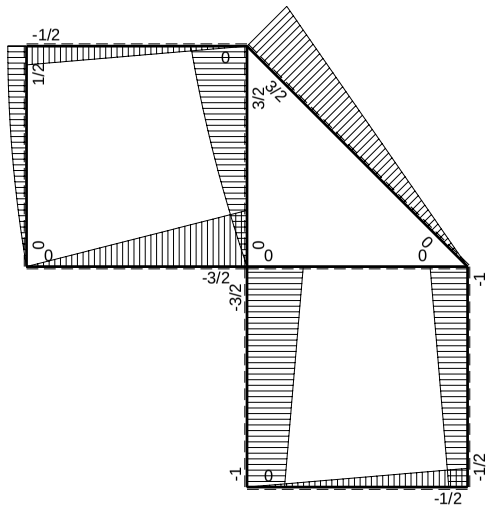
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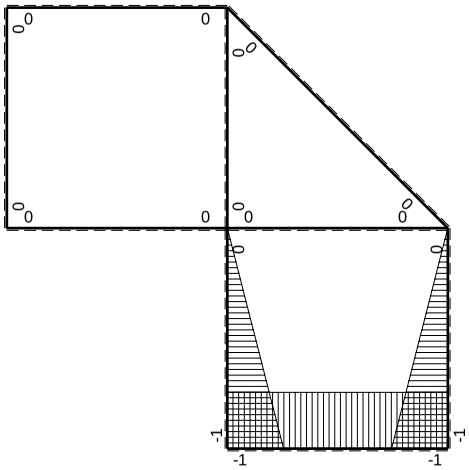

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3/2
3/2
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0
0
0
-3/2
-3/2
-1
3/10
13/10
4/5
4/5
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0		
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx^2/b	x^2/b^2	7/12Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb^2/EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE 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
ED b	x/b	Fb-1/2Fx	Fx-1/2Fx^2/b	x^2/b^2		
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-1/2Fx	0	0	0	0
GF b	0	1/2Fb-1/2Fx	0	0		
GA b	0	1/2Fb-1/2qx^2	0	0	0	0
AG b	0	-Fx+1/2qx^2	0	0		
FB b	0	3/2Fb-Fx-1/2qx^2	0	0	0	0
BF b	0	-2Fx+1/2qx^2	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				13/6Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-13/10Fb	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

$= (3/4\ b -1/6\ b)\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

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

$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

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

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

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

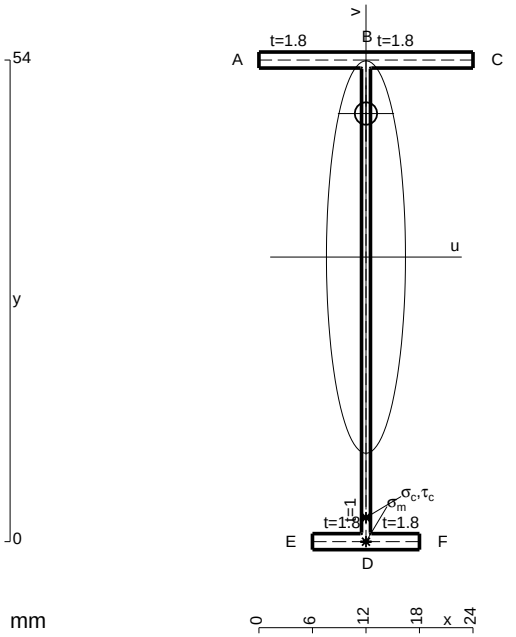
$= (1/2\ b -1/4\ b\ )\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

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

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

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

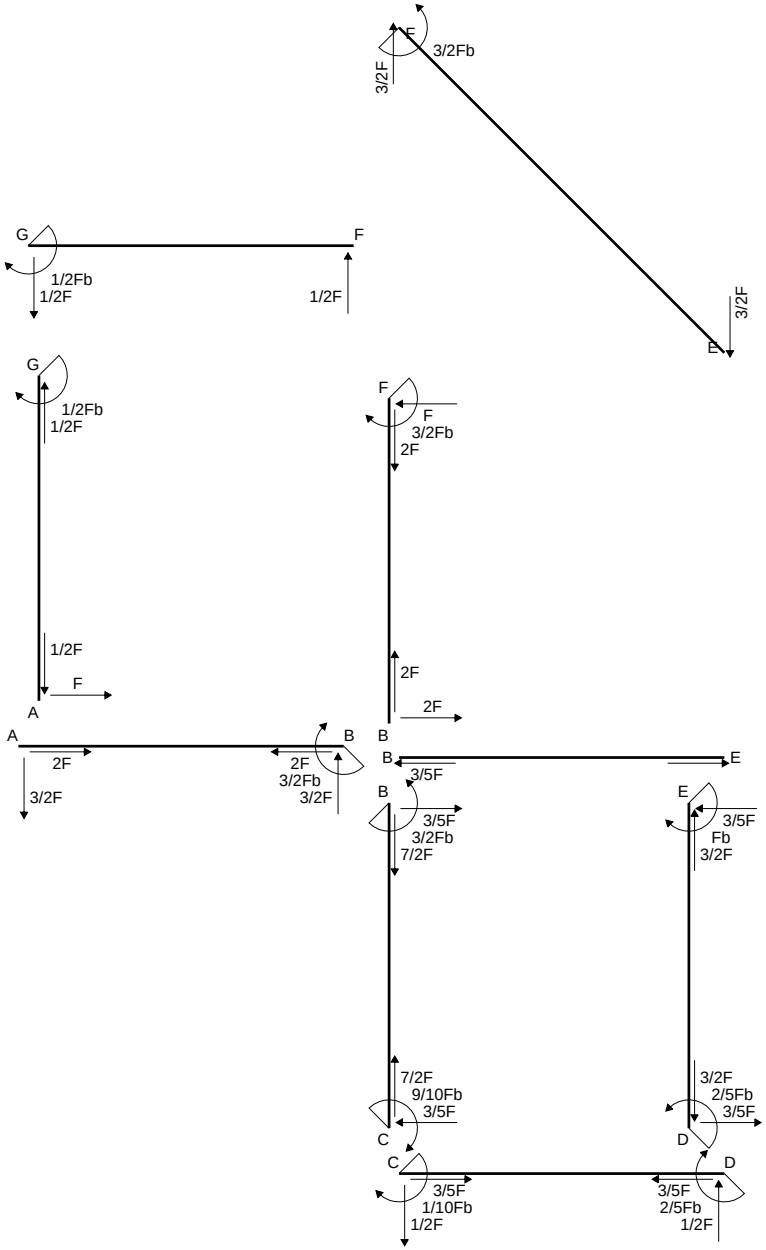
$= (1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/3\ Fb^2/EJ$

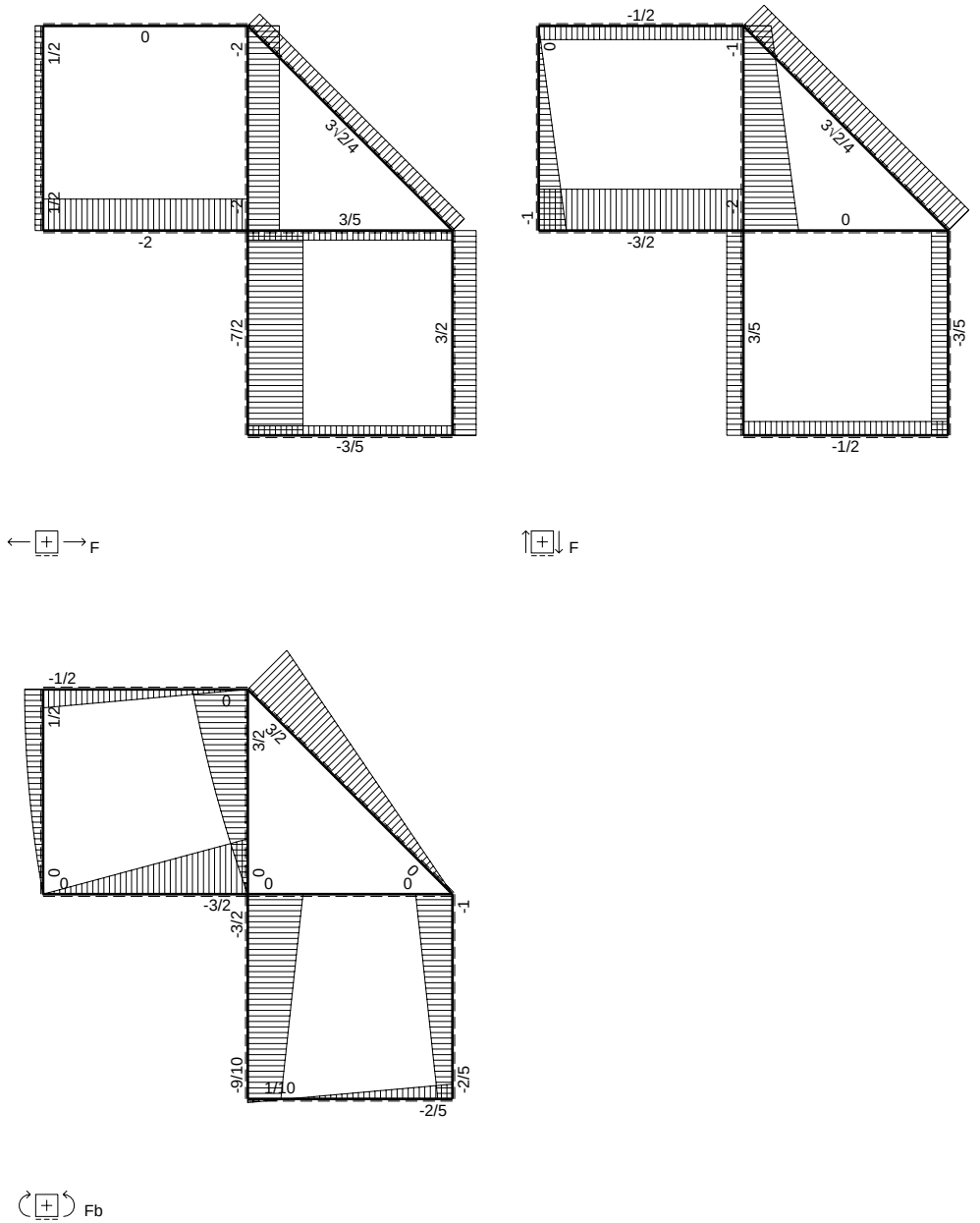


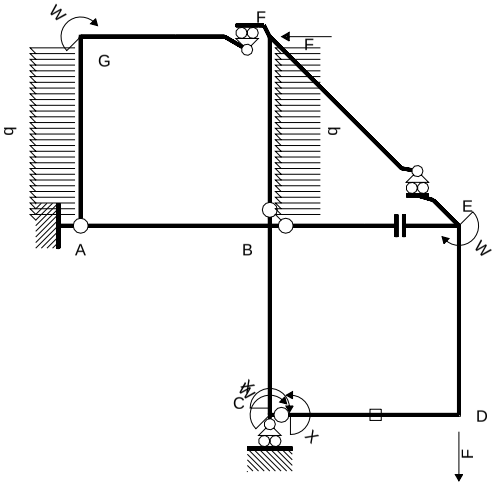
A = 118.8 mm^2
J_u = 57498. mm^4
J_v = 2333. mm^4
J_t = 87.98 mm^4
y_o = 16.09 mm
y_g = 31.91 mm
N = -600. N
T_y = -450. N
M_x = -387000. Nmm
x_m = 12. mm
v_m = -31.91 mm
$\sigma_m = N/A - Mv/J_u$ = -219.8 N/mm^2
y_c = 3. mm
u_c = -12. mm
v_c = -28.91 mm
$\sigma_c = N/A - Mv/J_u$ = -219.8 N/mm^2
$\tau_c = TS^*/tJ_u$ = 5.394 N/mm^2
$\tau_g = TS^*/tJ_u$ = 5.394 N/mm^2
t_c = 300. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 220. N/mm^2

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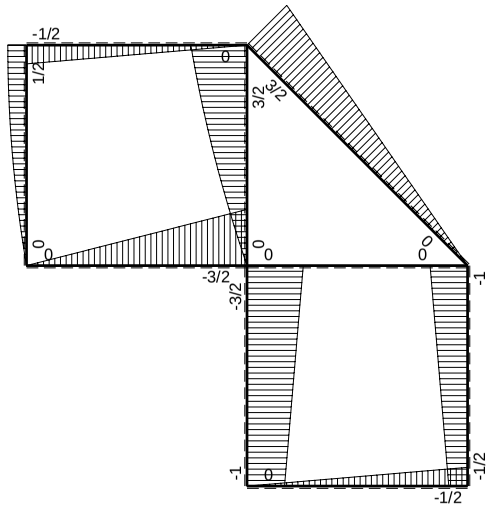
@ Adolfo Zavelani Rossi, Politecnico di Milano, vers.27.03.13 16.04.26


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3/5F
Fb
3/2F
7/2F
9/10Fb
3/5F
3/2F
2/5Fb
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1/2F

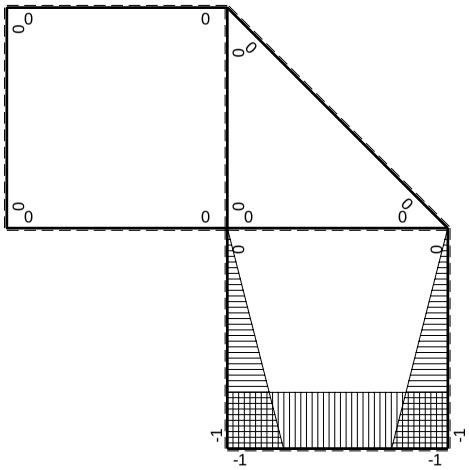

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3√2/4
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0
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3√2/4
-1
2
0
-3/2
3/5
-3/5
-1/2
F
-1/2
1/2
0
3√2/4
0
0
0
0
-3/2
-3/2
-1
-9/10
1/10
-2/5
-2/5
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0		
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx^2/b	x^2/b^2	7/12Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb^2/EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE 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
ED b	x/b	Fb-1/2Fx	Fx-1/2Fx^2/b	x^2/b^2		
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-1/2Fx	0	0	0	0
GF b	0	1/2Fb-1/2Fx	0	0		
GA b	0	1/2Fb-1/2qx^2	0	0	0	0
AG b	0	-Fx+1/2qx^2	0	0		
FB b	0	3/2Fb-Fx-1/2qx^2	0	0	0	0
BF b	0	-2Fx+1/2qx^2	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				-Fb^2/EJ	
	totali				1/6Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-1/10Fb	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

$= (3/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

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

$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

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

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

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

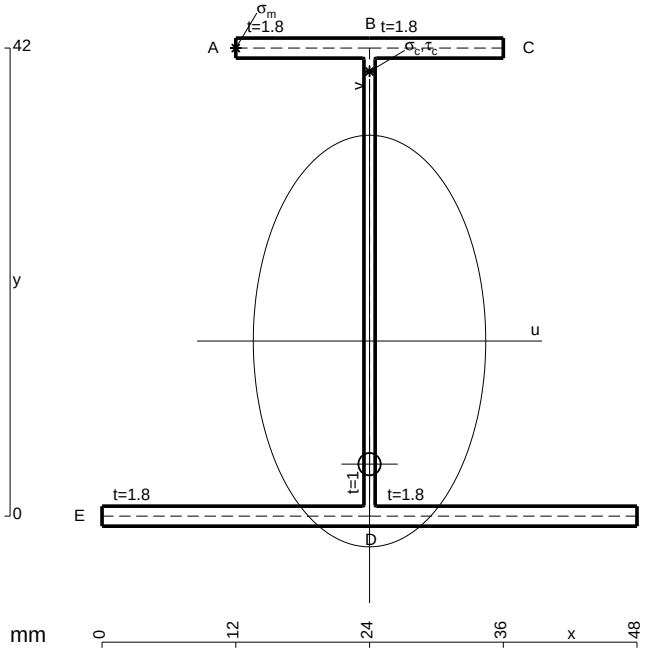
$= (1/2\ b -1/4\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -3/4\ \ Fb^2/EJ$

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

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

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

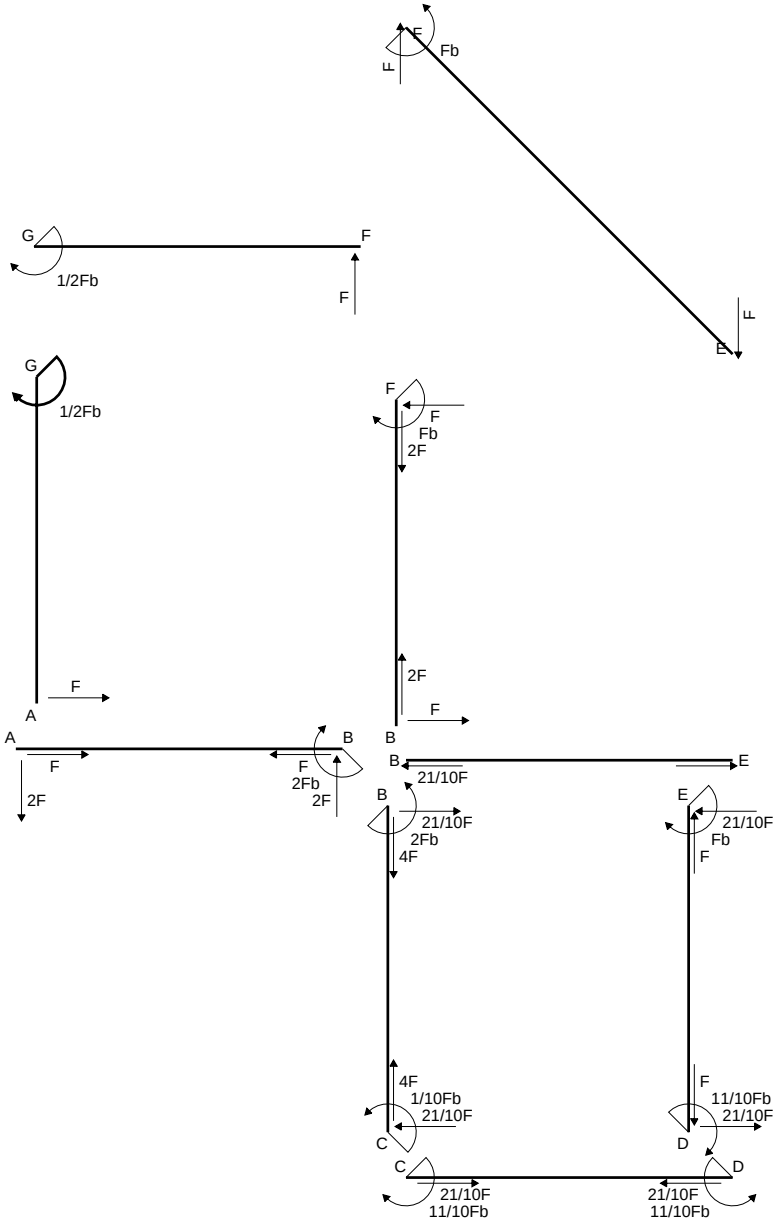
$= (1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/3\ \ Fb^2/EJ$

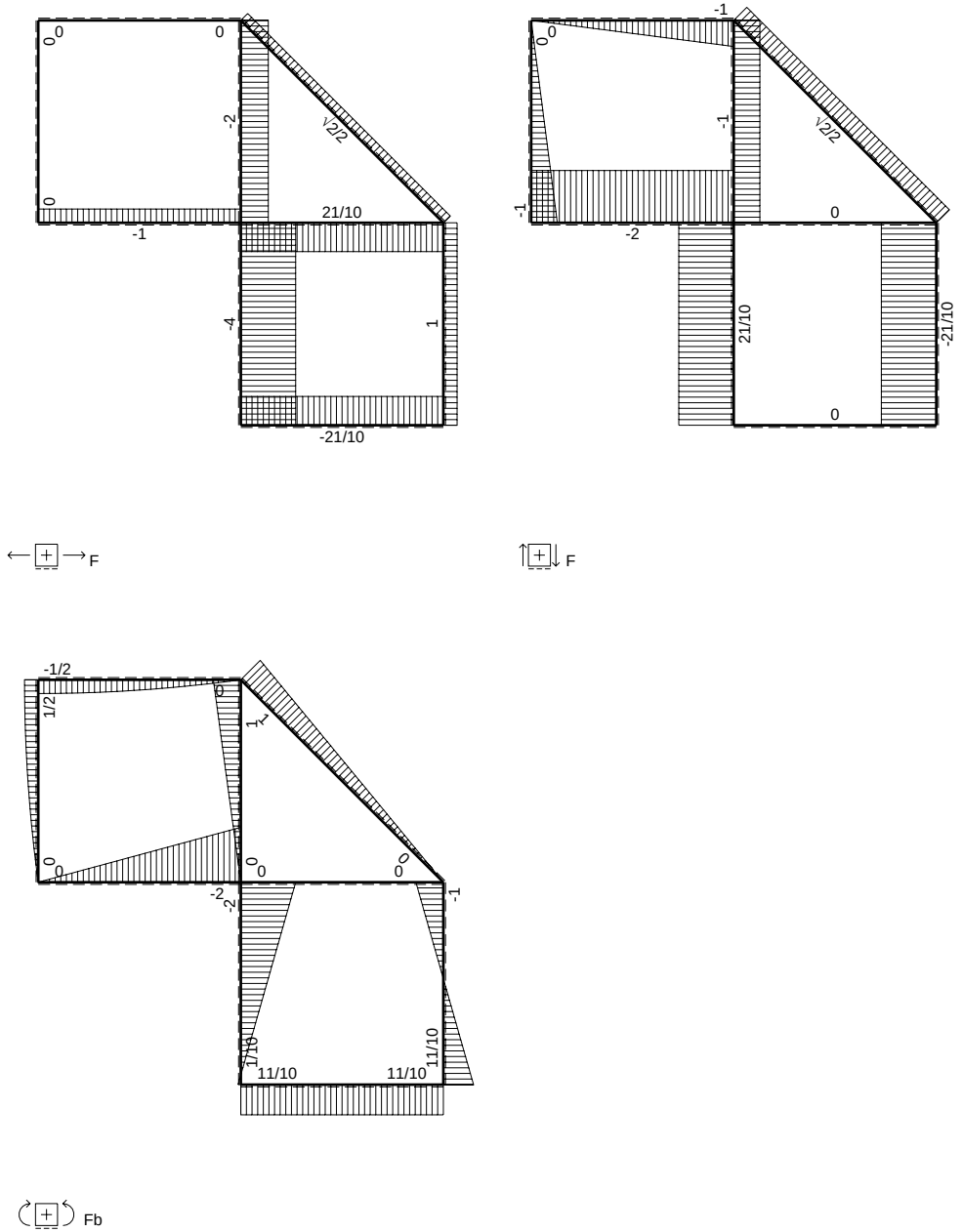


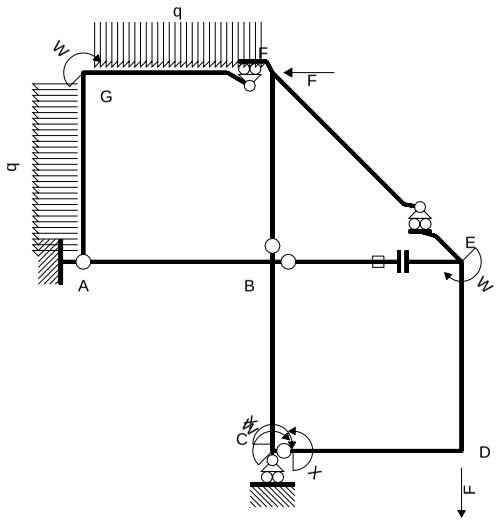
A = 171.6 mm^2
J_u = 58532. mm^4
J_v = 18662. mm^4
J_t = 154. mm^4
y_o = -11.05 mm
y_g = 15.71 mm
N = -960. N
T_y = -720. N
M_x = -518400. Nmm
x_m = 12. mm
y_m = 42. mm
u_m = -12. mm
v_m = 26.29 mm
$\sigma_m = N/A - Mv/J_u$ = 227.2 N/mm^2
x_c = 24. mm
y_c = 42. mm
v_c = 26.29 mm
$\sigma_c = N/A - Mv/J_u$ = 227.2 N/mm^2
$\tau_c = TS^*/tJ_u$ = 13.97 N/mm^2
$\tau_g = TS^*/tJ_u$ = 13.97 N/mm^2
t_c = 480. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 228.5 N/mm^2

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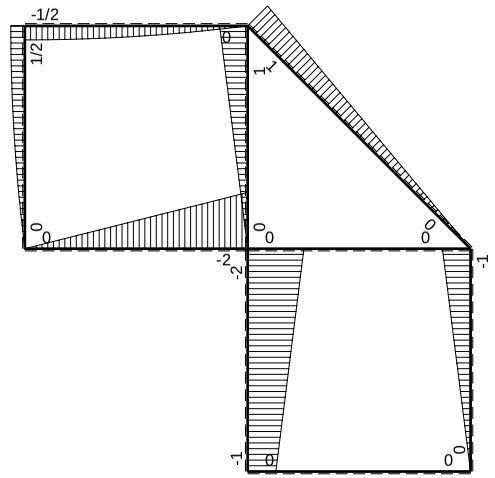
@ Adolfo Zavelani Rossi, Politecnico di Milano, vers.27.03.13 16.04.26


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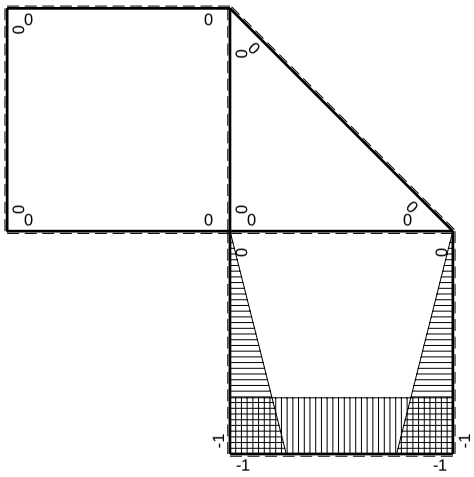

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-21/10
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1/2
0
1
0
0
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-2
-2
-1
11/10
11/10
11/10
11/10
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0		
BC b	-x/b	-2Fb+Fx	2Fx-Fx^2/b	x^2/b^2	$2/3Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	-Fx	Fx-Fx^2/b	1-2x/b+x^2/b^2	$1/6Fb^2/EJ$	1/3Xb/EJ
ED b	x/b	Fb-Fx	Fx-Fx^2/b	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-Fx+1/2qx^2	0	0	0	0
GF b	0	1/2Fb-1/2qx^2	0	0		
GA b	0	1/2Fb-1/2qx^2	0	0	0	0
AG b	0	-Fx+1/2qx^2	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$11/6Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-11/10Fb	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

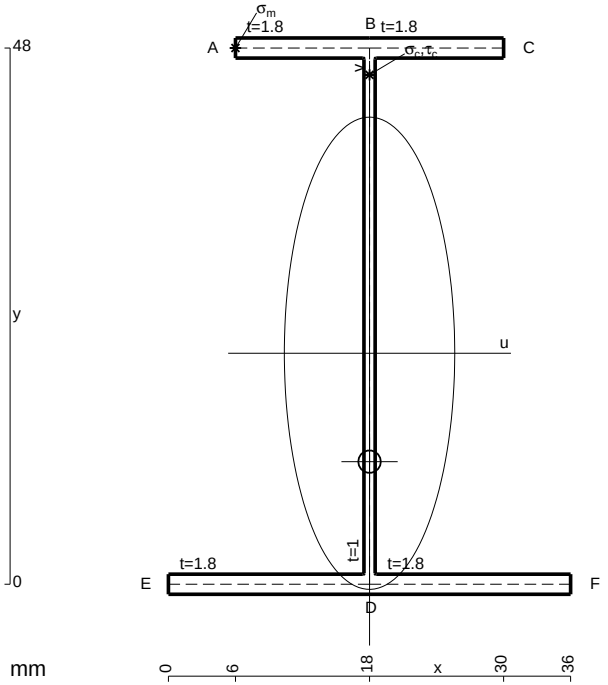
$L^{Xo}_{DE} = \int_o^b (x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

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

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

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

PROCEDIMENTO E RISULTATI 265064 CI02.xxxx.019

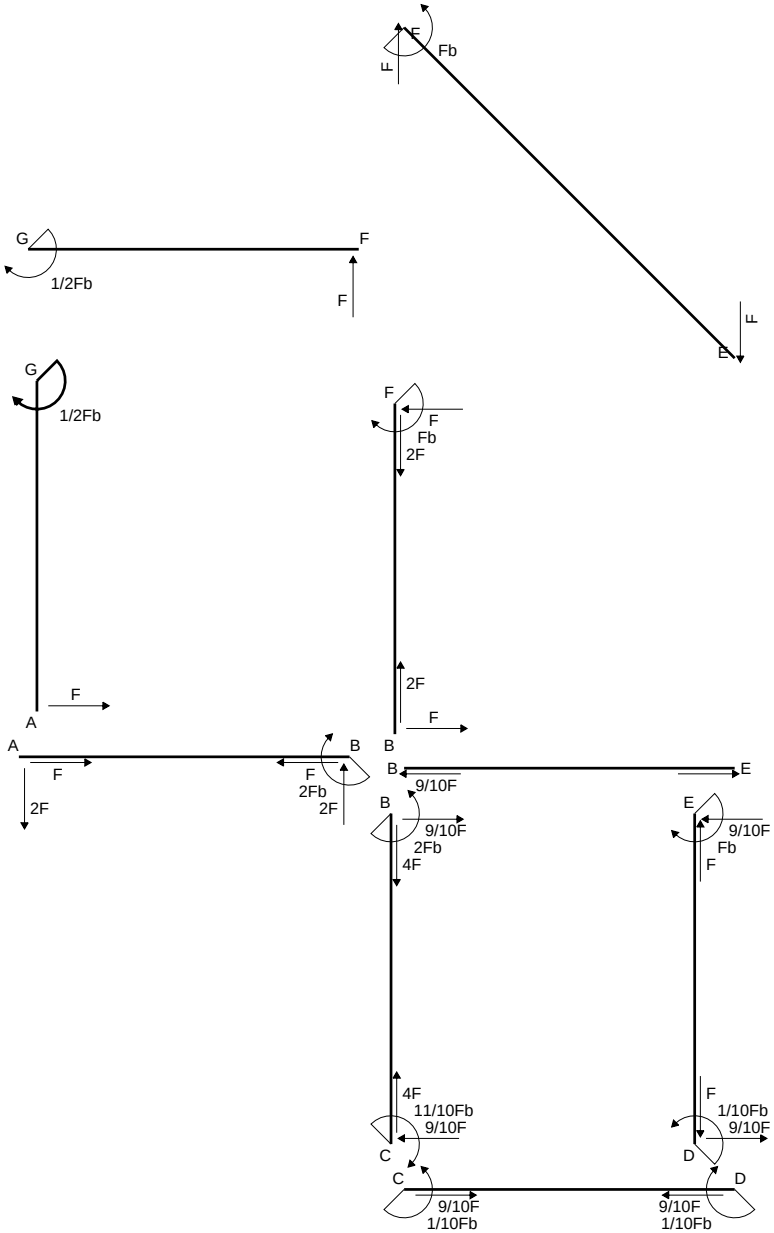


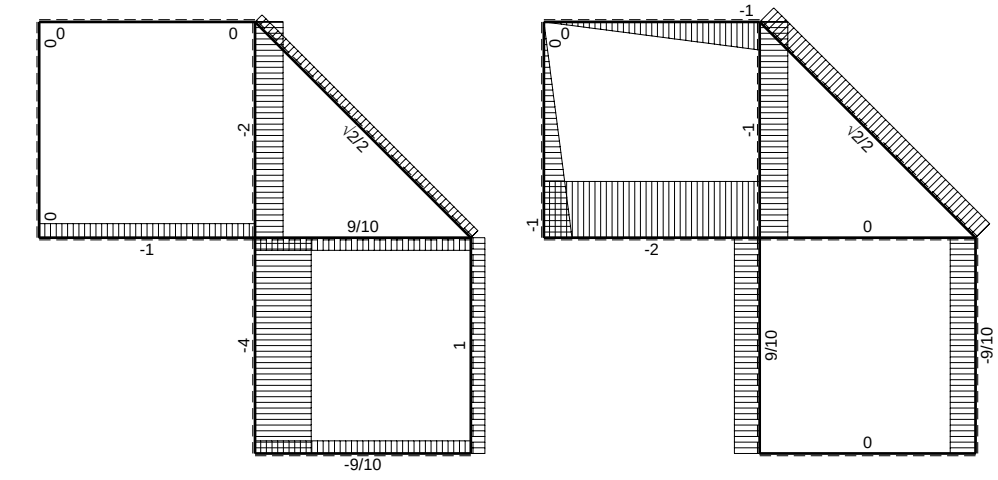
A = 156. mm^2
J_u = 69701. mm^4
J_v = 9072. mm^4
J_t = 132.6 mm^4
y_o = -9.705 mm
y_g = 20.68 mm
N = -360. N
T_y = -720. N
M_x = -612000. Nmm
x_m = 6. mm
y_m = 48. mm
u_m = -12. mm
v_m = 27.32 mm
$\sigma_m = N/A - Mv/J_u$ = 237.6 N/mm^2
x_c = 18. mm
y_c = 48. mm
v_c = 27.32 mm
$\sigma_c = N/A - Mv/J_u$ = 237.6 N/mm^2
$\tau_c = TS^*/tJ_u$ = 12.19 N/mm^2
$\tau_g = TS^*/tJ_u$ = 12.19 N/mm^2
t_c = 360. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 238.5 N/mm^2

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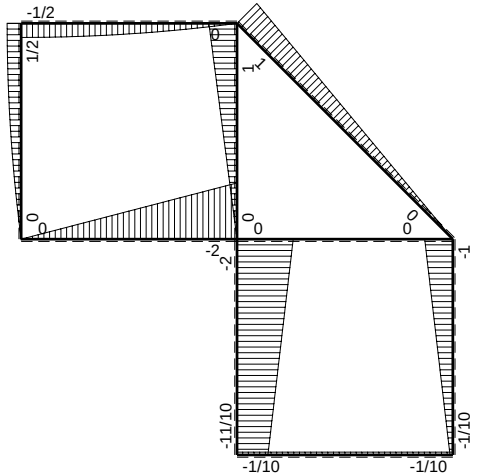
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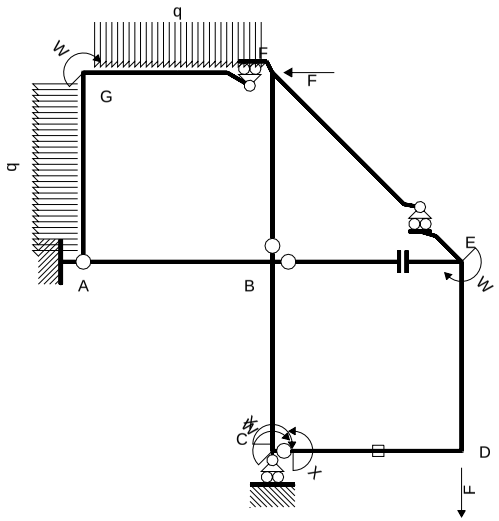

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4F
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1/10Fb
9/10F
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1/10Fb
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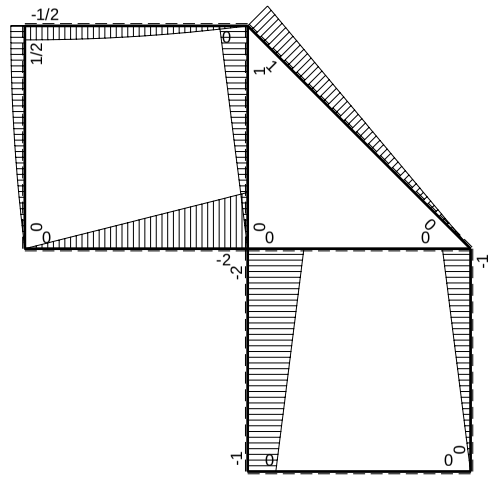
F F


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-1/10
-1/10

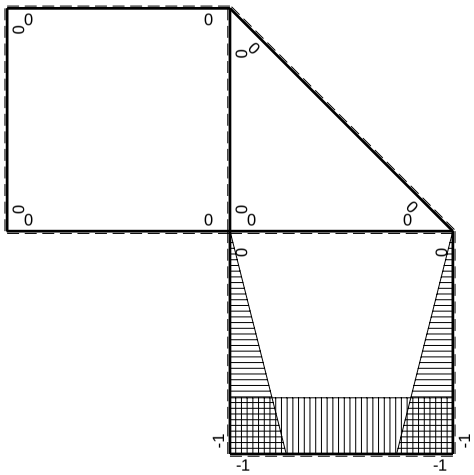
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0		
BC b	-x/b	-2Fb+Fx	2Fx-Fx^2/b	x^2/b^2	2/3Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	-Fx	Fx-Fx^2/b	1-2x/b+x^2/b^2	1/6Fb^2/EJ	1/3Xb/EJ
ED b	x/b	Fb-Fx	Fx-Fx^2/b	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-Fx+1/2qx^2	0	0	0	0
GF b	0	1/2Fb-1/2qx^2	0	0		
GA b	0	1/2Fb-1/2qx^2	0	0	0	0
AG b	0	-Fx+1/2qx^2	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				-Fb^2/EJ	
	totali				-1/6Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				1/10Fb	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

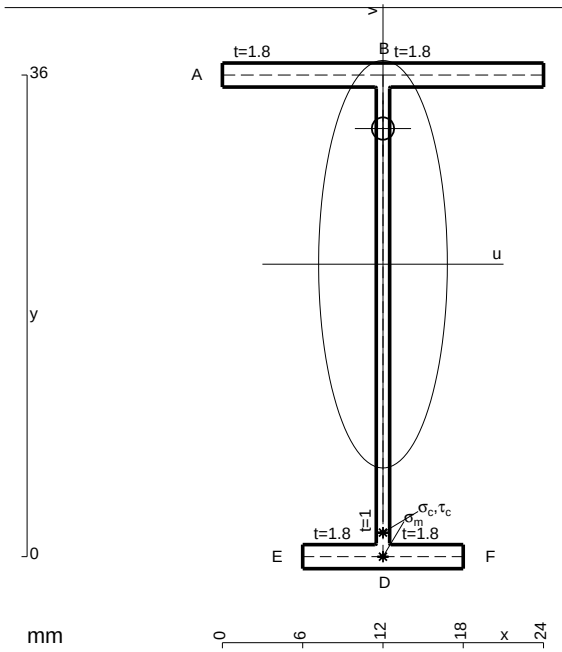
$= (\ b - 1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

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

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

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

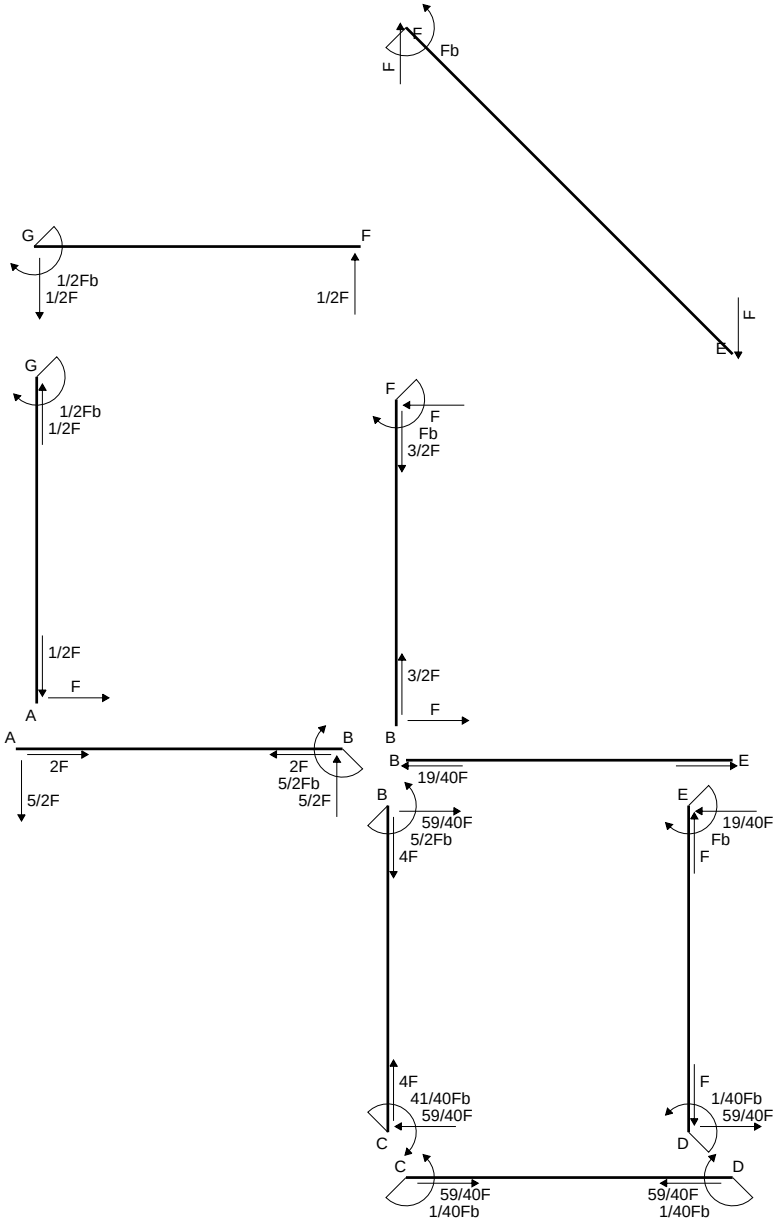
$= (1/2\ b - 1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

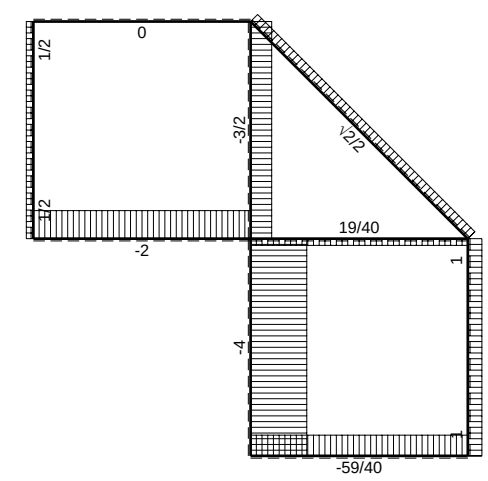


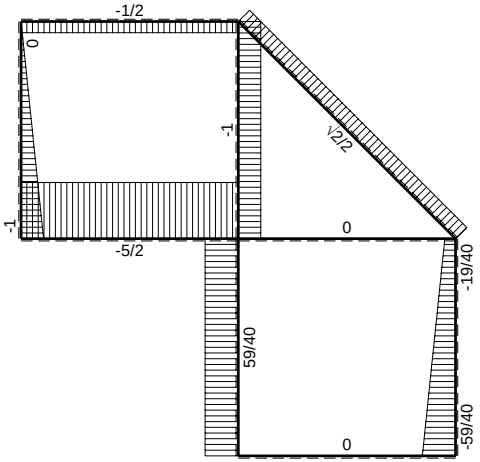
A = 100.8 mm^2
J_u = 23384. mm^4
J_v = 2333. mm^4
J_t = 81.98 mm^4
y_o = 10.14 mm
y_g = 21.86 mm
N = -300. N
T_y = -600. N
M_x = -204000. Nmm
x_m = 12. mm
v_m = -21.86 mm
$\sigma_m = N/A - Mv/J_u$ = -193.7 N/mm^2
y_c = 3. mm
u_c = -12. mm
v_c = -18.86 mm
$\sigma_c = N/A - Mv/J_u$ = -193.7 N/mm^2
$\tau_c = TS^*/tJ_u$ = 12.11 N/mm^2
$\tau_g = TS^*/tJ_u$ = 12.11 N/mm^2
t_c = 300. mm
$\sigma_o = \sqrt{\sigma^2 + 3\tau^2}$ = 194.8 N/mm^2

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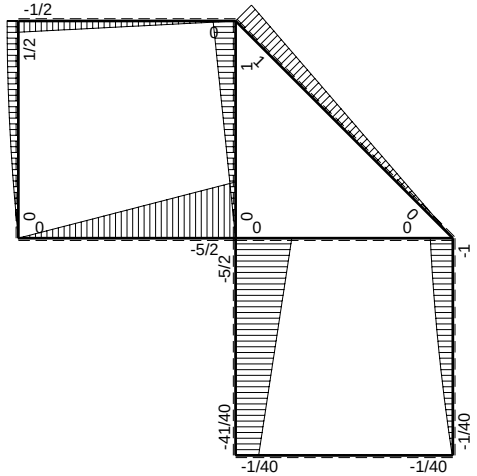

F
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1/2F
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G
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3/2F
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B
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2F
2F
5/2Fb
5/2F
5/2F
B
E
19/40F
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59/40F
5/2Fb
4F
E
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Fb
F
4F
41/40Fb
59/40F
C
F
1/40Fb
59/40F
D
C
D
59/40F
1/40Fb
59/40F
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-3/2
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-4
1
-59/40

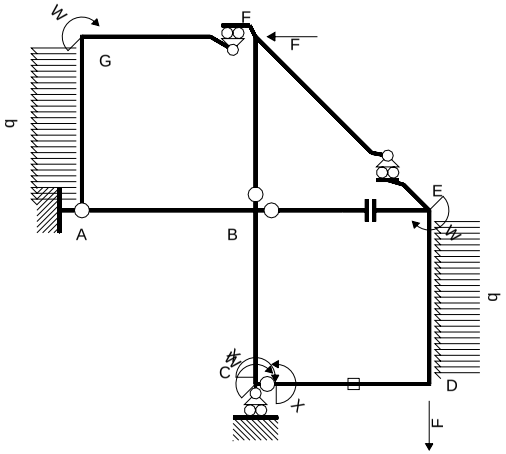

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-59/40

F

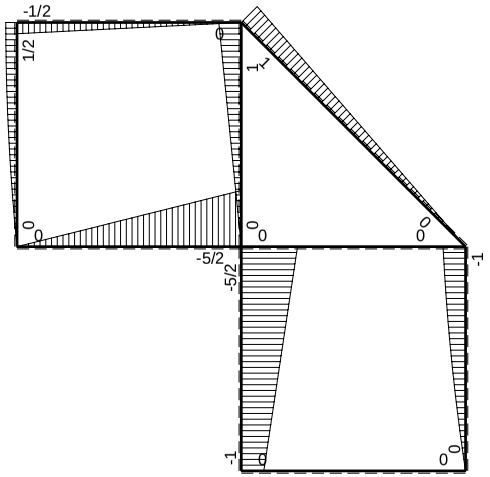
F


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-1/40

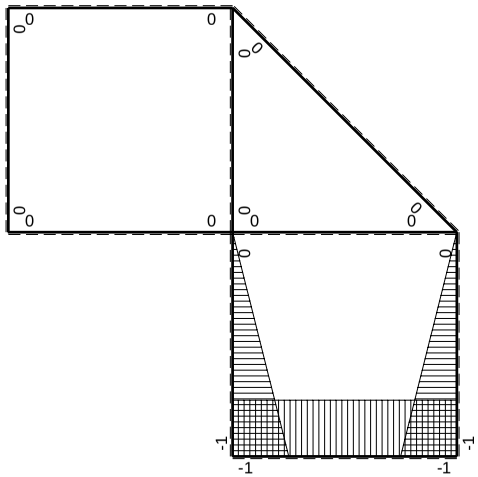
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0		
BC b	-x/b	-5/2Fb+3/2Fx	$5/2Fx-3/2Fx^2/b$	x^2/b^2	$3/4Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+3/2Fx	$Fb+1/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	$-3/2Fx+1/2qx^2$	$3/2Fx-2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$5/24Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$Fb-1/2Fx-1/2qx^2$	$Fx-1/2Fx^2/b-1/2qx^3/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-1/2Fx	0	0	0	0
GF b	0	1/2Fb-1/2Fx	0	0		
GA b	0	$1/2Fb-1/2qx^2$	0	0	0	0
AG b	0	$-Fx+1/2qx^2$	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/24Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				1/40Fb	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ \ Fb^2/EJ$

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

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

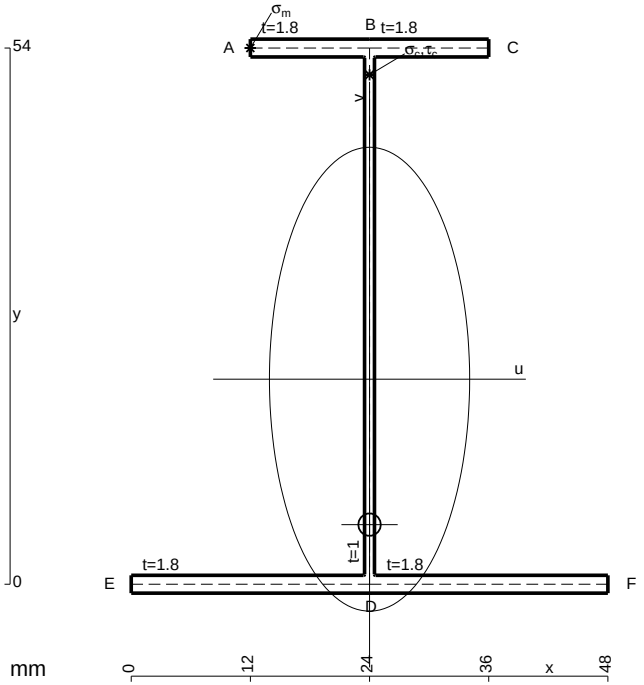
$L^{Xo}_{DE} = \int_o^b (3/2\ x/b -2\ x^2/b^2 +1/2\ x^3/b^3)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -2/3\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

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

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

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

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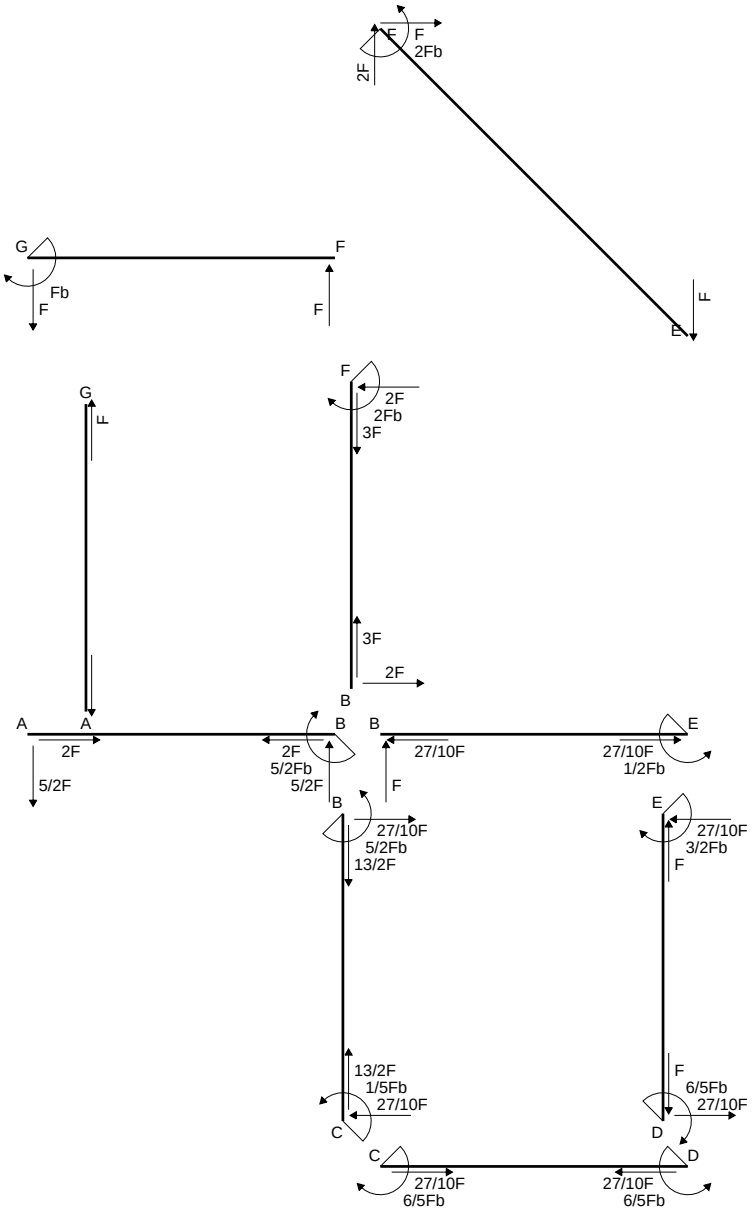


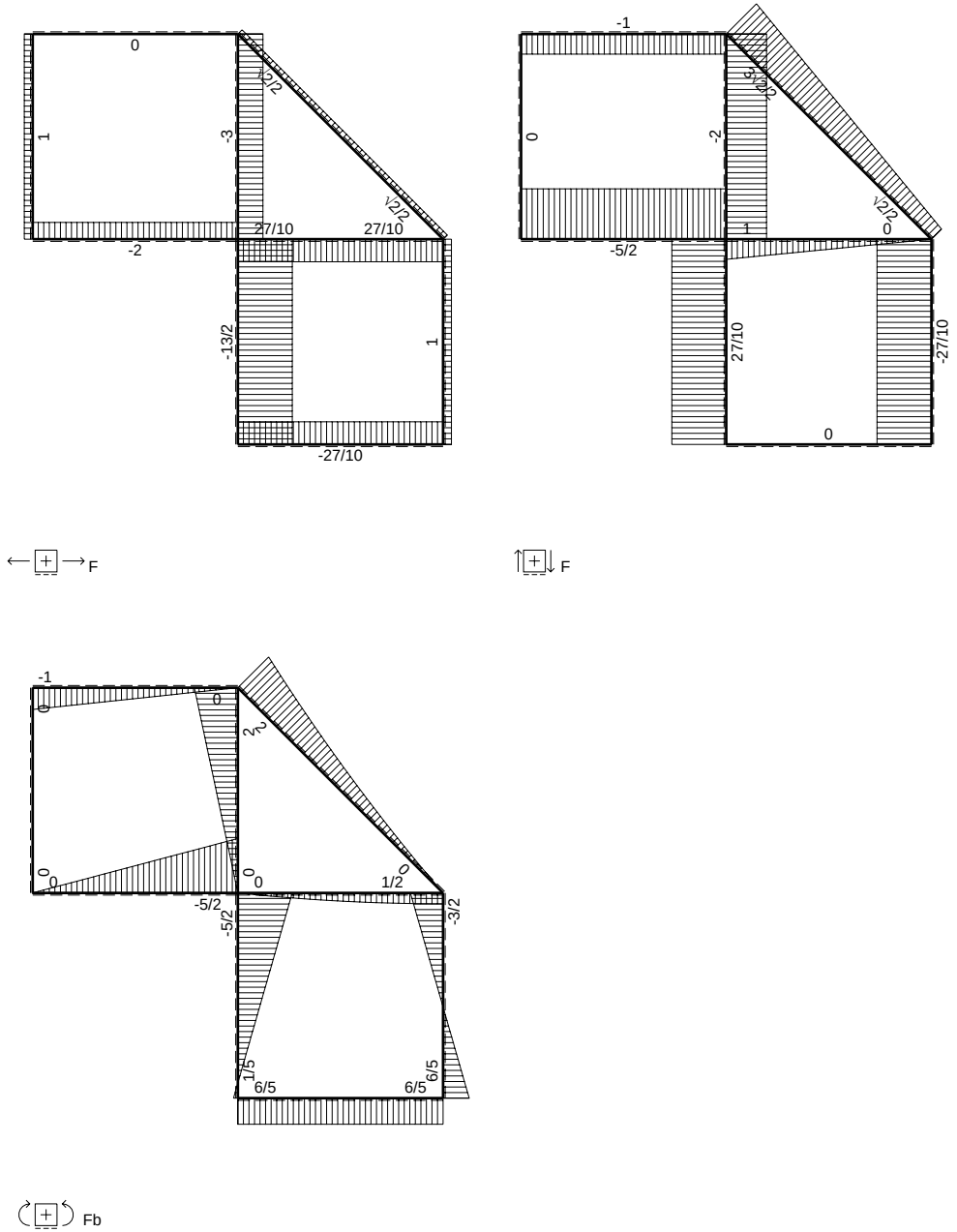
A = 183.6 mm^2
J_u = 100190. mm^4
J_v = 18662. mm^4
J_t = 158. mm^4
y_o = -14.65 mm
y_g = 20.65 mm
N = -920. N
T_y = -1150. N
M_x = -644000. Nmm
x_m = 12. mm
y_m = 54. mm
u_m = -12. mm
v_m = 33.35 mm
$\sigma_m = N/A - Mv/J_u$ = 209.4 N/mm^2
x_c = 24. mm
y_c = 54. mm
v_c = 33.35 mm
$\sigma_c = N/A - Mv/J_u$ = 209.4 N/mm^2
$\tau_c = TS^*/tJ_u$ = 16.54 N/mm^2
$\tau_g = TS^*/tJ_u$ = 16.54 N/mm^2
t_c = 460. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 211.3 N/mm^2

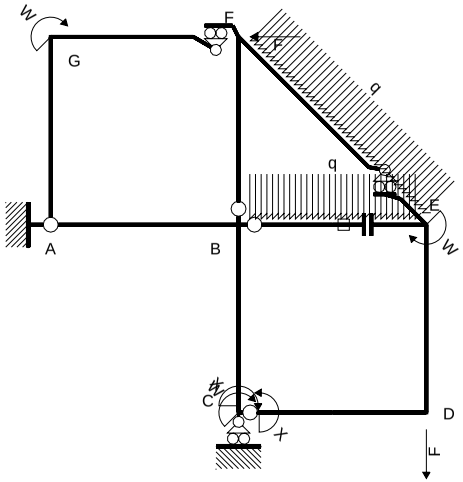
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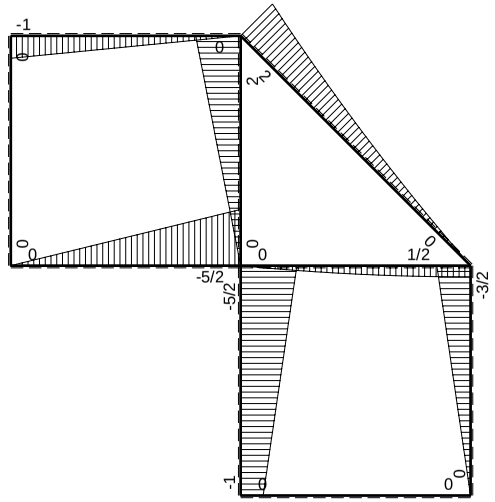
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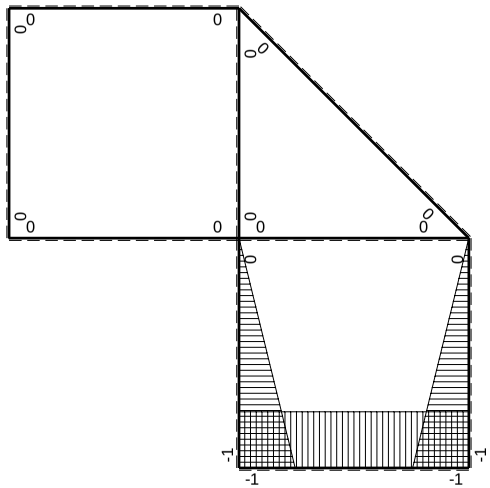

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Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0		
BC b	-x/b	-5/2Fb+3/2Fx	5/2Fx-3/2Fx^2/b	x^2/b^2	3/4Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	Fb+1/2Fx-3/2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE 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
ED b	x/b	3/2Fb-3/2Fx	3/2Fx-3/2Fx^2/b	x^2/b^2		
EF √2b	0	√2/2Fx+1/2qx^2	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	Fx-1/2qx^2	0	0	0	0
EB b	0	-1/2Fb+1/2qx^2	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				2Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-6/5Fb	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ \ Fb^2/EJ$

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

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

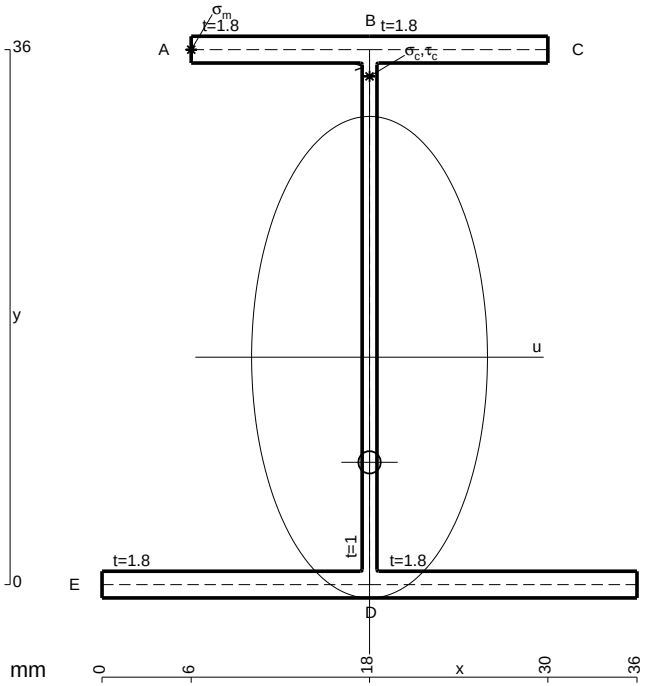
$L^{Xo}_{DE} = \int_o^b (3/2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

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

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

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

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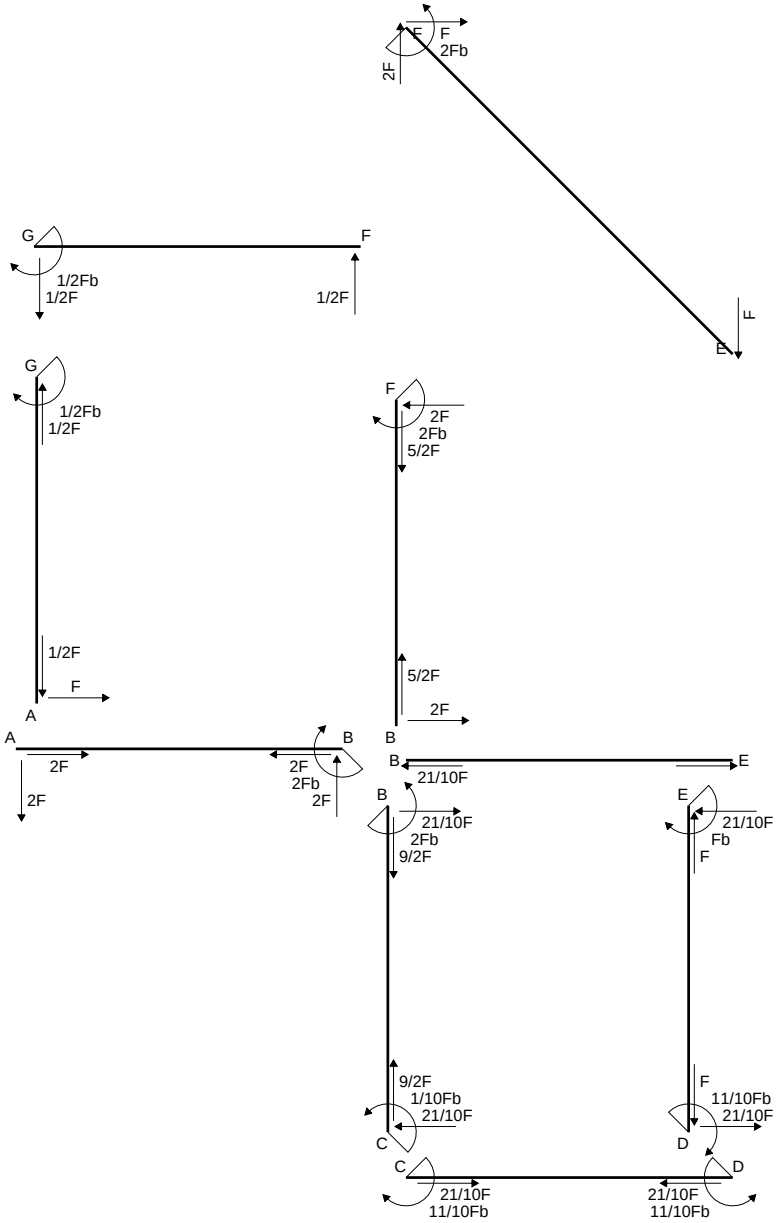


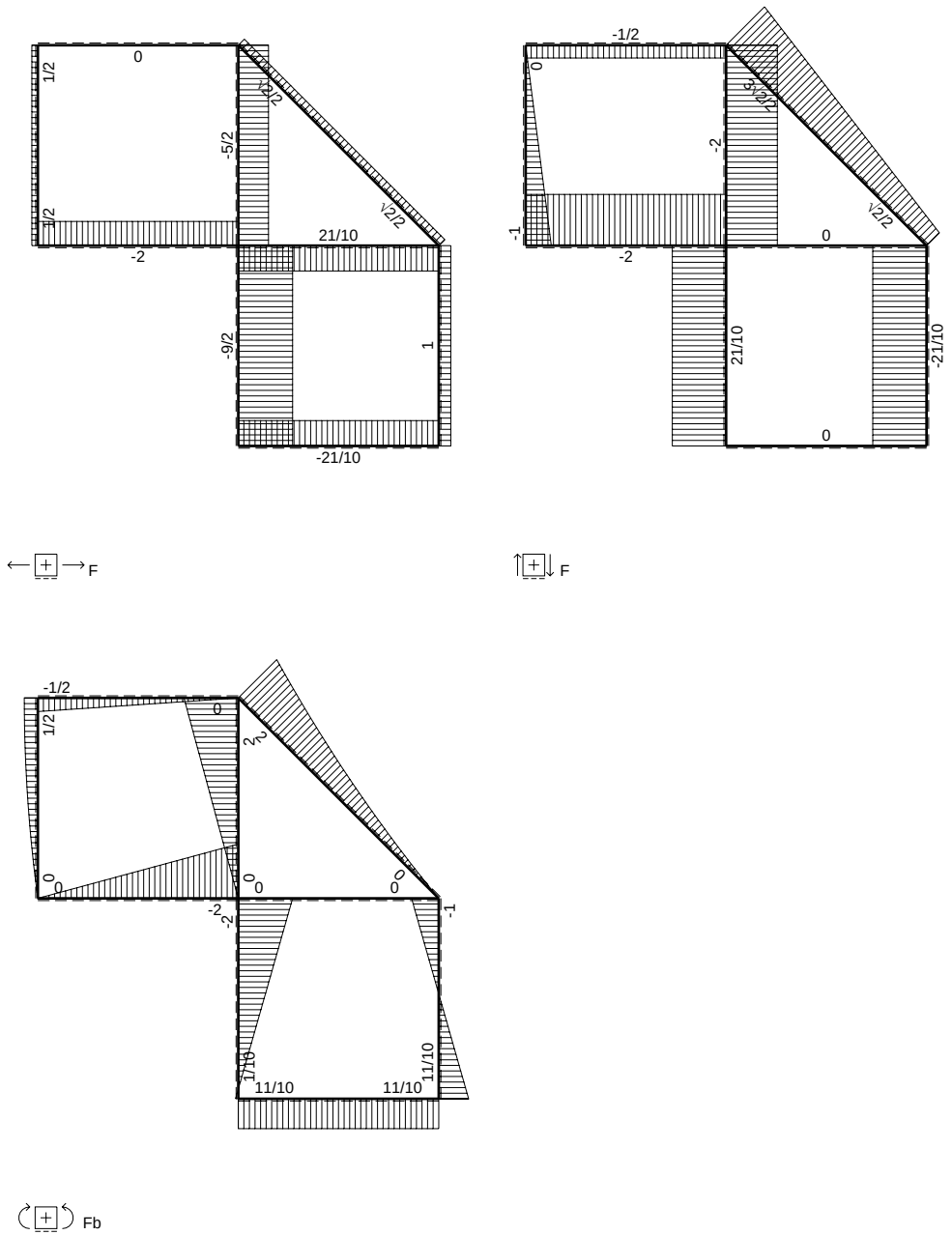
A = 144. mm^2
J_u = 37830. mm^4
J_v = 9072. mm^4
J_t = 128.6 mm^4
y_o = -7.071 mm
y_g = 15.3 mm
N = -820. N
T_y = -1025. N
M_x = -410000. Nmm
x_m = 6. mm
y_m = 36. mm
u_m = -12. mm
v_m = 20.7 mm
$\sigma_m = N/A - Mv/J_u$ = 218.6 N/mm^2
x_c = 18. mm
y_c = 36. mm
v_c = 20.7 mm
$\sigma_c = N/A - Mv/J_u$ = 218.6 N/mm^2
$\tau_c = TS^*/tJ_u$ = 24.23 N/mm^2
$\tau_g = TS^*/tJ_u$ = 24.23 N/mm^2
t_c = 410. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 222.6 N/mm^2

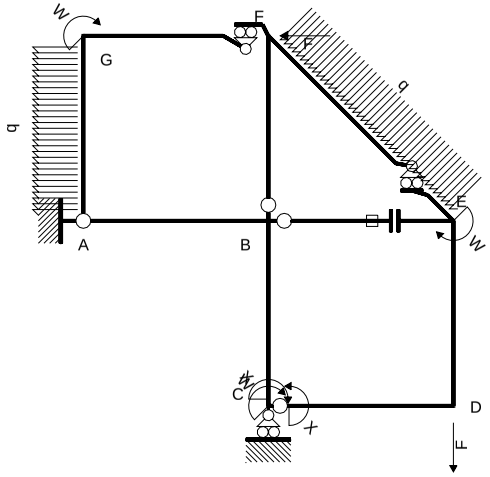
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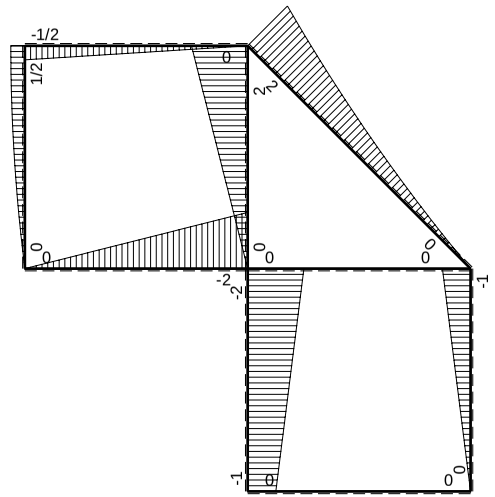
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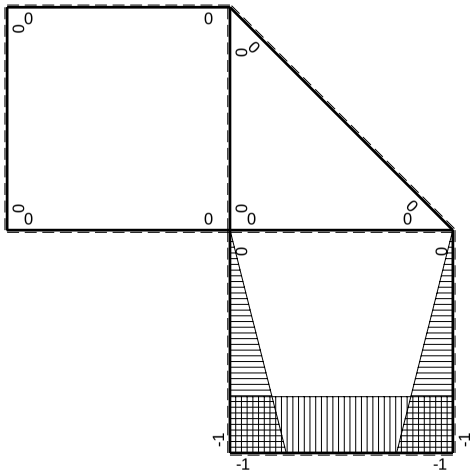

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Fb



Schema di calcolo iperstatico



M_o flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0		
BC b	-x/b	-2Fb+Fx	2Fx-Fx^2/b	x^2/b^2	$2/3Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	-Fx	Fx-Fx^2/b	1-2x/b+x^2/b^2	$1/6Fb^2/EJ$	1/3Xb/EJ
ED b	x/b	Fb-Fx	Fx-Fx^2/b	x^2/b^2		
EF √2b	0	√2/2Fx+1/2qx^2	0	0	0	0
FG b	0	-1/2Fx	0	0	0	0
GF b	0	1/2Fb-1/2Fx	0	0		
GA b	0	1/2Fb-1/2qx^2	0	0	0	0
AG b	0	-Fx+1/2qx^2	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$11/6Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-11/10Fb	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

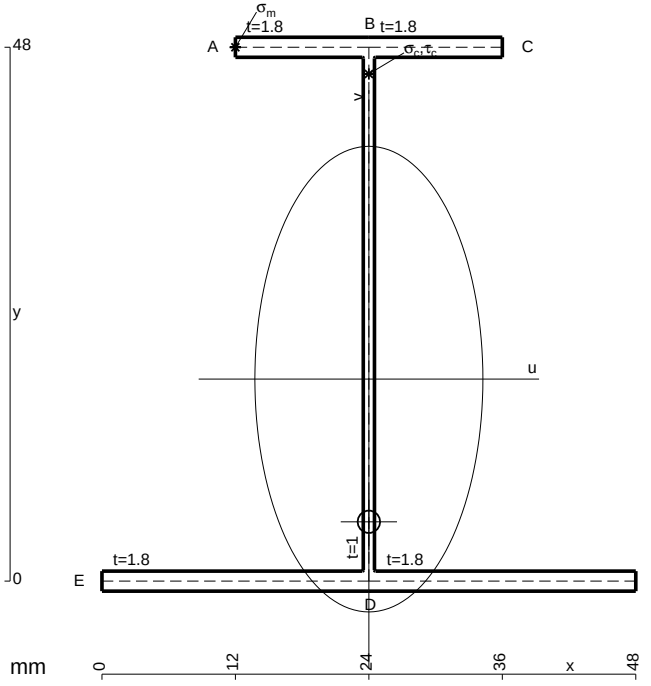
$= (\ b - 1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

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

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

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

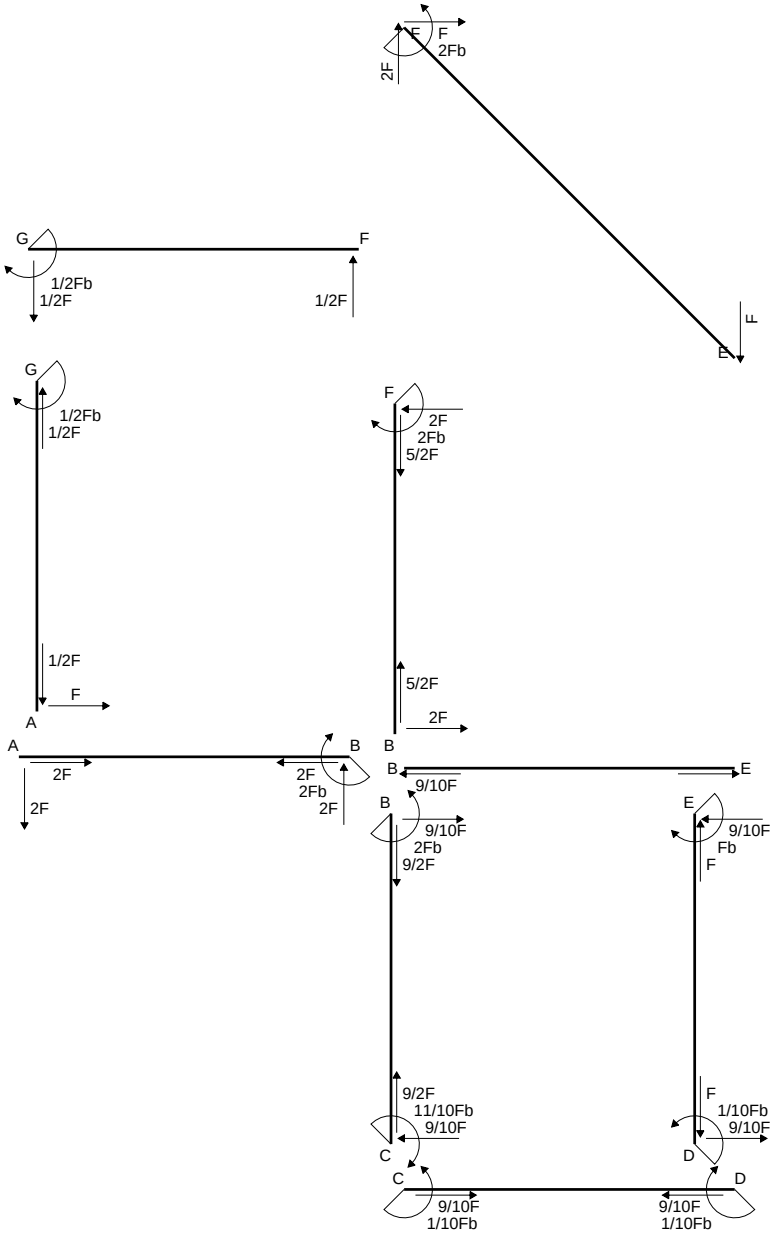
$= (1/2\ b - 1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

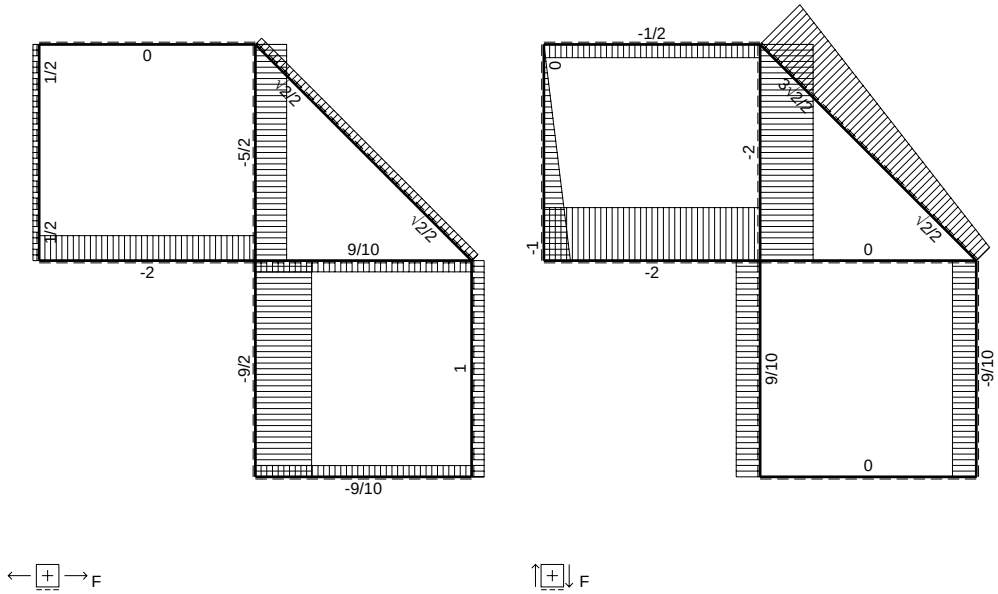


A = 177.6 mm^2
J_u = 77813. mm^4
J_v = 18662. mm^4
J_t = 156. mm^4
y_o = -12.83 mm
y_g = 18.16 mm
N = 367.7 N
T_y = 1103. N
M_x = 603200. Nmm
x_m = 12. mm
y_m = 48. mm
u_m = -12. mm
v_m = 29.84 mm
$\sigma_m = N/A - Mv/J_u$ = -229.2 N/mm^2
x_c = 24. mm
y_c = 48. mm
v_c = 29.84 mm
$\sigma_c = N/A - Mv/J_u$ = -229.2 N/mm^2
$\tau_c = TS^*/tJ_u$ = 18.27 N/mm^2
$\tau_g = TS^*/tJ_u$ = 18.27 N/mm^2
t_c = 520. mm
$\sigma_o = \sqrt{\sigma^2 + 3\tau^2}$ = 231.4 N/mm^2

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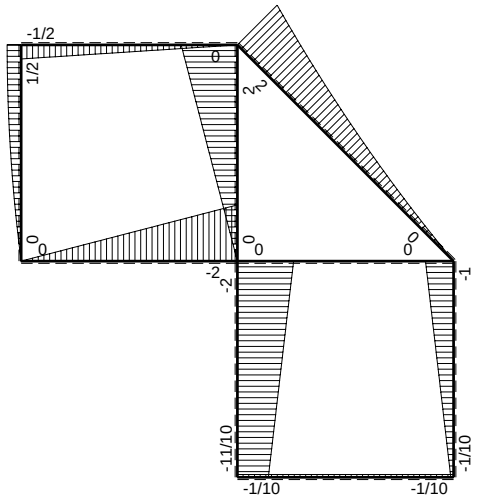
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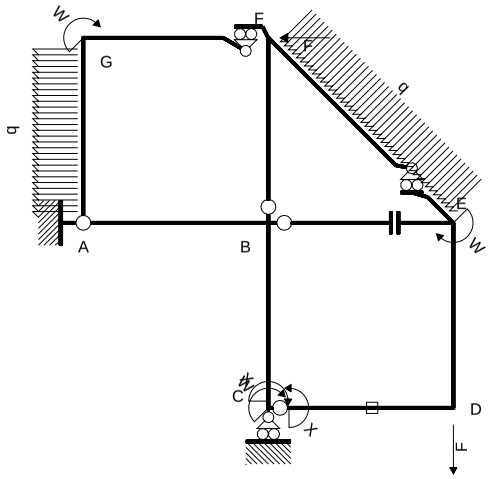

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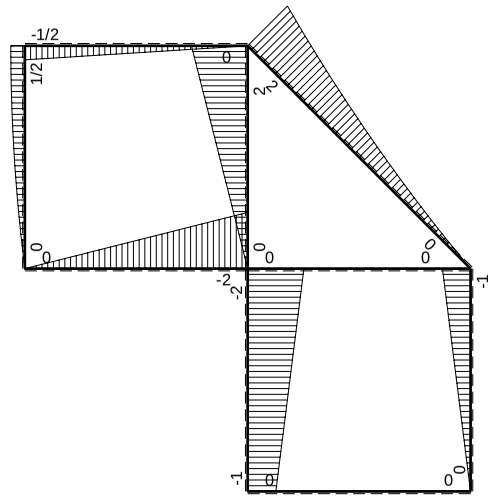
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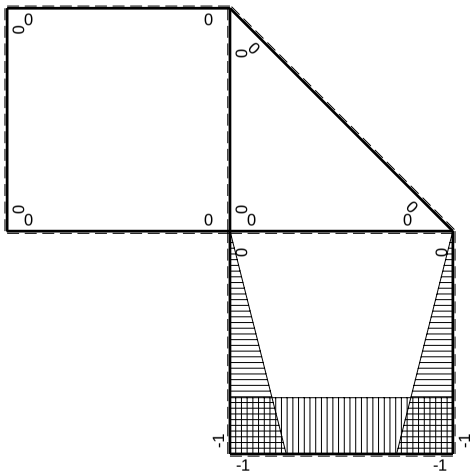

Fb



Schema di calcolo iperstatico



M_o flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0		
BC b	-x/b	-2Fb+Fx	2Fx-Fx^2/b	x^2/b^2	$2/3Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+Fx	Fb-Fx^2/b	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	-Fx	Fx-Fx^2/b	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	Fb-Fx	Fx-Fx^2/b	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}$/2Fx+1/2qx^2	0	0	0	0
FG b	0	-1/2Fx	0	0	0	0
GF b	0	1/2Fb-1/2Fx	0	0		
GA b	0	1/2Fb-1/2qx^2	0	0	0	0
AG b	0	-Fx+1/2qx^2	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/6Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				$1/10Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

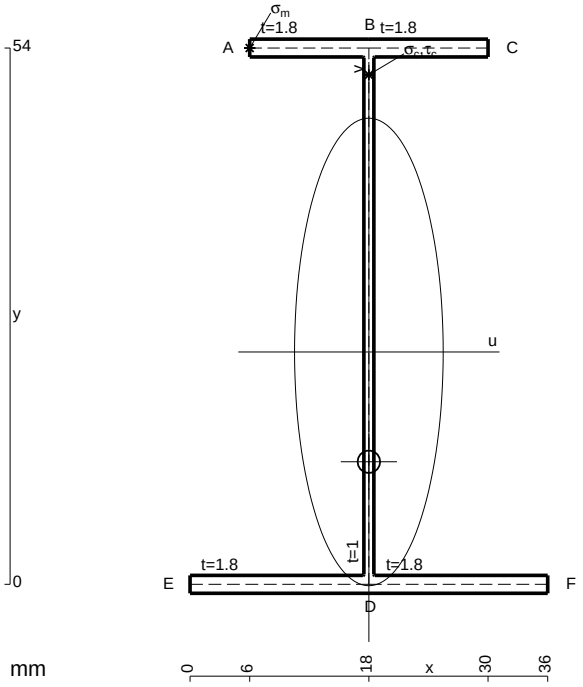
$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

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

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

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

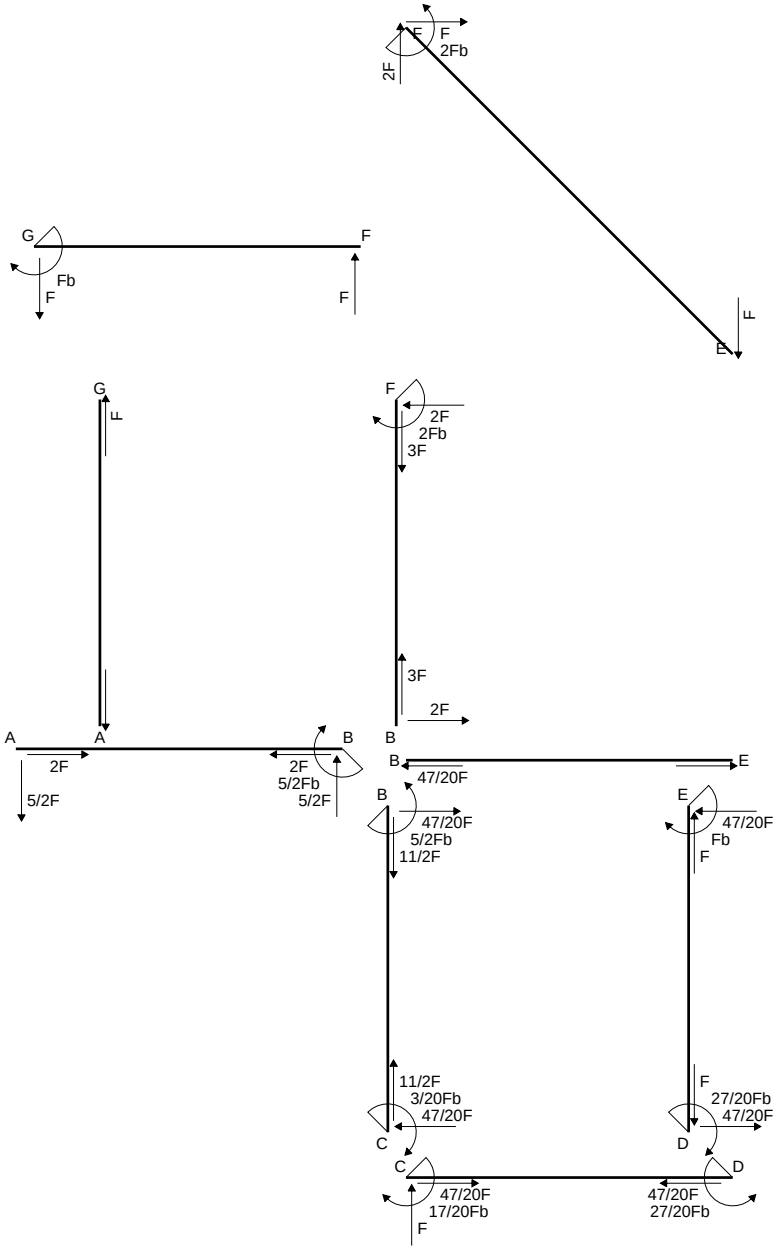
$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

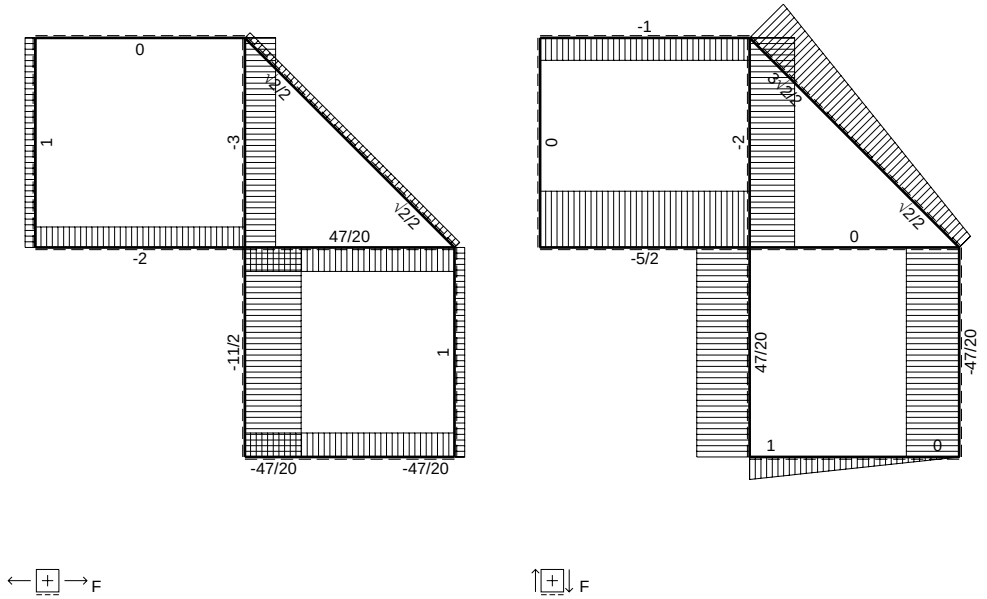


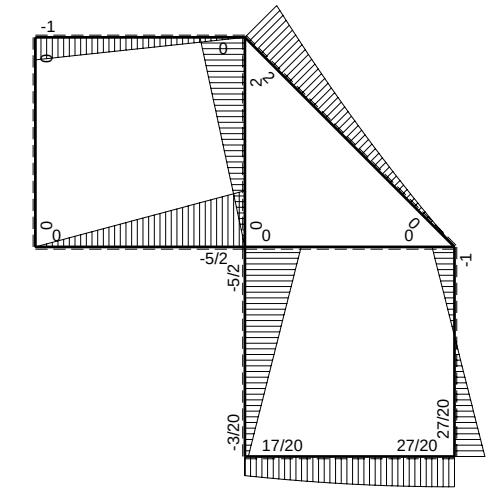
A = 162. mm^2
J_u = 89755. mm^4
J_v = 9072. mm^4
J_t = 134.6 mm^4
y_o = -11.06 mm
y_g = 23.4 mm
N = 353.6 N
T_y = 1061. N
M_x = 710000. Nmm
x_m = 6. mm
y_m = 54. mm
u_m = -12. mm
v_m = 30.6 mm
$\sigma_m = N/A - Mv/J_u$ = -239.9 N/mm^2
x_c = 18. mm
y_c = 54. mm
v_c = 30.6 mm
$\sigma_c = N/A - Mv/J_u$ = -239.9 N/mm^2
$\tau_c = TS^*/tJ_u$ = 15.62 N/mm^2
$\tau_g = TS^*/tJ_u$ = 15.62 N/mm^2
t_c = 500. mm
$\sigma_o = \sqrt{\sigma^2 + 3\tau^2}$ = 241.4 N/mm^2

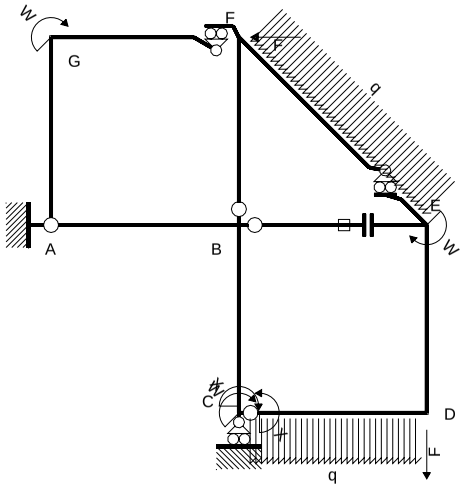
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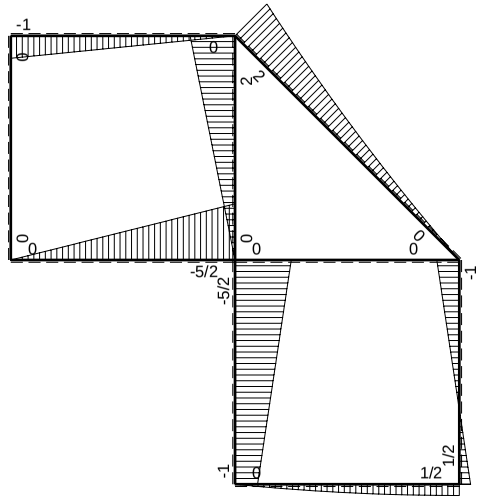

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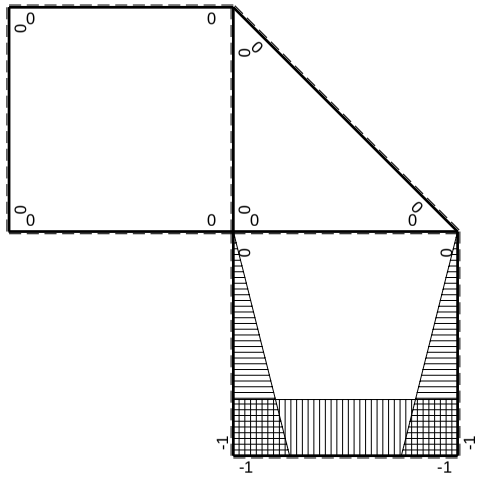

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Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0		
BC b	-x/b	-5/2Fb+3/2Fx	$5/2Fx-3/2Fx^2/b$	x^2/b^2	$3/4Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	$Fb+1/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	$Fx-1/2qx^2$	$-Fx+1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fb+1/2qx^2$	$-1/2Fb+1/2Fx^2/b$	1		
DE b	-1+x/b	1/2Fb-3/2Fx	$-1/2Fb+2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	0	1/3Xb/EJ
ED b	x/b	Fb-3/2Fx	$Fx-3/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx+1/2qx^2$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$17/12Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-17/20Fb	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ \ Fb^2/EJ$

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

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

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

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

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

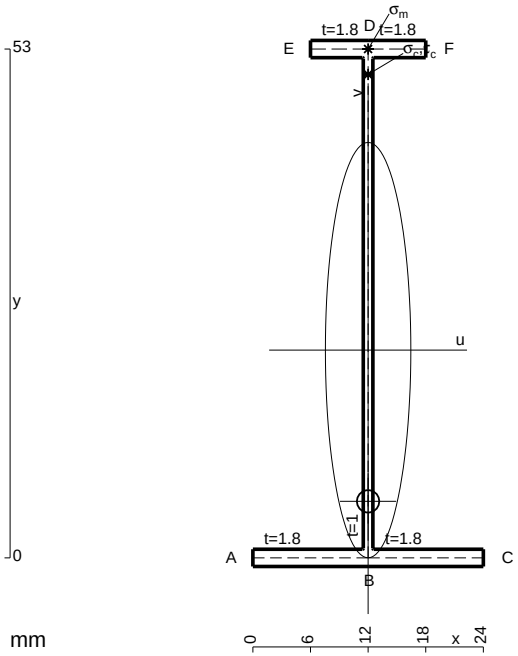
$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/3\ \ Fb^2/EJ$

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

$= (-1/2\ b + b -1/2\ b\ )\ Fb\ 1/EJ\ = 0$

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

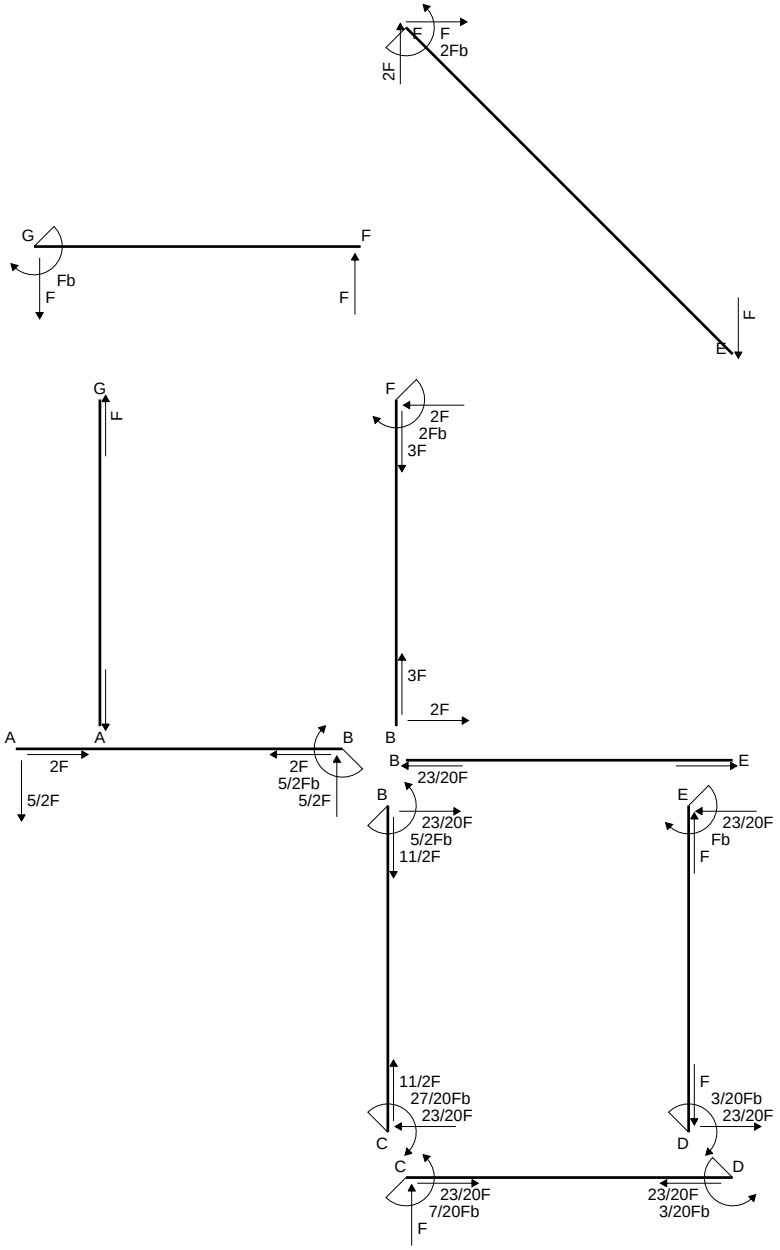
$= (1/2\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 0$

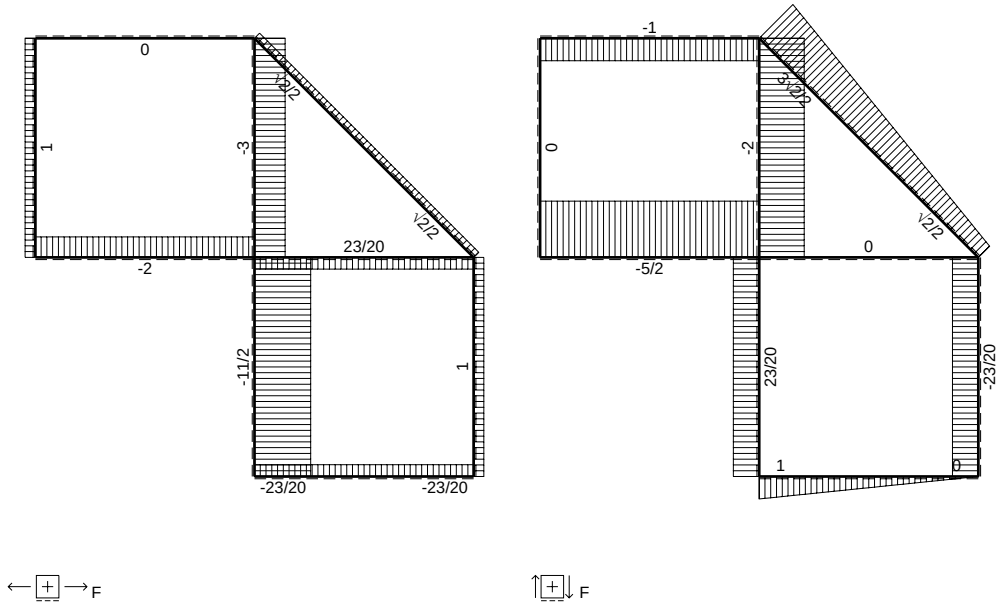


A = 117.8 mm^2
J_u = 55131. mm^4
J_v = 2333. mm^4
J_t = 87.65 mm^4
y_o = -15.75 mm
y_g = 21.64 mm
N = -380. N
T_y = -475. N
M_x = -356250. Nmm
x_m = 12. mm
y_m = 53. mm
v_m = 31.36 mm
$\sigma_m = N/A - Mv/J_u$ = 199.4 N/mm^2
y_c = 2. mm
u_c = -12. mm
v_c = -19.64 mm
$\sigma_c = N/A - Mv/J_u$ = 199.4 N/mm^2
$\tau_c = TS^*/tJ_u$ = 5.836 N/mm^2
$\tau_g = TS^*/tJ_u$ = 5.836 N/mm^2
t_c = 190. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 199.7 N/mm^2

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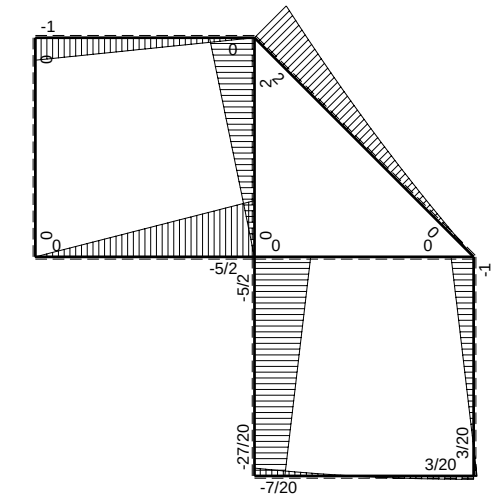
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Fb
F
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27/20Fb
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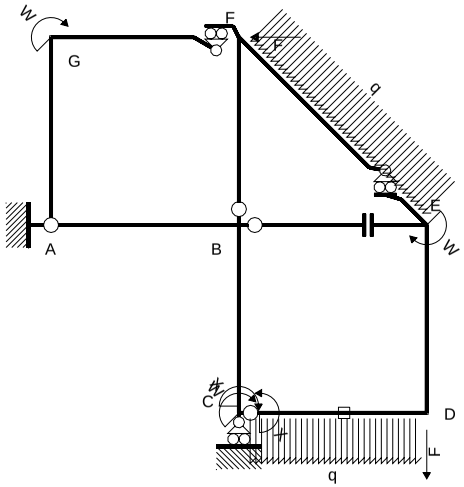

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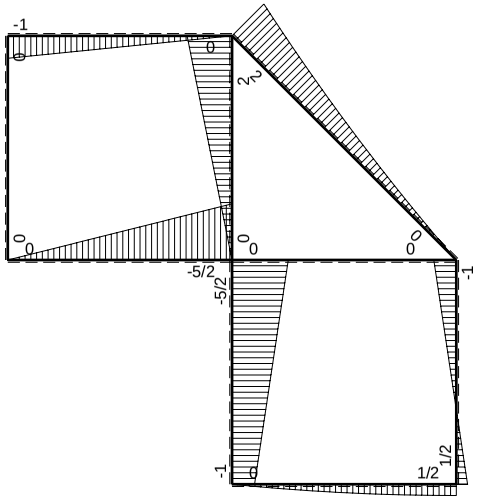
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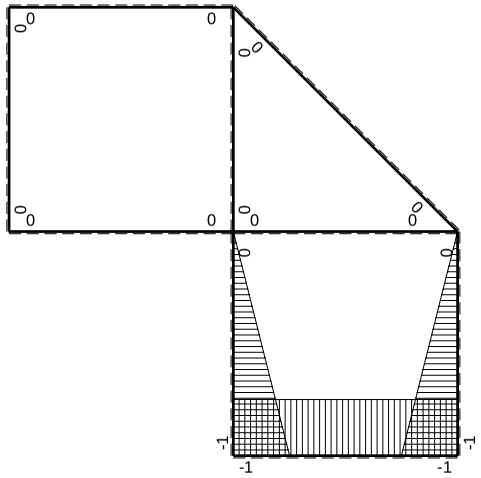
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0		
BC b	-x/b	-5/2Fb+3/2Fx	5/2Fx-3/2Fx^2/b	x^2/b^2	3/4Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	Fb+1/2Fx-3/2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	Fx-1/2qx^2	-Fx+1/2Fx^2/b	1	-1/3Fb^2/EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx^2	-1/2Fb+1/2Fx^2/b	1		
DE b	-1+x/b	1/2Fb-3/2Fx	-1/2Fb+2Fx-3/2Fx^2/b	1-2x/b+x^2/b^2	0	1/3Xb/EJ
ED b	x/b	Fb-3/2Fx	Fx-3/2Fx^2/b	x^2/b^2		
EF √2b	0	√2/2Fx+1/2qx^2	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				-Fb^2/EJ	
	totali				-7/12Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				7/20Fb	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ Fb^2/EJ$

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

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

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

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

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

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

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

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

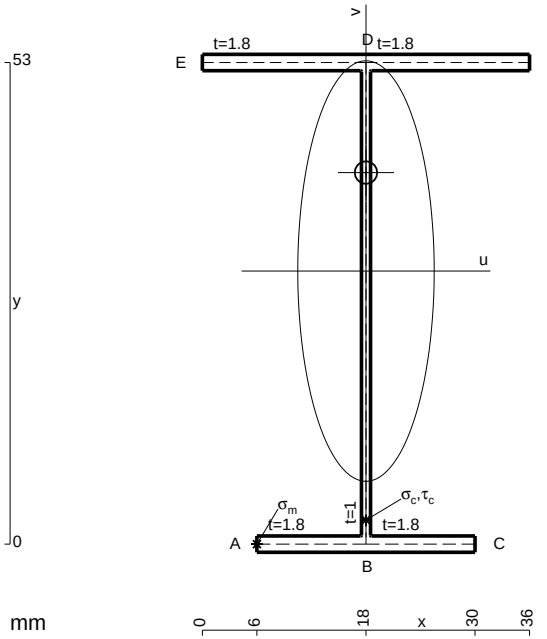
$L^{Xo}_{DE} = \int_o^b (-1/2 +2\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/2\ x + x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b + b -1/2\ b\ )\ Fb\ 1/EJ\ = 0$

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

$= (1/2\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 0$

PROCEDIMENTO E RISULTATI 218343 CI02.xxxx.026

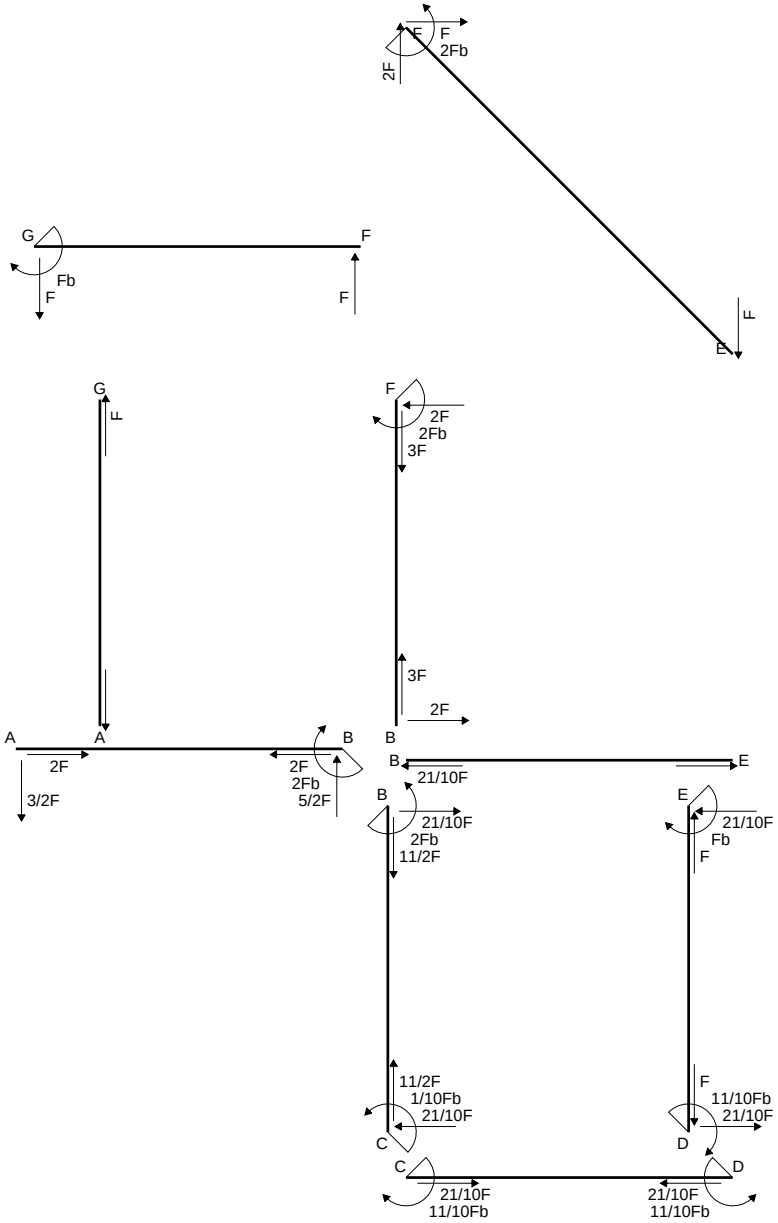


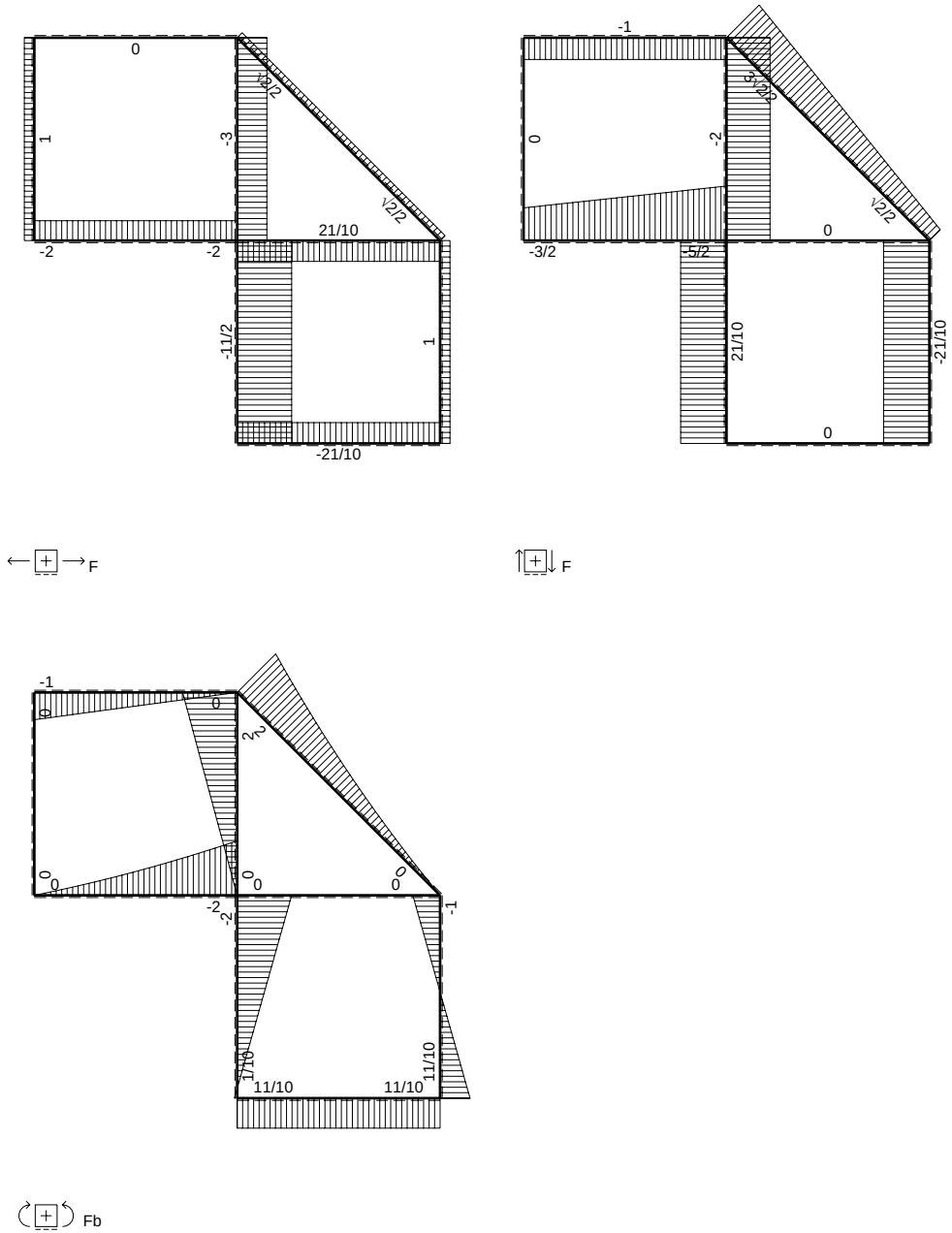
A = 161. mm^2
J_u = 86214. mm^4
J_v = 9072. mm^4
J_t = 134.3 mm^4
y_o = 10.83 mm
y_g = 30.06 mm
N = -580. N
T_y = -725. N
M_x = -580000. Nmm
x_m = 6. mm
u_m = -12. mm
v_m = -30.06 mm
$\sigma_m = N/A - Mv/J_u$ = -205.8 N/mm^2
x_c = 18. mm
v_c = -30.06 mm
$\sigma_c = N/A - Mv/J_u$ = -205.8 N/mm^2
$\tau_c = TS^*/tJ_u$ = 10.92 N/mm^2
$\tau_g = TS^*/tJ_u$ = 10.92 N/mm^2
t_c = 290. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 206.7 N/mm^2

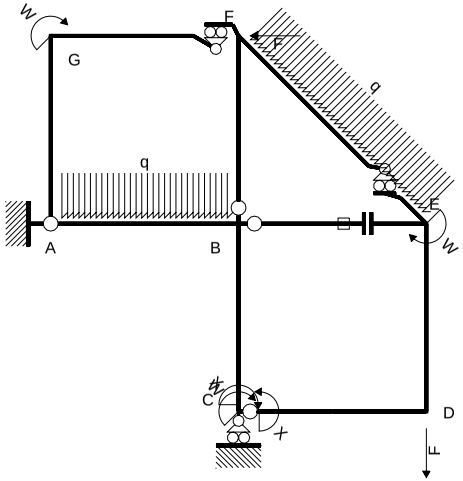
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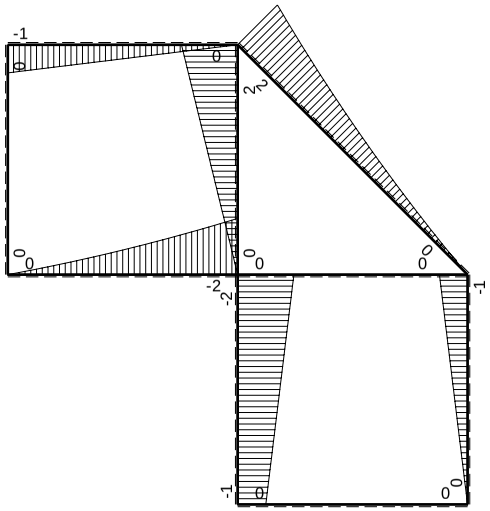
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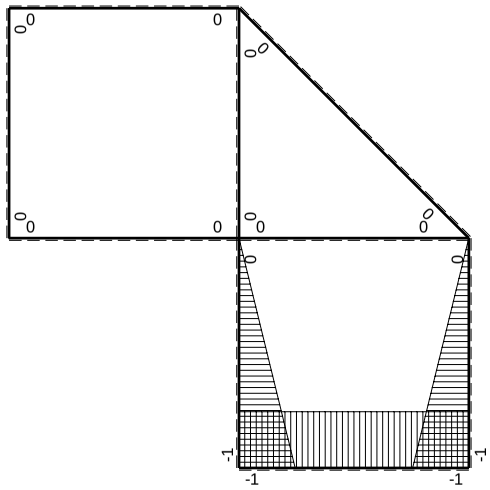

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Schema di calcolo iperstatico



M_o flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-3/2Fx-1/2qx^2$	0	0	0	0
BA b	0	$2Fb-5/2Fx+1/2qx^2$	0	0		
BC b	-x/b	-2Fb+Fx	$2Fx-Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+Fx	$Fb-Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx+1/2qx^2$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$11/6Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				-11/10Fb	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

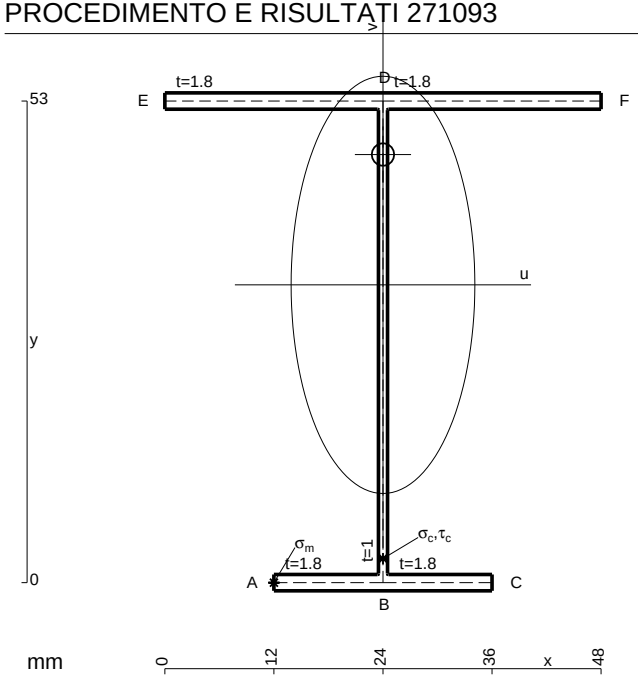
$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

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

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

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

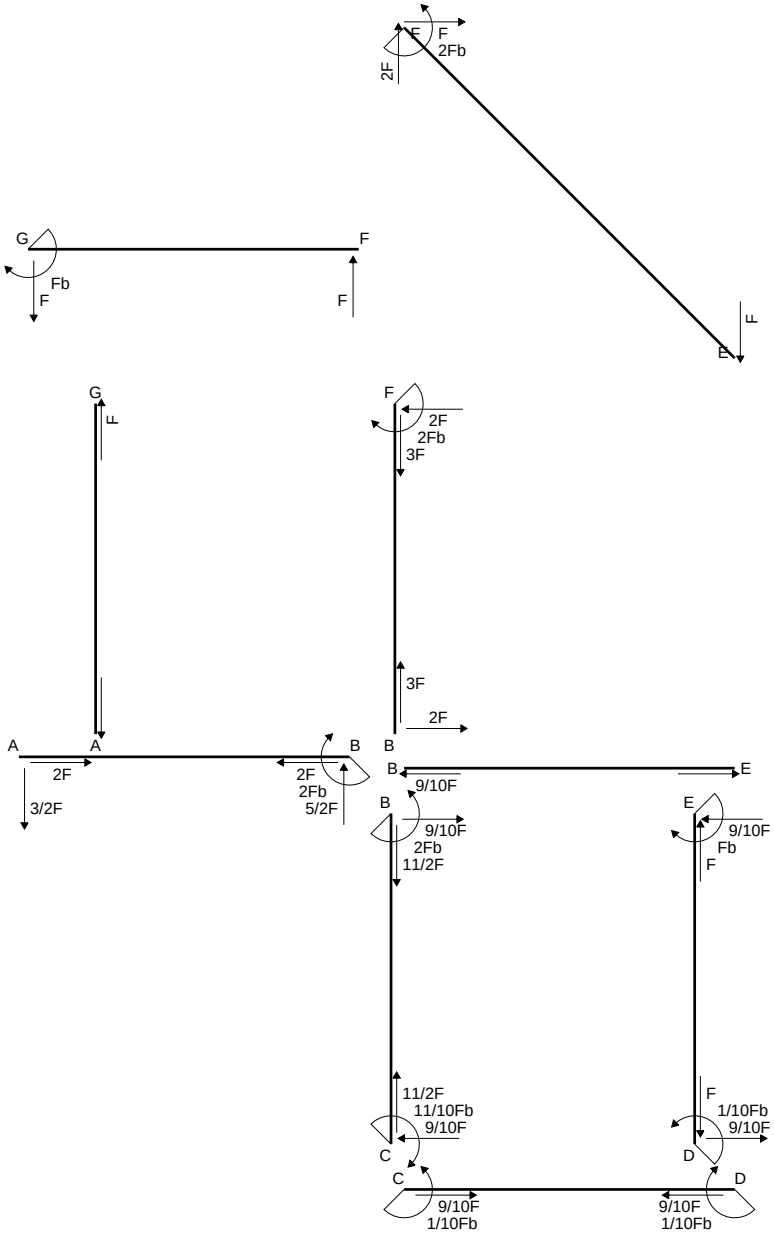
$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

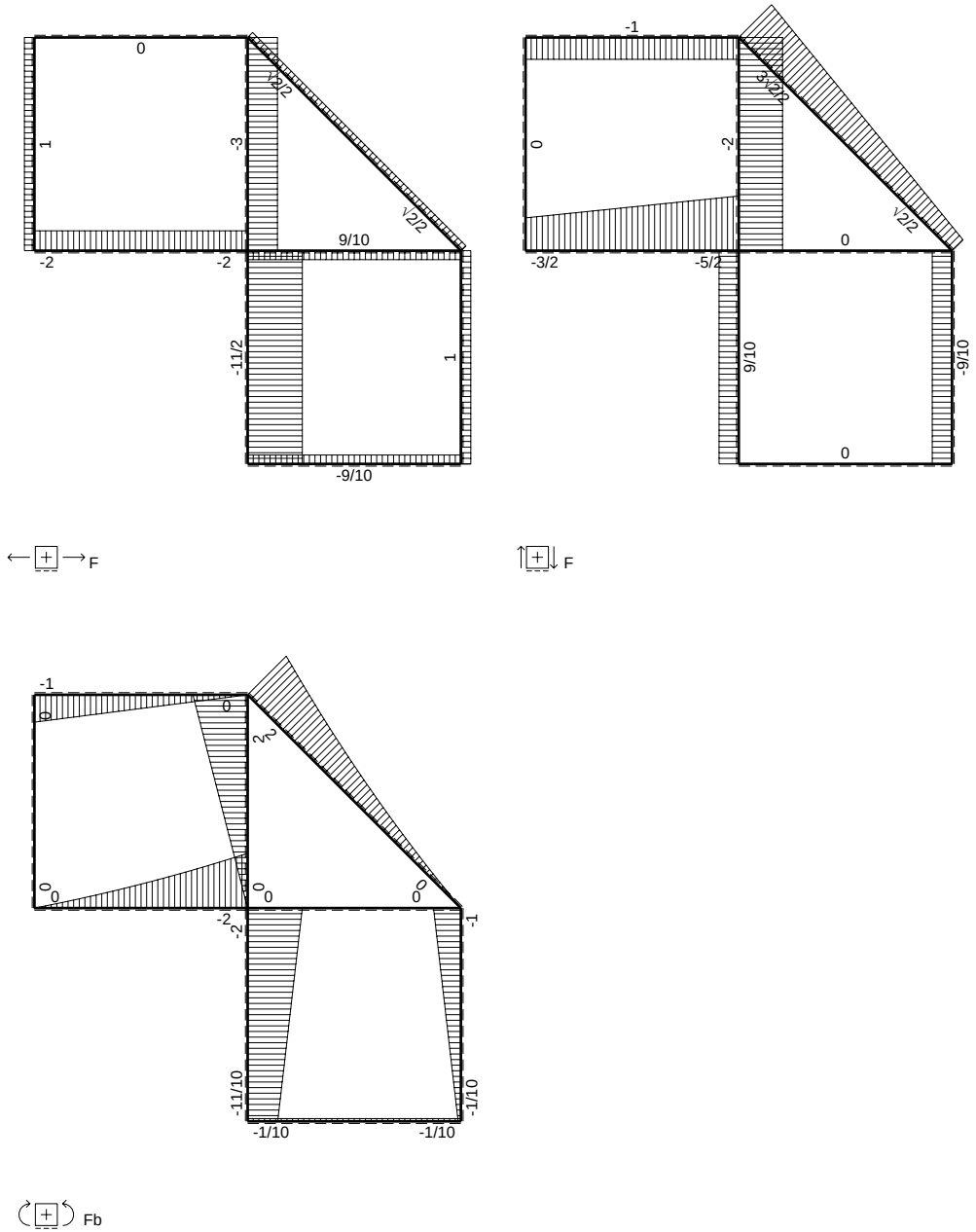


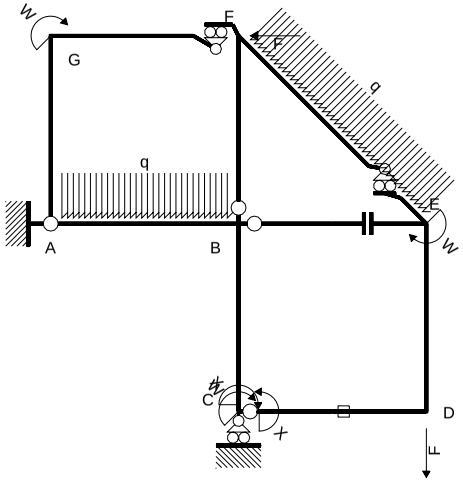
A = 182.6 mm^2
J_u = 96241. mm^4
J_v = 18662. mm^4
J_t = 157.6 mm^4
y_o = 14.34 mm
y_g = 32.77 mm
N = -740. N
T_y = -925. N
M_x = -629000. Nmm
x_m = 12. mm
u_m = -12. mm
v_m = -32.77 mm
$\sigma_m = N/A - Mv/J_u$ = -218.2 N/mm^2
x_c = 24. mm
v_c = -32.77 mm
$\sigma_c = N/A - Mv/J_u$ = -218.2 N/mm^2
$\tau_c = TS^*/tJ_u$ = 13.61 N/mm^2
$\tau_g = TS^*/tJ_u$ = 13.61 N/mm^2
t_c = 370. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 219.5 N/mm^2

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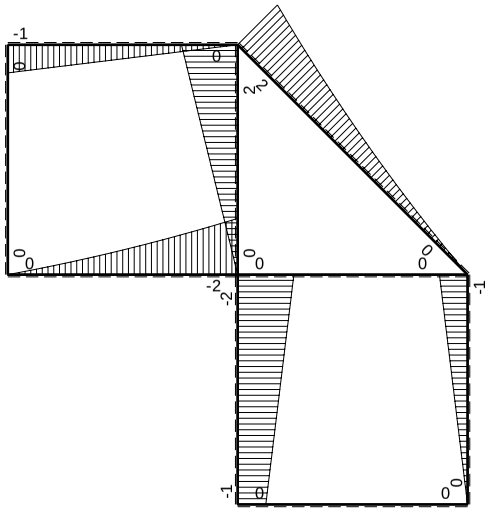
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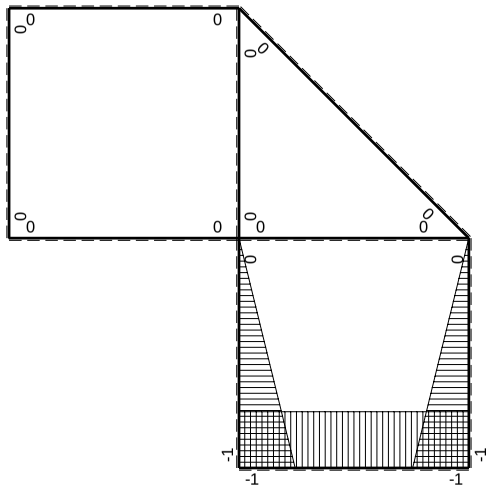

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Fb



Schema di calcolo iperstatico



M_o flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-3/2Fx-1/2qx^2$	0	0	0	0
BA b	0	$2Fb-5/2Fx+1/2qx^2$	0	0		
BC b	-x/b	-2Fb+Fx	$2Fx-Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	$Fb-Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	1/3Xb/EJ
ED b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2		
EF √2b	0	$\sqrt{2}/2Fx+1/2qx^2$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/6Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				1/10Fb	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

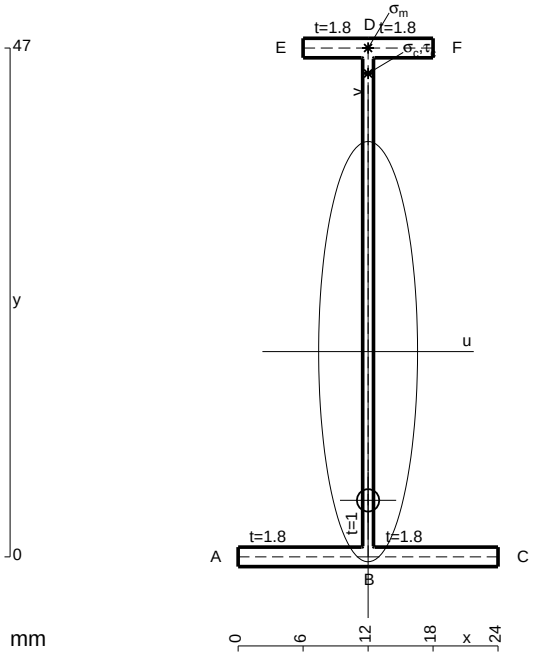
$= (\ b - 1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

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

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

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

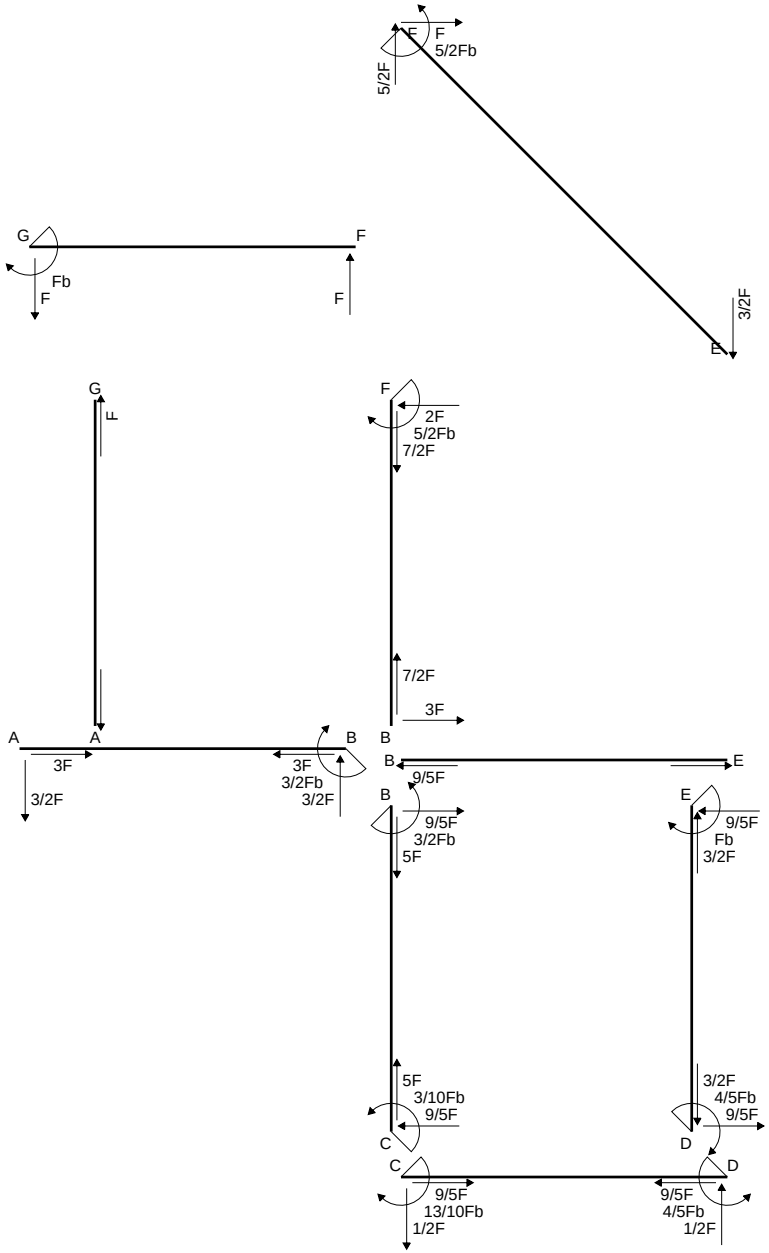
$= (1/2\ b - 1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

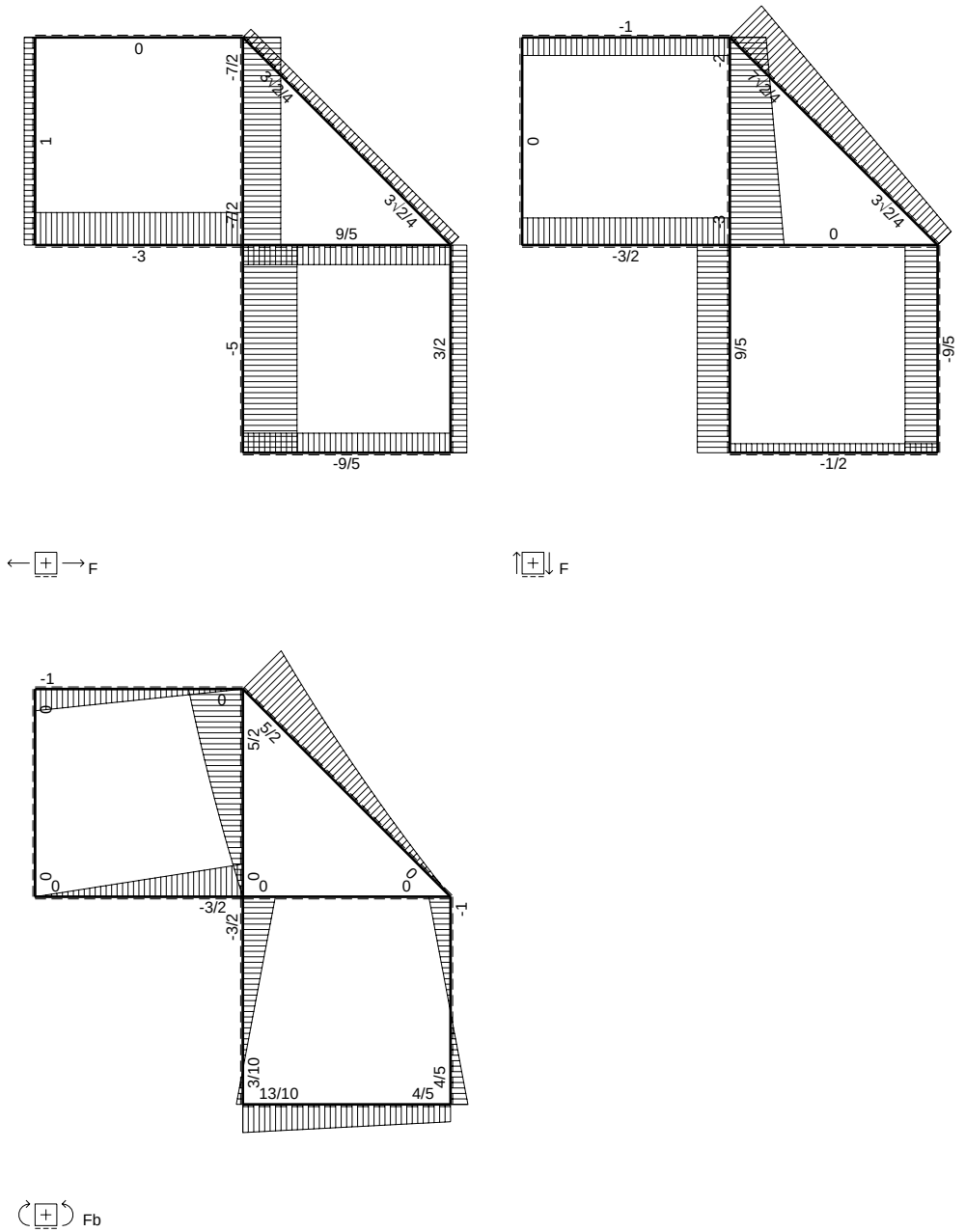


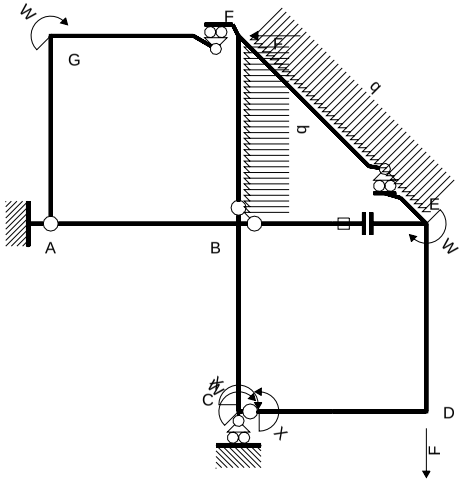
A = 111.8 mm^2
J_u = 42133. mm^4
J_v = 2333. mm^4
J_t = 85.65 mm^4
y_o = -13.74 mm
y_g = 18.96 mm
N = -440. N
T_y = -550. N
M_x = -347600. Nmm
x_m = 12. mm
y_m = 47. mm
v_m = 28.04 mm
$\sigma_m = N/A - Mv/J_u$ = 227.4 N/mm^2
y_c = 2. mm
u_c = -12. mm
v_c = -16.96 mm
$\sigma_c = N/A - Mv/J_u$ = 227.4 N/mm^2
$\tau_c = TS^*/tJ_u$ = 7.906 N/mm^2
$\tau_g = TS^*/tJ_u$ = 7.906 N/mm^2
t_c = 220. mm
$\sigma_o = \sqrt{\sigma^2 + 3\tau^2}$ = 227.8 N/mm^2

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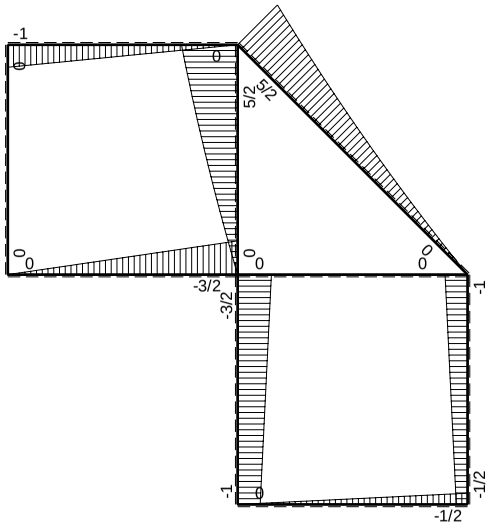
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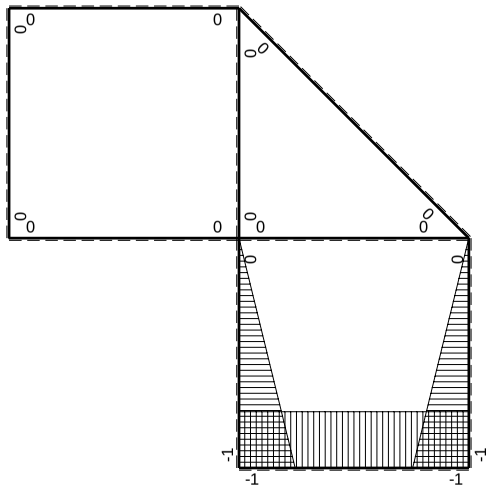

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Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0		
BC b	-x/b	-3/2Fb+1/2Fx	$3/2Fx-1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+1/2Fx	$Fb-1/2Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	-1/2Fx	1/2Fx	1	$1/4Fb^2/EJ$	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE b	-1+x/b	-1/2Fb-1/2Fx	$1/2Fb-1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/3Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	Fb-1/2Fx	$Fx-1/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$3\sqrt{2}/4Fx+1/2qx^2$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	$5/2Fb-2Fx-1/2qx^2$	0	0	0	0
BF b	0	$-3Fx+1/2qx^2$	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$13/6Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				-13/10Fb	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

$= (3/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

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

$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

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

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

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

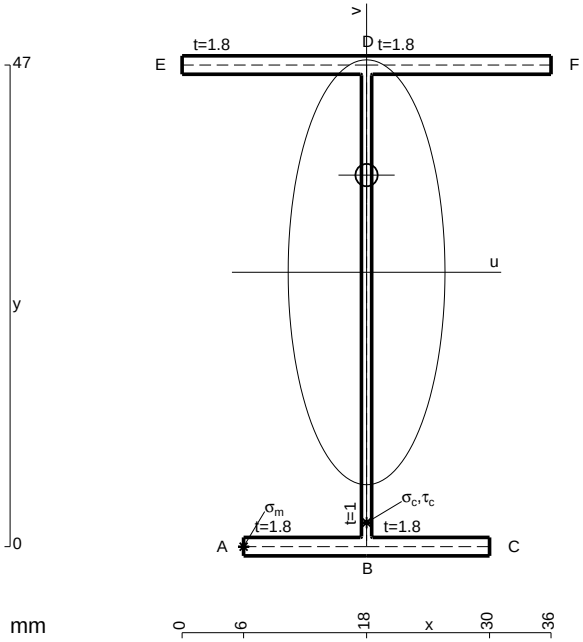
$= (1/2\ b -1/4\ b\ )\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

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

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

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

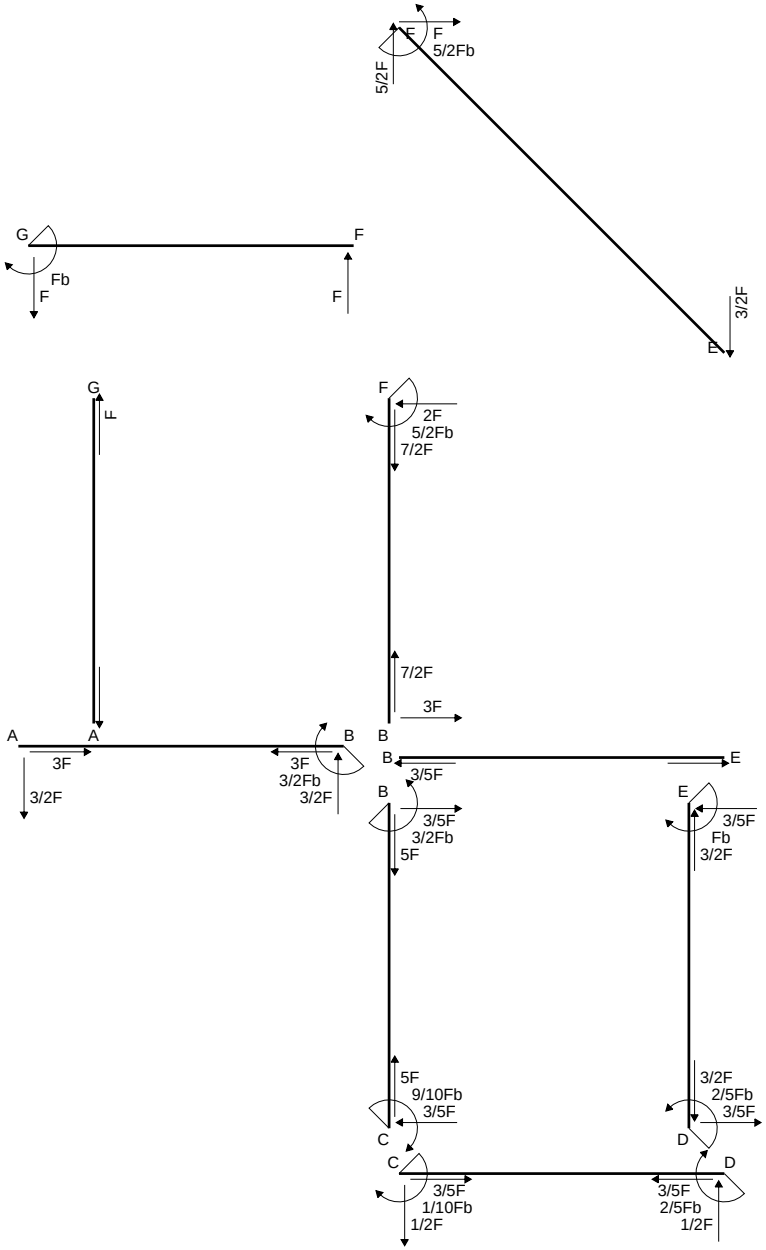
$= (1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/3\ Fb^2/EJ$

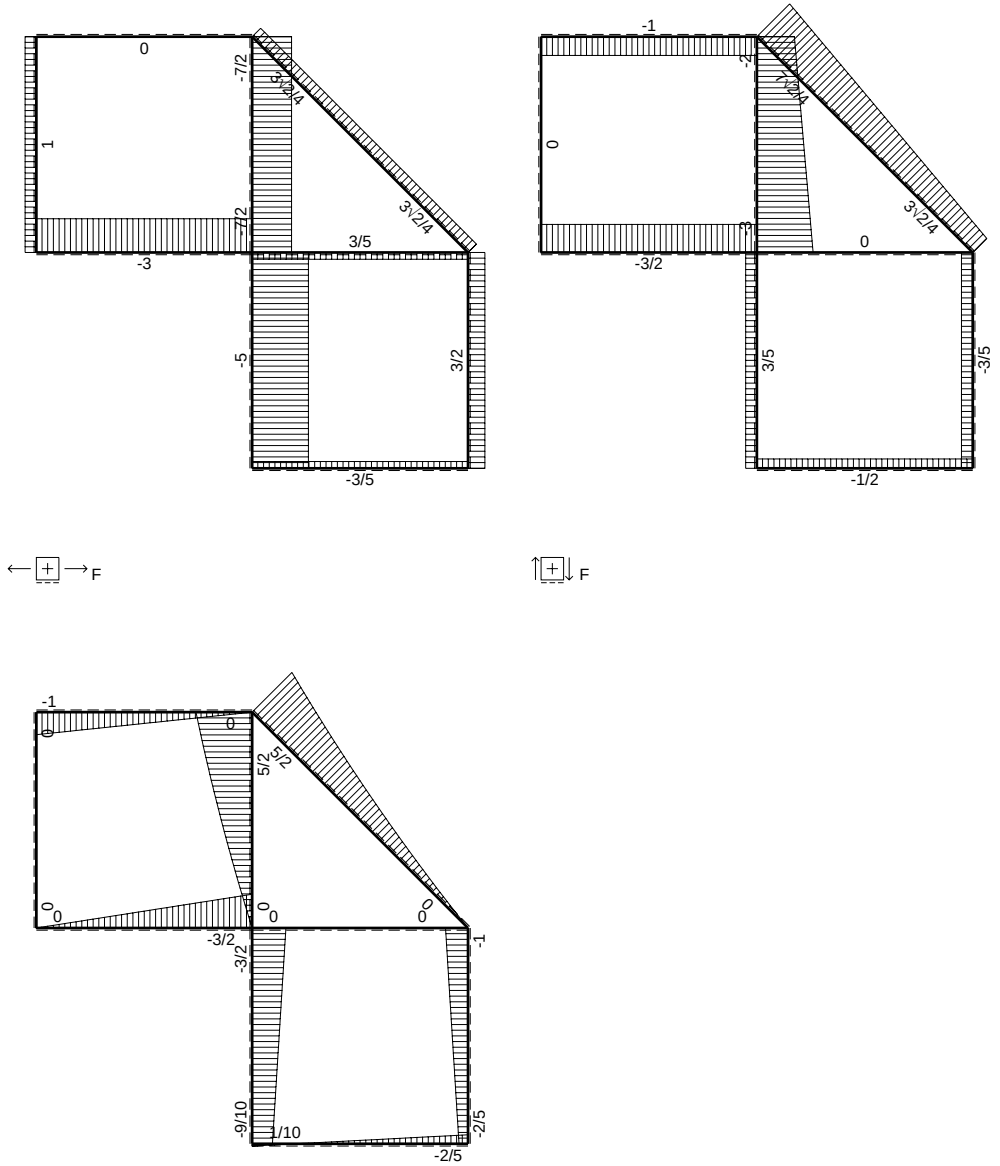


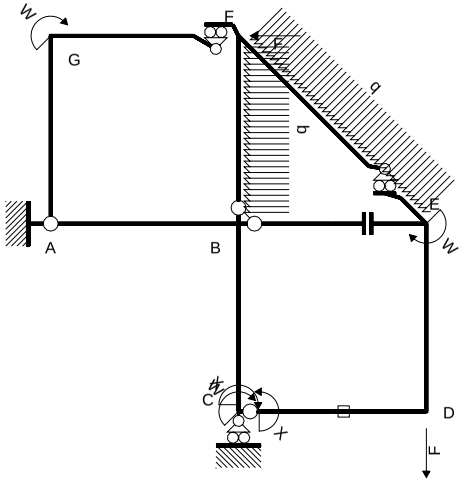
A = 155. mm^2
J_u = 66633. mm^4
J_v = 9072. mm^4
J_t = 132.3 mm^4
y_o = 9.482 mm
y_g = 26.77 mm
N = 297. N
T_y = 693. N
M_x = 581000. Nmm
x_m = 6. mm
u_m = -12. mm
v_m = -26.77 mm
$\sigma_m = N/A - Mv/J_u$ = 235.4 N/mm^2
x_c = 18. mm
v_c = -26.77 mm
$\sigma_c = N/A - Mv/J_u$ = 235.4 N/mm^2
$\tau_c = TS^*/tJ_u$ = 12.03 N/mm^2
$\tau_g = TS^*/tJ_u$ = 12.03 N/mm^2
t_c = 280. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 236.3 N/mm^2

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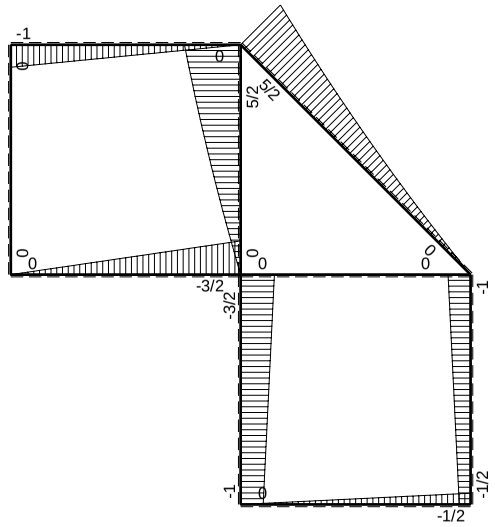
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3/2F
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1/2F

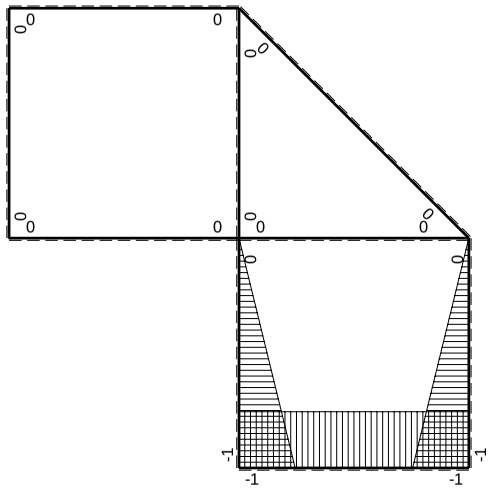

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0
-3/2
-3/2
-1
-9/10
1/10
-2/5
-2/5
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0		
BC b	-x/b	-3/2Fb+1/2Fx	$3/2Fx-1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	$Fb-1/2Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	-1/2Fx	1/2Fx	1	$1/4Fb^2/EJ$	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE 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
ED b	x/b	Fb-1/2Fx	$Fx-1/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$3\sqrt{2}/4Fx+1/2qx^2$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	$5/2Fb-2Fx-1/2qx^2$	0	0	0	0
BF b	0	$-3Fx+1/2qx^2$	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$1/6Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-1/10Fb	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

$= (3/4\ b -1/6\ b)\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

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

$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

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

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

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

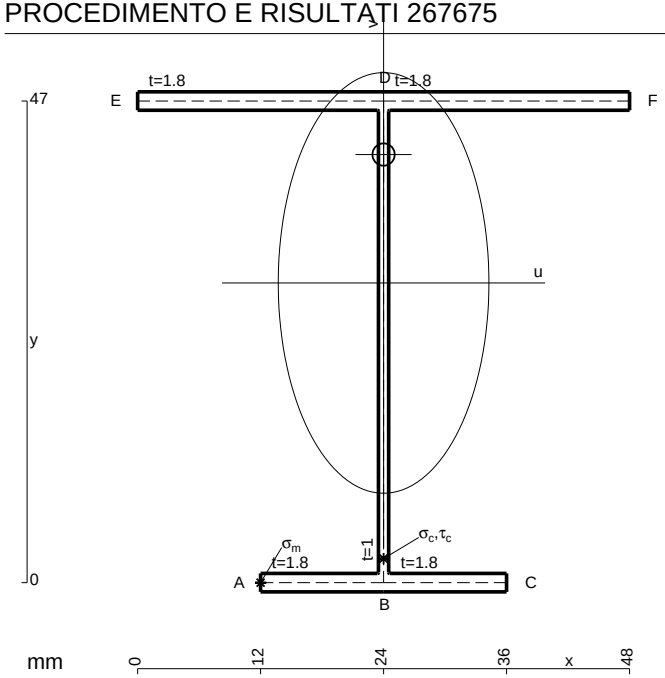
$= (1/2\ b -1/4\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -3/4\ \ Fb^2/EJ$

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

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

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

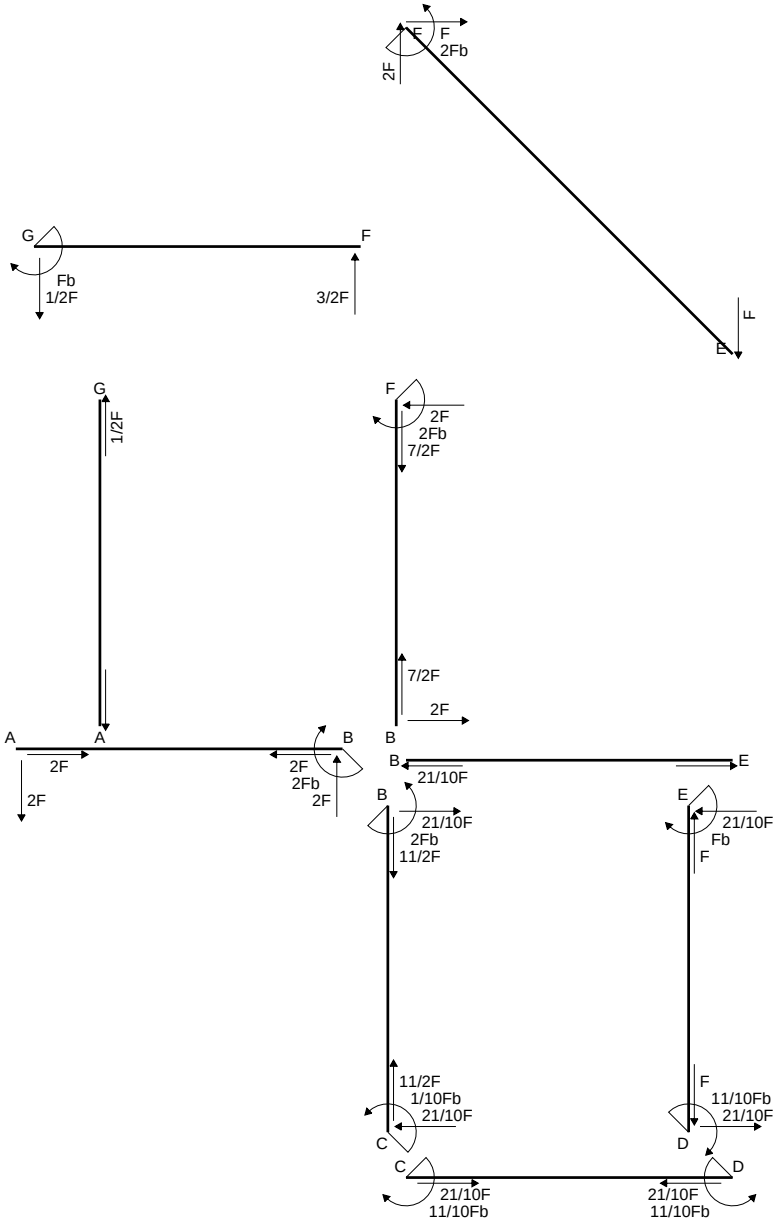
$= (1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/3\ \ Fb^2/EJ$

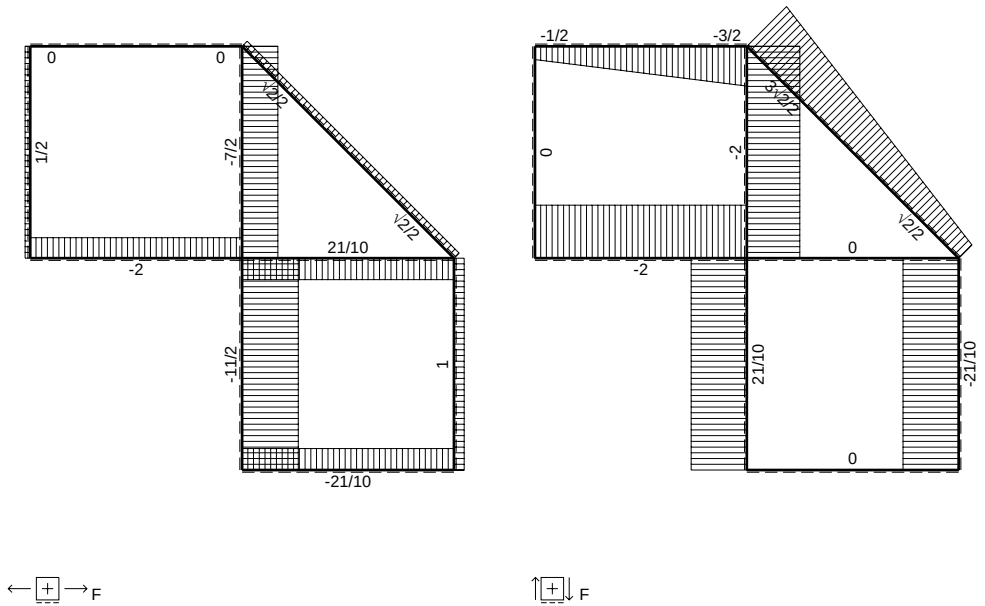


A = 176.6 mm^2
J_u = 74388. mm^4
J_v = 18662. mm^4
J_t = 155.6 mm^4
y_o = 12.53 mm
y_g = 29.25 mm
N = 477.3 N
T_y = 1114. N
M_x = 495000. Nmm
x_m = 12. mm
u_m = -12. mm
v_m = -29.25 mm
$\sigma_m = N/A - Mv/J_u$ = 197.3 N/mm^2
x_c = 24. mm
v_c = -29.25 mm
$\sigma_c = N/A - Mv/J_u$ = 197.3 N/mm^2
$\tau_c = TS^*/tJ_u$ = 18.92 N/mm^2
$\tau_g = TS^*/tJ_u$ = 18.92 N/mm^2
t_c = 450. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 200. N/mm^2

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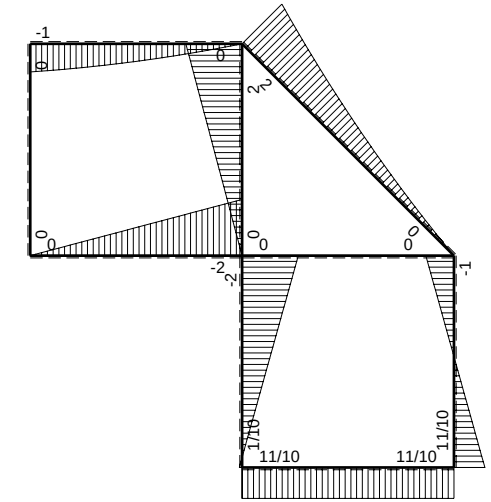
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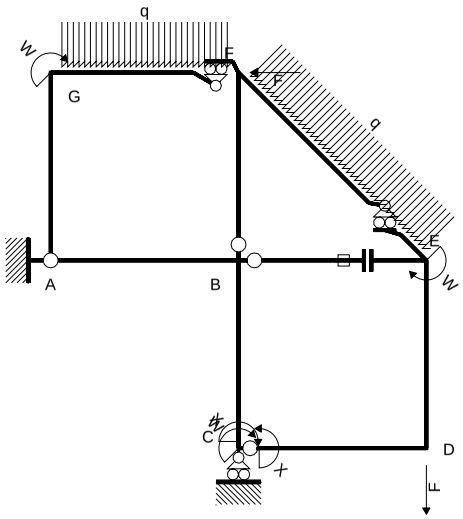

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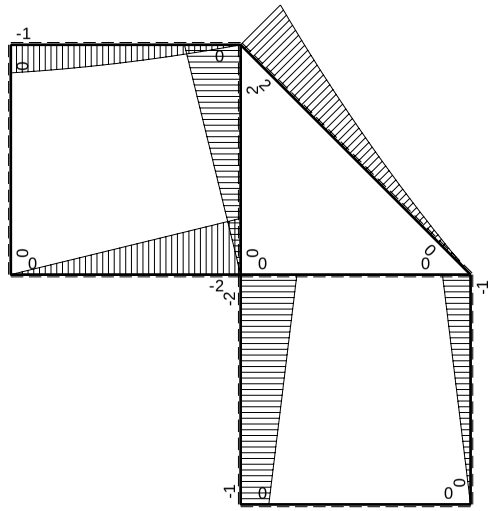
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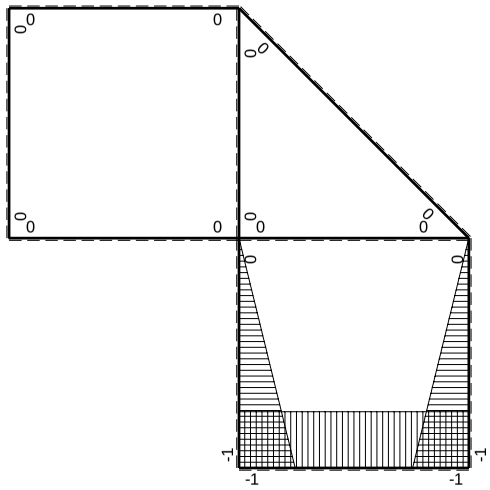
Fb



Schema di calcolo iperstatico



M_o flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0		
BC b	-x/b	-2Fb+Fx	2Fx-Fx^2/b	x^2/b^2	2/3Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	-Fx	Fx-Fx^2/b	1-2x/b+x^2/b^2	1/6Fb^2/EJ	1/3Xb/EJ
ED b	x/b	Fb-Fx	Fx-Fx^2/b	x^2/b^2		
EF √2b	0	√2/2Fx+1/2qx^2	0	0	0	0
FG b	0	-3/2Fx+1/2qx^2	0	0	0	0
GF b	0	Fb-1/2Fx-1/2qx^2	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				11/6Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-11/10Fb	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

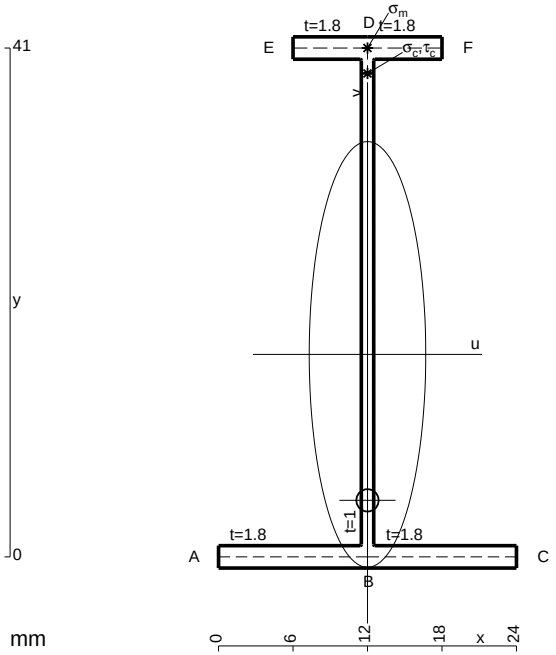
$= (\ b - 1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

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

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

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

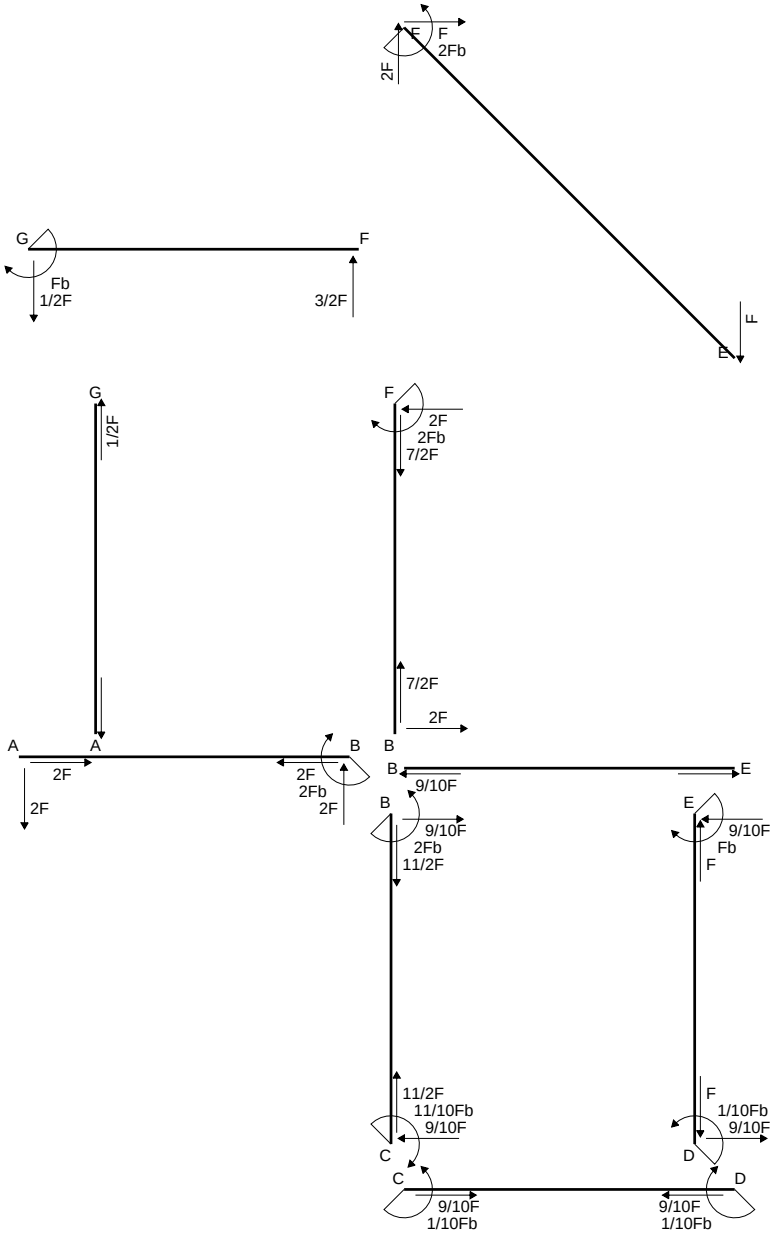
$= (1/2\ b - 1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

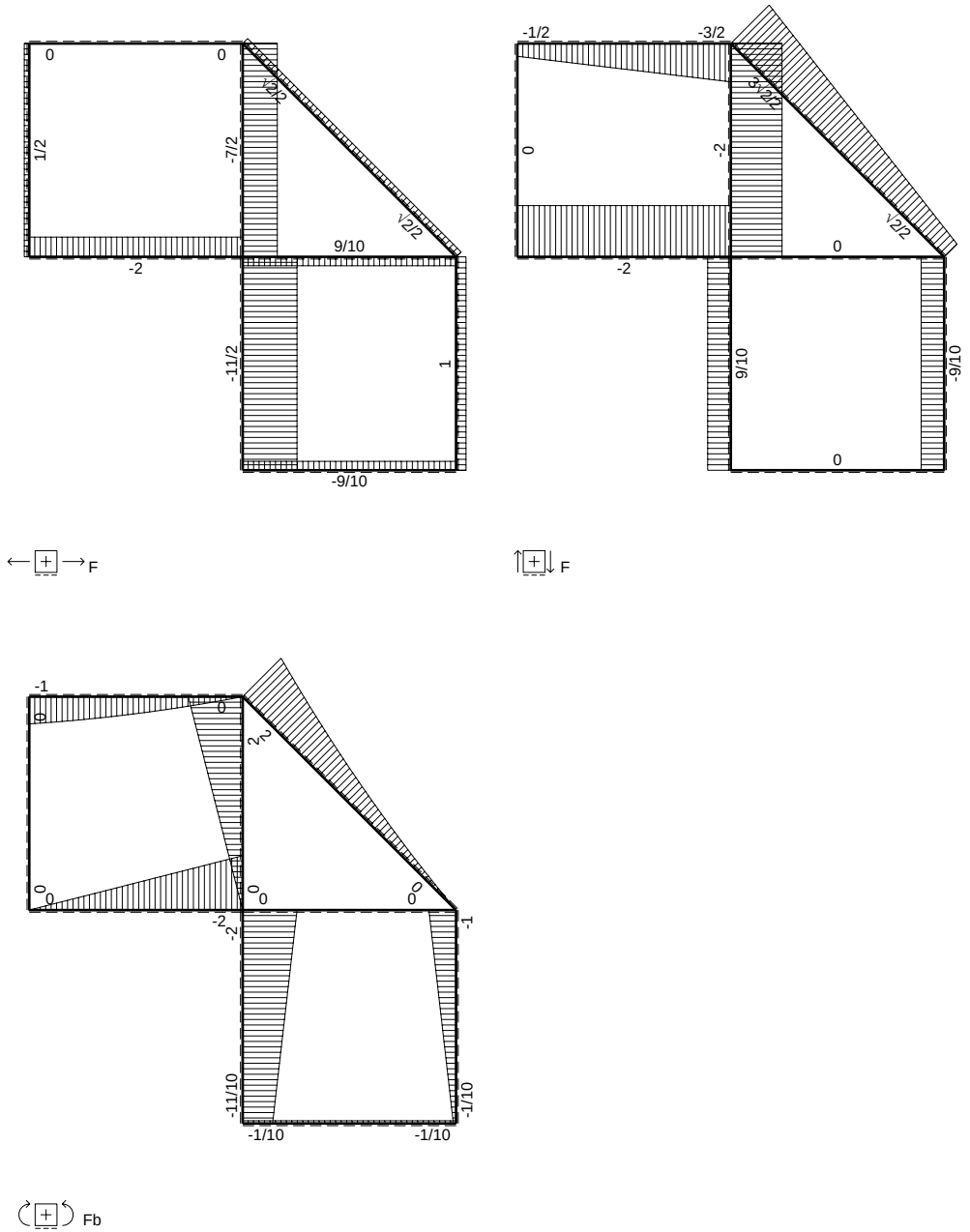


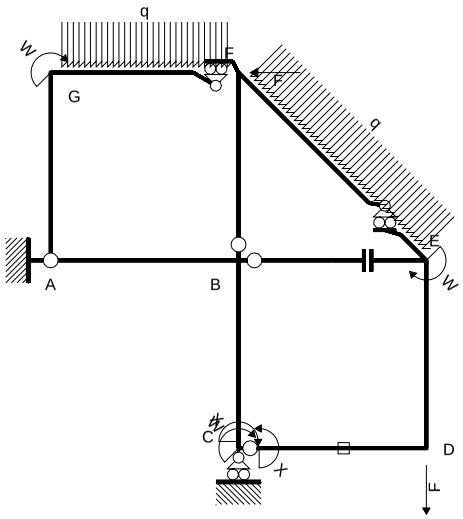
A = 105.8 mm^2
J_u = 31122. mm^4
J_v = 2333. mm^4
J_t = 83.65 mm^4
y_o = -11.76 mm
y_g = 16.31 mm
N = 219.2 N
T_y = 657.6 N
M_x = 260400. Nmm
x_m = 12. mm
y_m = 41. mm
v_m = 24.69 mm
$\sigma_m = N/A - Mv/J_u$ = -204.5 N/mm^2
y_c = 2. mm
u_c = -12. mm
v_c = -14.31 mm
$\sigma_c = N/A - Mv/J_u$ = -204.5 N/mm^2
$\tau_c = TS^*/tJ_u$ = 11.27 N/mm^2
$\tau_g = TS^*/tJ_u$ = 11.27 N/mm^2
t_c = 310. mm
$\sigma_o = \sqrt{\sigma^2 + 3\tau^2}$ = 205.4 N/mm^2

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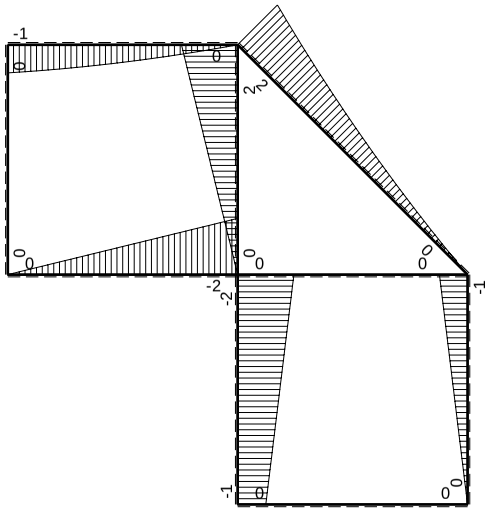
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F
2Fb
2F
G
F
Fb
1/2F
3/2F
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F
G
1/2F
F
2F
2Fb
7/2F
7/2F
2F
A
A
B
B
B
E
2F
2F
2Fb
2F
2F
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B
9/10F
2Fb
11/2F
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9/10F
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9/10F
1/10Fb

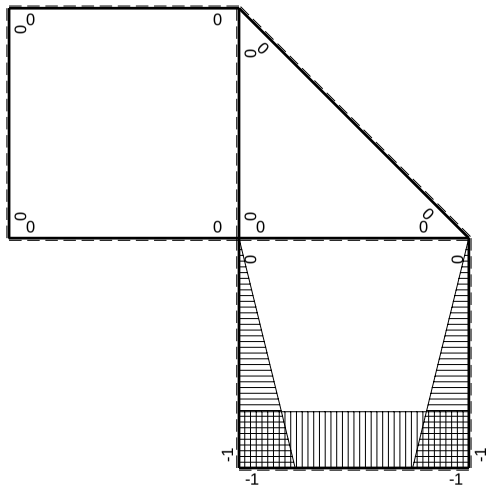

0
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9/10
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-11/2
1
-9/10
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-1/2
-3/2
0
-2
1/2
1/2
0
-2
9/10
-9/10
0
F
-1
0
0
0
0
0
0
0
-2
-2
-1
-11/10
-1/10
-1/10
-1/10
Fb



Schema di calcolo iperstatico



M_o flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0		
BC b	-x/b	-2Fb+Fx	2Fx-Fx^2/b	x^2/b^2	2/3Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	-Fx	Fx-Fx^2/b	1-2x/b+x^2/b^2	1/6Fb^2/EJ	1/3Xb/EJ
ED b	x/b	Fb-Fx	Fx-Fx^2/b	x^2/b^2		
EF √2b	0	$\sqrt{2}$/2Fx+1/2qx^2	0	0	0	0
FG b	0	-3/2Fx+1/2qx^2	0	0	0	0
GF b	0	Fb-1/2Fx-1/2qx^2	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				-Fb^2/EJ	
	totali				-1/6Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				1/10Fb	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

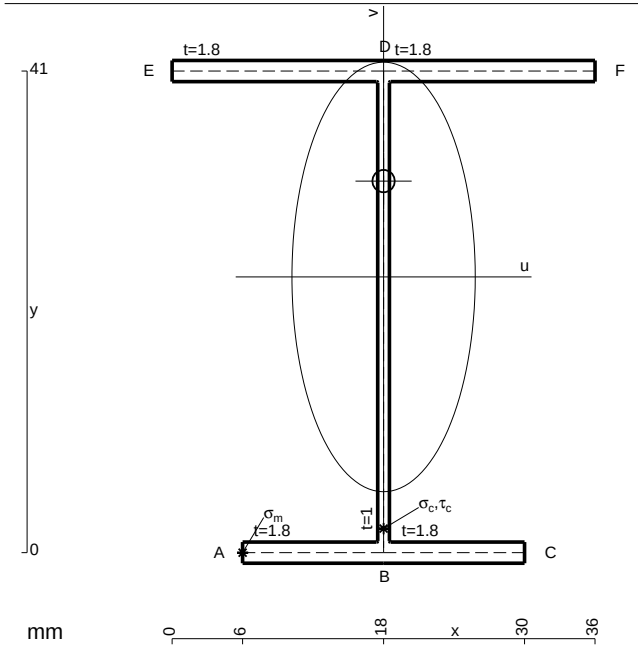
$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

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

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

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

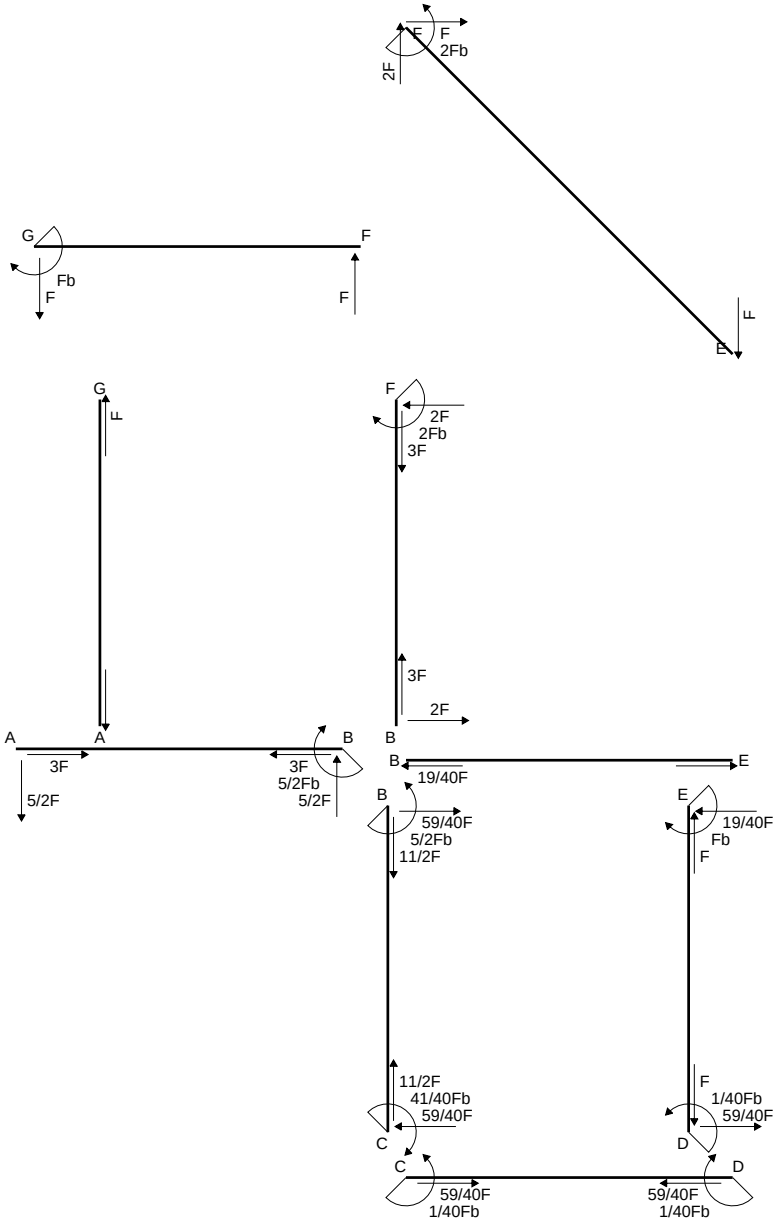
$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

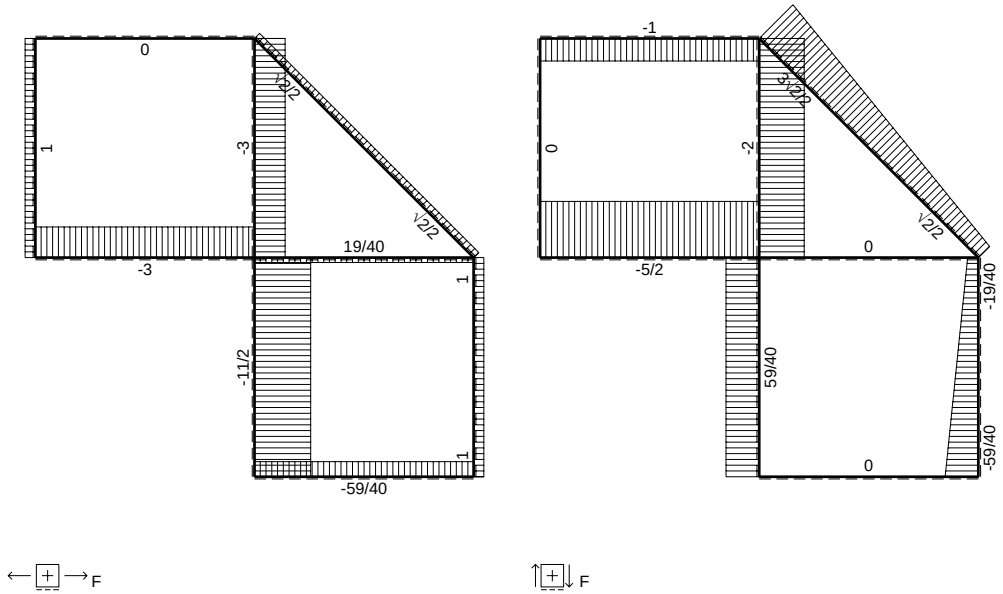


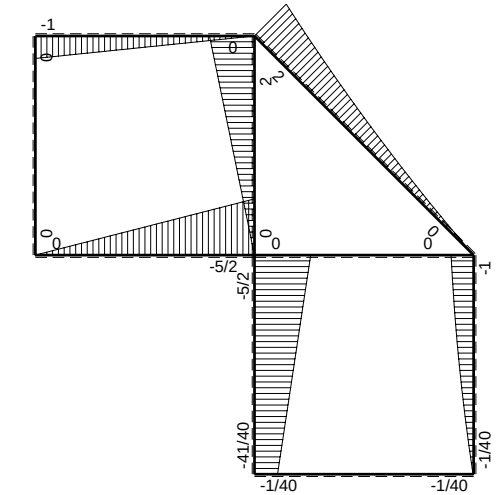
A = 149. mm^2
J_u = 49815. mm^4
J_v = 9072. mm^4
J_t = 130.3 mm^4
y_o = 8.157 mm
y_g = 23.47 mm
N = 353.6 N
T_y = 1061. N
M_x = 460000. Nmm
x_m = 6. mm
u_m = -12. mm
v_m = -23.47 mm
$\sigma_m = N/A - Mv/J_u$ = 219.1 N/mm^2
x_c = 18. mm
v_c = -23.47 mm
$\sigma_c = N/A - Mv/J_u$ = 219.1 N/mm^2
$\tau_c = TS^*/tJ_u$ = 21.59 N/mm^2
$\tau_g = TS^*/tJ_u$ = 21.59 N/mm^2
t_c = 500. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 222.3 N/mm^2

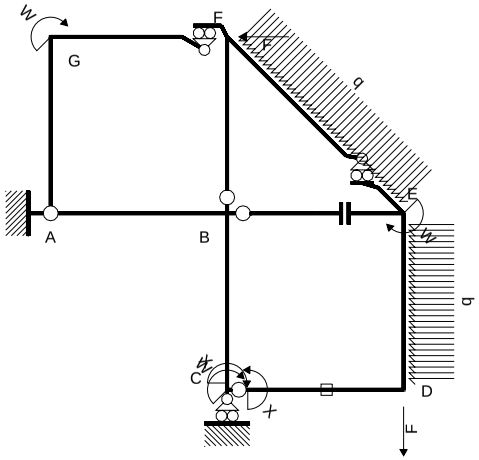
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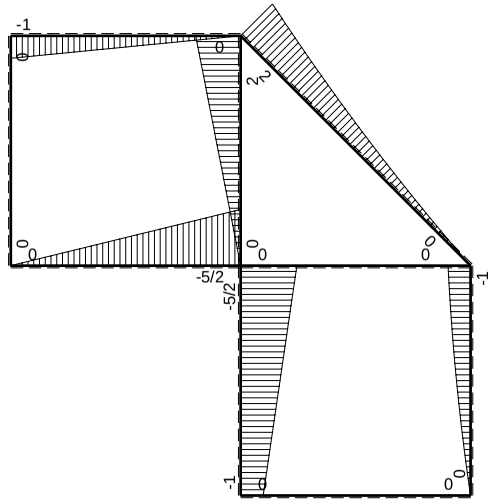

F F
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3F
3F
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B
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E
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11/2F
41/40Fb
59/40F
C
F
1/40Fb
59/40F
D
C
D
59/40F
1/40Fb
59/40F
1/40Fb


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1
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√2/2
-3
19/40
1
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-1
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√2/2
-5/2
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59/40
-19/40
-59/40
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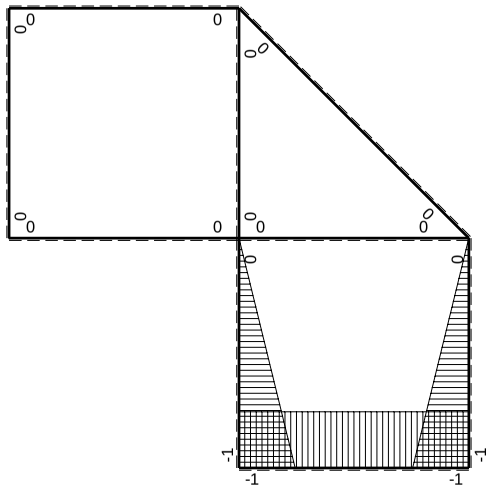

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√2/2
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0
0
0
-5/2
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-5/2
-41/40
-1/40
-1/40
-1/40



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0		
BC b	-x/b	-5/2Fb+3/2Fx	$5/2Fx-3/2Fx^2/b$	x^2/b^2	$3/4Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+3/2Fx	$Fb+1/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	$-3/2Fx+1/2qx^2$	$3/2Fx-2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$5/24Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$Fb-1/2Fx-1/2qx^2$	$Fx-1/2Fx^2/b-1/2qx^3/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx+1/2qx^2$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/24Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				$1/40Fb$	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -1/2\ b)\ Fb\ 1/EJ\ = 3/4\ Fb^2/EJ$

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

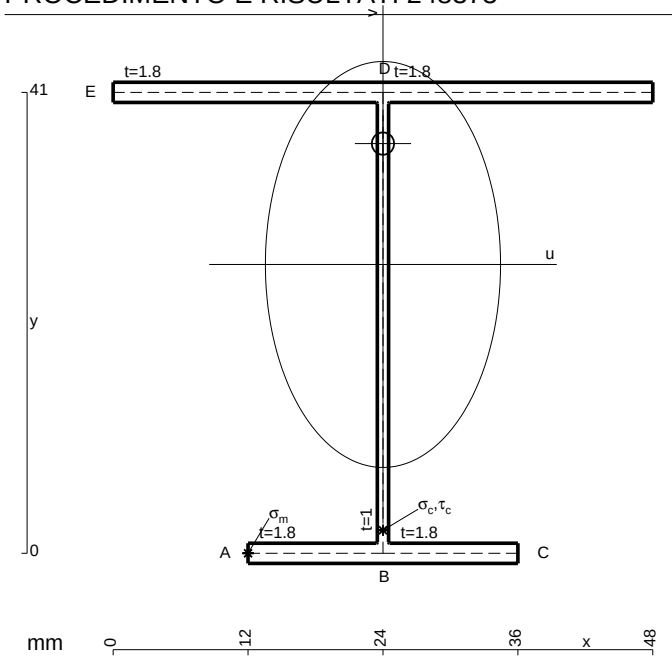
$= (\ b +1/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ Fb^2/EJ$

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

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

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

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



$A = 170.6\ mm^2$

$J_u = 55611.\ mm^4$

$J_v = 18662.\ mm^4$

$J_t = 153.6\ mm^4$

$y_o = 10.75\ mm$

$y_g = 25.69\ mm$

$N = -1140.\ N$

$T_y = -950.\ N$

$M_x = -475000.\ Nmm$

$x_m = 12.\ mm$

$u_m = -12.\ mm$

$v_m = -25.69\ mm$

$\sigma_m = N/A - Mv/J_u = -226.1\ N/mm^2$

$x_c = 24.\ mm$

$v_c = -25.69\ mm$

$\sigma_c = N/A - Mv/J_u = -226.1\ N/mm^2$

$\tau_c = TS^*/tJ_u = 18.96\ N/mm^2$

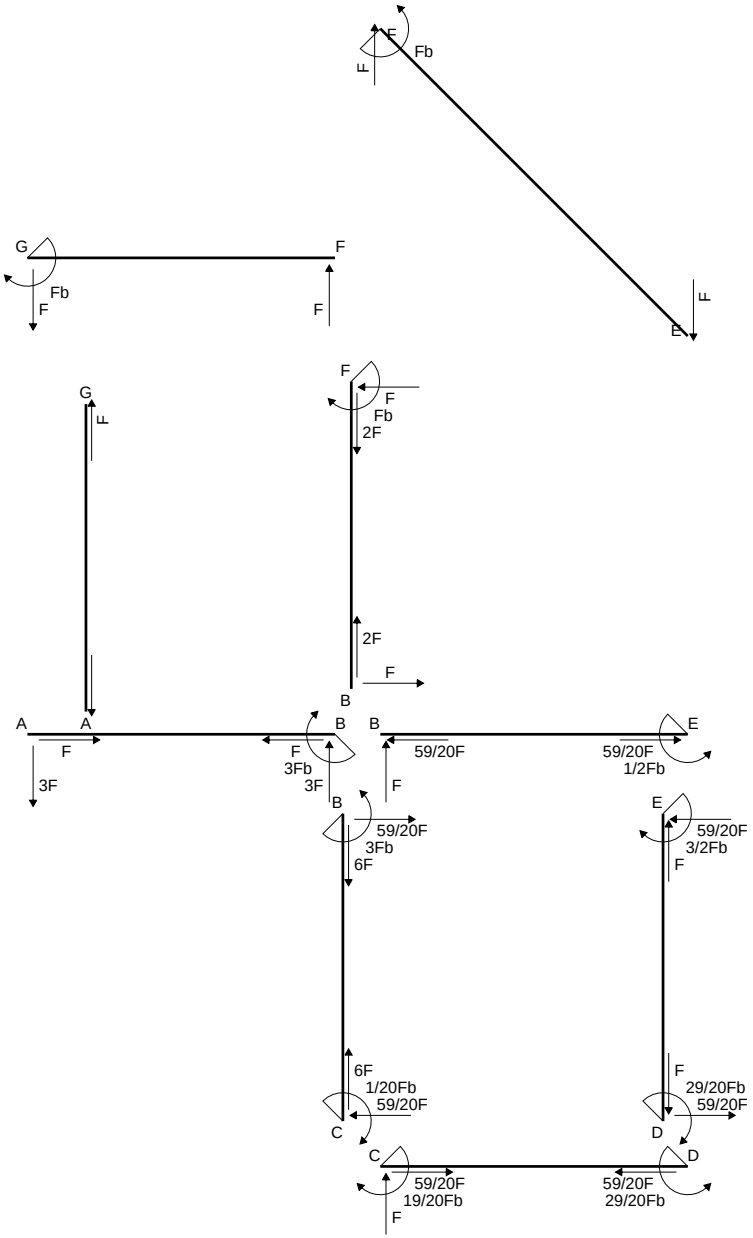
$\tau_g = TS^*/tJ_u = 18.96\ N/mm^2$

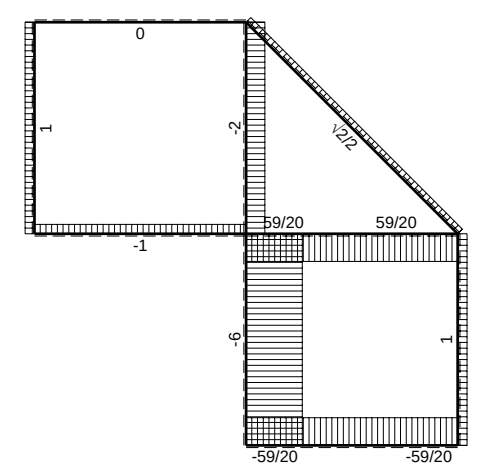
$t_c = 380.\ mm$

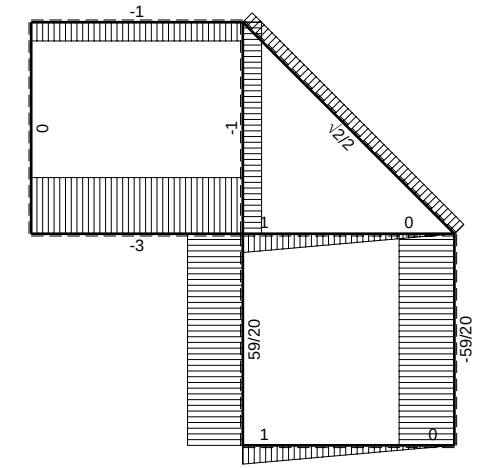
$\sigma_o = \sqrt{\sigma^2+3\tau^2} = 228.5\ N/mm^2$

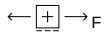
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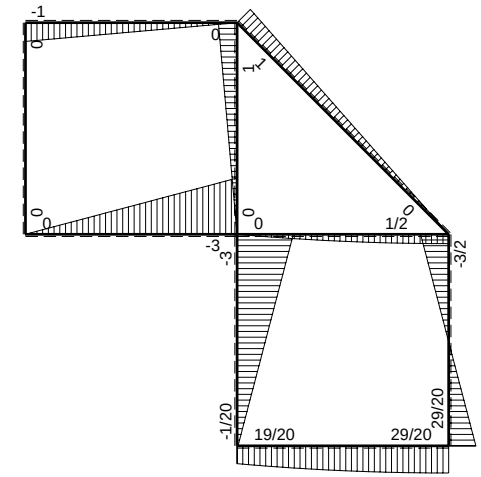






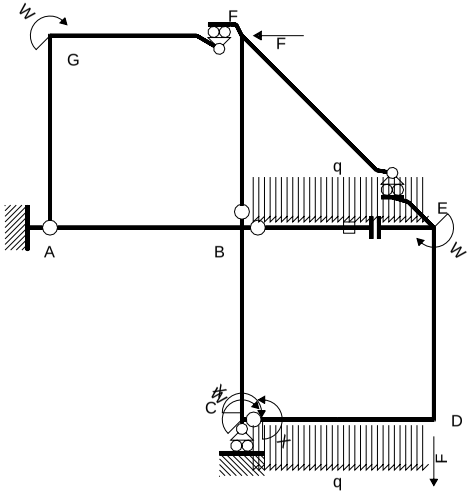




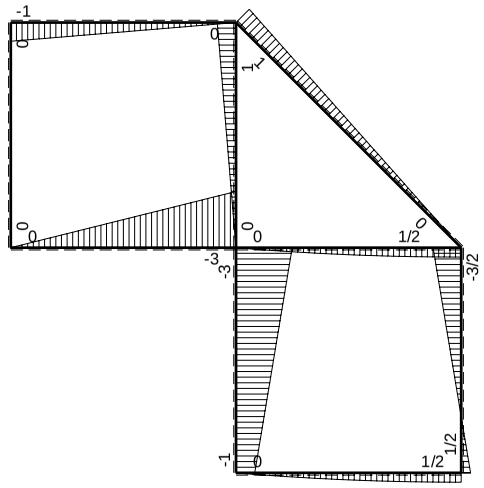




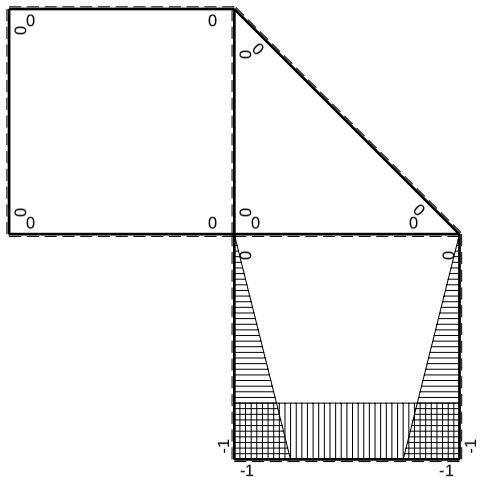
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Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3Fx	0	0	0	0
BA b	0	3Fb-3Fx	0	0		
BC b	-x/b	-3Fb+2Fx	$3Fx-2Fx^2/b$	x^2/b^2	$5/6Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+2Fx	$Fb+Fx-2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	$Fx-1/2qx^2$	$-Fx+1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fb+1/2qx^2$	$-1/2Fb+1/2Fx^2/b$	1		
DE b	-1+x/b	1/2Fb-2Fx	$-1/2Fb+5/2Fx-2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	3/2Fb-2Fx	$3/2Fx-2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	$Fx-1/2qx^2$	0	0	0	0
EB b	0	$-1/2Fb+1/2qx^2$	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$19/12Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				-19/20Fb	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

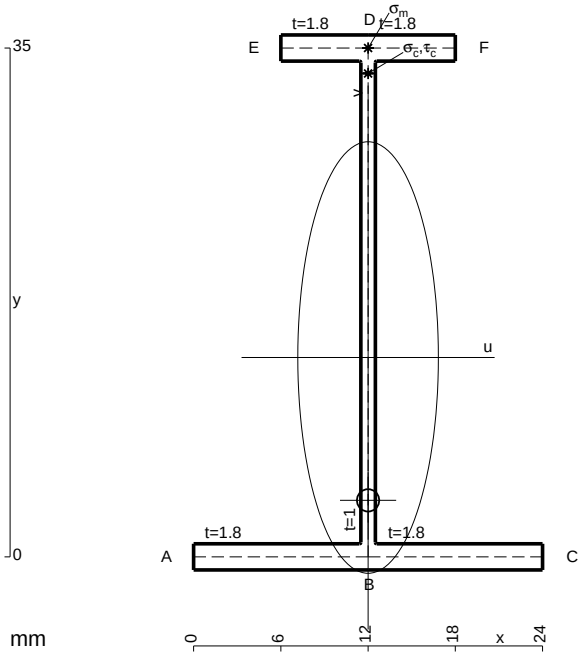
$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/3\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (-1/2 +5/2\ x/b -2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/2\ x +5/4\ x^2/b -2/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +5/4\ b -2/3\ b\ )\ Fb\ 1/EJ\ = 1/12\ \ Fb^2/EJ$

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

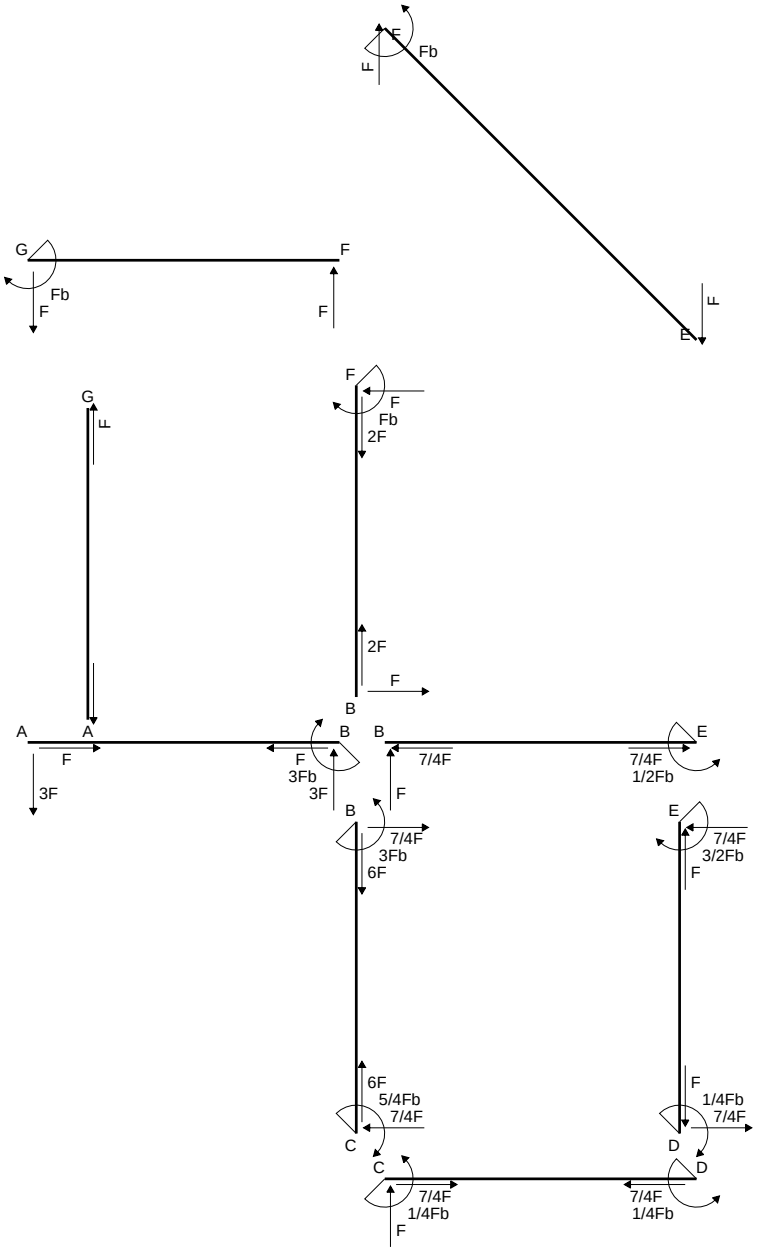
$= (3/4\ b -2/3\ b\ )\ Fb\ 1/EJ\ = 1/12\ \ Fb^2/EJ$

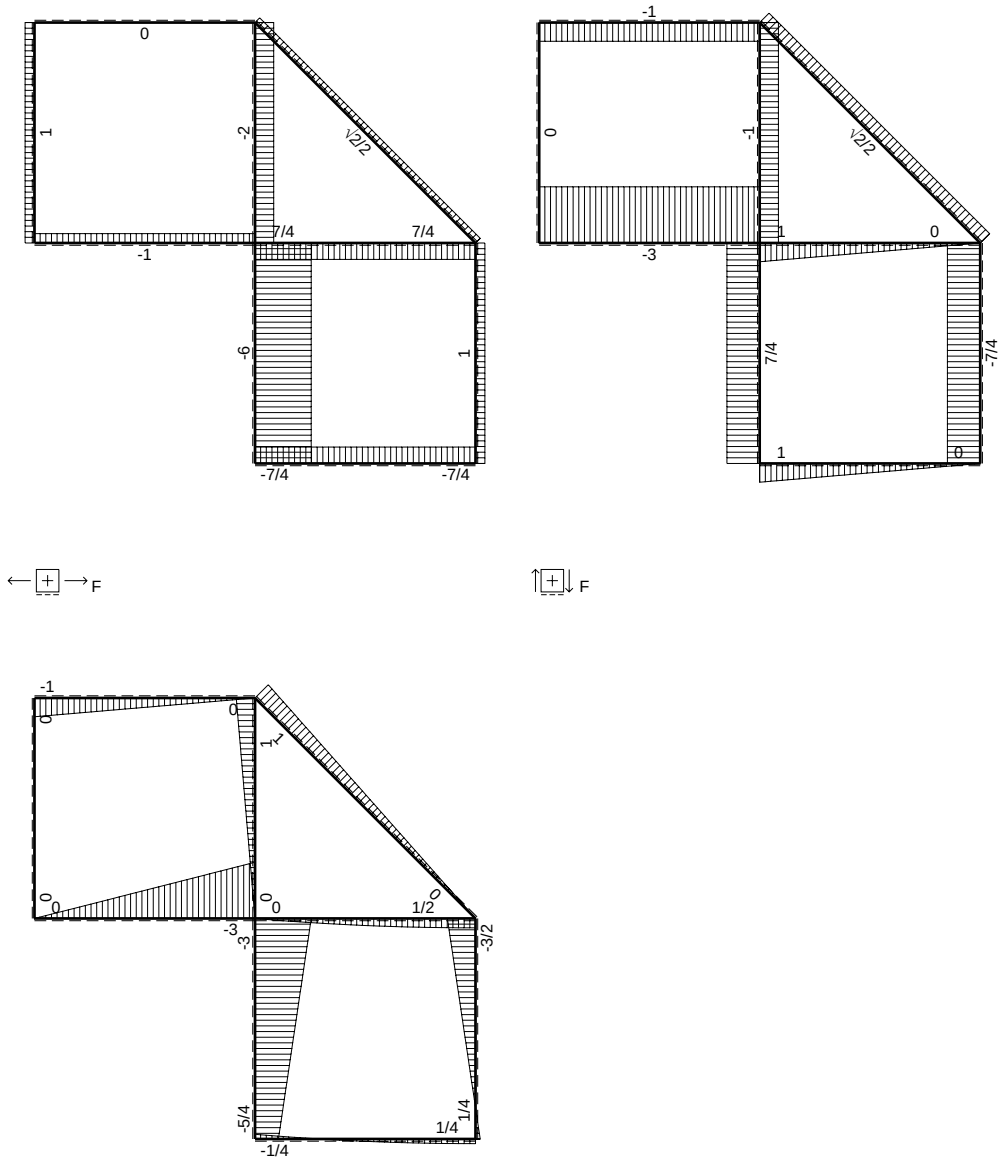


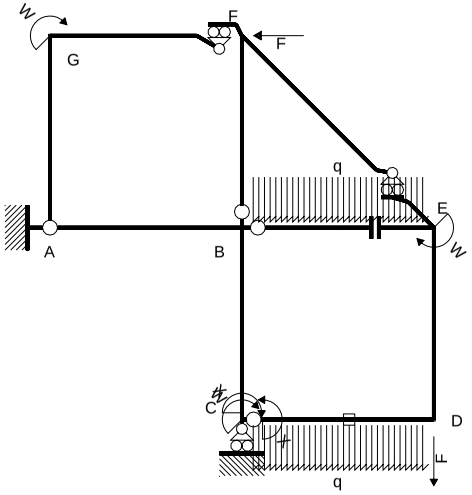
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J_u = 21986. mm^4
J_v = 2333. mm^4
J_t = 81.65 mm^4
y_o = -9.824 mm
y_g = 13.71 mm
N = -180. N
T_y = -540. N
M_x = -248400. Nmm
x_m = 12. mm
y_m = 35. mm
v_m = 21.29 mm
$\sigma_m = N/A - Mv/J_u$ = 238.7 N/mm^2
y_c = 2. mm
u_c = -12. mm
v_c = -11.71 mm
$\sigma_c = N/A - Mv/J_u$ = 238.7 N/mm^2
$\tau_c = TS^*/tJ_u$ = 11.29 N/mm^2
$\tau_g = TS^*/tJ_u$ = 11.29 N/mm^2
t_c = 180. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 239.5 N/mm^2

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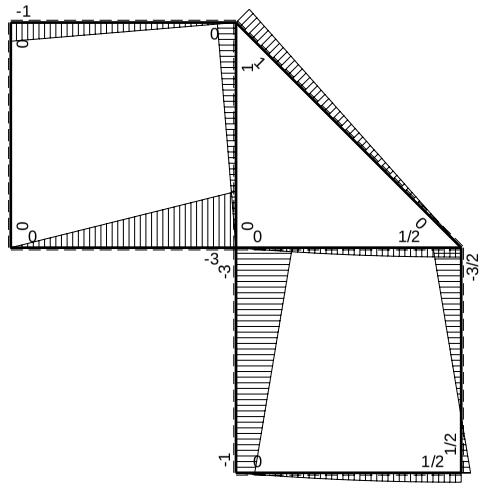
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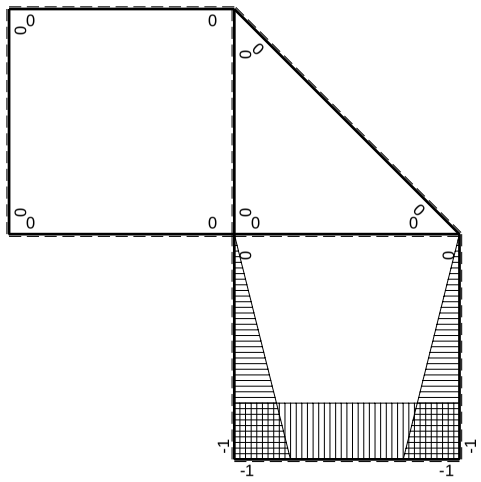

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-3
-3/2
-5/4
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-1/4
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3Fx	0	0	0	0
BA b	0	3Fb-3Fx	0	0		
BC b	-x/b	-3Fb+2Fx	$3Fx-2Fx^2/b$	x^2/b^2	$5/6Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+2Fx	$Fb+Fx-2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	$Fx-1/2qx^2$	$-Fx+1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fb+1/2qx^2$	$-1/2Fb+1/2Fx^2/b$	1		
DE b	-1+x/b	1/2Fb-2Fx	$-1/2Fb+5/2Fx-2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/12Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	3/2Fb-2Fx	$3/2Fx-2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	$Fx-1/2qx^2$	0	0	0	0
EB b	0	$-1/2Fb+1/2qx^2$	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-5/12Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				1/4Fb	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

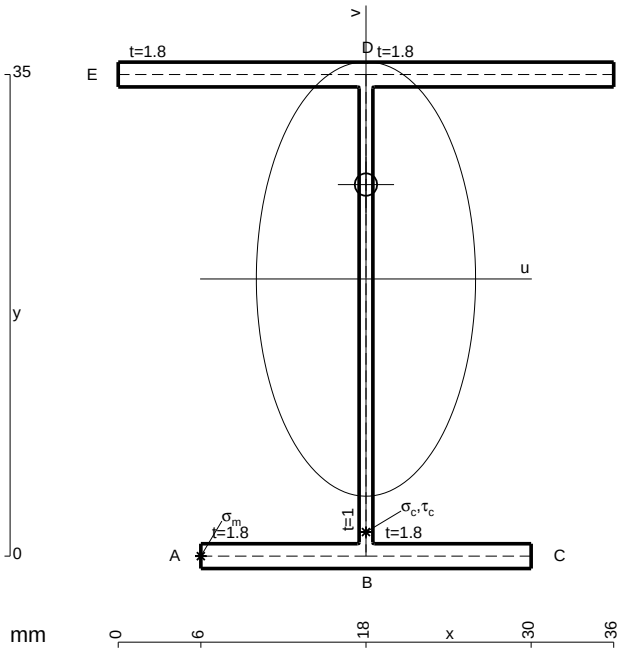
$L^{Xo}_{DE} = \int_o^b (-1/2 +5/2\ x/b -2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/2\ x +5/4\ x^2/b -2/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +5/4\ b -2/3\ b\ )\ Fb\ 1/EJ\ = 1/12\ \ Fb^2/EJ$

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

$= (3/4\ b -2/3\ b\ )\ Fb\ 1/EJ\ = 1/12\ \ Fb^2/EJ$

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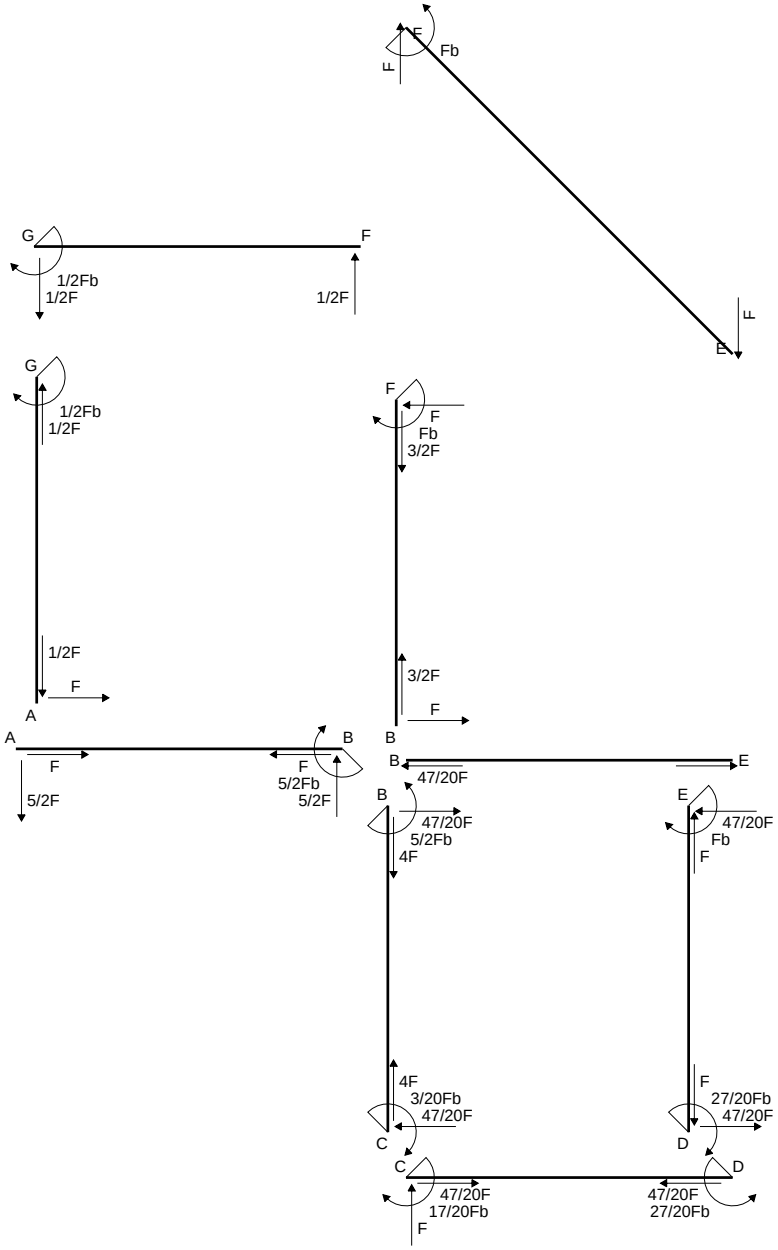


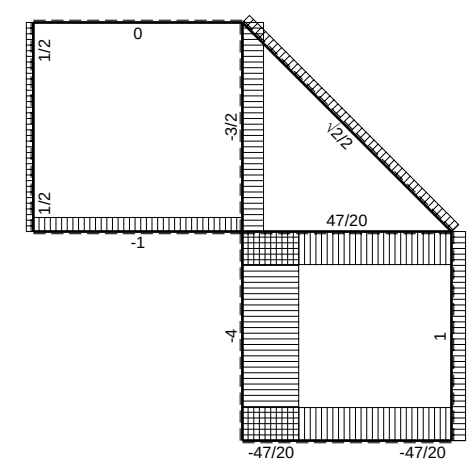
A = 143. mm^2
J_u = 35649. mm^4
J_v = 9072. mm^4
J_t = 128.3 mm^4
y_o = 6.857 mm
y_g = 20.14 mm
N = -230. N
T_y = -690. N
M_x = -338100. Nmm
x_m = 6. mm
u_m = -12. mm
v_m = -20.14 mm
$\sigma_m = N/A - Mv/J_u$ = -192.7 N/mm^2
x_c = 18. mm
v_c = -20.14 mm
$\sigma_c = N/A - Mv/J_u$ = -192.7 N/mm^2
$\tau_c = TS^*/tJ_u$ = 16.84 N/mm^2
$\tau_g = TS^*/tJ_u$ = 16.84 N/mm^2
t_c = 230. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 194.8 N/mm^2

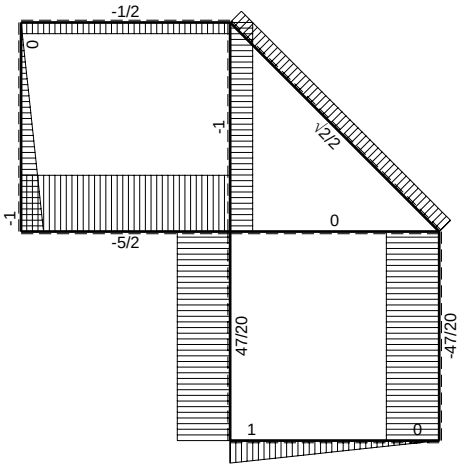
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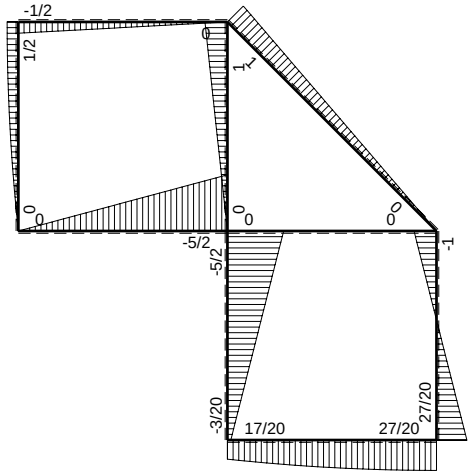

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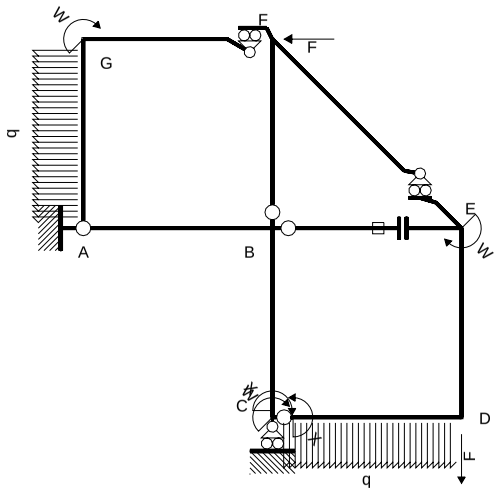

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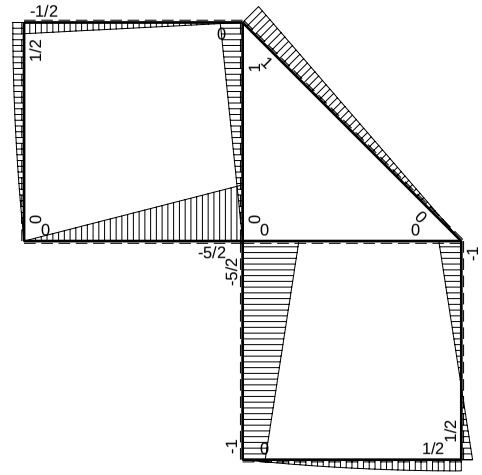
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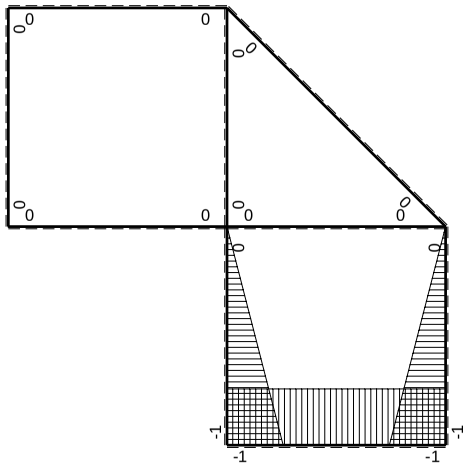
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0		
BC b	-x/b	-5/2Fb+3/2Fx	5/2Fx-3/2Fx^2/b	x^2/b^2	3/4Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	Fb+1/2Fx-3/2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	Fx-1/2qx^2	-Fx+1/2Fx^2/b	1	-1/3Fb^2/EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx^2	-1/2Fb+1/2Fx^2/b	1		
DE b	-1+x/b	1/2Fb-3/2Fx	-1/2Fb+2Fx-3/2Fx^2/b	1-2x/b+x^2/b^2	0	1/3Xb/EJ
ED b	x/b	Fb-3/2Fx	Fx-3/2Fx^2/b	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-1/2Fx	0	0	0	0
GF b	0	1/2Fb-1/2Fx	0	0		
GA b	0	1/2Fb-1/2qx^2	0	0	0	0
AG b	0	-Fx+1/2qx^2	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				17/12Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-17/20Fb	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ Fb^2/EJ$

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

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

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

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

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

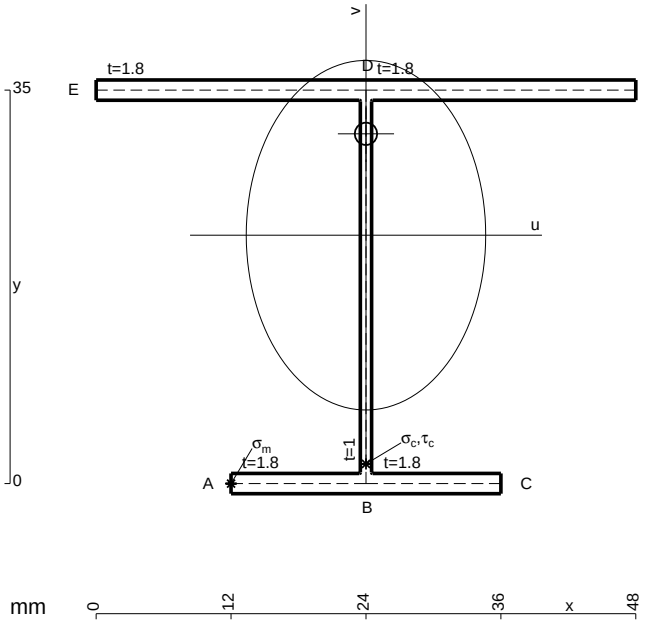
$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/3\ Fb^2/EJ$

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

$= (-1/2\ b + b -1/2\ b\ )\ Fb\ 1/EJ\ = 0$

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

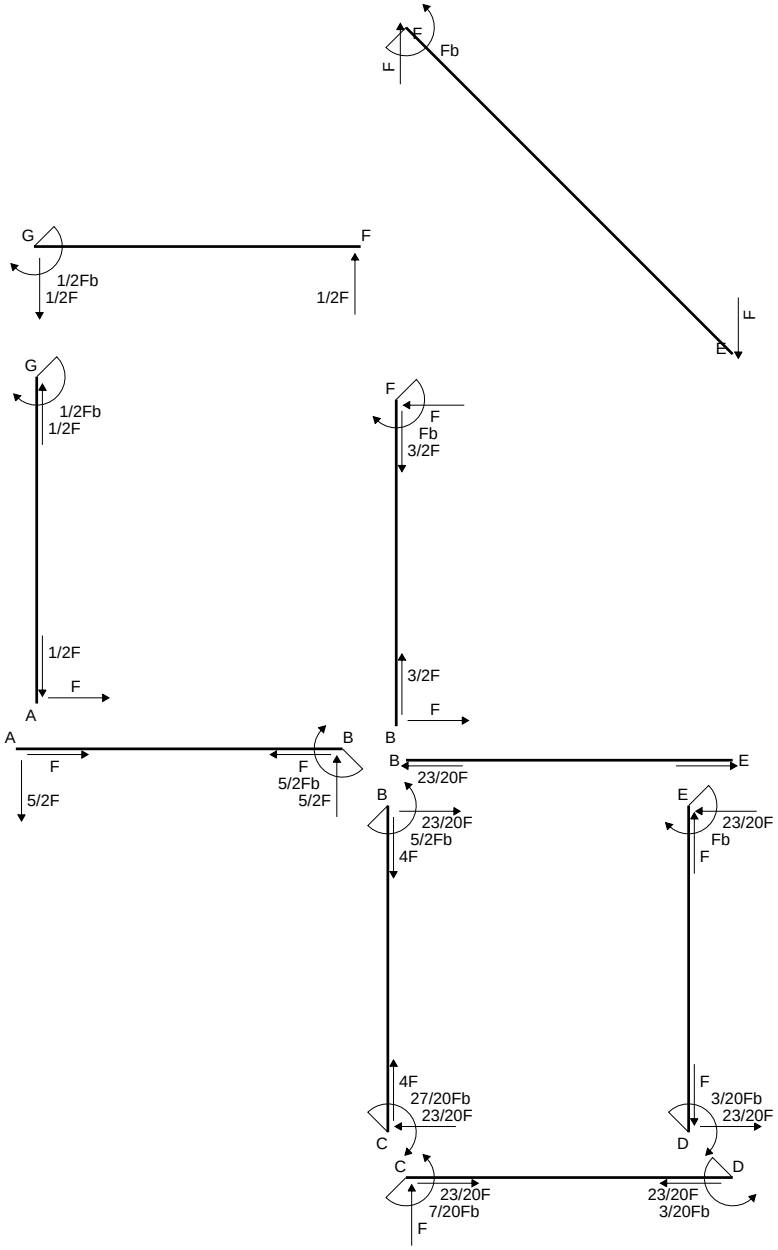
$= (1/2\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 0$

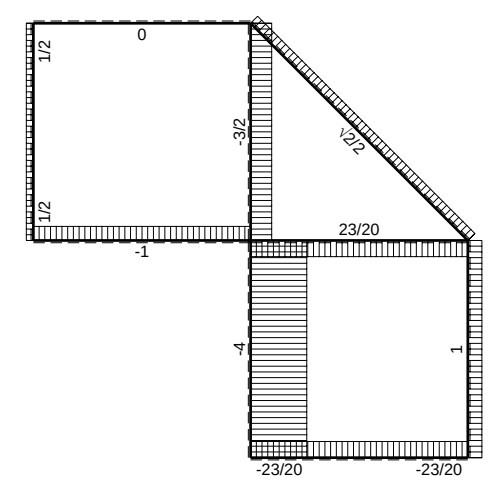


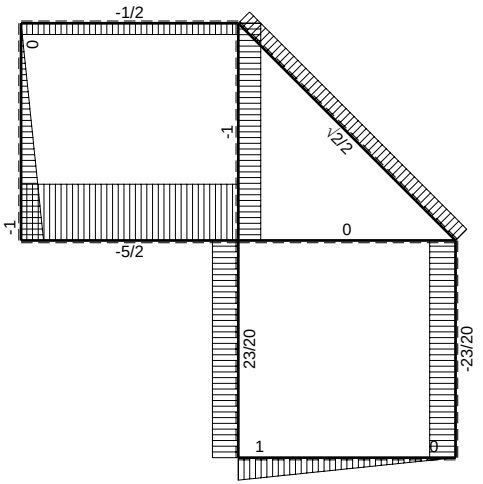
A = 164.6 mm^2
J_u = 39791. mm^4
J_v = 18662. mm^4
J_t = 151.6 mm^4
y_o = 9.018 mm
y_g = 22.09 mm
N = -280. N
T_y = -700. N
M_x = -364000. Nmm
x_m = 12. mm
u_m = -12. mm
v_m = -22.09 mm
$\sigma_m = N/A - Mv/J_u$ = -203.8 N/mm^2
x_c = 24. mm
v_c = -22.09 mm
$\sigma_c = N/A - Mv/J_u$ = -203.8 N/mm^2
$\tau_c = TS^*/tJ_u$ = 16.79 N/mm^2
$\tau_g = TS^*/tJ_u$ = 16.79 N/mm^2
t_c = 280. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 205.9 N/mm^2

CI02.xxxx.036

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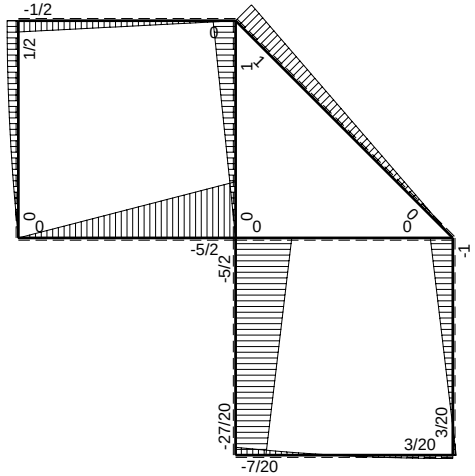

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-23/20

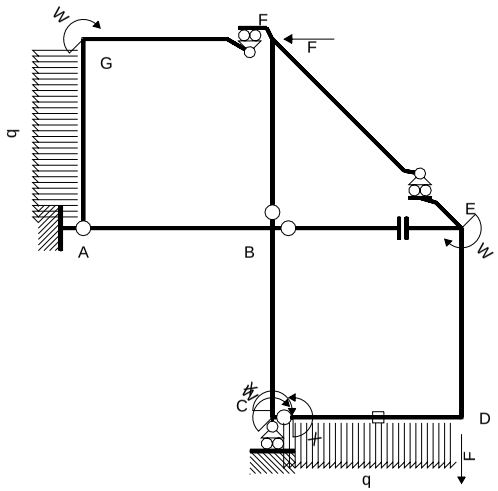

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-23/20
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0

←□→ F

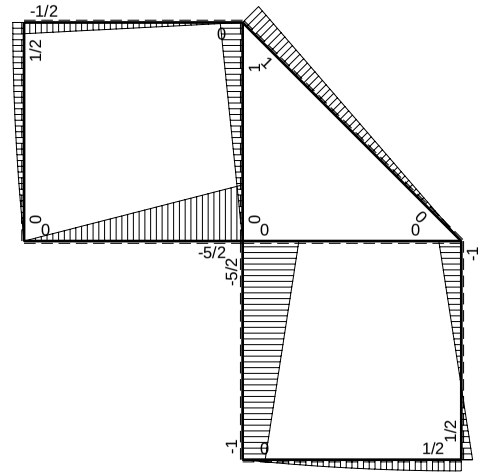
↑□↓ F


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3/20
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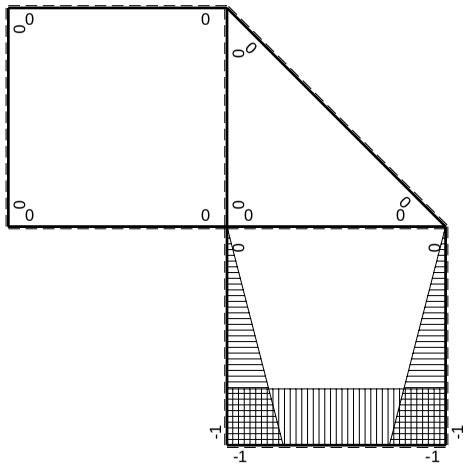
↻□↺ Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0		
BC b	-x/b	-5/2Fb+3/2Fx	5/2Fx-3/2Fx^2/b	x^2/b^2	3/4Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	Fb+1/2Fx-3/2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	Fx-1/2qx^2	-Fx+1/2Fx^2/b	1	-1/3Fb^2/EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx^2	-1/2Fb+1/2Fx^2/b	1		
DE b	-1+x/b	1/2Fb-3/2Fx	-1/2Fb+2Fx-3/2Fx^2/b	1-2x/b+x^2/b^2	0	1/3Xb/EJ
ED b	x/b	Fb-3/2Fx	Fx-3/2Fx^2/b	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-1/2Fx	0	0	0	0
GF b	0	1/2Fb-1/2Fx	0	0		
GA b	0	1/2Fb-1/2qx^2	0	0	0	0
AG b	0	-Fx+1/2qx^2	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				-Fb^2/EJ	
	totali				-7/12Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				7/20Fb	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ Fb^2/EJ$

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

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

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

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

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

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

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

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

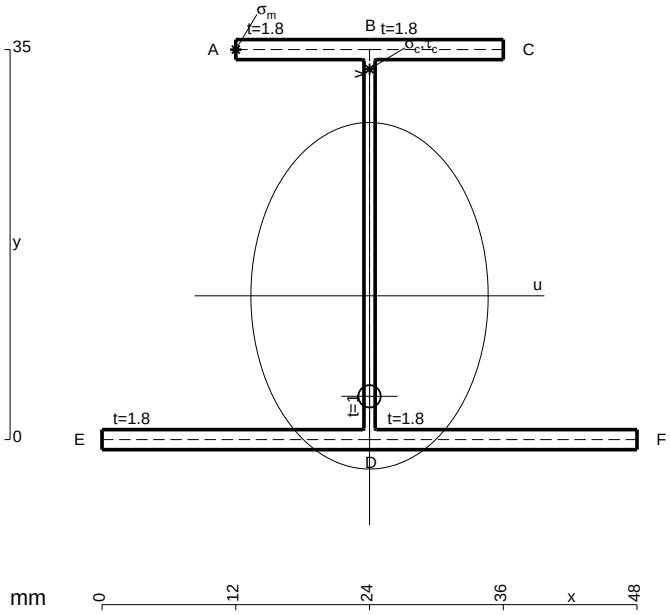
$L^{Xo}_{DE} = \int_o^b (-1/2 +2\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/2\ x + x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b + b -1/2\ b\ )\ Fb\ 1/EJ\ = 0$

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

$= (1/2\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 0$

PROCEDIMENTO E RISULTATI 270236 CI02.xxxx.037



$A = 164.6\ mm^2$

$J_u = 39791.\ mm^4$

$J_v = 18662.\ mm^4$

$J_t = 151.6\ mm^4$

$y_o = -9.018\ mm$

$y_g = 12.91\ mm$

$N = -280.\ N$

$T_y = -700.\ N$

$M_x = -392000.\ Nmm$

$x_m = 12.\ mm$

$y_m = 35.\ mm$

$u_m = -12.\ mm$

$v_m = 22.09\ mm$

$\sigma_m = N/A - Mv/J_u = 215.9\ N/mm^2$

$x_c = 24.\ mm$

$y_c = 35.\ mm$

$v_c = 22.09\ mm$

$\sigma_c = N/A - Mv/J_u = 215.9\ N/mm^2$

$\tau_c = TS^*/tJ_u = 16.79\ N/mm^2$

$\tau_g = TS^*/tJ_u = 16.79\ N/mm^2$

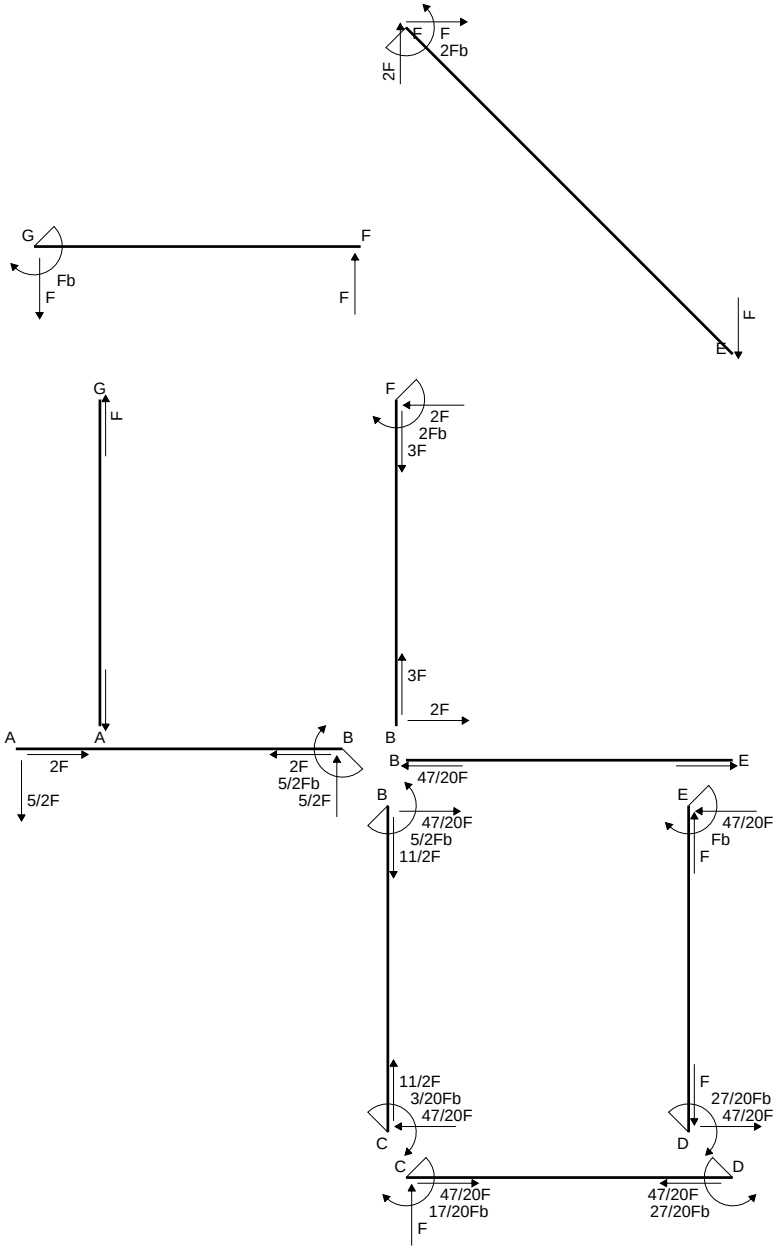
$t_c = 280.\ mm$

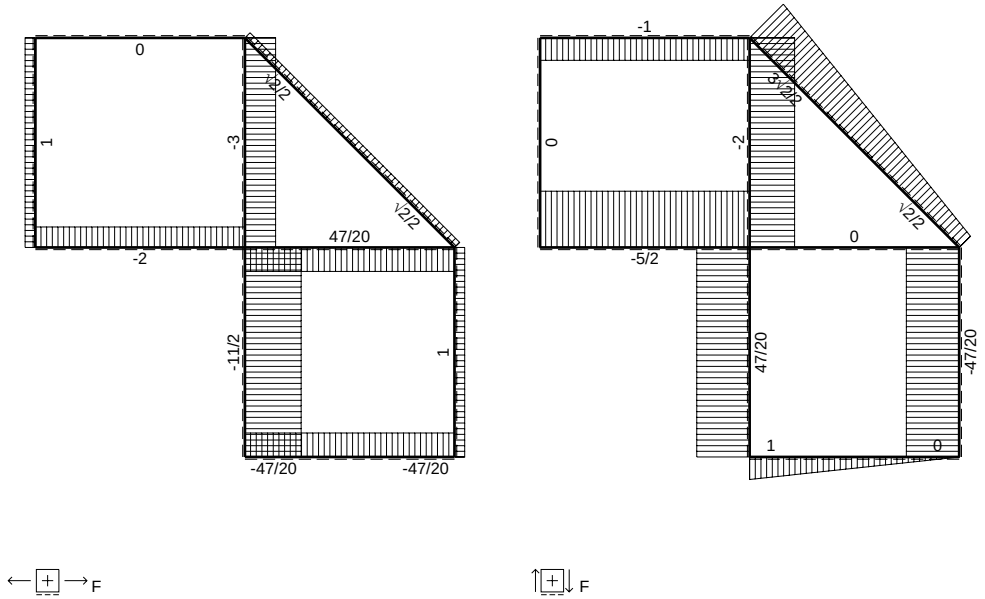
$\sigma_o = \sqrt{\sigma^2 + 3\tau^2} = 217.9\ N/mm^2$

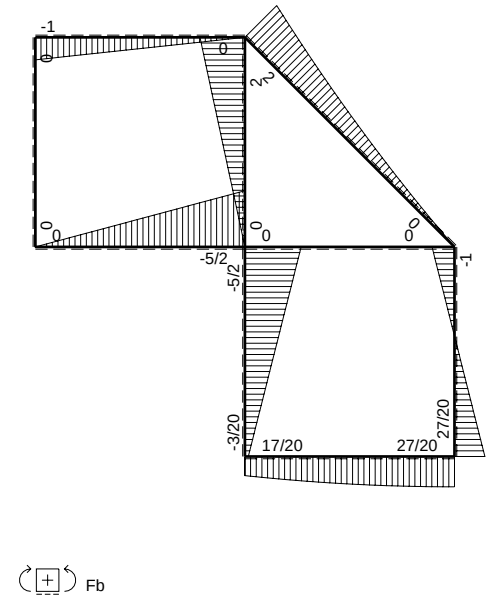
@ Adolfo Zavelani Rossi, Politecnico di Milano, vers.27.03.13 16.04.26

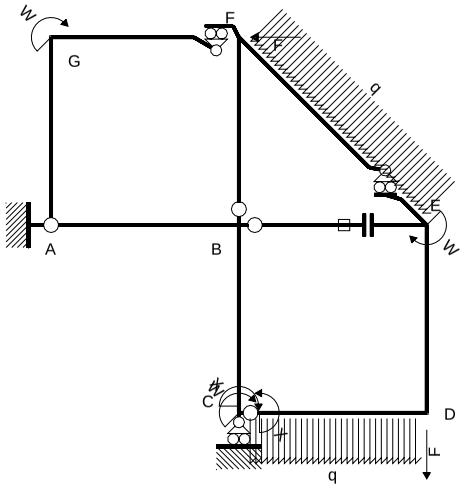
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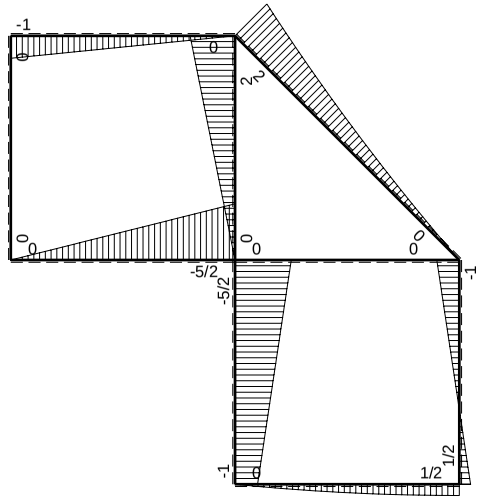

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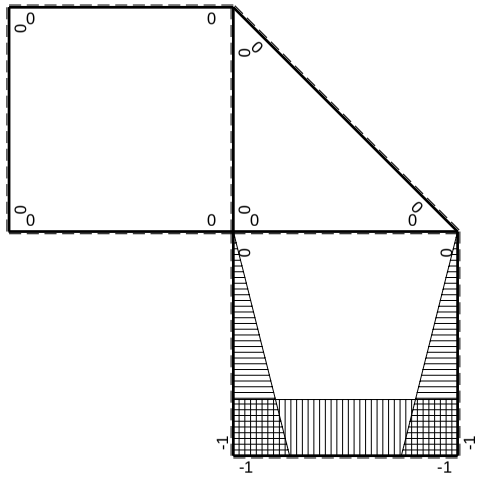

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-5/2
-5/2
-1
-3/20
17/20
27/20
27/20
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0		
BC b	-x/b	-5/2Fb+3/2Fx	$5/2Fx-3/2Fx^2/b$	x^2/b^2	$3/4Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	$Fb+1/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	$Fx-1/2qx^2$	$-Fx+1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fb+1/2qx^2$	$-1/2Fb+1/2Fx^2/b$	1		
DE b	-1+x/b	1/2Fb-3/2Fx	$-1/2Fb+2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	0	1/3Xb/EJ
ED b	x/b	Fb-3/2Fx	$Fx-3/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx+1/2qx^2$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$17/12Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-17/20Fb	

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

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

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

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

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ \ Fb^2/EJ$

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

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

$L^{Xo}_{CD} = \int_o^b (-\ x/b +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/3\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2 +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

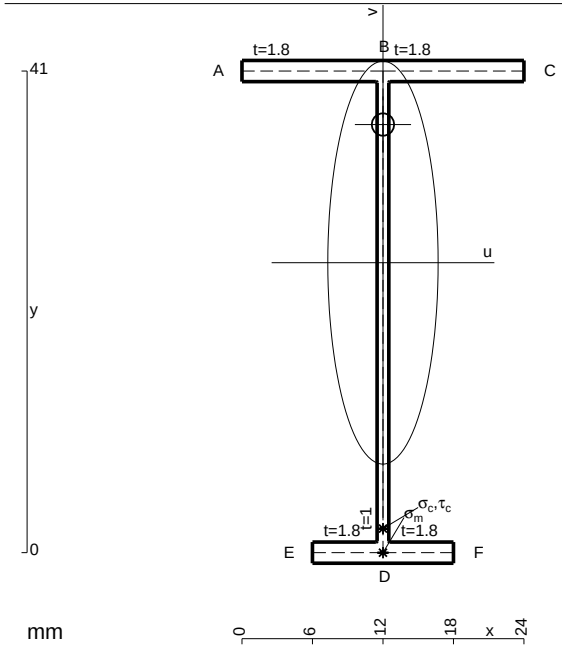
$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/3\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (-1/2 +2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x + x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b + b -1/2\ b\ )\ Fb\ 1/EJ\ = 0$

$L^{Xo}_{ED} = \int_o^b (\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

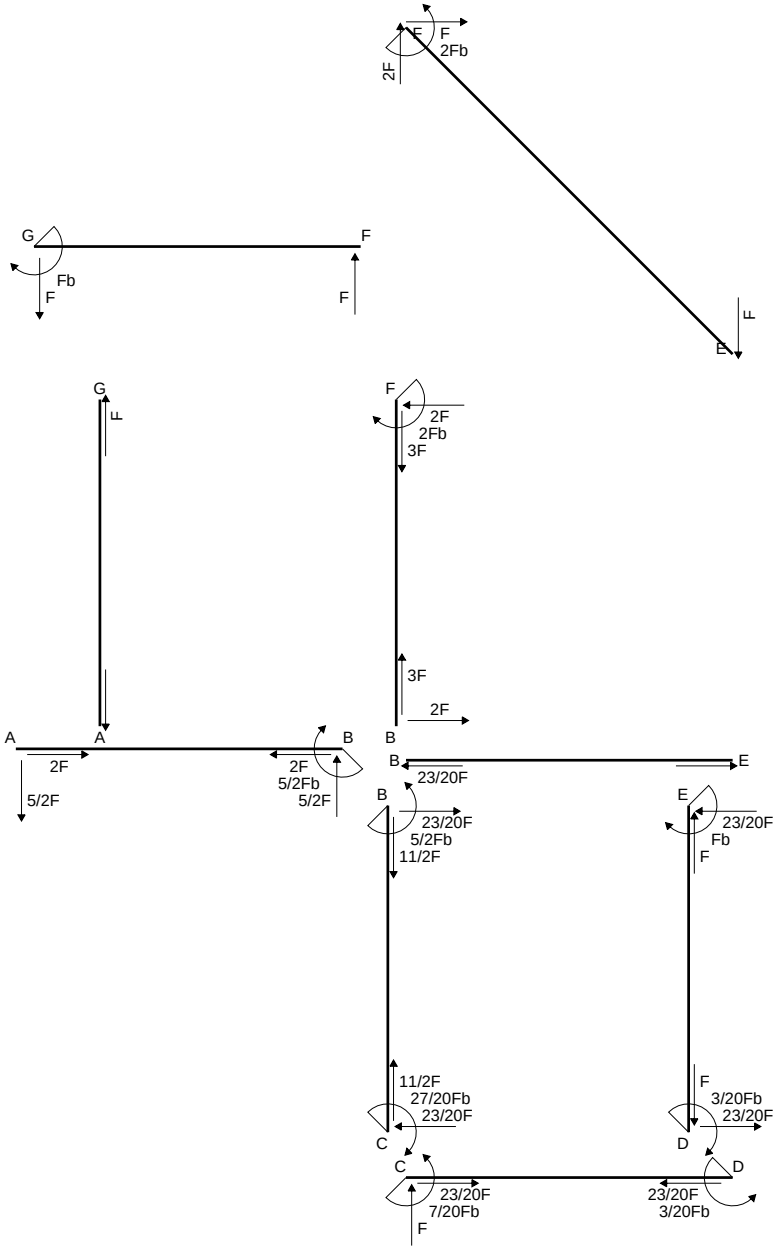
$= (1/2\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 0$

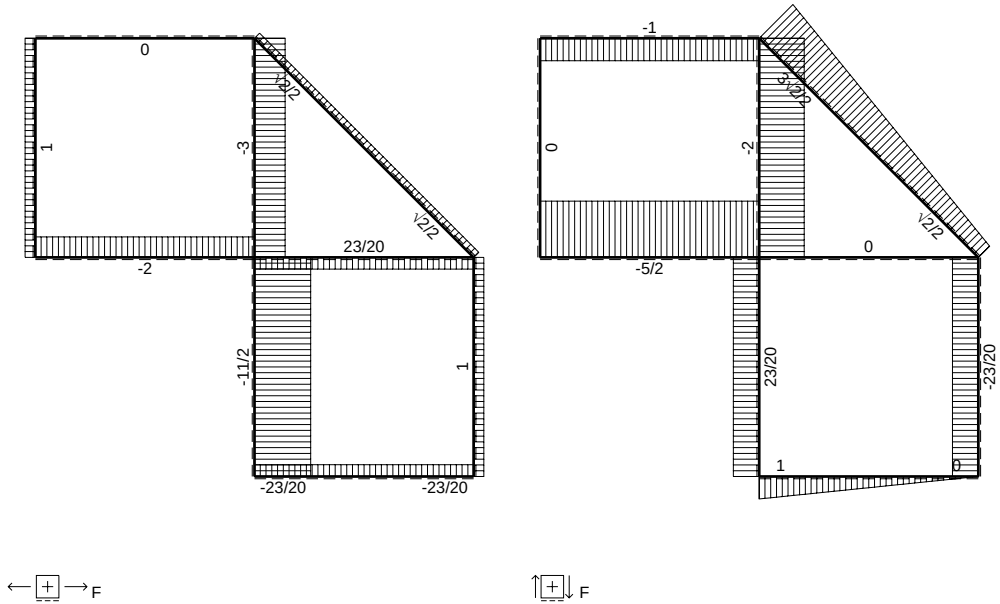


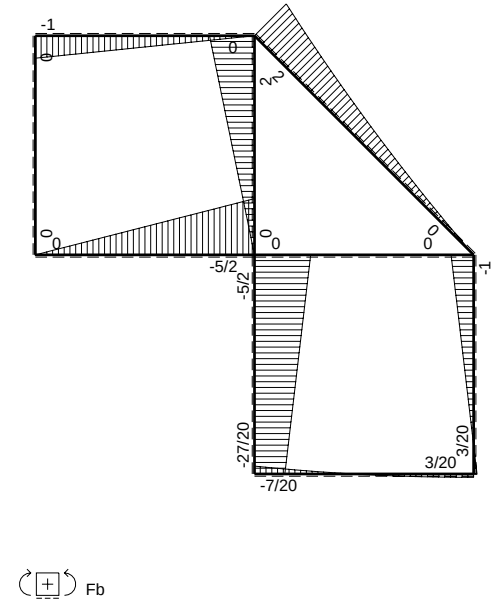
A = 105.8 mm^2
J_u = 31122. mm^4
J_v = 2333. mm^4
J_t = 83.65 mm^4
y_o = 11.76 mm
y_g = 24.69 mm
N = -320. N
T_y = -400. N
M_x = -280000. Nmm
x_m = 12. mm
v_m = -24.69 mm
$\sigma_m = N/A - Mv/J_u$ = -225.1 N/mm^2
y_c = 3. mm
u_c = -12. mm
v_c = -21.69 mm
$\sigma_c = N/A - Mv/J_u$ = -225.1 N/mm^2
$\tau_c = TS^*/tJ_u$ = 6.853 N/mm^2
$\tau_g = TS^*/tJ_u$ = 6.853 N/mm^2
t_c = 160. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 225.4 N/mm^2

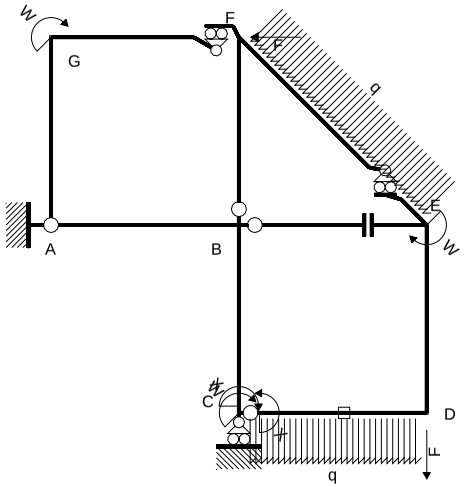
CI02.xxxx.038

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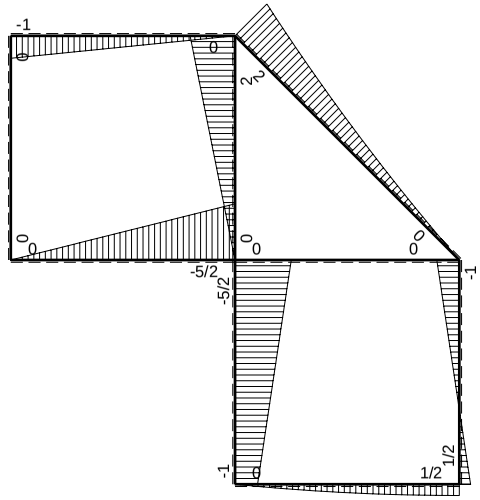

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F
23/20F
3/20Fb


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√2/2
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0
F
F

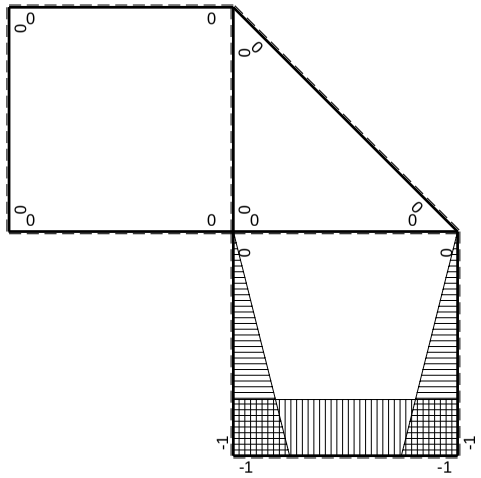

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0
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0
0
0
0
-5/2
-5/2
-1
-27/20
3/20
3/20
-7/20
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0		
BC b	-x/b	-5/2Fb+3/2Fx	5/2Fx-3/2Fx^2/b	x^2/b^2	3/4Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	Fb+1/2Fx-3/2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	Fx-1/2qx^2	-Fx+1/2Fx^2/b	1	-1/3Fb^2/EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx^2	-1/2Fb+1/2Fx^2/b	1		
DE b	-1+x/b	1/2Fb-3/2Fx	-1/2Fb+2Fx-3/2Fx^2/b	1-2x/b+x^2/b^2	0	1/3Xb/EJ
ED b	x/b	Fb-3/2Fx	Fx-3/2Fx^2/b	x^2/b^2		
EF √2b	0	√2/2Fx+1/2qx^2	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				-Fb^2/EJ	
	totali				-7/12Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				7/20Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2\ )\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 +1/2\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x +1/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b +1/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -4/3\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2 +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/2\ x +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -4/3\ \ Fb^2/EJ$

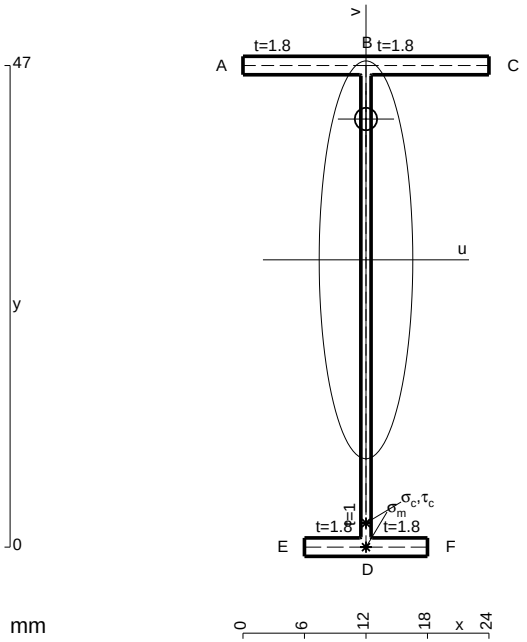
$L^{Xo}_{DE} = \int_o^b (-1/2 +2\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/2\ x + x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b + b -1/2\ b\ )\ Fb\ 1/EJ\ = 0$

$L^{Xo}_{ED} = \int_o^b (\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 0$

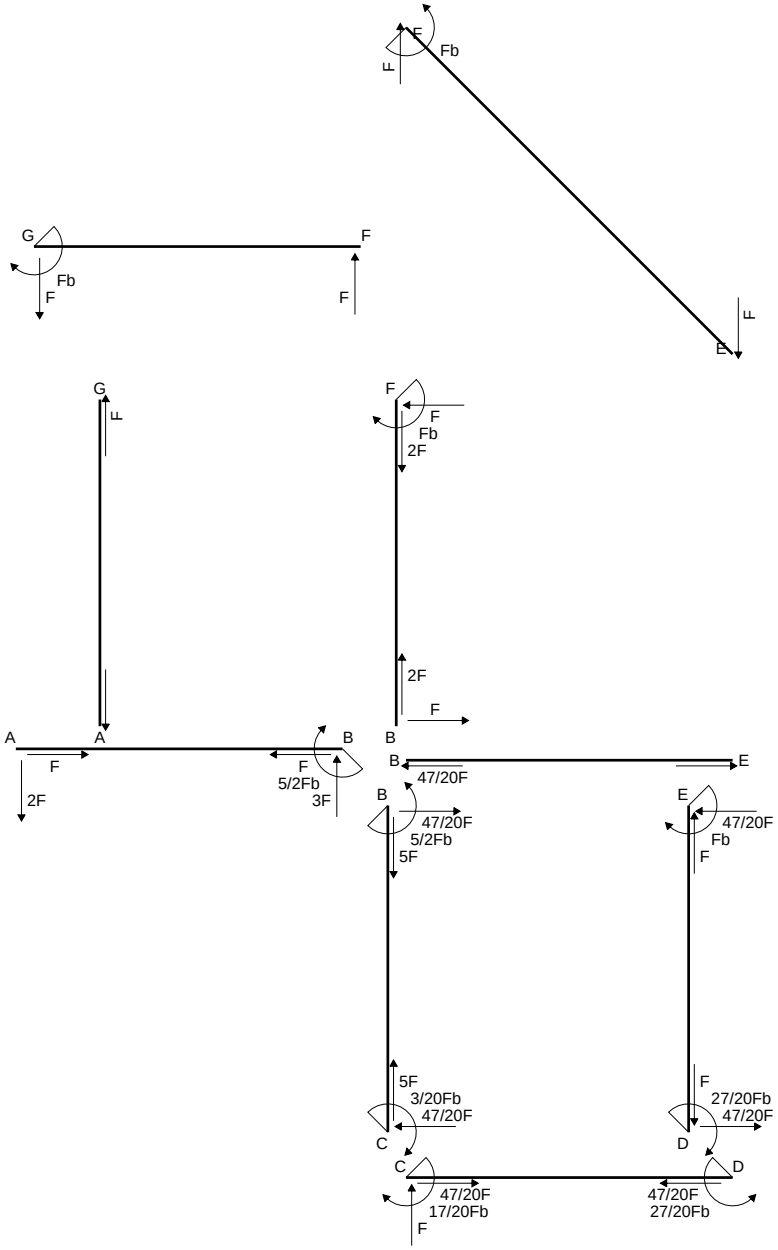
PROCEDIMENTO E RISULTATI 270578 CI02.xxxx.039

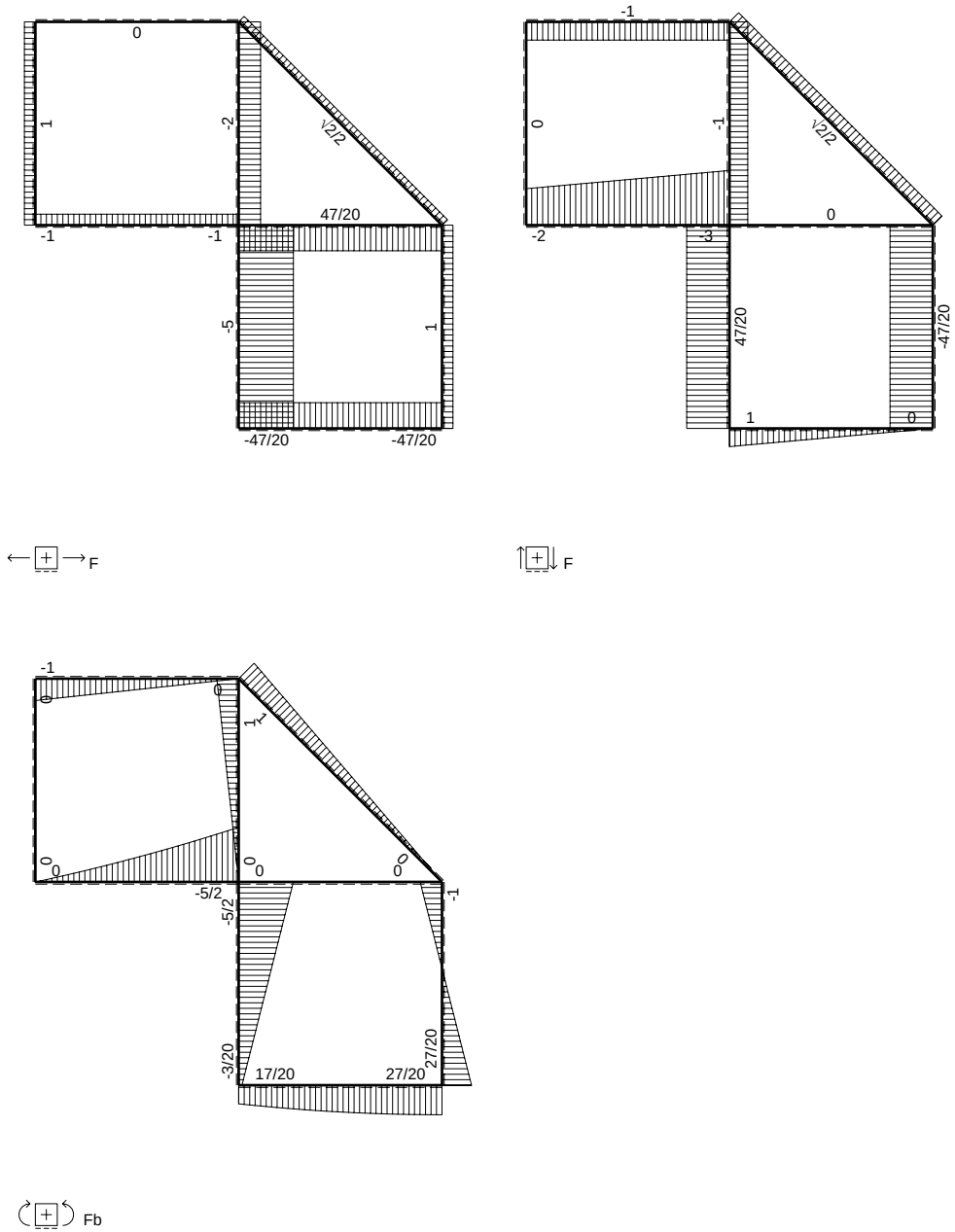


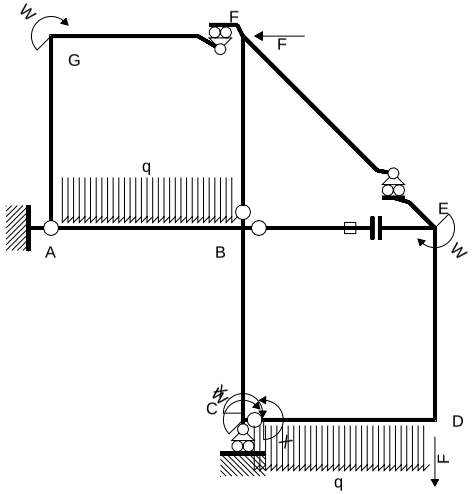
A = 111.8 mm^2
J_u = 42133. mm^4
J_v = 2333. mm^4
J_t = 85.65 mm^4
y_o = 13.74 mm
y_g = 28.04 mm
N = -340. N
T_y = -425. N
M_x = -352750. Nmm
x_m = 12. mm
v_m = -28.04 mm
$\sigma_m = N/A - Mv/J_u$ = -237.8 N/mm^2
y_c = 3. mm
u_c = -12. mm
v_c = -25.04 mm
$\sigma_c = N/A - Mv/J_u$ = -237.8 N/mm^2
$\tau_c = TS^*/tJ_u$ = 6.109 N/mm^2
$\tau_g = TS^*/tJ_u$ = 6.109 N/mm^2
t_c = 170. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 238. N/mm^2

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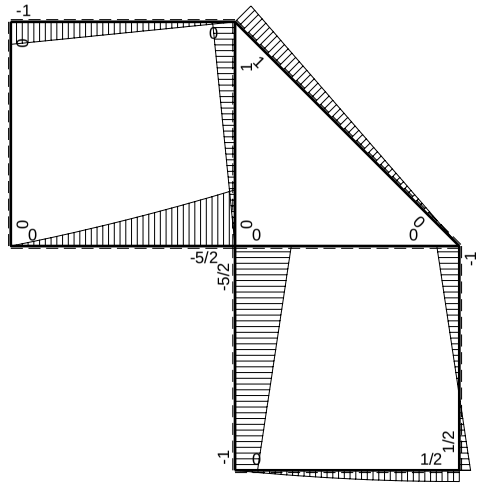
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27/20Fb

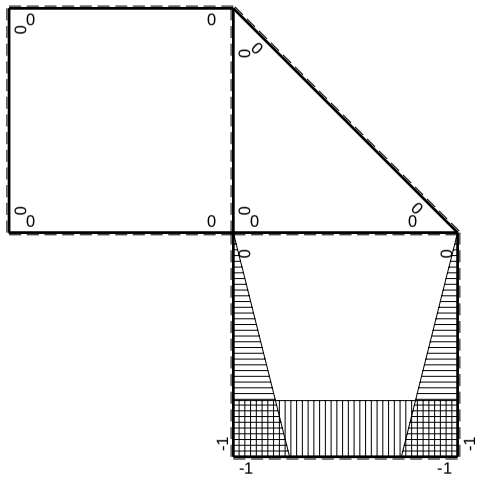

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√2/2
-2
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0
47/20
-47/20
1
0
F
-1
0
1
0
0
0
0
0
-5/2
-5/2
-1
-3/20
17/20
27/20
27/20
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-2Fx-1/2qx^2$	0	0	0	0
BA b	0	$5/2Fb-3Fx+1/2qx^2$	0	0		
BC b	-x/b	$-5/2Fb+3/2Fx$	$5/2Fx-3/2Fx^2/b$	x^2/b^2	$3/4Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	$Fb+3/2Fx$	$Fb+1/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	$Fx-1/2qx^2$	$-Fx+1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fb+1/2qx^2$	$-1/2Fb+1/2Fx^2/b$	1		
DE b	-1+x/b	1/2Fb-3/2Fx	$-1/2Fb+2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	0	1/3Xb/EJ
ED b	x/b	Fb-3/2Fx	$Fx-3/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$17/12Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-17/20Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 +1/2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x +1/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b +1/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ \ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-\ x/b +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/3\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2 +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

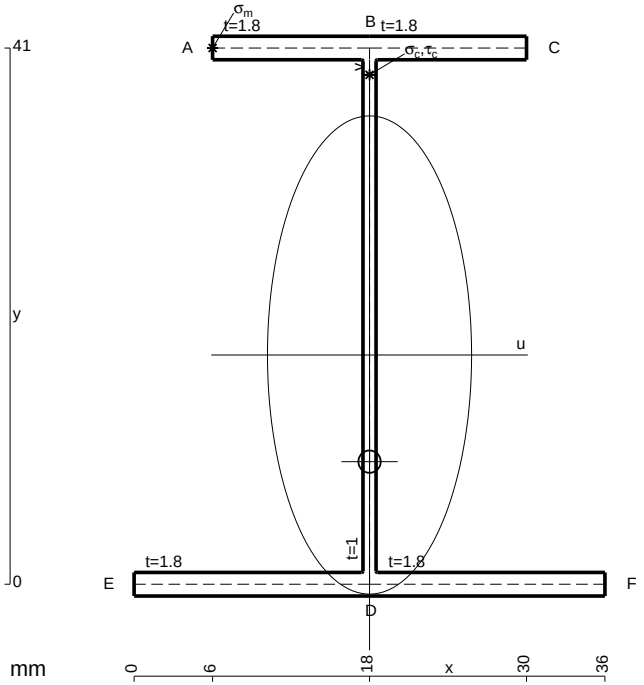
$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/3\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (-1/2 +2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x + x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b + b -1/2\ b\ )\ Fb\ 1/EJ\ = 0$

$L^{Xo}_{ED} = \int_o^b (\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

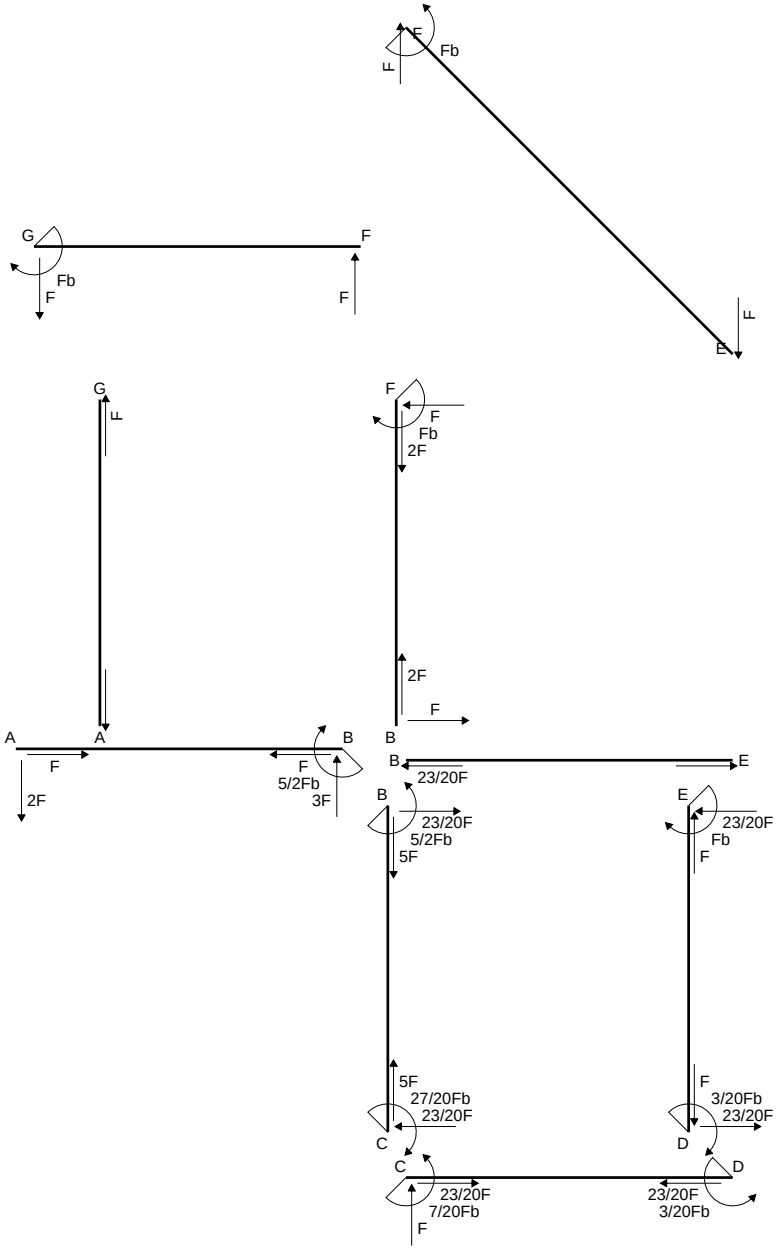
$= (1/2\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 0$

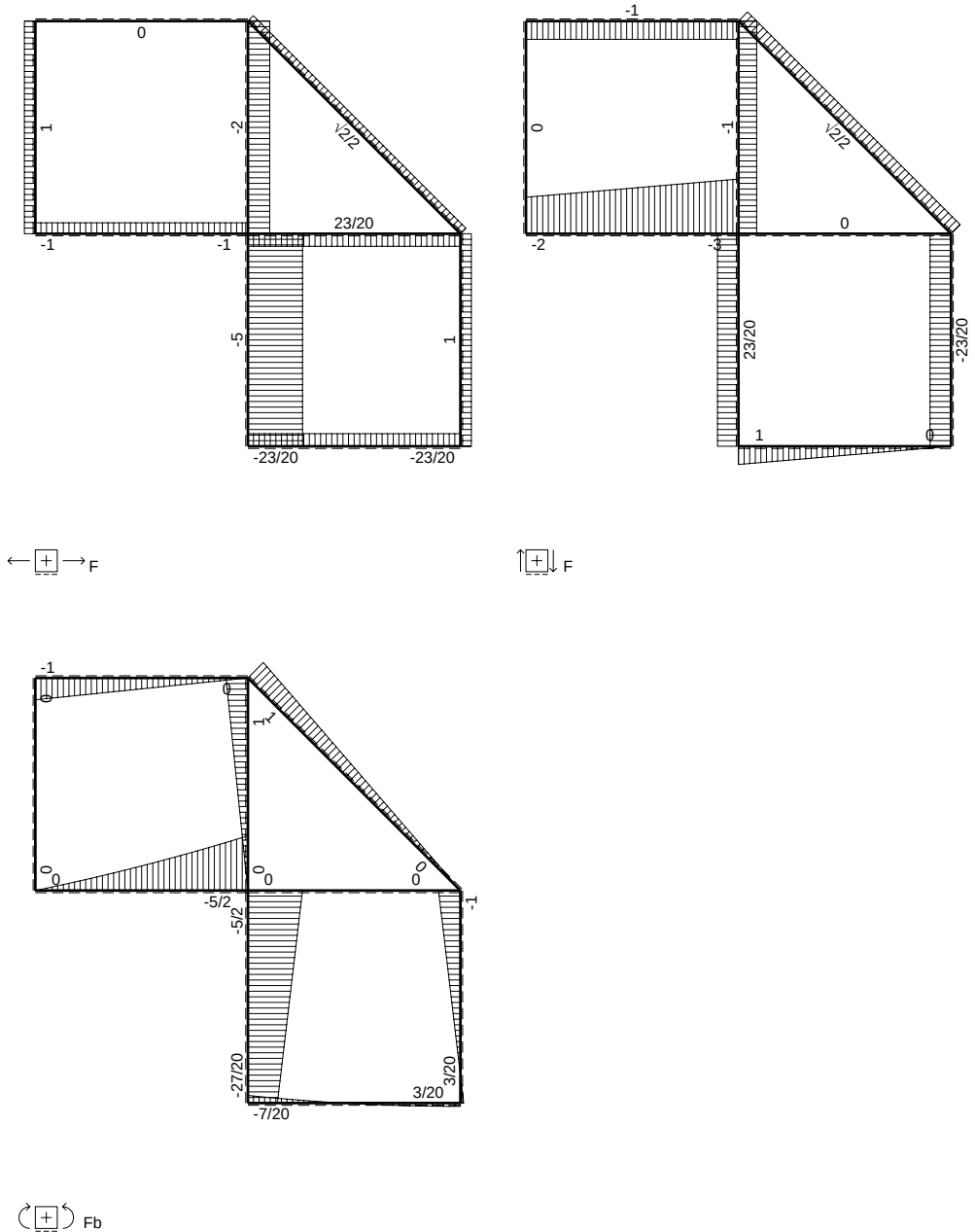


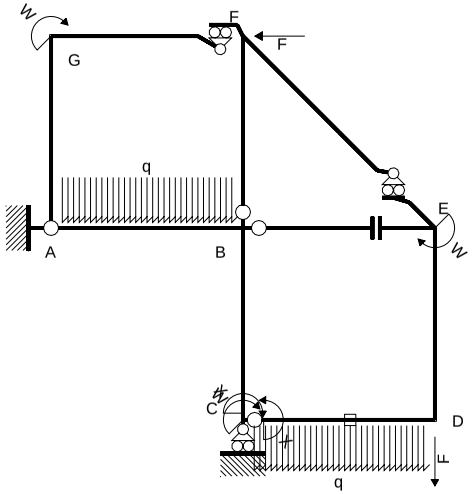
A = 149. mm^2
J_u = 49815. mm^4
J_v = 9072. mm^4
J_t = 130.3 mm^4
y_o = -8.157 mm
y_g = 17.53 mm
N = -440. N
T_y = -1320. N
M_x = -429000. Nmm
x_m = 6. mm
y_m = 41. mm
u_m = -12. mm
v_m = 23.47 mm
$\sigma_m = N/A - Mv/J_u$ = 199.2 N/mm^2
x_c = 18. mm
y_c = 41. mm
v_c = 23.47 mm
$\sigma_c = N/A - Mv/J_u$ = 199.2 N/mm^2
$\tau_c = TS^*/tJ_u$ = 26.87 N/mm^2
$\tau_g = TS^*/tJ_u$ = 26.87 N/mm^2
t_c = 440. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 204.5 N/mm^2

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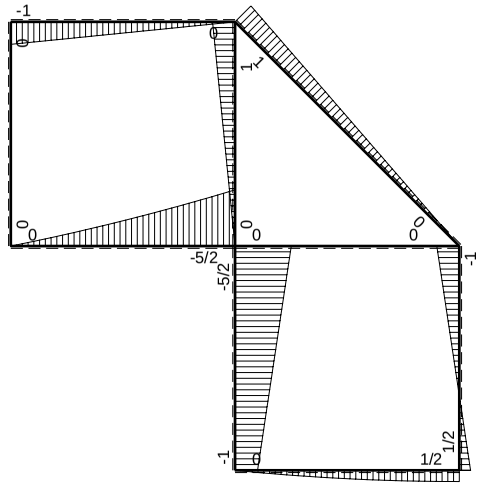
@ Adolfo Zavelani Rossi, Politecnico di Milano, vers.27.03.13 16.04.26


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7/20Fb
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3/20Fb

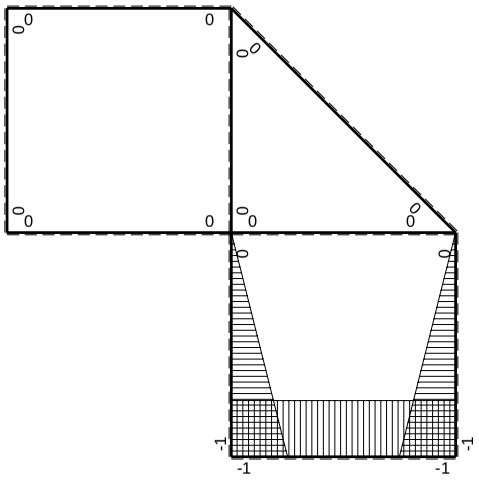

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-23/20
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0
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-5/2
-1
-27/20
3/20
3/20
-7/20
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-2Fx-1/2qx^2$	0	0	0	0
BA b	0	$5/2Fb-3Fx+1/2qx^2$	0	0		
BC b	-x/b	$-5/2Fb+3/2Fx$	$5/2Fx-3/2Fx^2/b$	x^2/b^2	$3/4Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	$Fb+3/2Fx$	$Fb+1/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	$Fx-1/2qx^2$	$-Fx+1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fb+1/2qx^2$	$-1/2Fb+1/2Fx^2/b$	1		
DE b	-1+x/b	$1/2Fb-3/2Fx$	$-1/2Fb+2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	0	1/3Xb/EJ
ED b	x/b	$Fb-3/2Fx$	$Fx-3/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-7/12Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				7/20Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2\ )\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 +1/2\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x +1/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b +1/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -4/3\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2 +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/2\ x +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -4/3\ \ Fb^2/EJ$

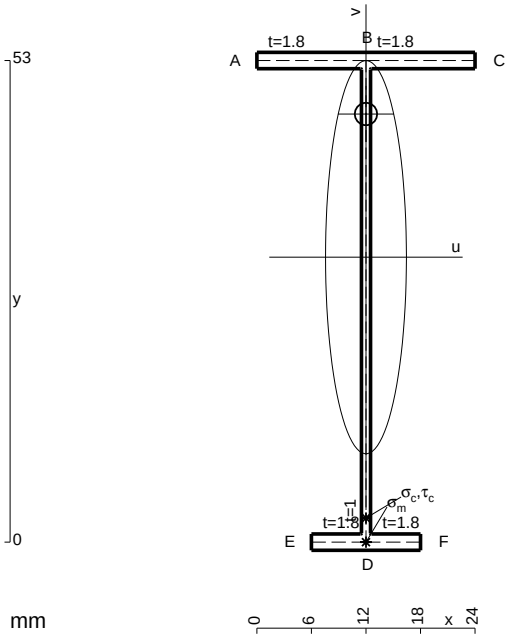
$L^{Xo}_{DE} = \int_o^b (-1/2 +2\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/2\ x + x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b + b -1/2\ b\ )\ Fb\ 1/EJ\ = 0$

$L^{Xo}_{ED} = \int_o^b (\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 0$

PROCEDIMENTO E RISULTATI 991322 CI02.xxxx.041

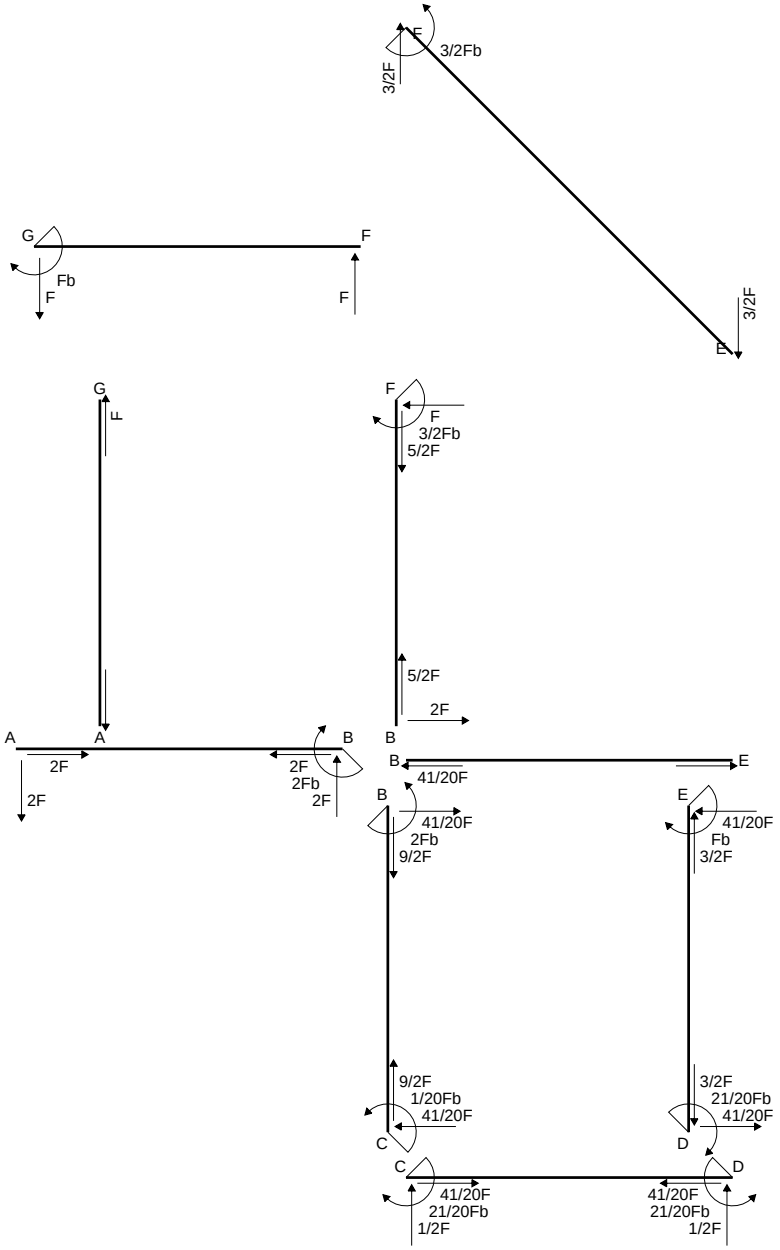


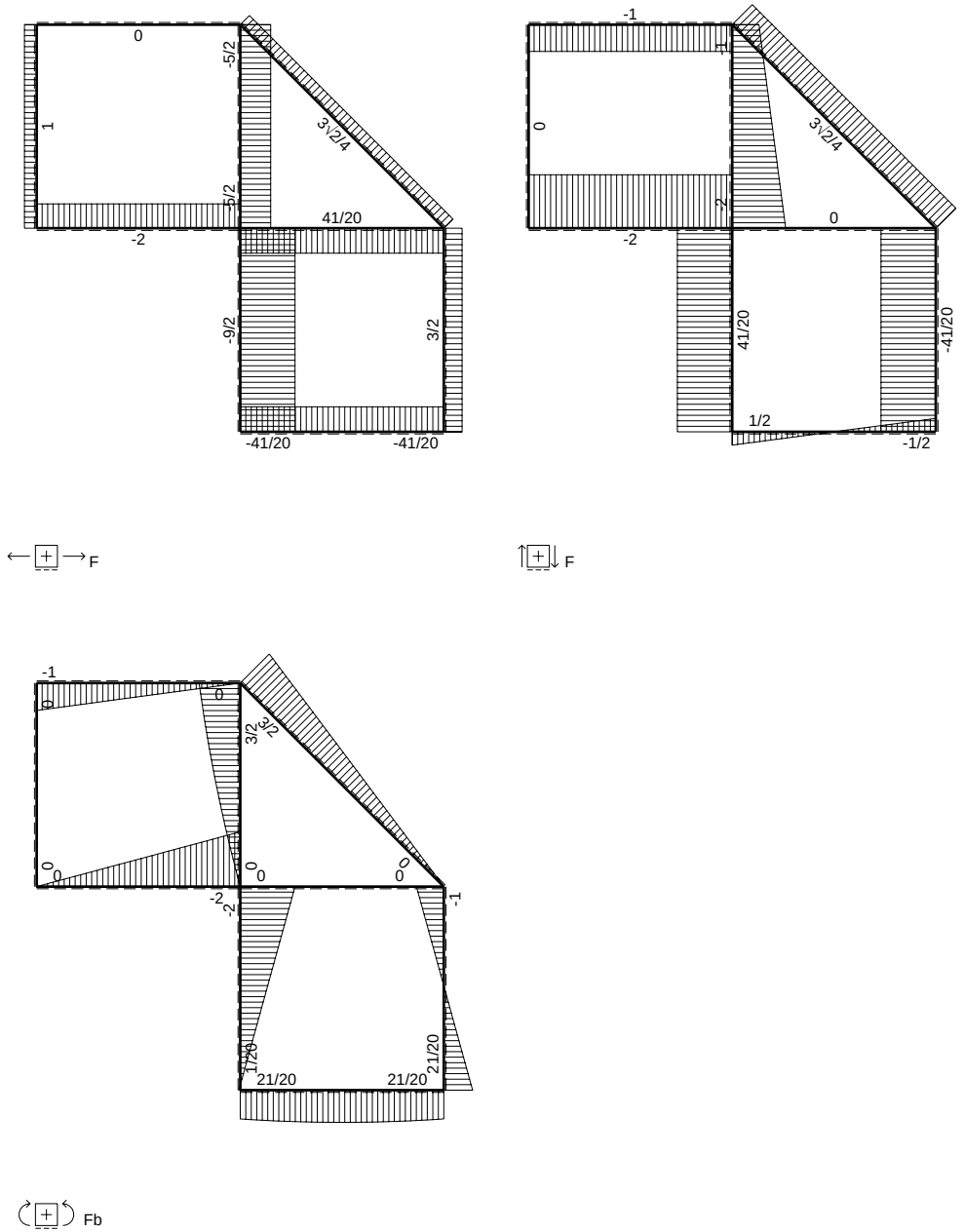
A = 117.8 mm^2
J_u = 55131. mm^4
J_v = 2333. mm^4
J_t = 87.65 mm^4
y_o = 15.75 mm
y_g = 31.36 mm
N = -260. N
T_y = -780. N
M_x = -357500. Nmm
x_m = 12. mm
v_m = -31.36 mm
$\sigma_m = N/A - Mv/J_u$ = -205.6 N/mm^2
y_c = 3. mm
u_c = -12. mm
v_c = -28.36 mm
$\sigma_c = N/A - Mv/J_u$ = -205.6 N/mm^2
$\tau_c = TS^*/tJ_u$ = 9.583 N/mm^2
$\tau_g = TS^*/tJ_u$ = 9.583 N/mm^2
t_c = 260. mm
$\sigma_o = \sqrt{\sigma^2 + 3\tau^2}$ = 206.2 N/mm^2

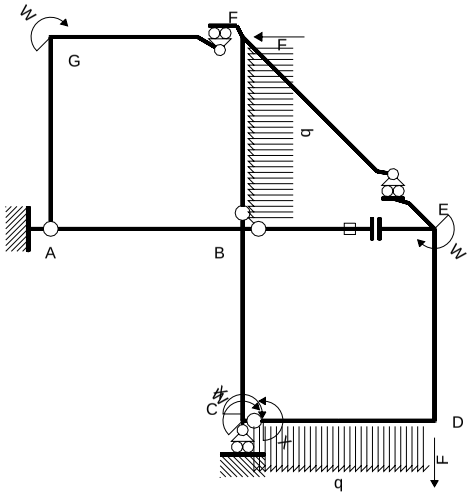
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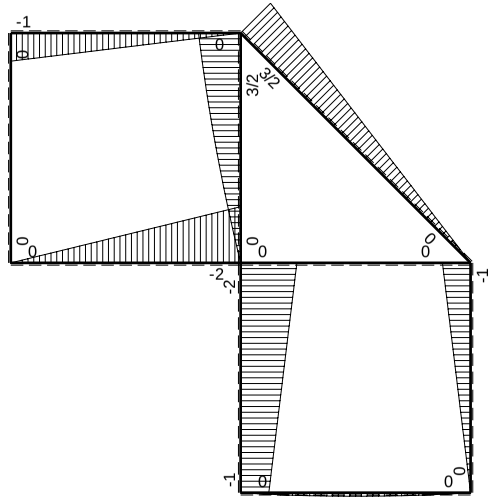
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1/20Fb
41/20F
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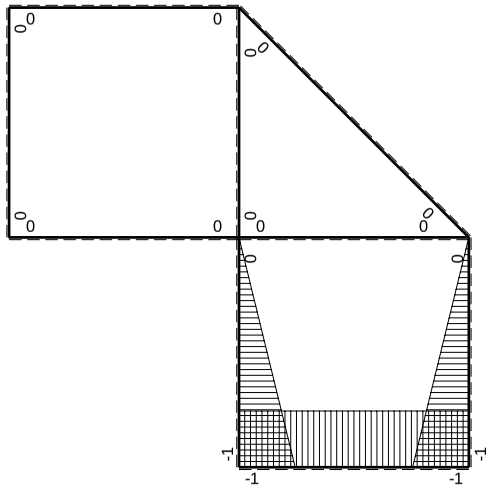

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Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0		
BC b	-x/b	-2Fb+Fx	2Fx-Fx^2/b	x^2/b^2	$2/3Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	1/2Fx-1/2qx^2	-1/2Fx+1/2Fx^2/b	1	$-1/12Fb^2/EJ$	Xb/EJ
DC b	1	-1/2Fx+1/2qx^2	-1/2Fx+1/2Fx^2/b	1		
DE b	-1+x/b	-Fx	Fx-Fx^2/b	1-2x/b+x^2/b^2	$1/6Fb^2/EJ$	1/3Xb/EJ
ED b	x/b	Fb-Fx	Fx-Fx^2/b	x^2/b^2		
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	3/2Fb-Fx-1/2qx^2	0	0	0	0
BF b	0	-2Fx+1/2qx^2	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$7/4Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-21/20Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2\ )\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (2\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-1/2\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/4\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/12\ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

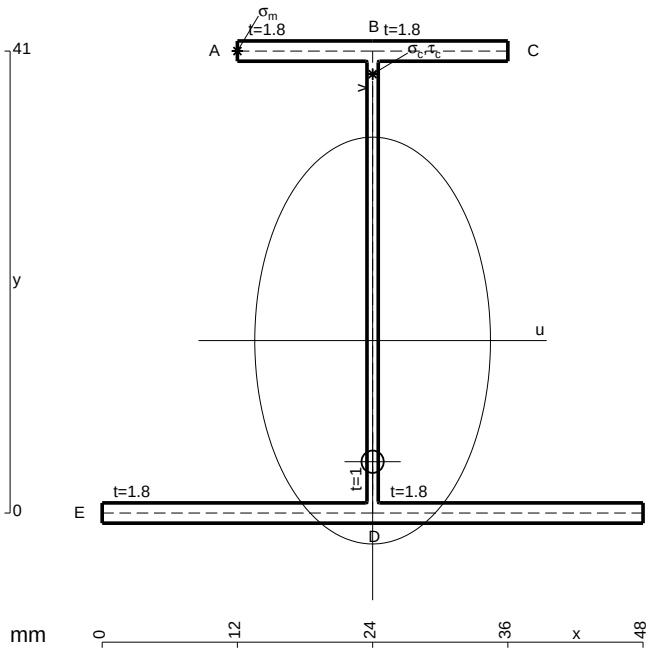
$= (-1/4\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/12\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

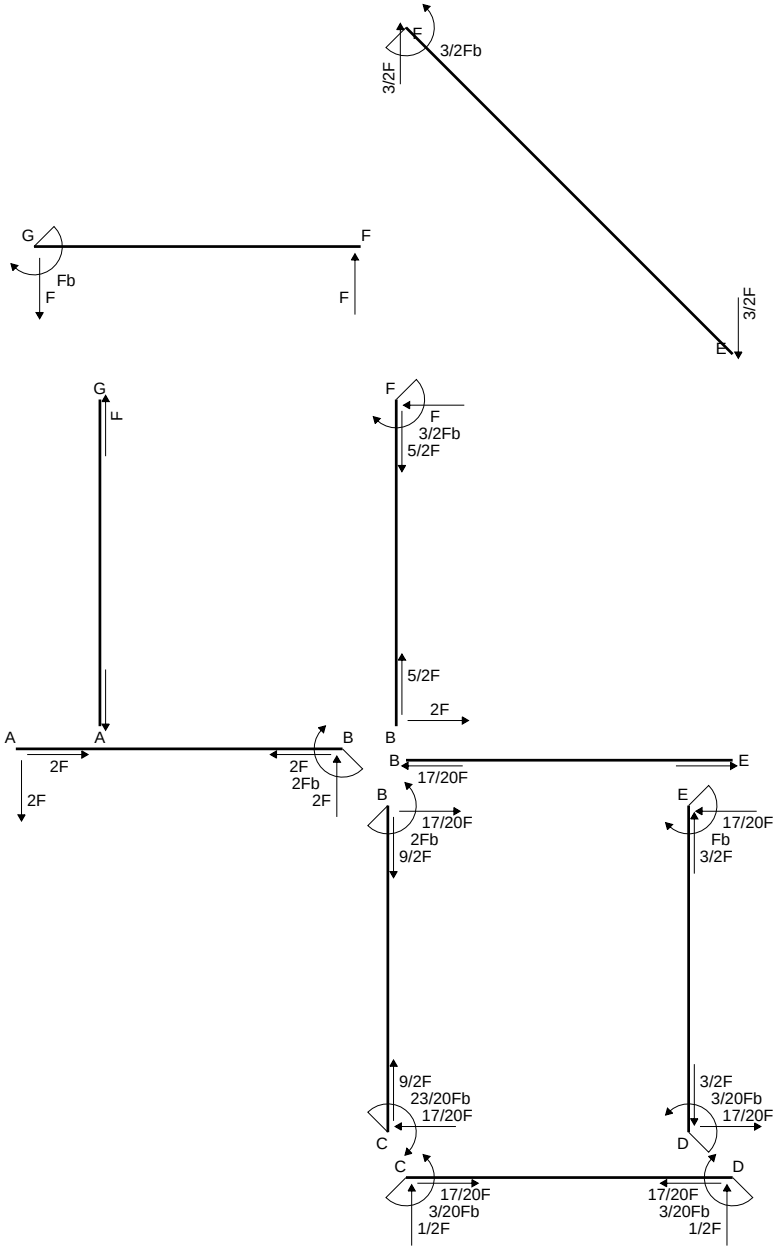
$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

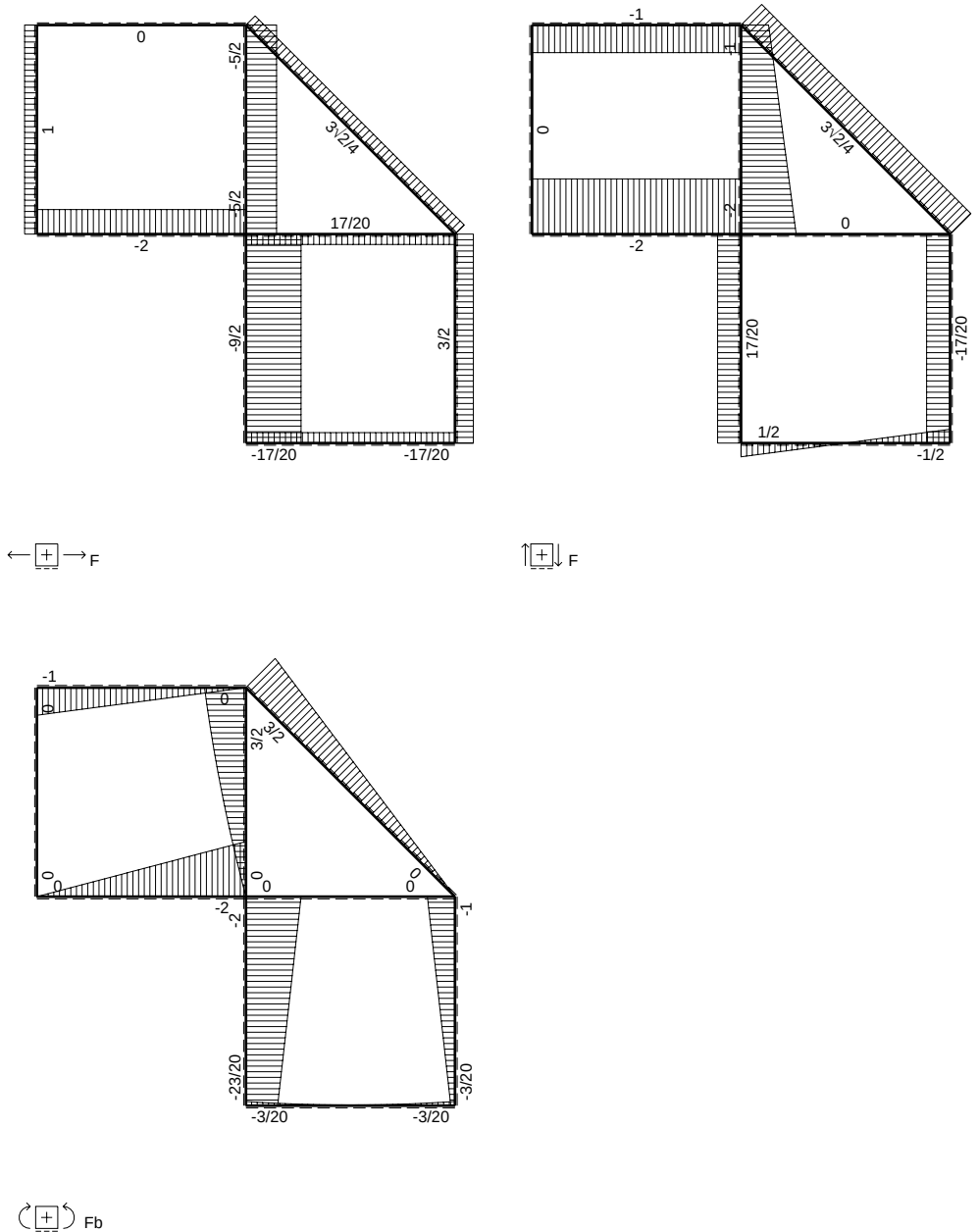


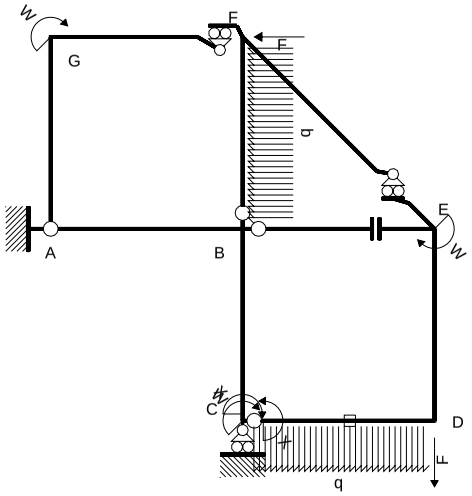
A = 170.6 mm^2
J_u = 55611. mm^4
J_v = 18662. mm^4
J_t = 153.6 mm^4
y_o = -10.75 mm
y_g = 15.31 mm
N = -1060. N
T_y = -1060. N
M_x = -487600. Nmm
x_m = 12. mm
y_m = 41. mm
u_m = -12. mm
v_m = 25.69 mm
$\sigma_m = N/A - Mv/J_u$ = 219. N/mm^2
x_c = 24. mm
y_c = 41. mm
v_c = 25.69 mm
$\sigma_c = N/A - Mv/J_u$ = 219. N/mm^2
$\tau_c = TS^*/tJ_u$ = 21.16 N/mm^2
$\tau_g = TS^*/tJ_u$ = 21.16 N/mm^2
t_c = 530. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 222.1 N/mm^2

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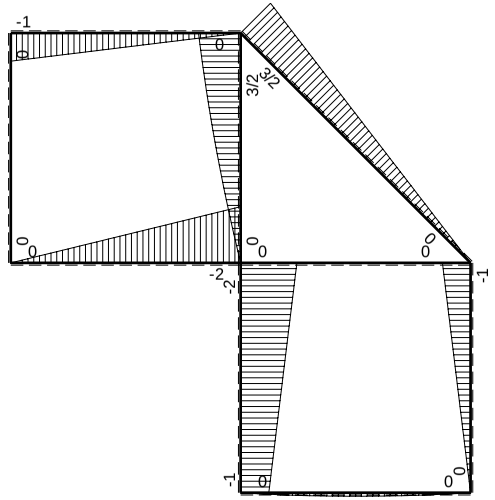
@ Adolfo Zavelani Rossi, Politecnico di Milano, vers.27.03.13 16.04.26


F
3/2Fb
3/2F
G
F
Fb
F
F
3/2F
E
G
F
F
F
3/2Fb
5/2F
5/2F
2F
A
A
B
B
2F
2F
2F
2Fb
2F
B
E
17/20F
B
17/20F
2Fb
9/2F
E
17/20F
Fb
3/2F
9/2F
23/20Fb
17/20F
3/2F
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17/20F
3/20Fb
1/2F

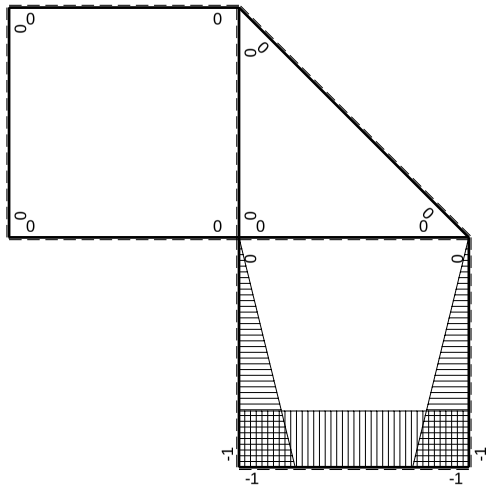

0
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1
3√2/4
-5/2
17/20
-2
-9/2
3/2
-17/20
-17/20
F
-1
-1
0
3√2/4
2
0
-2
17/20
-17/20
1/2
-1/2
F
-1
0
3/2
3/2
0
0
0
0
-2
-2
-1
-23/20
-3/20
-3/20
-3/20
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0		
BC b	-x/b	-2Fb+Fx	2Fx-Fx^2/b	x^2/b^2	2/3Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	1/2Fx-1/2qx^2	-1/2Fx+1/2Fx^2/b	1	-1/12Fb^2/EJ	Xb/EJ
DC b	1	-1/2Fx+1/2qx^2	-1/2Fx+1/2Fx^2/b	1		
DE b	-1+x/b	-Fx	Fx-Fx^2/b	1-2x/b+x^2/b^2	1/6Fb^2/EJ	1/3Xb/EJ
ED b	x/b	Fb-Fx	Fx-Fx^2/b	x^2/b^2		
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	3/2Fb-Fx-1/2qx^2	0	0	0	0
BF b	0	-2Fx+1/2qx^2	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				-Fb^2/EJ	
	totali				-1/4Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				3/20Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (2\ x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ \ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-1/2\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (-1/4\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -13/12\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

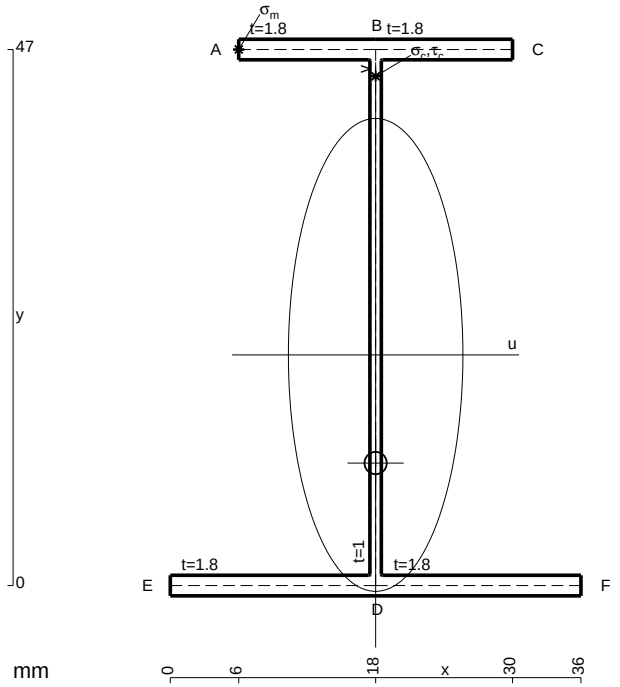
$= (-1/4\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -13/12\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

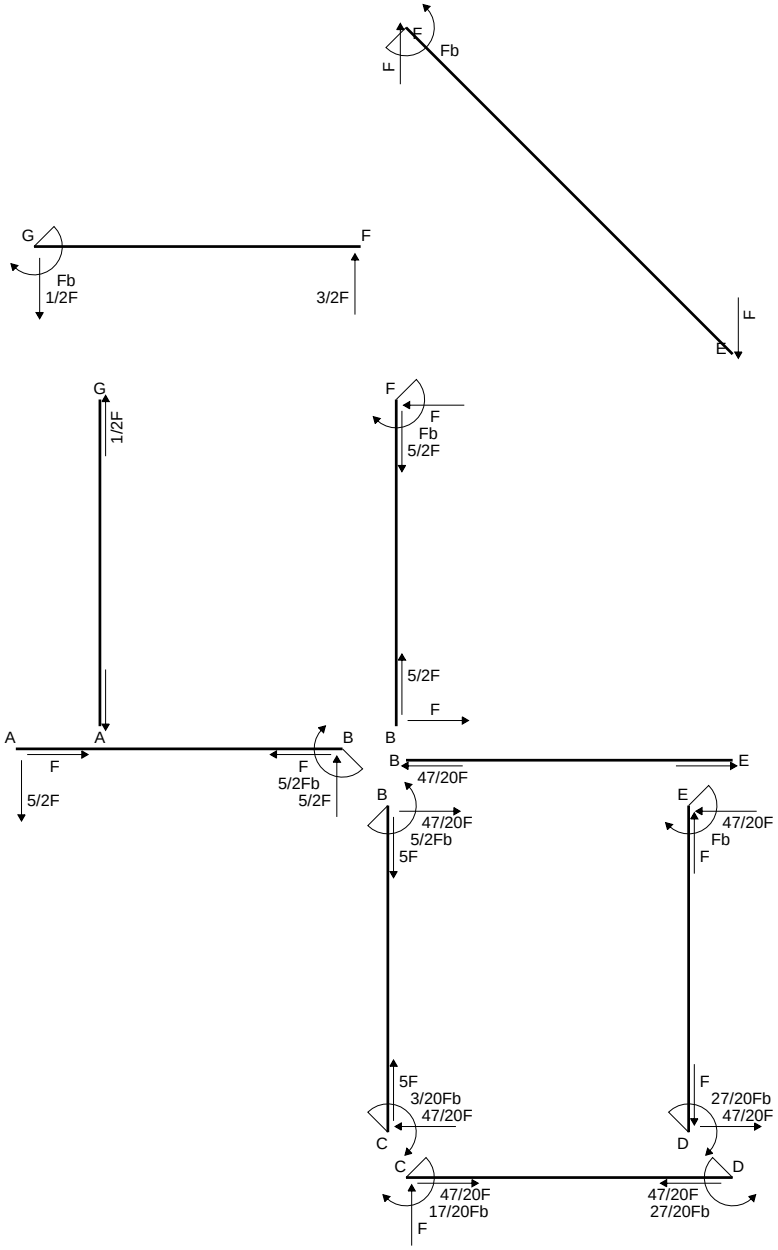
$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ \ Fb^2/EJ$

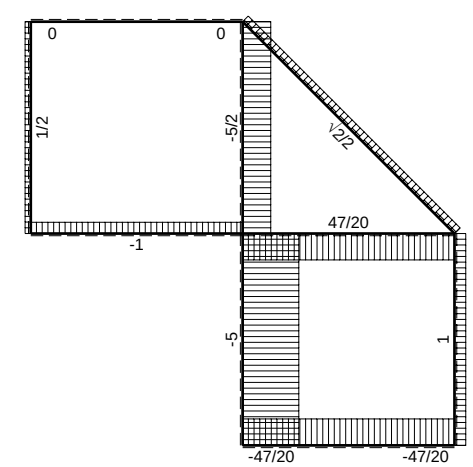


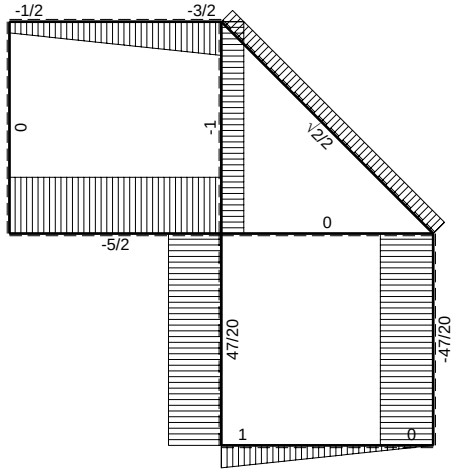
A = 155. mm^2
J_u = 66633. mm^4
J_v = 9072. mm^4
J_t = 132.3 mm^4
y_o = -9.482 mm
y_g = 20.23 mm
N = -1020. N
T_y = -1020. N
M_x = -581400. Nmm
x_m = 6. mm
y_m = 47. mm
u_m = -12. mm
v_m = 26.77 mm
$\sigma_m = N/A - Mv/J_u$ = 227. N/mm^2
x_c = 18. mm
y_c = 47. mm
v_c = 26.77 mm
$\sigma_c = N/A - Mv/J_u$ = 227. N/mm^2
$\tau_c = TS^*/tJ_u$ = 17.71 N/mm^2
$\tau_g = TS^*/tJ_u$ = 17.71 N/mm^2
t_c = 510. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 229.1 N/mm^2

CI02.xxxx.043

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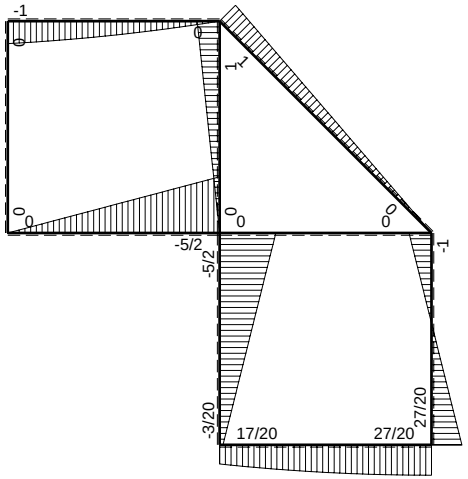

F
Fb
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G
F
Fb
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3/2F
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E
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Fb
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47/20F
5/2Fb
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47/20F
Fb
F
5F
3/20Fb
47/20F
C
F
27/20Fb
47/20F
D
C
D
47/20F
17/20Fb
F
47/20F
27/20Fb


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-5/2
√2/2
47/20
-1
-5
1
-47/20
-47/20

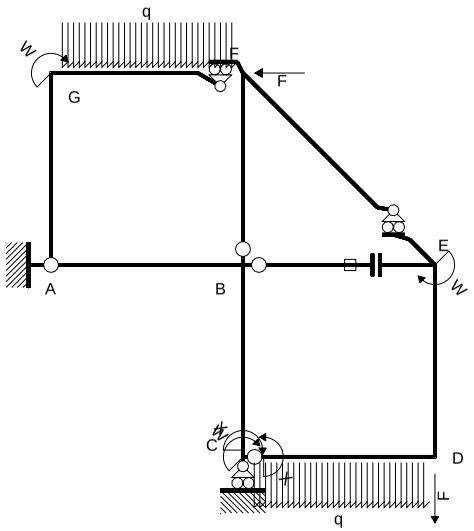

-1/2
-3/2
0
-1
√2/2
0
-5/2
47/20
-47/20
1
0

←⊞→ F

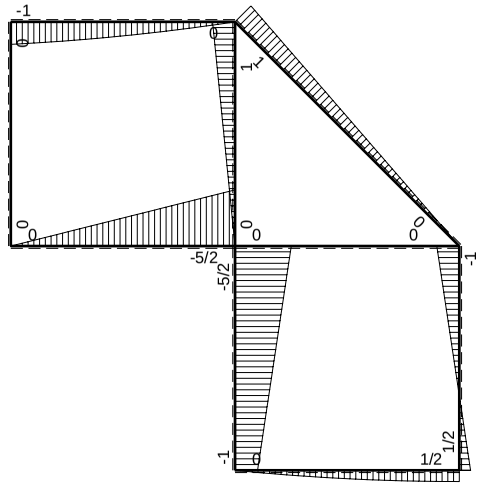
↑⊞↓ F


-1
0
1
0
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0
0
0
-5/2
-5/2
-1
-3/20
17/20
27/20
27/20

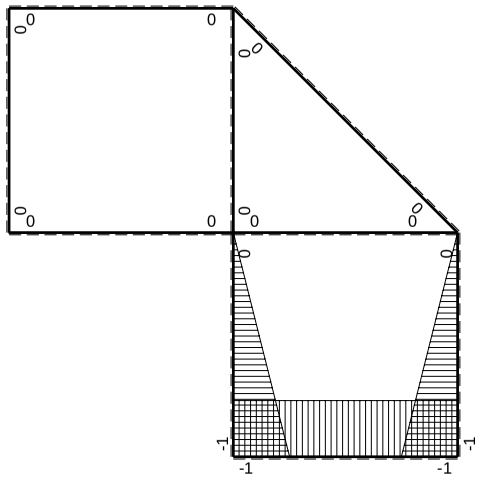
↺⊞↻ Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0		
BC b	-x/b	-5/2Fb+3/2Fx	5/2Fx-3/2Fx^2/b	x^2/b^2	3/4Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	Fb+1/2Fx-3/2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	Fx-1/2qx^2	-Fx+1/2Fx^2/b	1	-1/3Fb^2/EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx^2	-1/2Fb+1/2Fx^2/b	1		
DE b	-1+x/b	1/2Fb-3/2Fx	-1/2Fb+2Fx-3/2Fx^2/b	1-2x/b+x^2/b^2	0	1/3Xb/EJ
ED b	x/b	Fb-3/2Fx	Fx-3/2Fx^2/b	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-3/2Fx+1/2qx^2	0	0	0	0
GF b	0	Fb-1/2Fx-1/2qx^2	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				17/12Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-17/20Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 +1/2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x +1/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b +1/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ \ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-\ x/b +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/3\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2 +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

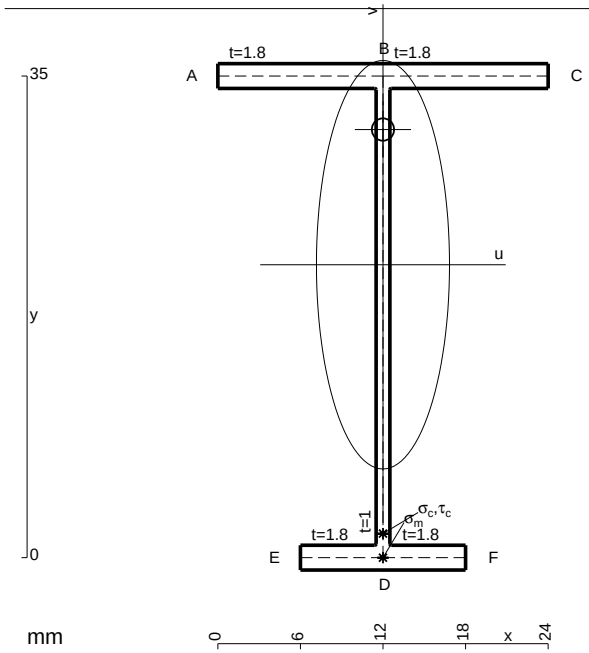
$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/3\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (-1/2 +2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x + x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b + b -1/2\ b\ )\ Fb\ 1/EJ\ = 0$

$L^{Xo}_{ED} = \int_o^b (\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

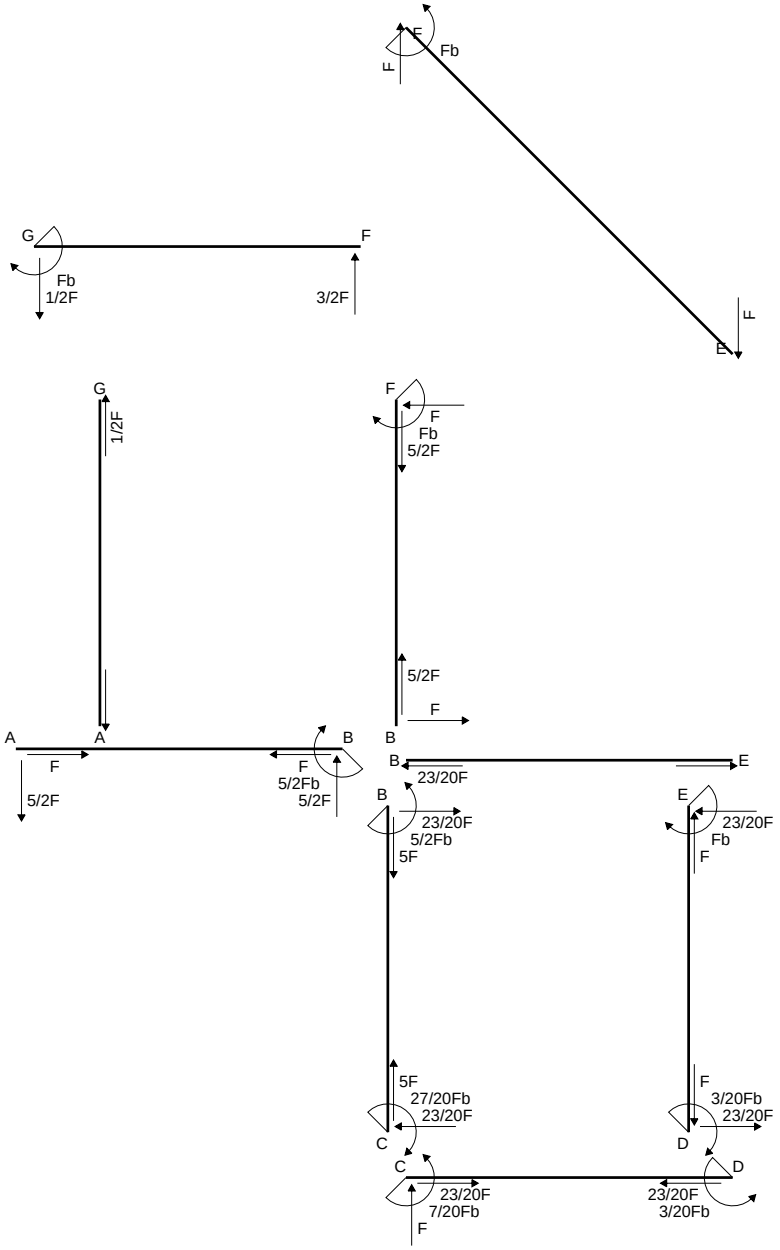
$= (1/2\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 0$

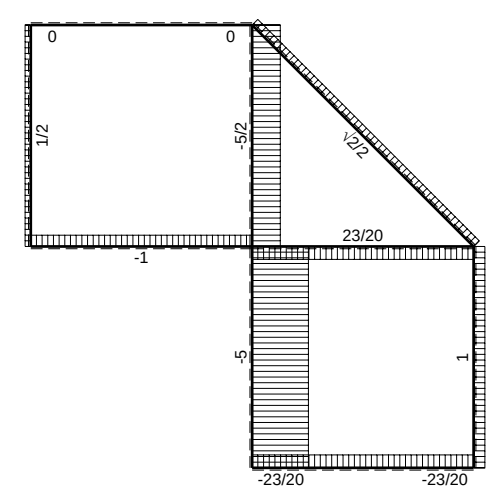


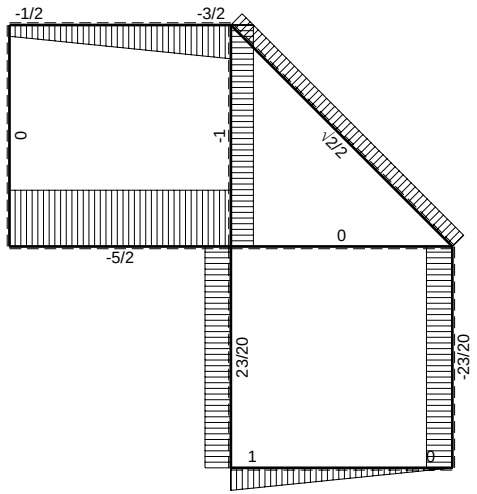
A = 99.8 mm^2
J_u = 21986. mm^4
J_v = 2333. mm^4
J_t = 81.65 mm^4
y_o = 9.824 mm
y_g = 21.29 mm
N = -210. N
T_y = -525. N
M_x = -241500. Nmm
x_m = 12. mm
v_m = -21.29 mm
$\sigma_m = N/A - Mv/J_u$ = -235.9 N/mm^2
y_c = 3. mm
u_c = -12. mm
v_c = -18.29 mm
$\sigma_c = N/A - Mv/J_u$ = -235.9 N/mm^2
$\tau_c = TS^*/tJ_u$ = 10.98 N/mm^2
$\tau_g = TS^*/tJ_u$ = 10.98 N/mm^2
t_c = 210. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 236.7 N/mm^2

CI02.xxxx.044

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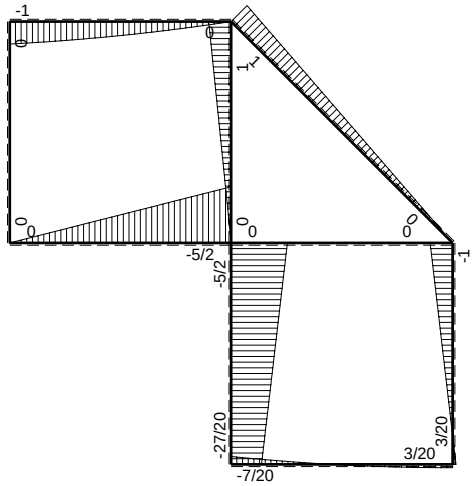

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5F
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Fb
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3/20Fb
23/20F
D
D
23/20F
7/20Fb
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23/20F
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23/20
-1
-5
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-23/20
-23/20

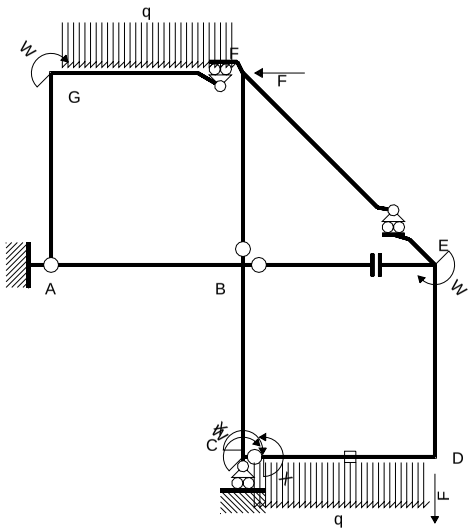

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-3/2
0
-1
√2/2
-5/2
0
23/20
-23/20
1
0

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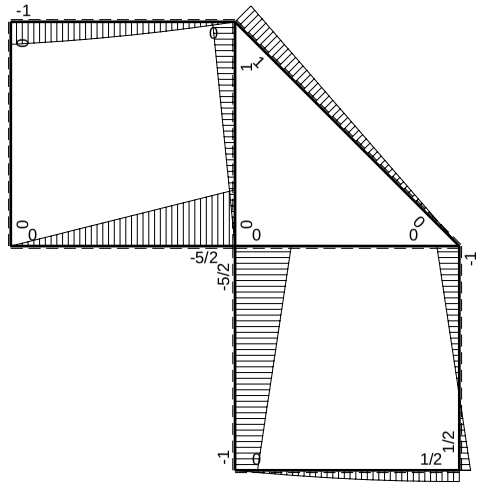
F


-1
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-5/2
-5/2
-1
-27/20
3/20
3/20
-7/20

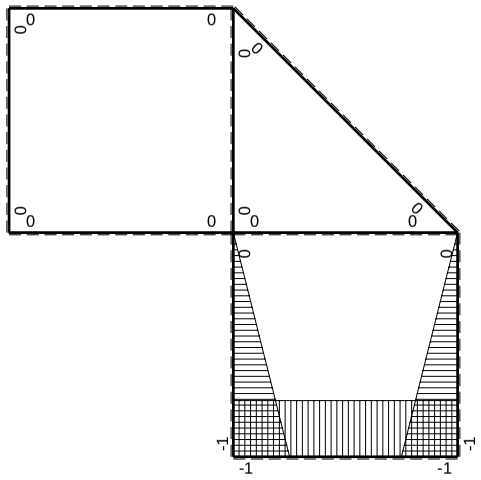
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0		
BC b	-x/b	-5/2Fb+3/2Fx	5/2Fx-3/2Fx^2/b	x^2/b^2	3/4Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	Fb+1/2Fx-3/2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	Fx-1/2qx^2	-Fx+1/2Fx^2/b	1	-1/3Fb^2/EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx^2	-1/2Fb+1/2Fx^2/b	1		
DE b	-1+x/b	1/2Fb-3/2Fx	-1/2Fb+2Fx-3/2Fx^2/b	1-2x/b+x^2/b^2	0	1/3Xb/EJ
ED b	x/b	Fb-3/2Fx	Fx-3/2Fx^2/b	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-3/2Fx+1/2qx^2	0	0	0	0
GF b	0	Fb-1/2Fx-1/2qx^2	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				-Fb^2/EJ	
	totali				-7/12Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				7/20Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2\ )\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 +1/2\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x +1/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b +1/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -4/3\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2 +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/2\ x +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

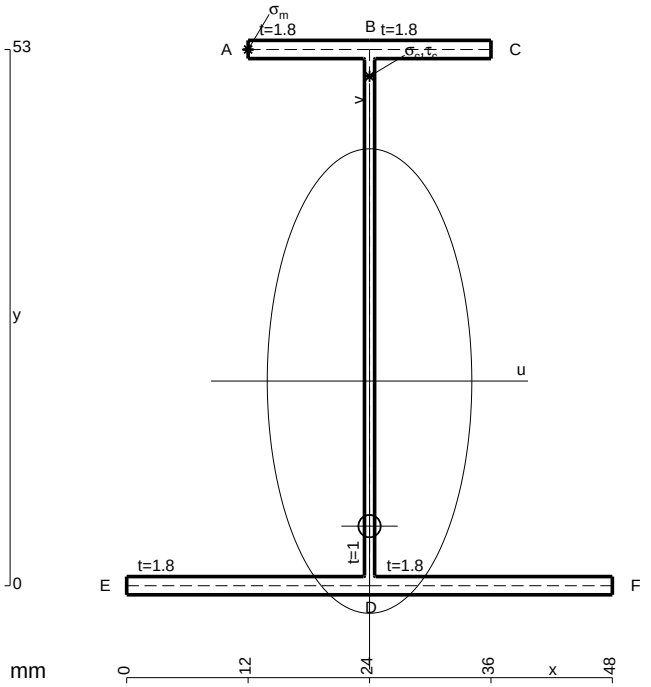
$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -4/3\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (-1/2 +2\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/2\ x + x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b + b -1/2\ b\ )\ Fb\ 1/EJ\ = 0$

$L^{Xo}_{ED} = \int_o^b (\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

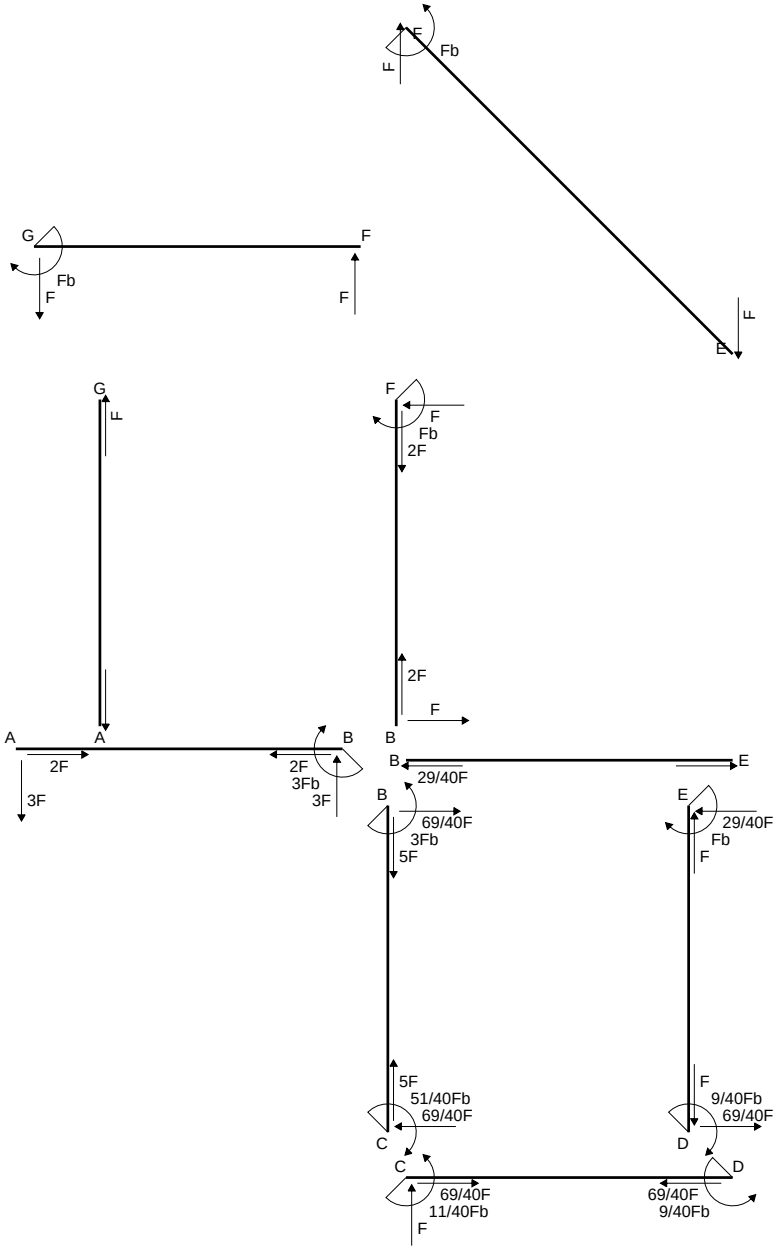
$= (1/2\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 0$

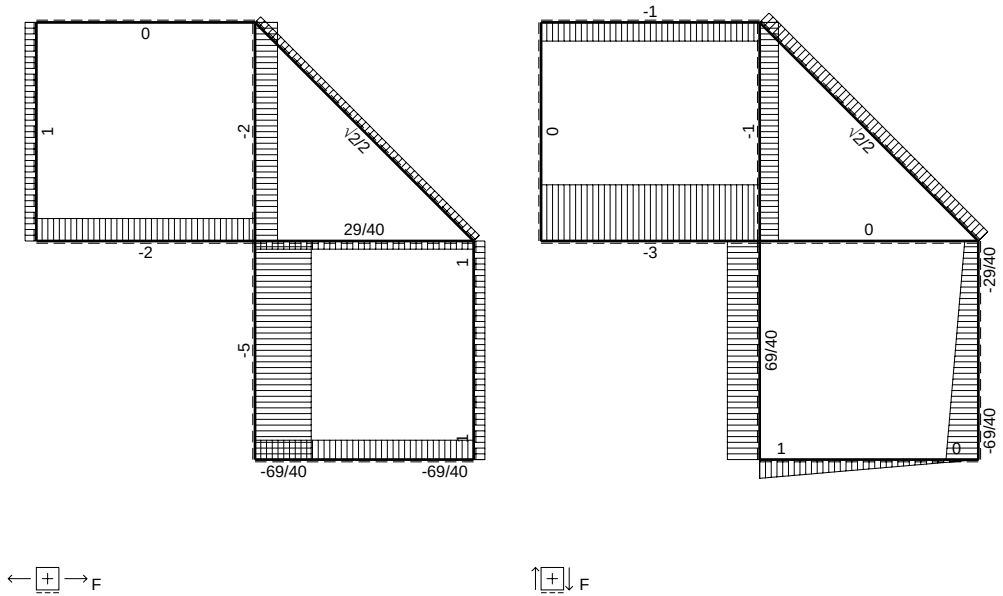


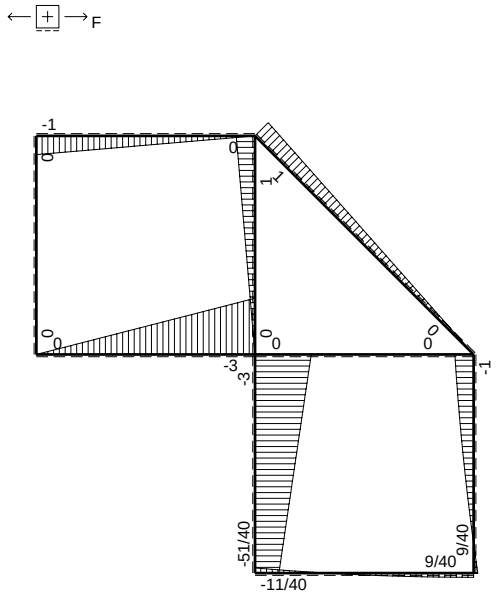
A = 182.6 mm^2
J_u = 96241. mm^4
J_v = 18662. mm^4
J_t = 157.6 mm^4
y_o = -14.34 mm
y_g = 20.23 mm
N = -310. N
T_y = -775. N
M_x = -581250. Nmm
x_m = 12. mm
y_m = 53. mm
u_m = -12. mm
v_m = 32.77 mm
$\sigma_m = N/A - Mv/J_u$ = 196.2 N/mm^2
x_c = 24. mm
y_c = 53. mm
v_c = 32.77 mm
$\sigma_c = N/A - Mv/J_u$ = 196.2 N/mm^2
$\tau_c = TS^*/tJ_u$ = 11.4 N/mm^2
$\tau_g = TS^*/tJ_u$ = 11.4 N/mm^2
t_c = 310. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 197.2 N/mm^2

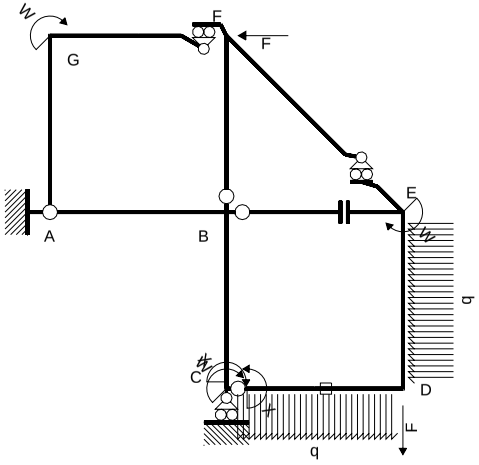
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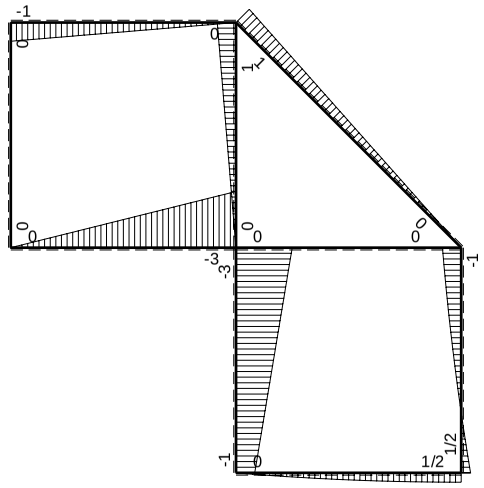

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F
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69/40F
D
D
69/40F
11/40Fb
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69/40F
9/40Fb


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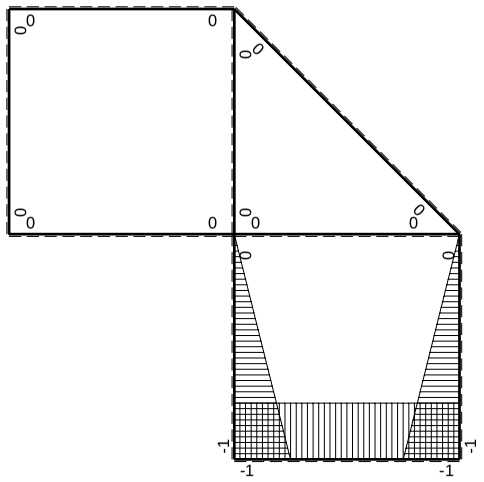

-1
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-3
-3
-1
-51/40
9/40
9/40
-11/40



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3Fx	0	0	0	0
BA b	0	3Fb-3Fx	0	0		
BC b	-x/b	-3Fb+2Fx	$3Fx-2Fx^2/b$	x^2/b^2	$5/6Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb+2Fx	$Fb+Fx-2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	$Fx-1/2qx^2$	$-Fx+1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fb+1/2qx^2$	$-1/2Fb+1/2Fx^2/b$	1		
DE b	-1+x/b	$1/2Fb-2Fx+1/2qx^2$	$-1/2Fb+5/2Fx-5/2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$1/24Fb^2/EJ$	1/3Xb/EJ
ED b	x/b	$Fb-Fx-1/2qx^2$	$Fx-Fx^2/b-1/2qx^3/b$	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-11/24Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				11/40Fb	

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Sviluppi di calcolo iperstatica

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$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2\ )\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3\ x/b -2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [3/2\ x^2/b -2/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/2\ b -2/3\ b\ )\ Fb\ 1/EJ\ = 5/6\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 + x/b -2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x +1/2\ x^2/b -2/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b +1/2\ b -2/3\ b\ )\ Fb\ 1/EJ\ = 5/6\ \ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -4/3\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2 +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/2\ x +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -4/3\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (-1/2 +5/2\ x/b -5/2\ x^2/b^2 +1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx$

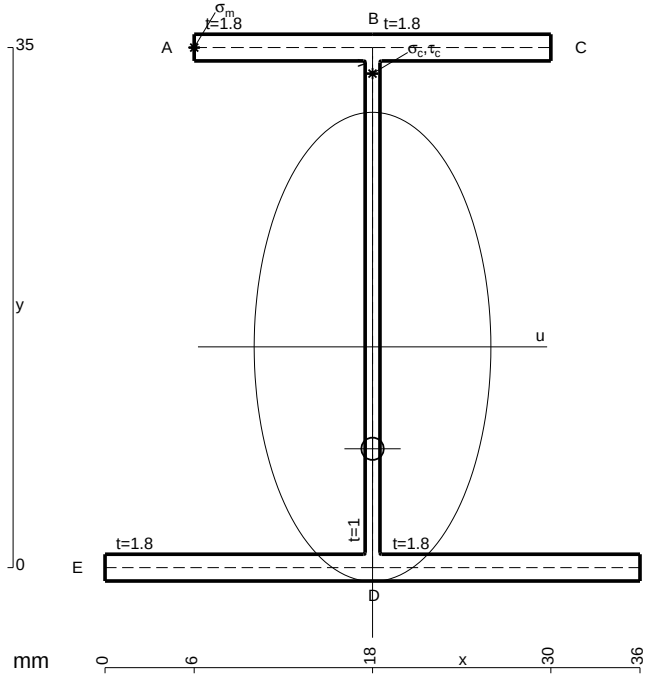
$= [-1/2\ x +5/4\ x^2/b -5/6\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +5/4\ b -5/6\ b +1/8\ b\ )\ Fb\ 1/EJ\ = 1/24\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (\ x/b - x^2/b^2 -1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2 -1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

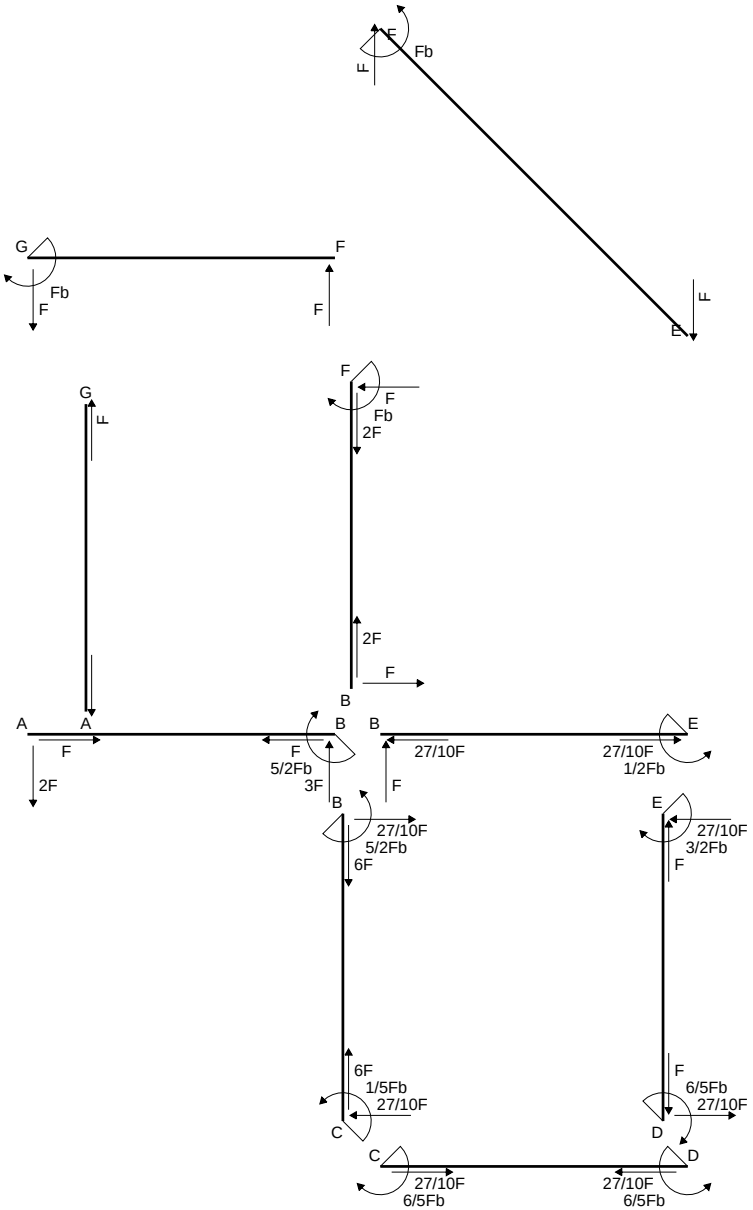
$= (1/2\ b -1/3\ b -1/8\ b\ )\ Fb\ 1/EJ\ = 1/24\ \ Fb^2/EJ$

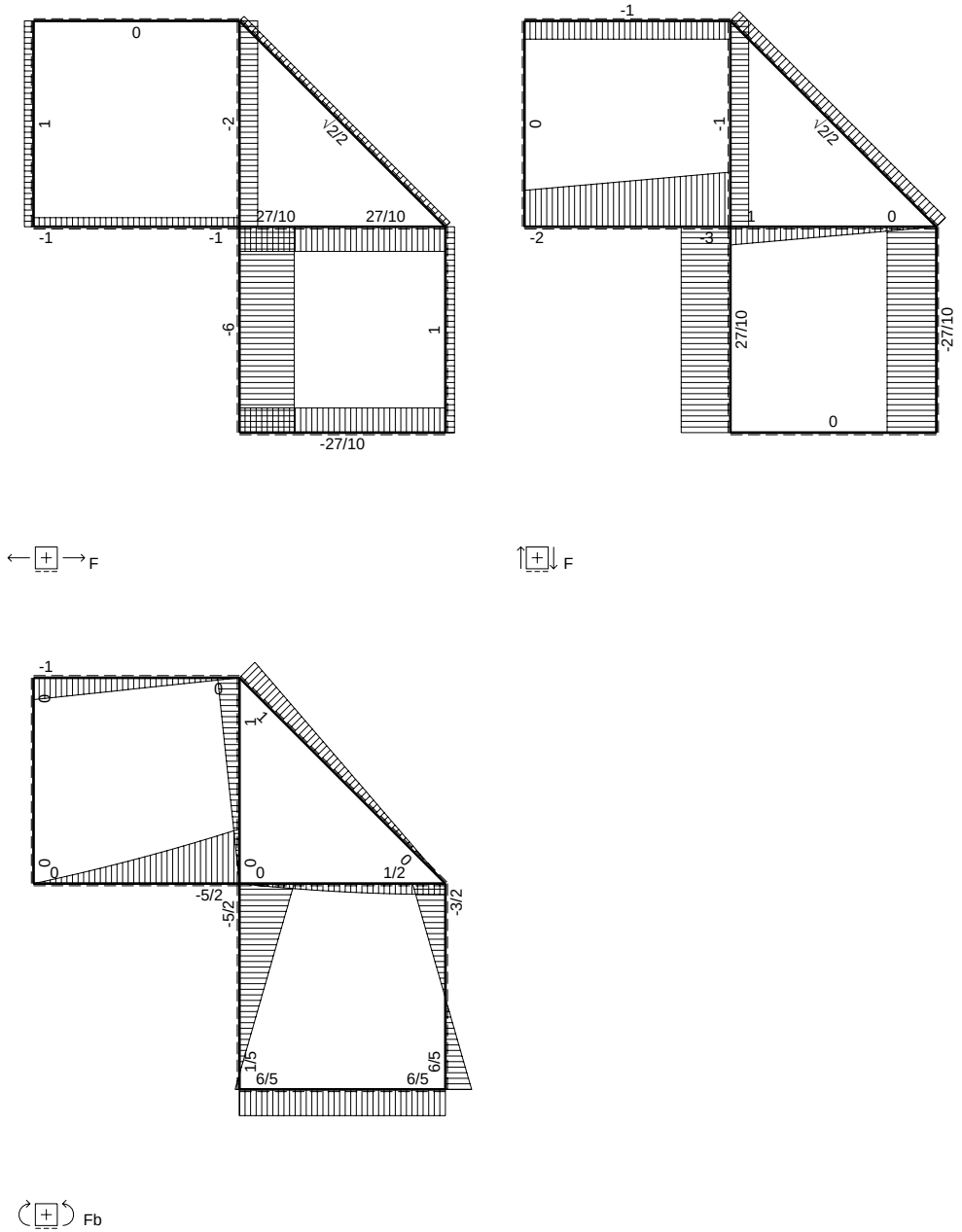
PROCEDIMENTO E RISULTATI 265892 CI02.xxxx.046

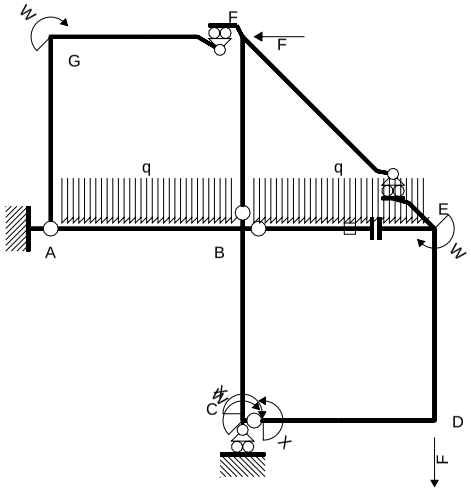


A = 143. mm^2
J_u = 35649. mm^4
J_v = 9072. mm^4
J_t = 128.3 mm^4
y_o = -6.857 mm
y_g = 14.86 mm
N = -480. N
T_y = -720. N
M_x = -374400. Nmm
x_m = 6. mm
y_m = 35. mm
u_m = -12. mm
v_m = 20.14 mm
$\sigma_m = N/A - Mv/J_u$ = 208.2 N/mm^2
x_c = 18. mm
y_c = 35. mm
v_c = 20.14 mm
$\sigma_c = N/A - Mv/J_u$ = 208.2 N/mm^2
$\tau_c = TS^*/tJ_u$ = 17.58 N/mm^2
$\tau_g = TS^*/tJ_u$ = 17.58 N/mm^2
t_c = 240. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 210.4 N/mm^2

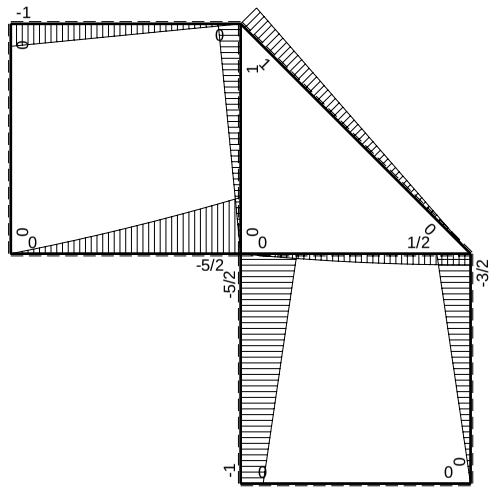
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2F
2F
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27/10F
27/10F
5/2Fb
3F
1/2Fb
2F
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27/10F
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6F
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1/5Fb
6/5Fb
27/10F
27/10F
C
D
C
D
27/10F
27/10F
6/5Fb
6/5Fb

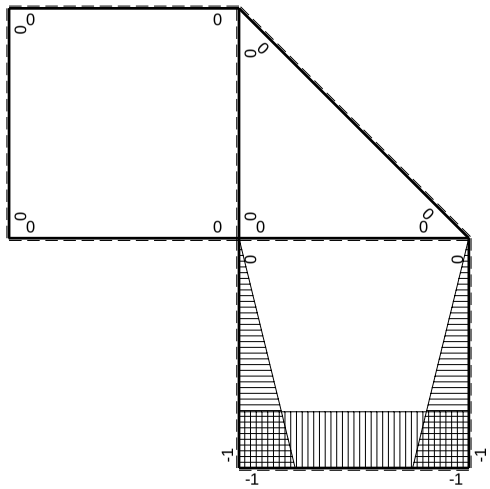

0
1
-2
√2/2
27/10
27/10
-1
-1
-6
1
-27/10
F
-1
0
-1
√2/2
-2
1
0
-3
27/10
-27/10
0
F
-1
0
1
0
0
0
0
1/2
-5/2
-5/2
-3/2
1/5
6/5
6/5
6/5
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-2Fx-1/2qx^2$	0	0	0	0
BA b	0	$5/2Fb-3Fx+1/2qx^2$	0	0		
BC b	-x/b	$-5/2Fb+3/2Fx$	$5/2Fx-3/2Fx^2/b$	x^2/b^2	$3/4Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	$Fb+3/2Fx$	$Fb+1/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE 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
ED b	x/b	$3/2Fb-3/2Fx$	$3/2Fx-3/2Fx^2/b$	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	$Fx-1/2qx^2$	0	0	0	0
EB b	0	$-1/2Fb+1/2qx^2$	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$2Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-6/5Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 +1/2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x +1/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

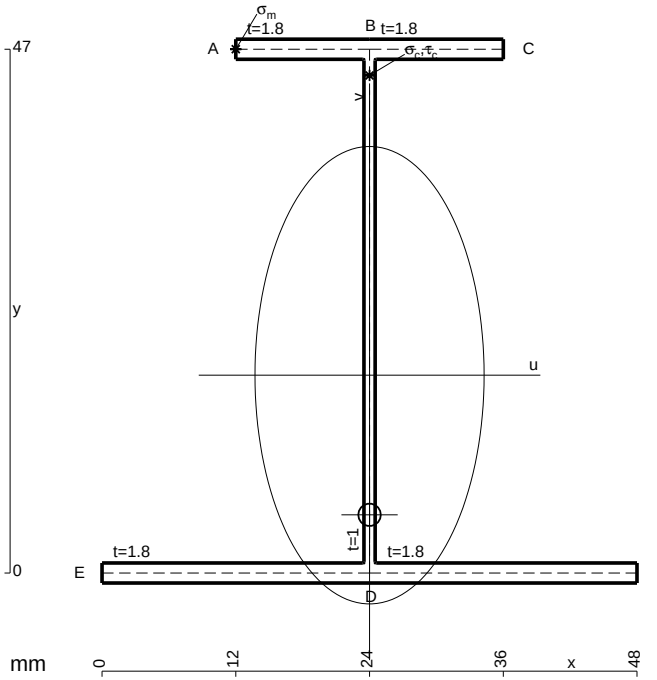
$= (\ b +1/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (3/2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (3/2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

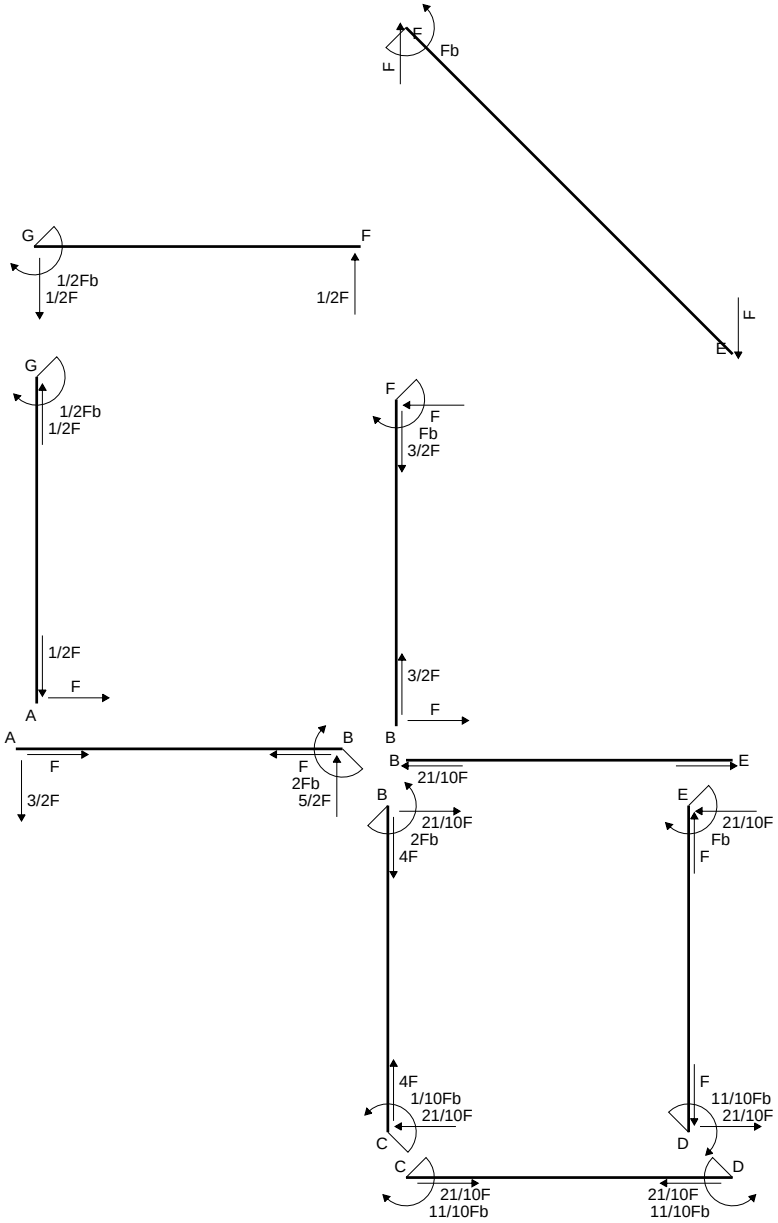
$= (3/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

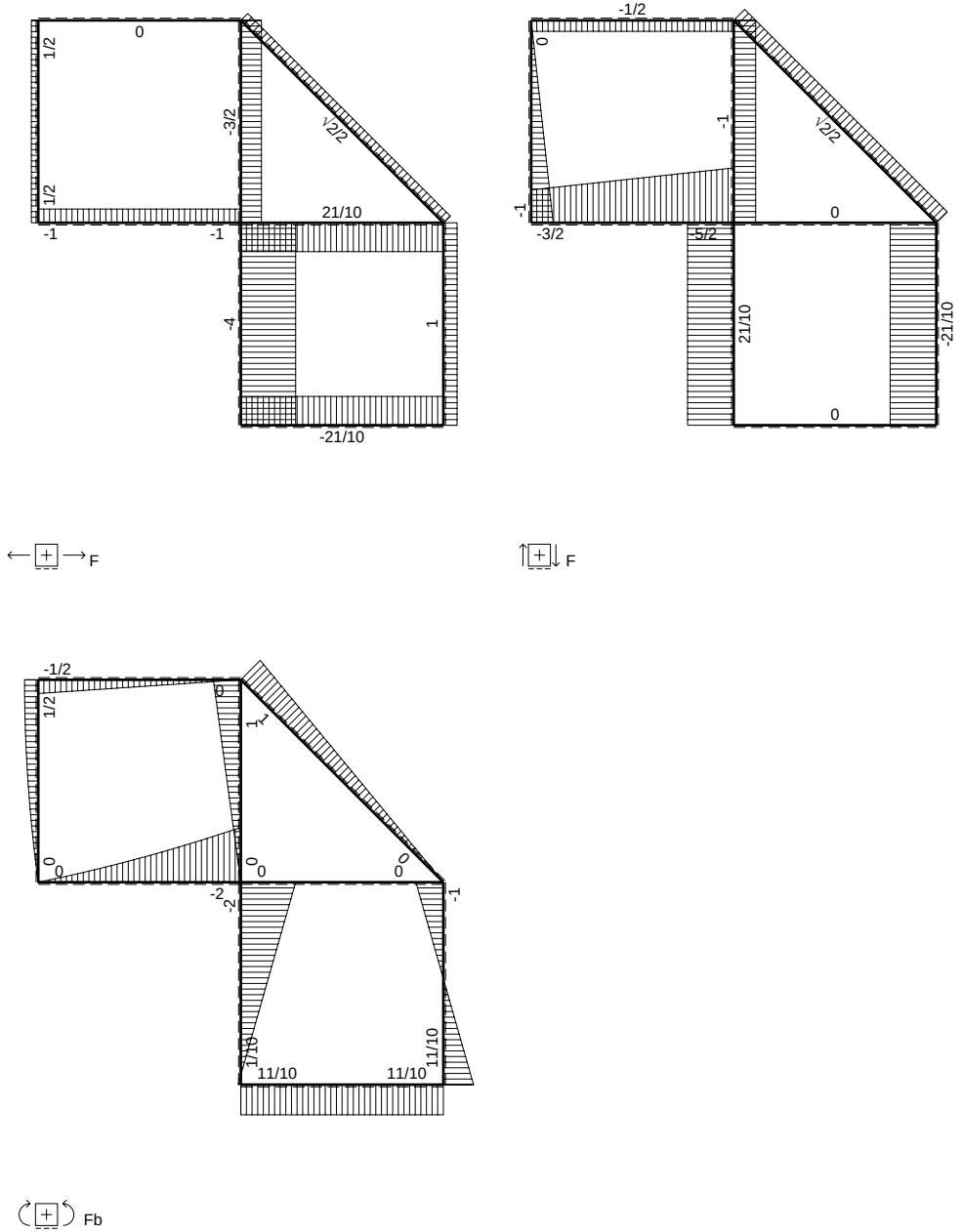


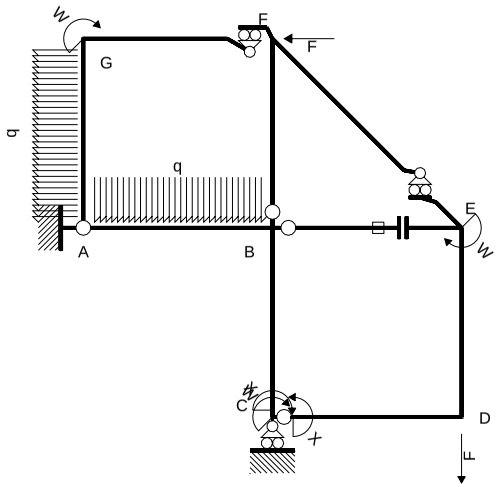
A = 176.6 mm^2
J_u = 74388. mm^4
J_v = 18662. mm^4
J_t = 155.6 mm^4
y_o = -12.53 mm
y_g = 17.75 mm
N = -300. N
T_y = -900. N
M_x = -555000. Nmm
x_m = 12. mm
y_m = 47. mm
u_m = -12. mm
v_m = 29.25 mm
$\sigma_m = N/A - Mv/J_u$ = 216.5 N/mm^2
x_c = 24. mm
y_c = 47. mm
v_c = 29.25 mm
$\sigma_c = N/A - Mv/J_u$ = 216.5 N/mm^2
$\tau_c = TS^*/tJ_u$ = 15.29 N/mm^2
$\tau_g = TS^*/tJ_u$ = 15.29 N/mm^2
t_c = 300. mm
$\sigma_o = \sqrt{\sigma^2 + 3\tau^2}$ = 218.1 N/mm^2

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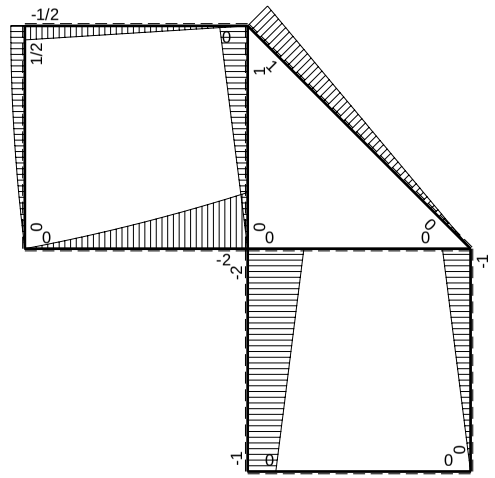
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F
Fb
F
G
F
1/2Fb
1/2F
1/2F
F
G
1/2Fb
1/2F
F
F
Fb
3/2F
1/2F
F
3/2F
F
A
A
B
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F
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4F
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Fb
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4F
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11/10Fb
21/10F
11/10Fb

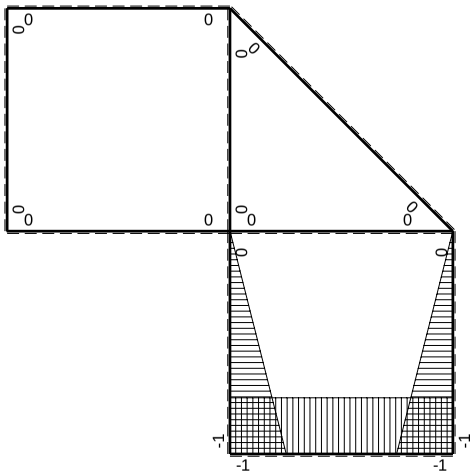

0
1/2
1/2
-3/2
√2/2
21/10
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-1
-4
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-21/10
F
-1/2
0
-1
√2/2
-1
0
-3/2
5/2
21/10
-21/10
0
F
-1/2
1/2
0
1
0
0
0
0
0
-2
-2
-1
1/10
11/10
11/10
11/10
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-3/2Fx-1/2qx^2$	0	0	0	0
BA b	0	$2Fb-5/2Fx+1/2qx^2$	0	0		
BC b	-x/b	-2Fb+Fx	$2Fx-Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+Fx	$Fb-Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-1/2Fx	0	0	0	0
GF b	0	1/2Fb-1/2Fx	0	0		
GA b	0	$1/2Fb-1/2qx^2$	0	0	0	0
AG b	0	$-Fx+1/2qx^2$	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$11/6Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				-11/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (2\ x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

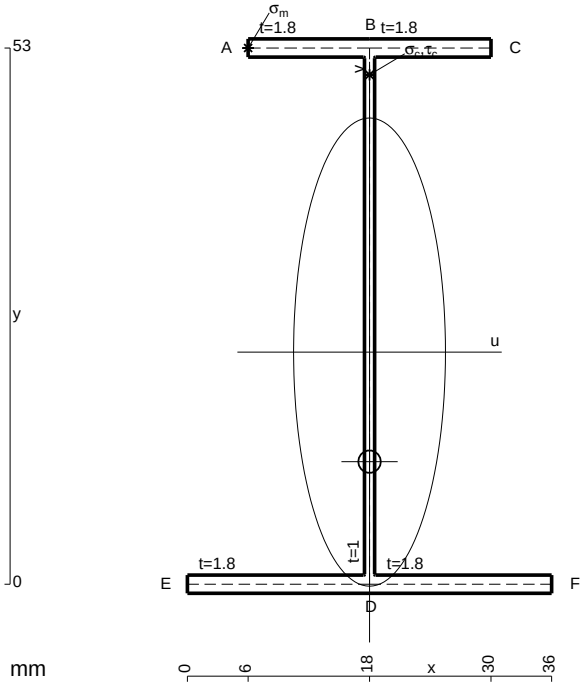
$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

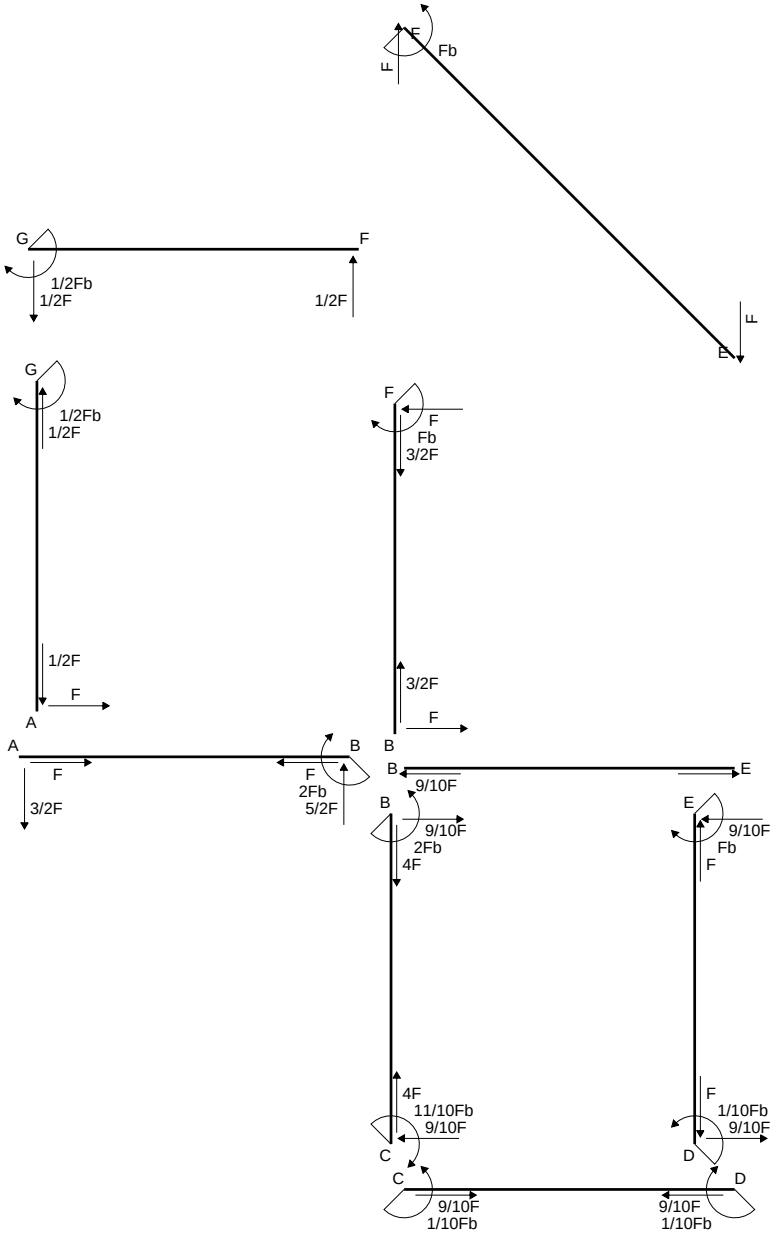
$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

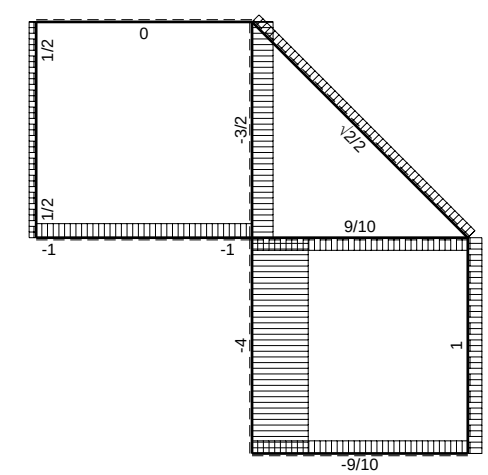


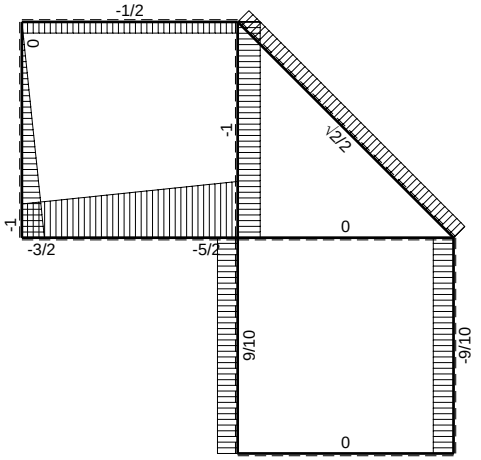
A = 161. mm^2
J_u = 86214. mm^4
J_v = 9072. mm^4
J_t = 134.3 mm^4
y_o = -10.83 mm
y_g = 22.94 mm
N = -370. N
T_y = -925. N
M_x = -666000. Nmm
x_m = 6. mm
y_m = 53. mm
u_m = -12. mm
v_m = 30.06 mm
$\sigma_m = N/A - Mv/J_u$ = 229.9 N/mm^2
x_c = 18. mm
y_c = 53. mm
v_c = 30.06 mm
$\sigma_c = N/A - Mv/J_u$ = 229.9 N/mm^2
$\tau_c = TS^*/tJ_u$ = 13.93 N/mm^2
$\tau_g = TS^*/tJ_u$ = 13.93 N/mm^2
t_c = 370. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 231.1 N/mm^2

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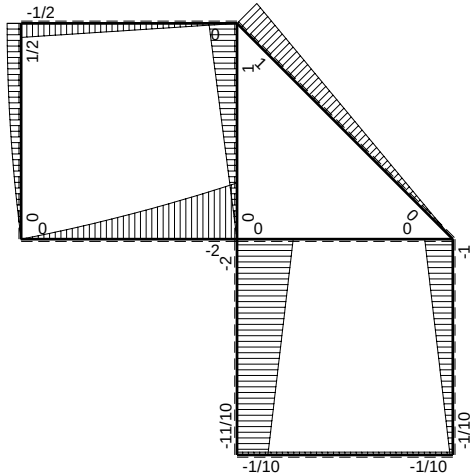

E
Fb
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G
F
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D
C
D
9/10F
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9/10F
1/10Fb


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-9/10

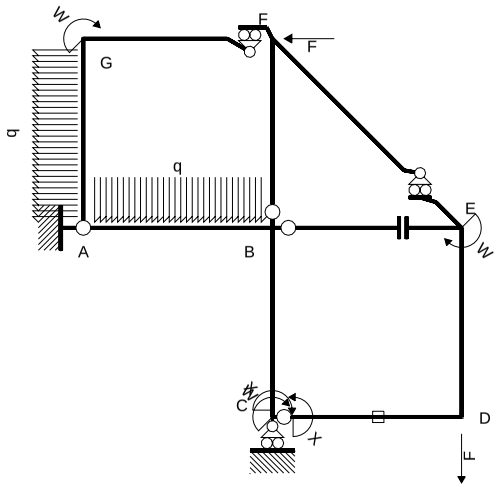

-1/2
0
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√2/2
-1
0
-3/2
-5/2
9/10
-9/10
0

←+→ F

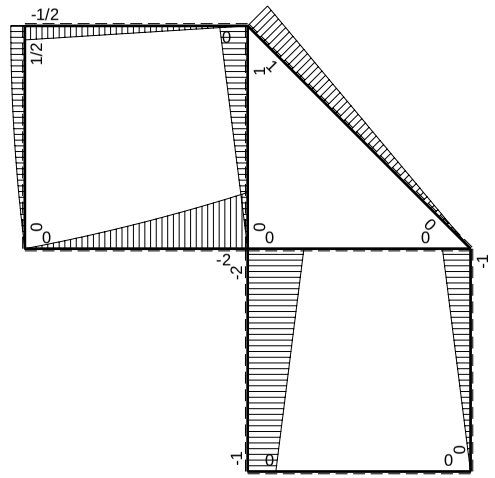
↑+↓ F


-1/2
1/2
0
1
0
0
0
0
0
-2
-2
-1
-11/10
-1/10
-1/10
-1/10

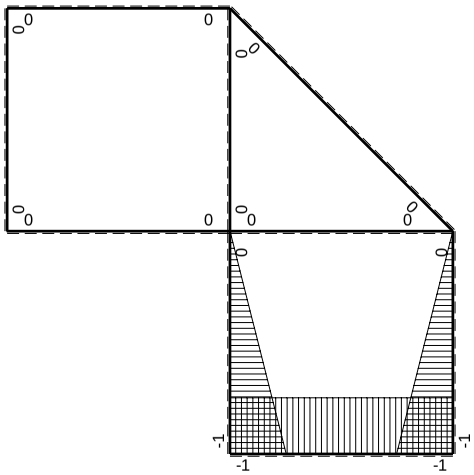
↻+↺ Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-3/2Fx-1/2qx^2$	0	0	0	0
BA b	0	$2Fb-5/2Fx+1/2qx^2$	0	0		
BC b	-x/b	-2Fb+Fx	$2Fx-Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	$Fb-Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	1/3Xb/EJ
ED b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-1/2Fx	0	0	0	0
GF b	0	1/2Fb-1/2Fx	0	0		
GA b	0	$1/2Fb-1/2qx^2$	0	0	0	0
AG b	0	$-Fx+1/2qx^2$	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/6Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				1/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (2\ x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

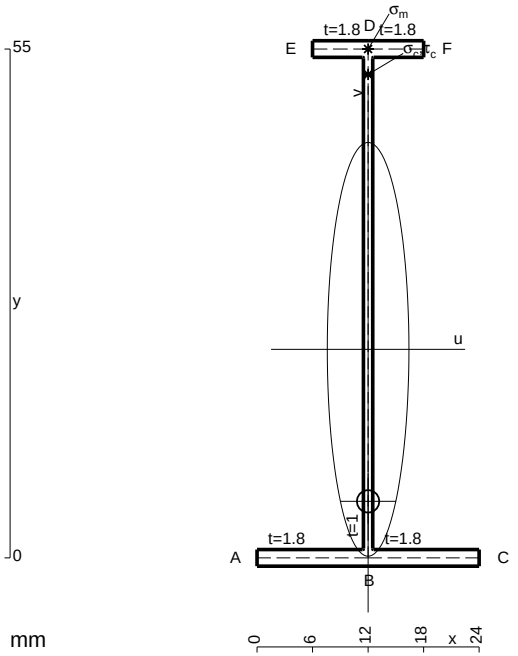
$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

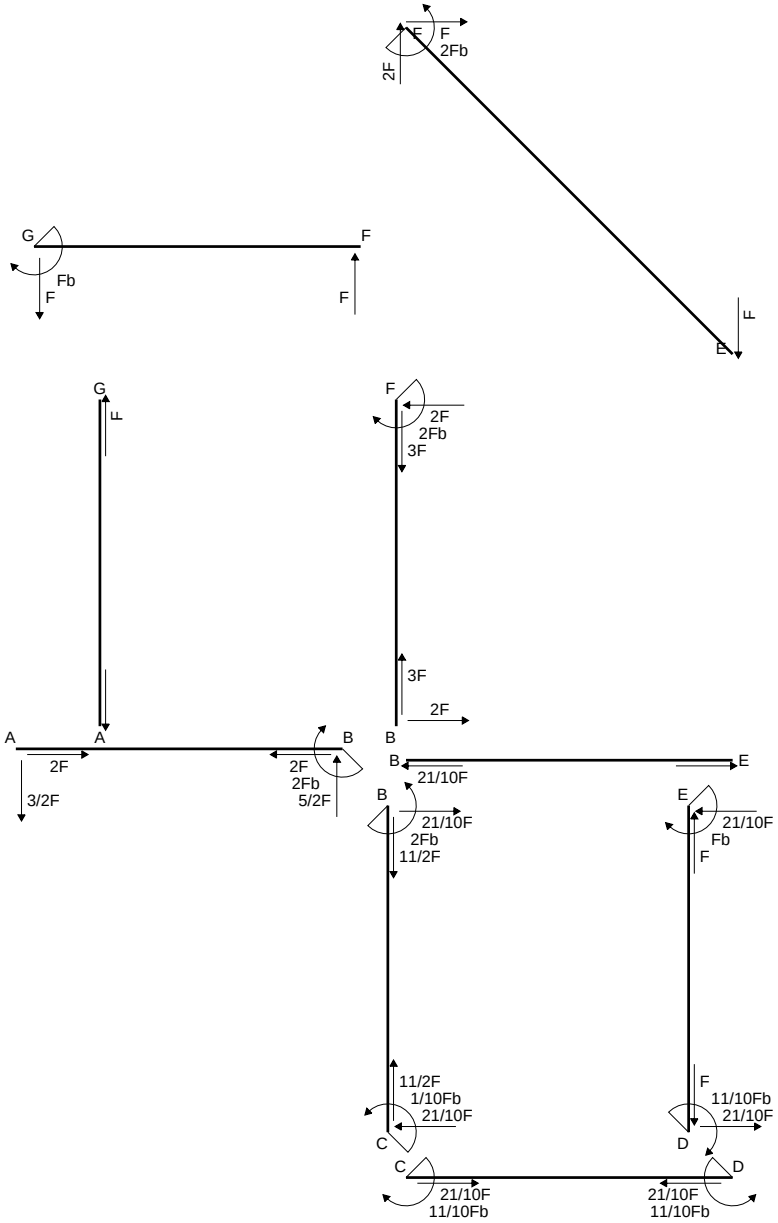
$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ \ Fb^2/EJ$

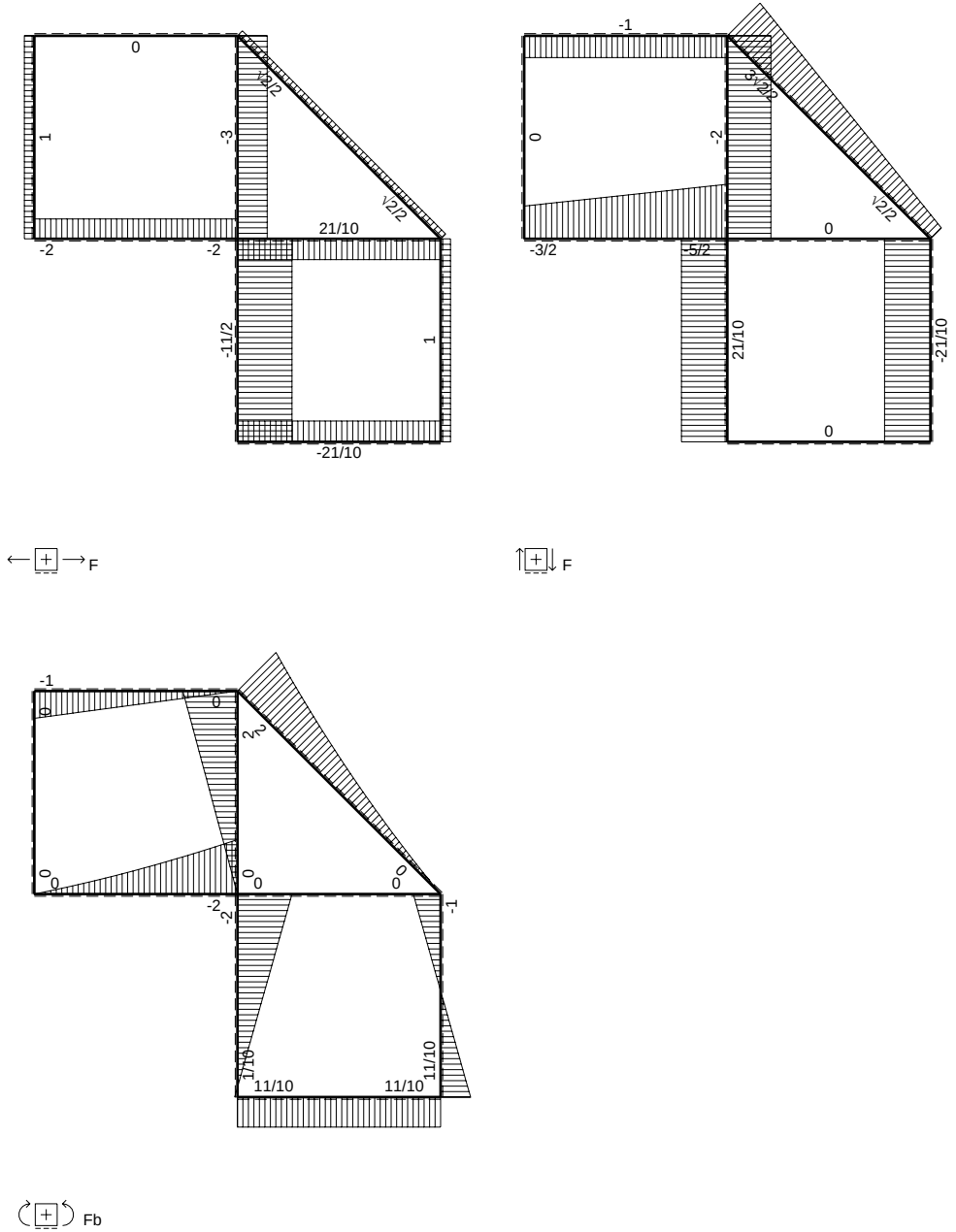


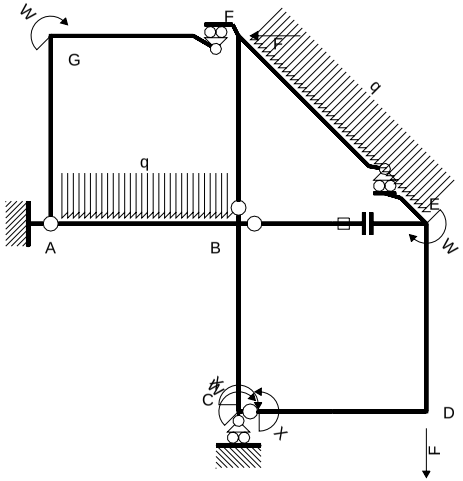
A = 119.8 mm^2
J_u = 59924. mm^4
J_v = 2333. mm^4
J_t = 88.32 mm^4
y_o = -16.43 mm
y_g = 22.54 mm
N = -220. N
T_y = -550. N
M_x = -431200. Nmm
x_m = 12. mm
y_m = 55. mm
v_m = 32.46 mm
$\sigma_m = N/A - Mv/J_u$ = 231.7 N/mm^2
y_c = 2. mm
u_c = -12. mm
v_c = -20.54 mm
$\sigma_c = N/A - Mv/J_u$ = 231.7 N/mm^2
$\tau_c = TS^*/tJ_u$ = 6.435 N/mm^2
$\tau_g = TS^*/tJ_u$ = 6.435 N/mm^2
t_c = 220. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 232. N/mm^2

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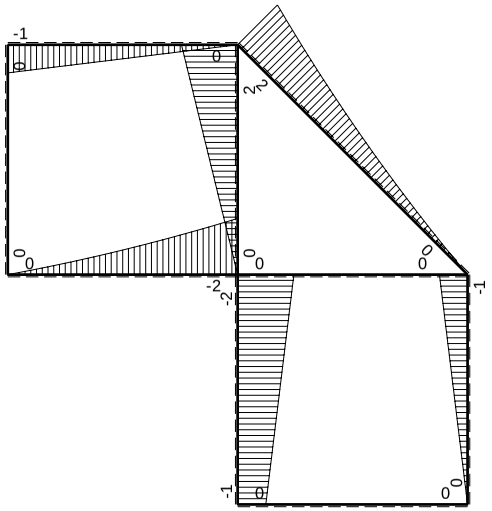
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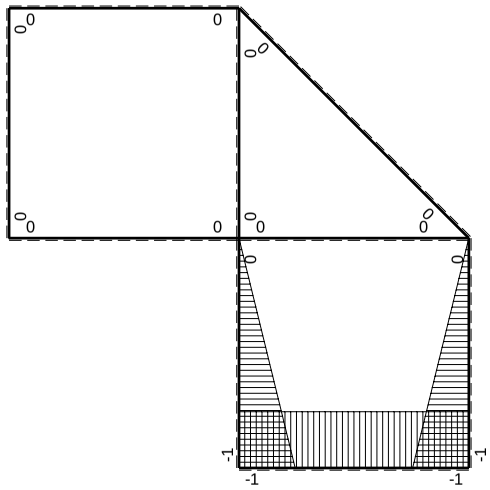

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Fb



Schema di calcolo iperstatico



M_o flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-3/2Fx-1/2qx^2$	0	0	0	0
BA b	0	$2Fb-5/2Fx+1/2qx^2$	0	0		
BC b	-x/b	-2Fb+Fx	$2Fx-Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+Fx	$Fb-Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx+1/2qx^2$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$11/6Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				-11/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (2\ x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

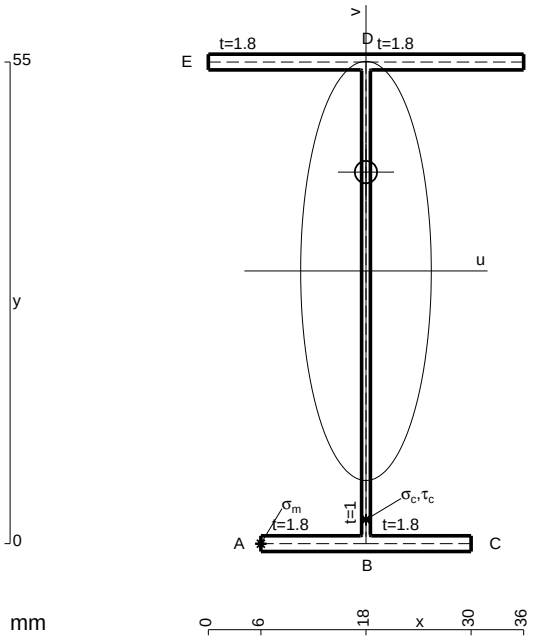
$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

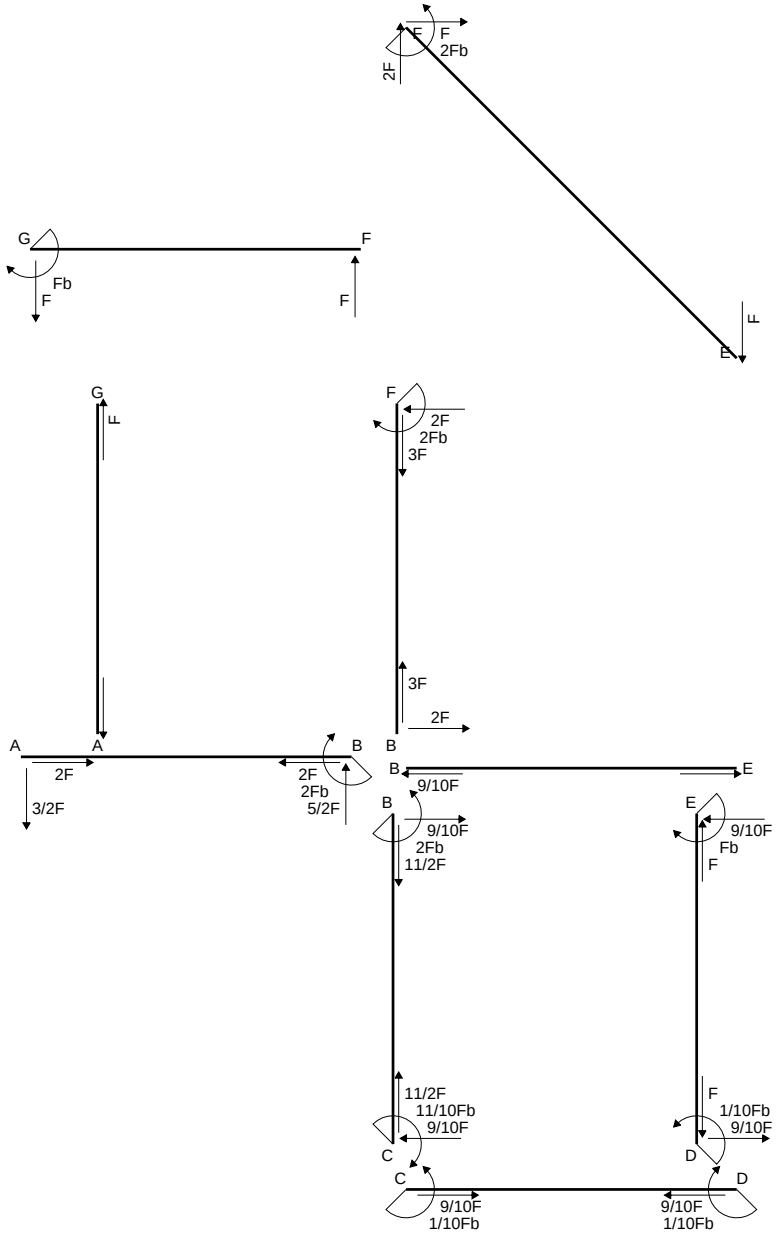
$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

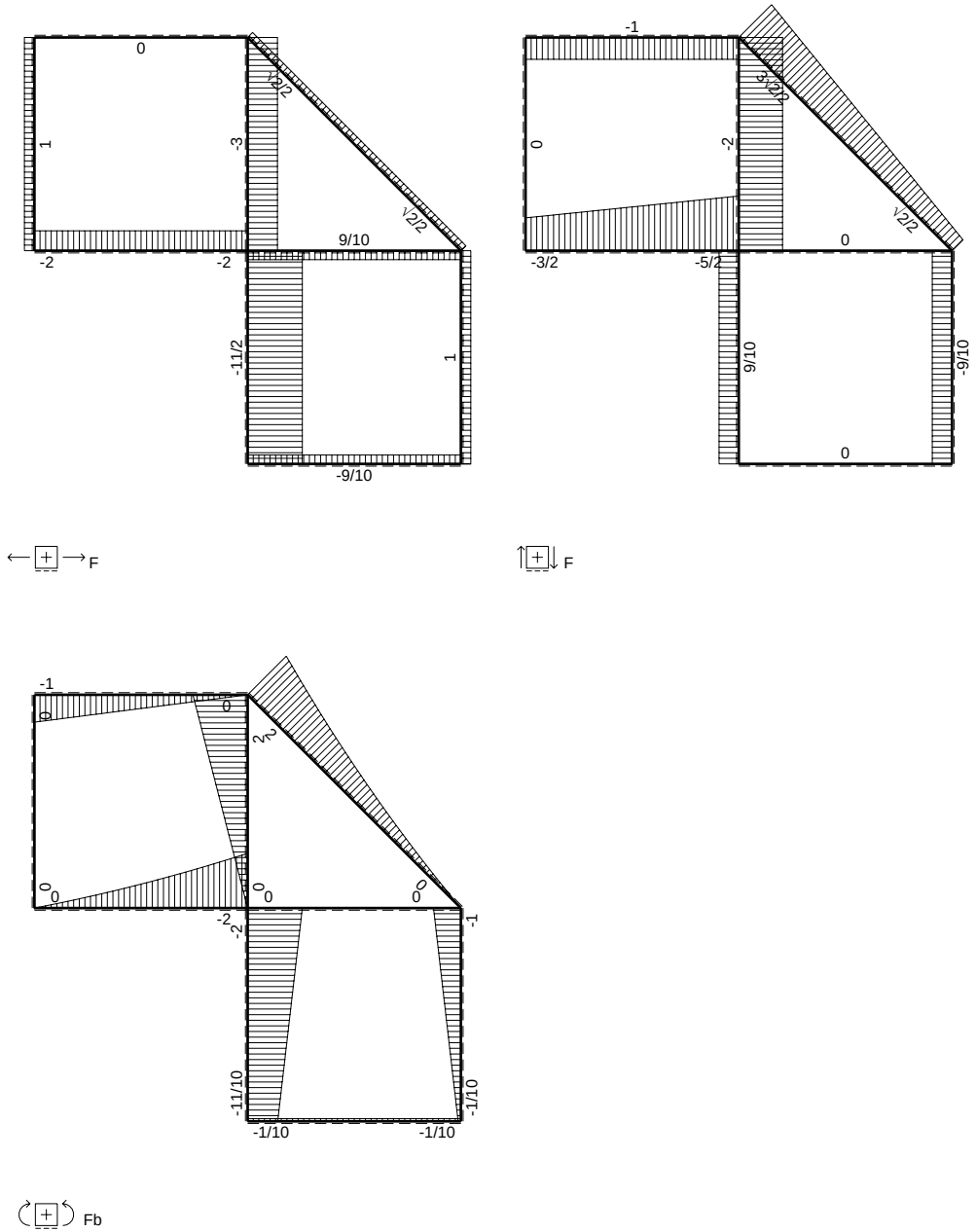


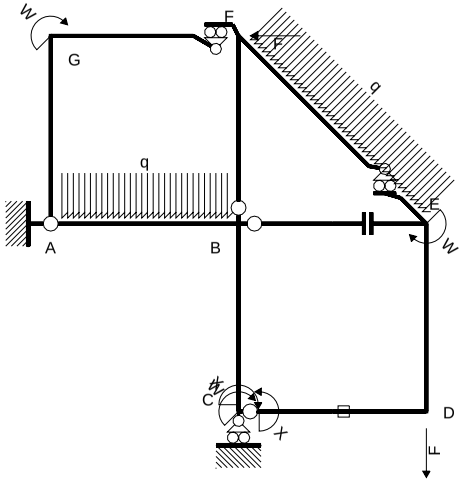
A = 163. mm^2
J_u = 93375. mm^4
J_v = 9072. mm^4
J_t = 135. mm^4
y_o = 11.28 mm
y_g = 31.14 mm
N = -1100. N
T_y = -1375. N
M_x = -572000. Nmm
x_m = 6. mm
u_m = -12. mm
v_m = -31.14 mm
$\sigma_m = N/A - Mv/J_u$ = -197.5 N/mm^2
x_c = 18. mm
v_c = -31.14 mm
$\sigma_c = N/A - Mv/J_u$ = -197.5 N/mm^2
$\tau_c = TS^*/tJ_u$ = 19.81 N/mm^2
$\tau_g = TS^*/tJ_u$ = 19.81 N/mm^2
t_c = 550. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 200.5 N/mm^2

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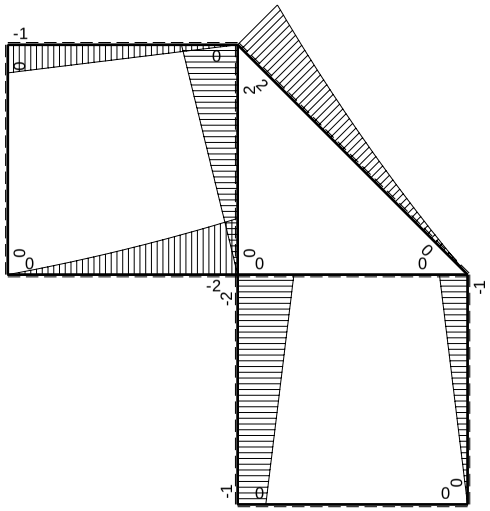
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2Fb
11/2F
E
9/10F
Fb
F
11/2F
11/10Fb
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1/10Fb
9/10F
1/10Fb

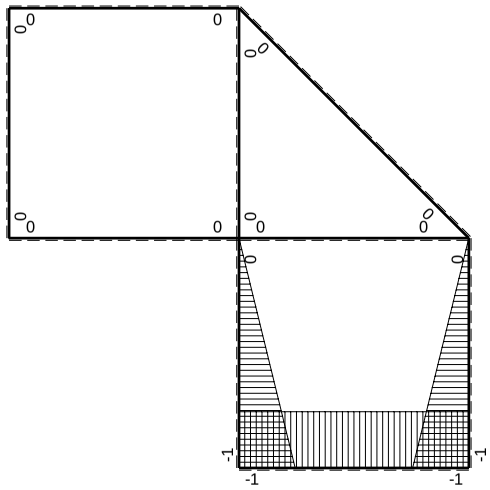

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-1/10
Fb



Schema di calcolo iperstatico



M_o flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-3/2Fx-1/2qx^2$	0	0	0	0
BA b	0	$2Fb-5/2Fx+1/2qx^2$	0	0		
BC b	-x/b	-2Fb+Fx	$2Fx-Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	$Fb-Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	1/3Xb/EJ
ED b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2		
EF √2b	0	$\sqrt{2}/2Fx+1/2qx^2$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/6Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				1/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 - 2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b + 1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b + 1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 - 2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b + 1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b + 1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (2\ x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x^2/b - 1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b - 1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x - 1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

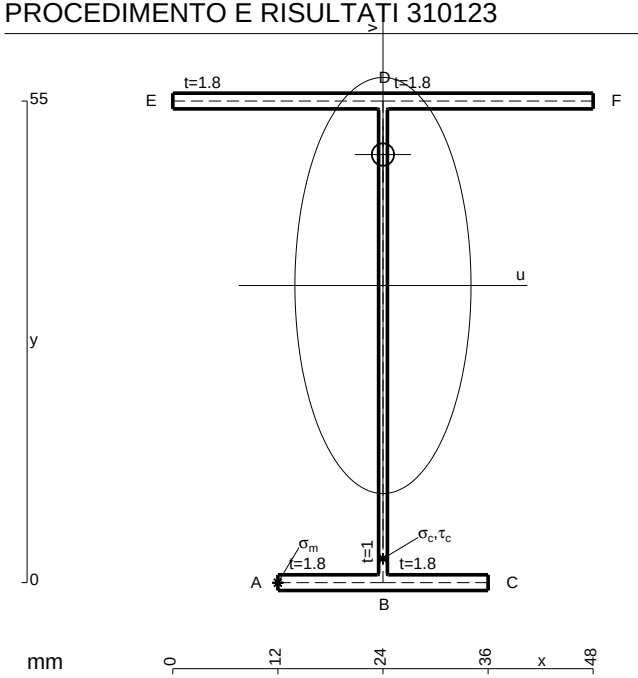
$= (\ b - 1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b - 1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b - 1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b - 1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

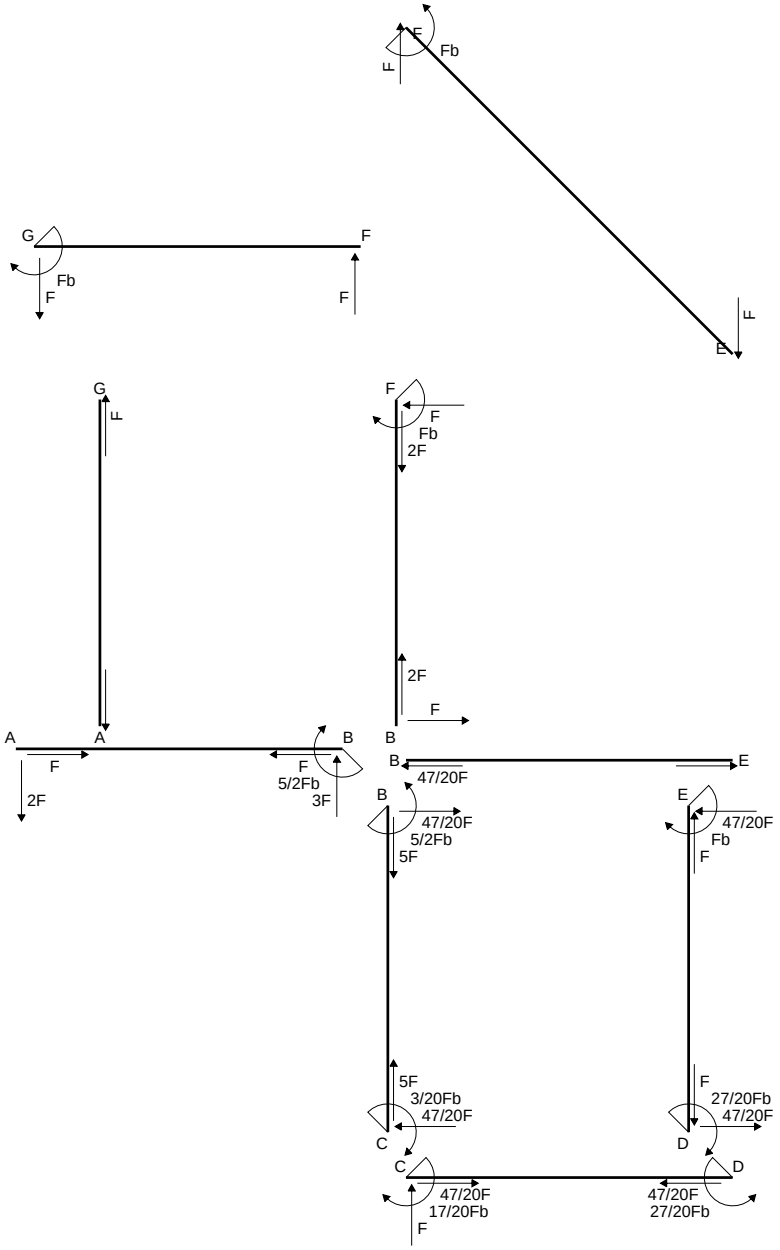
$= (1/2\ b - 1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

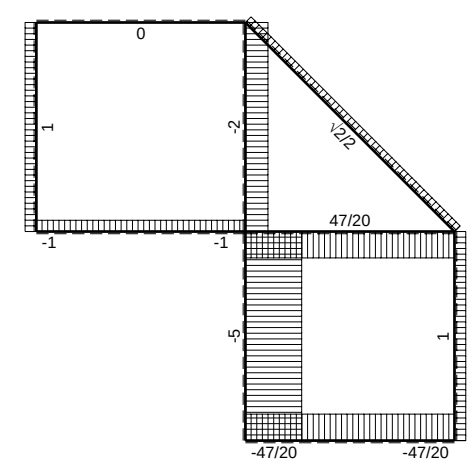


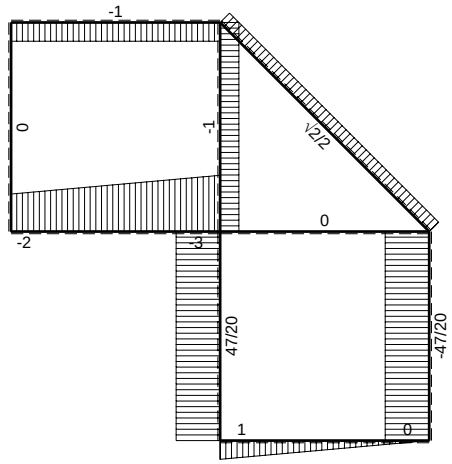
A = 184.6 mm^2
J_u = 104229. mm^4
J_v = 18662. mm^4
J_t = 158.3 mm^4
y_o = 14.95 mm
y_g = 33.94 mm
N = -1080. N
T_y = -1350. N
M_x = -615600. Nmm
x_m = 12. mm
u_m = -12. mm
v_m = -33.94 mm
$\sigma_m = N/A - Mv/J_u$ = -206.3 N/mm^2
x_c = 24. mm
v_c = -33.94 mm
$\sigma_c = N/A - Mv/J_u$ = -206.3 N/mm^2
$\tau_c = TS^*/tJ_u$ = 18.99 N/mm^2
$\tau_g = TS^*/tJ_u$ = 18.99 N/mm^2
t_c = 540. mm
$\sigma_o = \sqrt{\sigma^2 + 3\tau^2}$ = 208.9 N/mm^2

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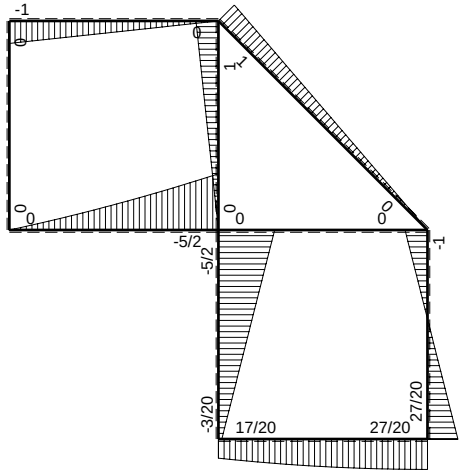

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-47/20
-47/20

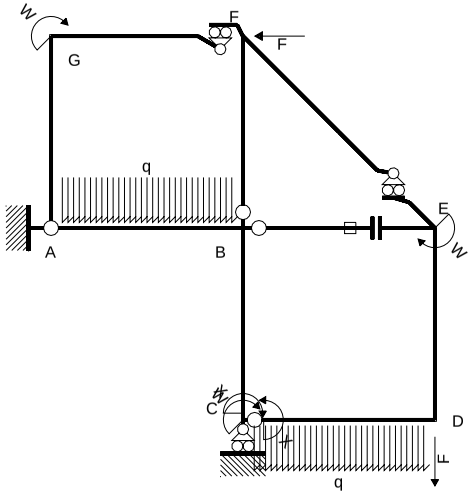

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-2
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47/20
-47/20
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0

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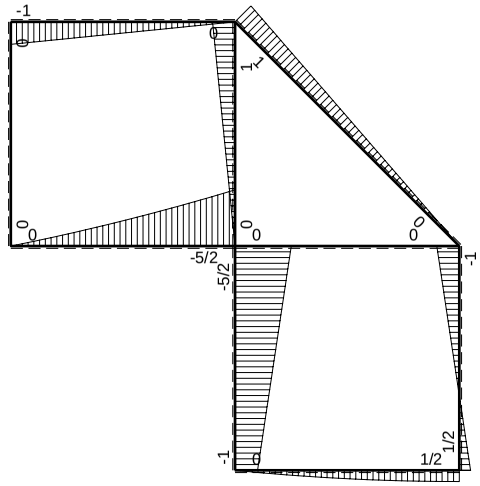
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27/20

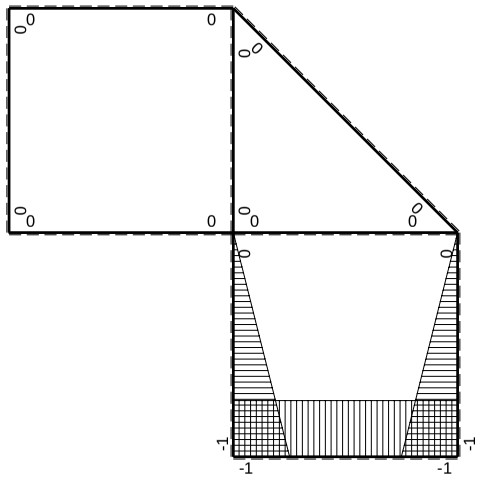
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-2Fx-1/2qx^2$	0	0	0	0
BA b	0	$5/2Fb-3Fx+1/2qx^2$	0	0		
BC b	-x/b	$-5/2Fb+3/2Fx$	$5/2Fx-3/2Fx^2/b$	x^2/b^2	$3/4Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	$Fb+3/2Fx$	$Fb+1/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	$Fx-1/2qx^2$	$-Fx+1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fb+1/2qx^2$	$-1/2Fb+1/2Fx^2/b$	1		
DE b	-1+x/b	1/2Fb-3/2Fx	$-1/2Fb+2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	0	1/3Xb/EJ
ED b	x/b	Fb-3/2Fx	$Fx-3/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$17/12Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-17/20Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 +1/2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x +1/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b +1/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ \ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-\ x/b +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/3\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2 +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

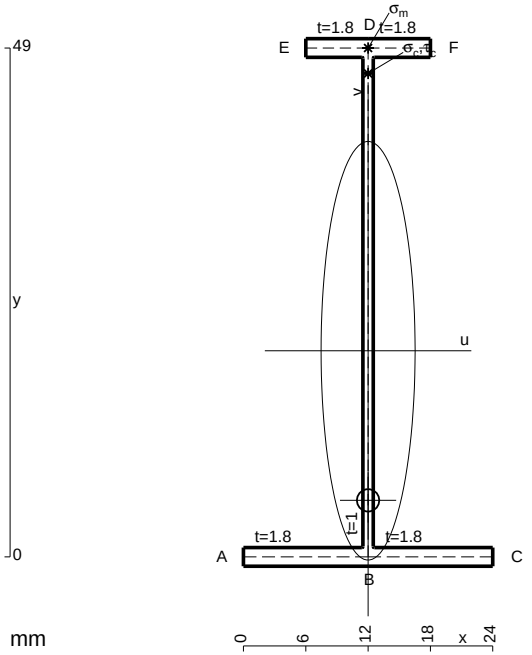
$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/3\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (-1/2 +2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x + x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b + b -1/2\ b\ )\ Fb\ 1/EJ\ = 0$

$L^{Xo}_{ED} = \int_o^b (\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

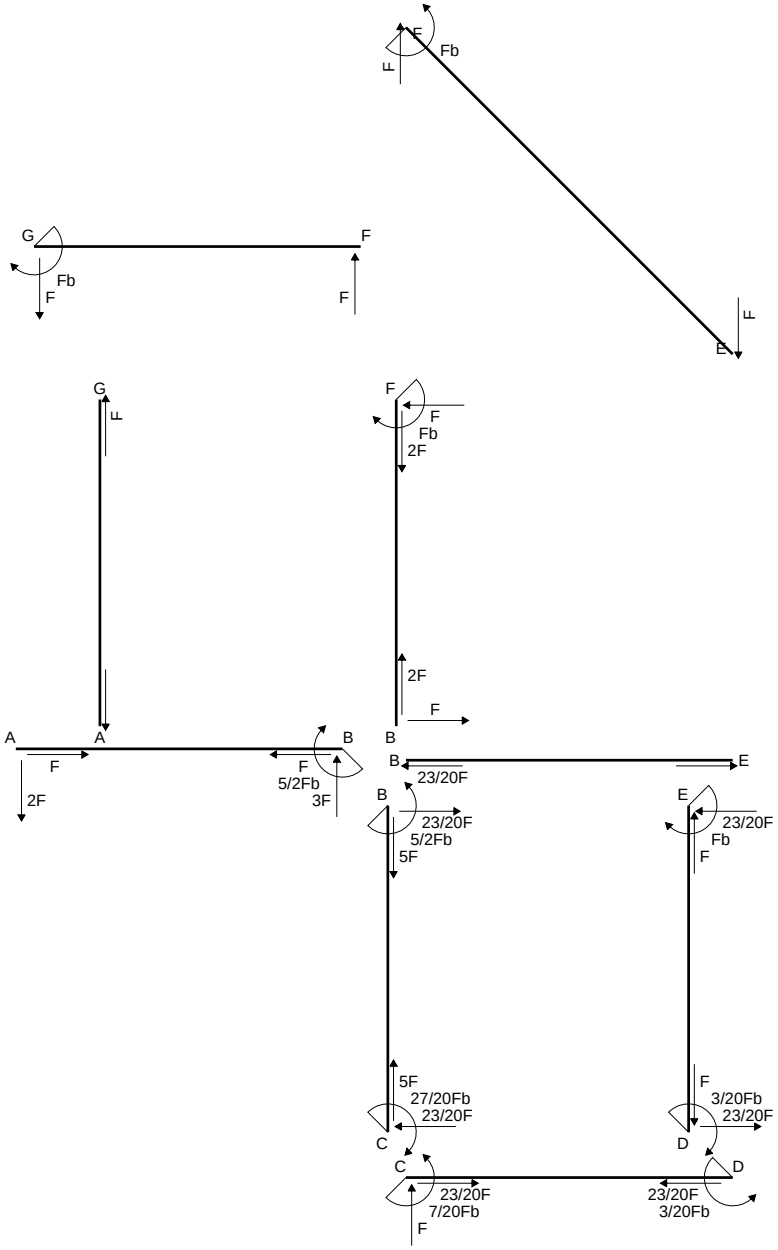
$= (1/2\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 0$

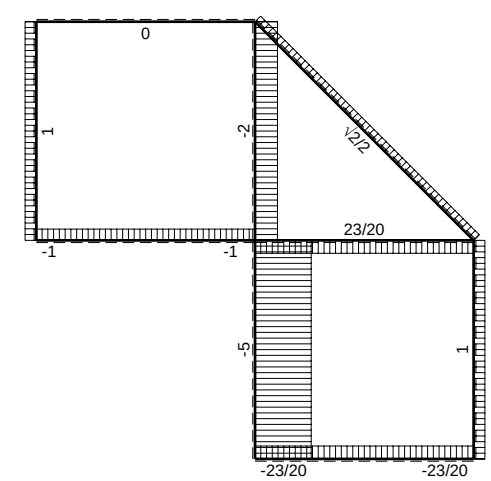


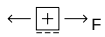
A = 113.8 mm^2
J_u = 46239. mm^4
J_v = 2333. mm^4
J_t = 86.32 mm^4
y_o = -14.41 mm
y_g = 19.85 mm
N = -250. N
T_y = -750. N
M_x = -343750. Nmm
x_m = 12. mm
y_m = 49. mm
v_m = 29.15 mm
$\sigma_m = N/A - Mv/J_u$ = 214.5 N/mm^2
y_c = 2. mm
u_c = -12. mm
v_c = -17.85 mm
$\sigma_c = N/A - Mv/J_u$ = 214.5 N/mm^2
$\tau_c = TS^*/tJ_u$ = 10.21 N/mm^2
$\tau_g = TS^*/tJ_u$ = 10.21 N/mm^2
t_c = 250. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 215.2 N/mm^2

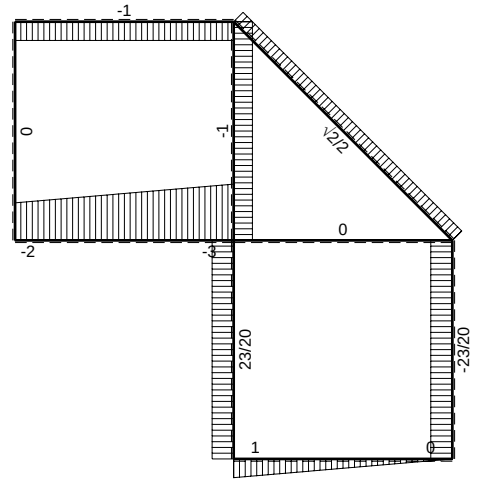
CI02.xxxx.052

@ Adolfo Zavelani Rossi, Politecnico di Milano, vers.27.03.13 16.04.26

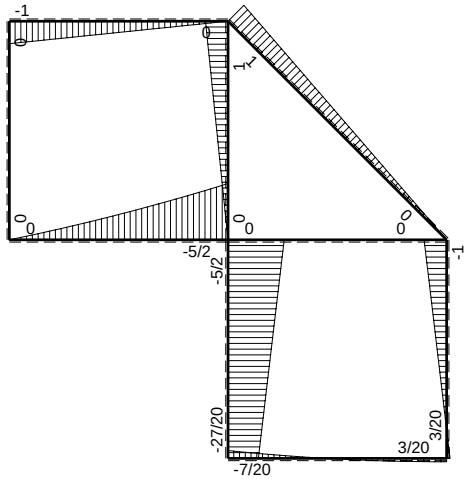

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5F
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23/20F
3/20Fb
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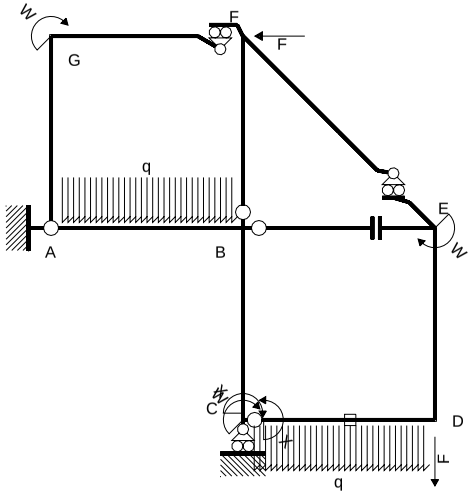

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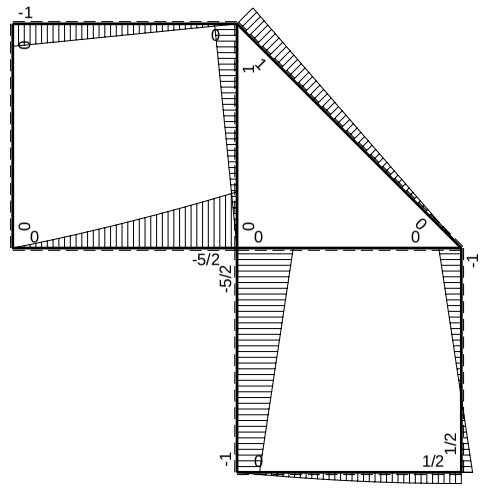

F


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3/20
3/20
-7/20

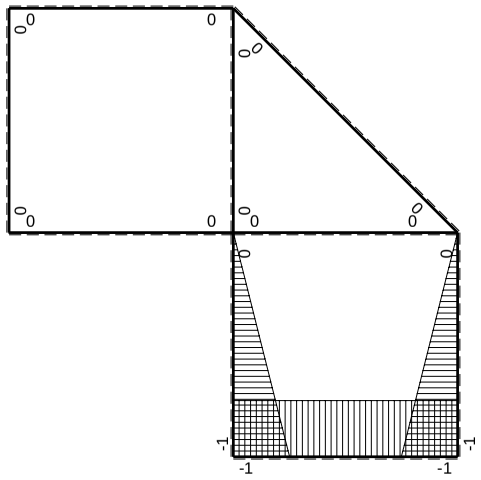

Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-2Fx-1/2qx^2$	0	0	0	0
BA b	0	$5/2Fb-3Fx+1/2qx^2$	0	0		
BC b	-x/b	$-5/2Fb+3/2Fx$	$5/2Fx-3/2Fx^2/b$	x^2/b^2	$3/4Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	$Fb+3/2Fx$	$Fb+1/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	$Fx-1/2qx^2$	$-Fx+1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fb+1/2qx^2$	$-1/2Fb+1/2Fx^2/b$	1		
DE b	-1+x/b	1/2Fb-3/2Fx	$-1/2Fb+2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	0	1/3Xb/EJ
ED b	x/b	Fb-3/2Fx	$Fx-3/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-7/12Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				7/20Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2\ )\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 +1/2\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x +1/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b +1/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -4/3\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2 +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/2\ x +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -4/3\ \ Fb^2/EJ$

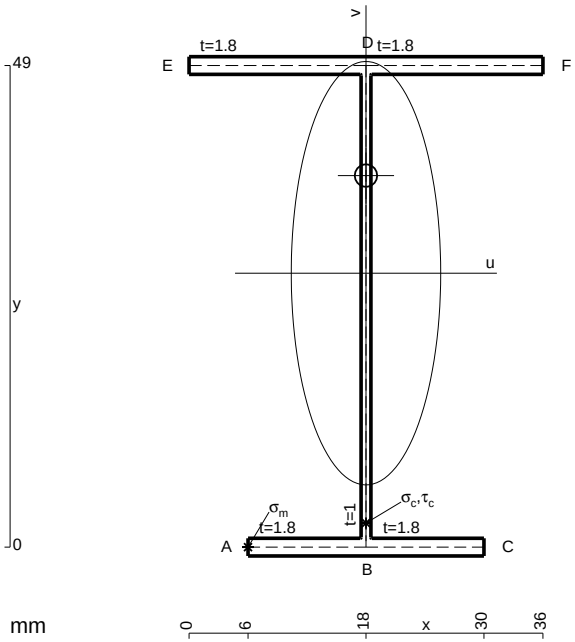
$L^{Xo}_{DE} = \int_o^b (-1/2 +2\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/2\ x + x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b + b -1/2\ b\ )\ Fb\ 1/EJ\ = 0$

$L^{Xo}_{ED} = \int_o^b (\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 0$

PROCEDIMENTO E RISULTATI 267850 CI02.xxxx.053

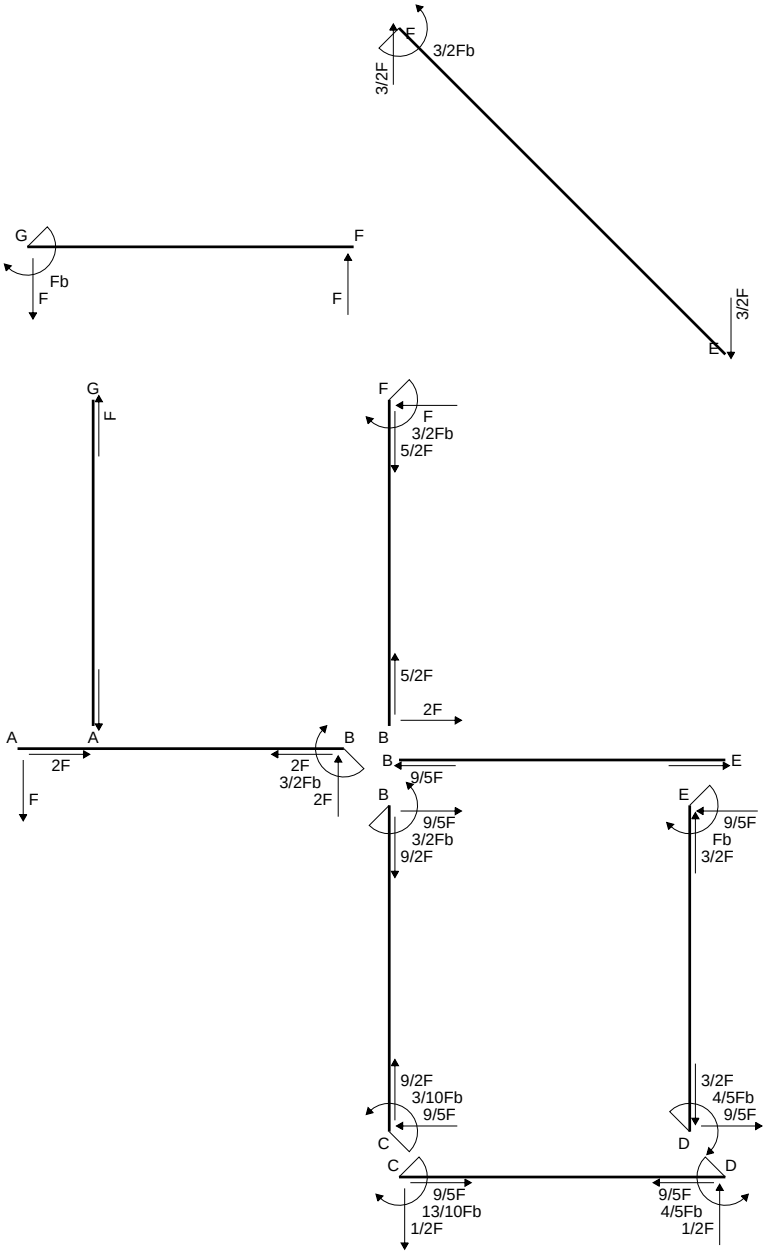


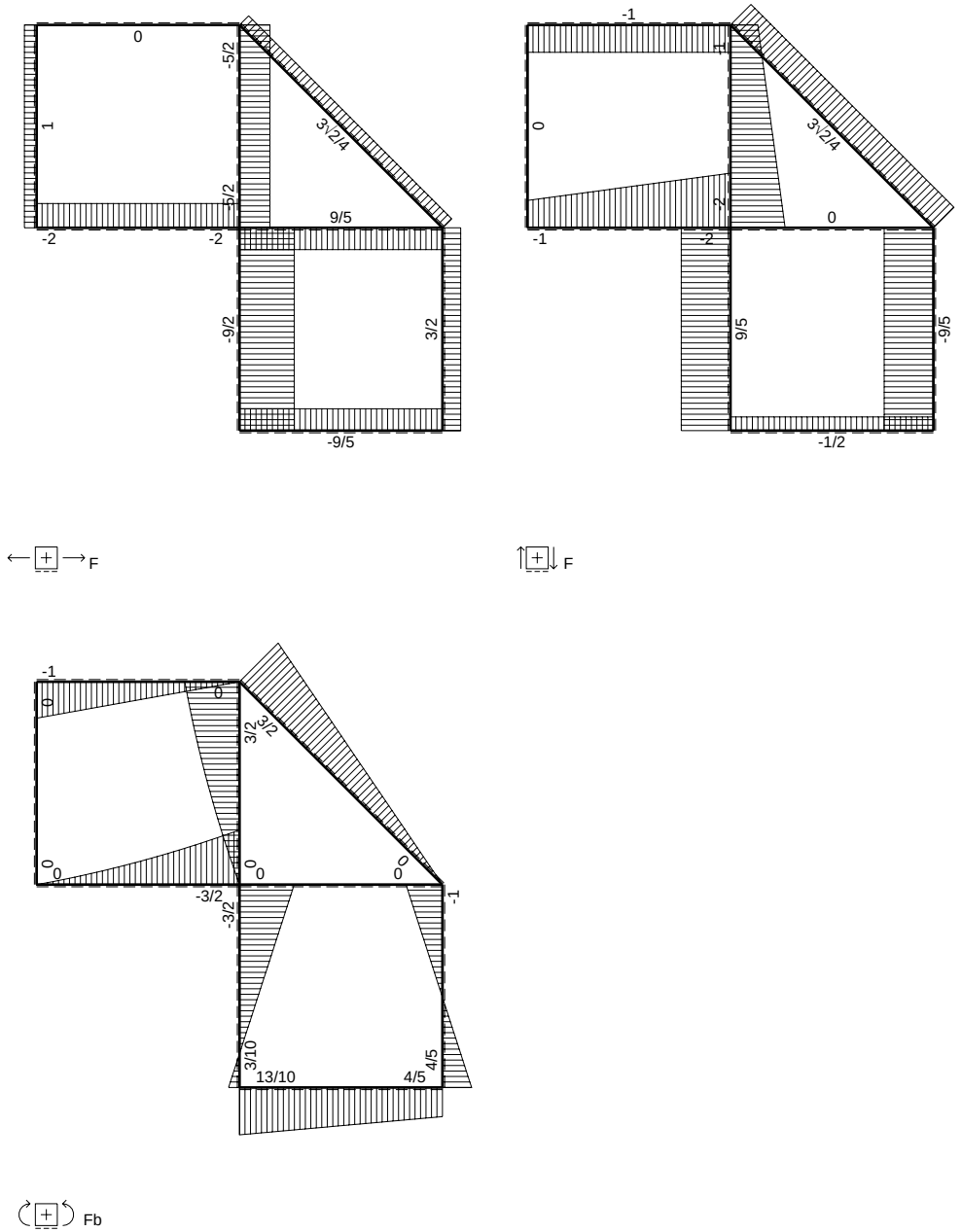
A = 157. mm^2
J_u = 72847. mm^4
J_v = 9072. mm^4
J_t = 133. mm^4
y_o = 9.929 mm
y_g = 27.87 mm
N = -400. N
T_y = -1200. N
M_x = -590000. Nmm
x_m = 6. mm
u_m = -12. mm
v_m = -27.87 mm
$\sigma_m = N/A - Mv/J_u$ = -228.3 N/mm^2
x_c = 18. mm
v_c = -27.87 mm
$\sigma_c = N/A - Mv/J_u$ = -228.3 N/mm^2
$\tau_c = TS^*/tJ_u$ = 19.83 N/mm^2
$\tau_g = TS^*/tJ_u$ = 19.83 N/mm^2
t_c = 400. mm
$\sigma_o = \sqrt{\sigma^2 + 3\tau^2}$ = 230.8 N/mm^2

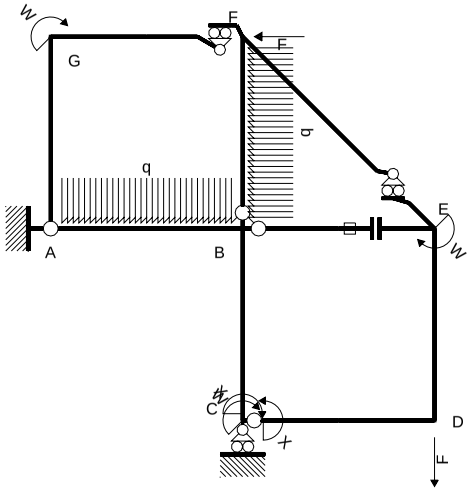
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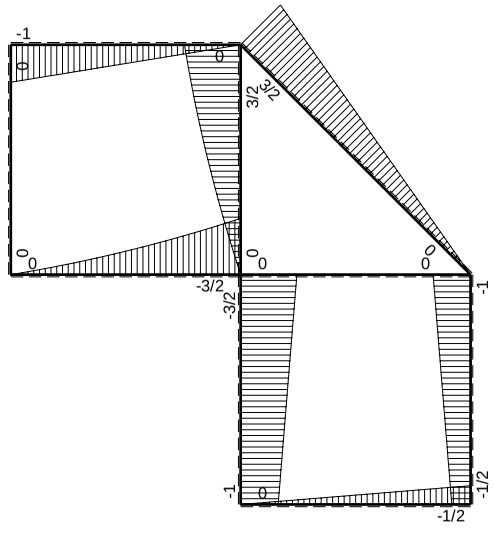
@ Adolfo Zavelani Rossi, Politecnico di Milano, vers.27.03.13 16.04.26


F
3/2Fb
3/2F
G
F
Fb
F
F
3/2F
E
G
F
F
F
3/2Fb
5/2F
5/2F
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2F
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9/5F
Fb
3/2F
9/2F
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9/5F
3/2F
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9/5F
4/5Fb
1/2F

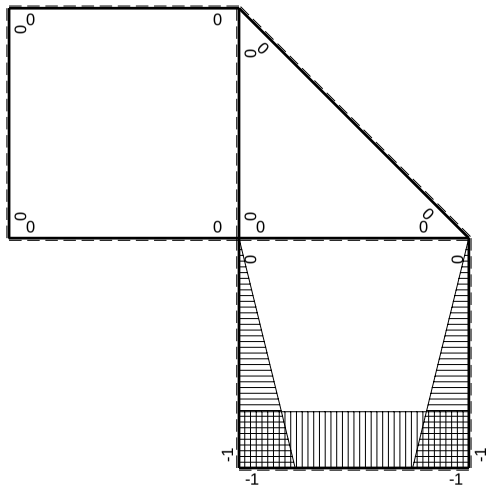

0
-5/2
1
3/2/4
5/2
9/5
-2
-2
-9/2
3/2
-9/5
-1
1
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3/2/4
2
0
-1
-2
9/5
-9/2
-1/2
F
F
-1
1
0
3/2
3/2
0
0
0
0
-3/2
-1
-3/2
3/10
13/10
4/5
4/5
Fb



Schema di calcolo iperstatico



M_o flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-Fx-1/2qx^2$	0	0	0	0
BA b	0	$3/2Fb-2Fx+1/2qx^2$	0	0		
BC b	-x/b	$-3/2Fb+1/2Fx$	$3/2Fx-1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	$Fb+1/2Fx$	$Fb-1/2Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	$-1/2Fx$	$1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
DC b	1	$1/2Fb-1/2Fx$	$1/2Fb-1/2Fx$	1		
DE 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
ED b	x/b	$Fb-1/2Fx$	$Fx-1/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	$3/2Fb-Fx-1/2qx^2$	0	0	0	0
BF b	0	$-2Fx+1/2qx^2$	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$13/6Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-13/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2\ )\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (1/2\ x/b\ )\ Fb\ 1/EJ\ dx = [1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b\ )\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (1/2 -1/2\ x/b\ )\ Fb\ 1/EJ\ dx = [1/2\ x -1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

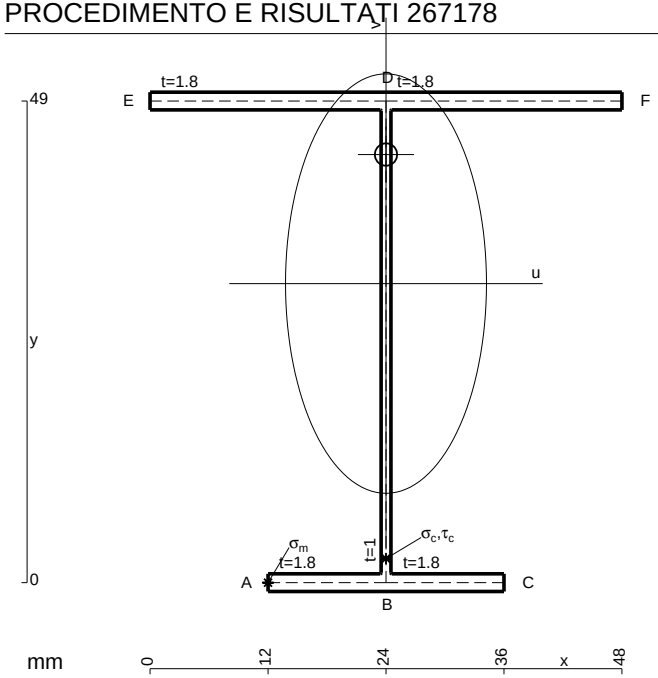
$= (1/2\ b -1/4\ b\ )\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2 -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/3\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (\ x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

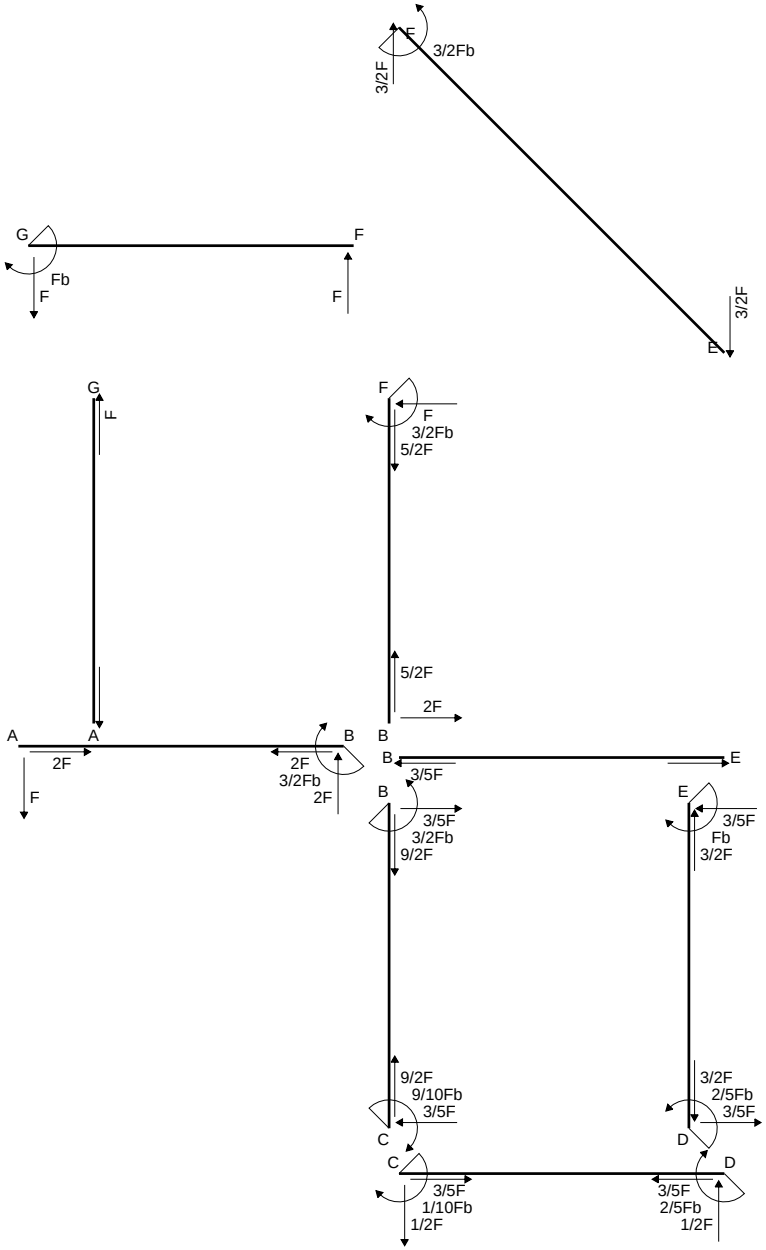
$= (1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/3\ Fb^2/EJ$

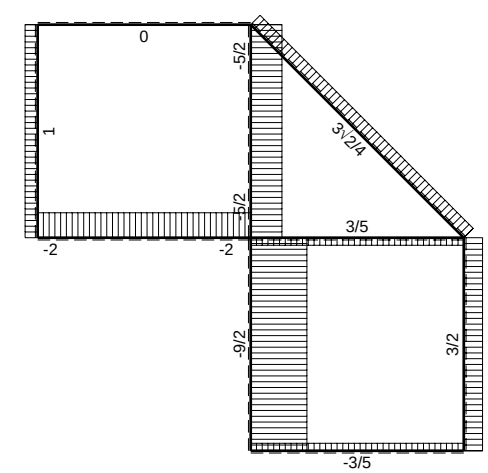


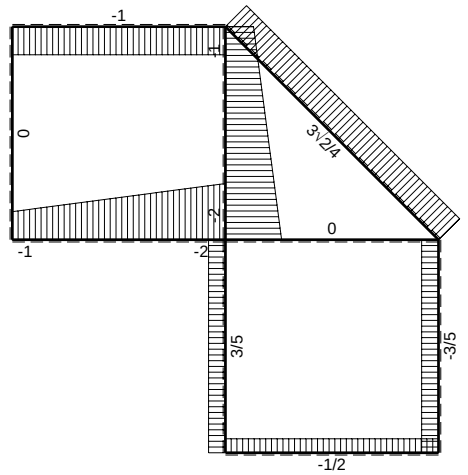
A = 178.6 mm^2
J_u = 81324. mm^4
J_v = 18662. mm^4
J_t = 156.3 mm^4
y_o = 13.13 mm
y_g = 30.43 mm
N = -1280. N
T_y = -1280. N
M_x = -614400. Nmm
x_m = 12. mm
u_m = -12. mm
v_m = -30.43 mm
$\sigma_m = N/A - Mv/J_u$ = -237. N/mm^2
x_c = 24. mm
v_c = -30.43 mm
$\sigma_c = N/A - Mv/J_u$ = -237. N/mm^2
$\tau_c = TS^*/tJ_u$ = 20.69 N/mm^2
$\tau_g = TS^*/tJ_u$ = 20.69 N/mm^2
t_c = 640. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 239.7 N/mm^2

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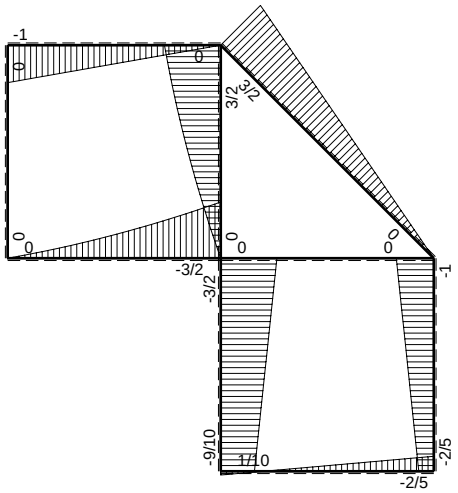
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3/2F
3/2Fb
E
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3/2Fb
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5/2F
2F
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A
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2F
2F
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1/2F

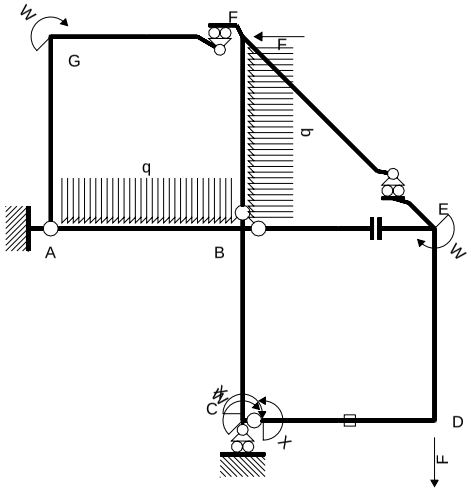

0
-5/2
1
3√2/4
-5/2
3/5
-2
-2
-9/2
3/2
-3/5


-1
-1
0
3√2/4
2
0
-1
-2
3/5
-3/5
-1/2

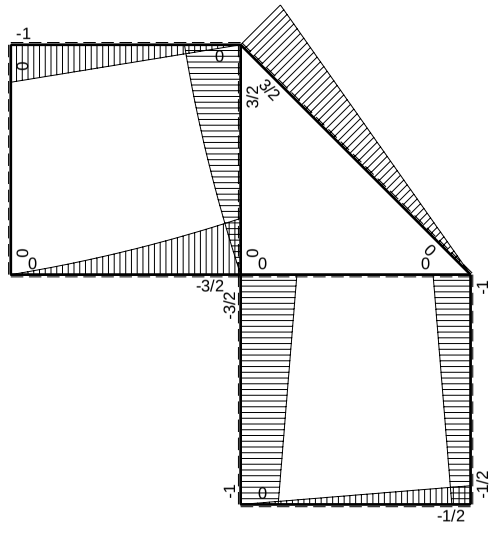
F F


-1
1
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3/2
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-1
-9/10
1/10
-2/5
-2/5

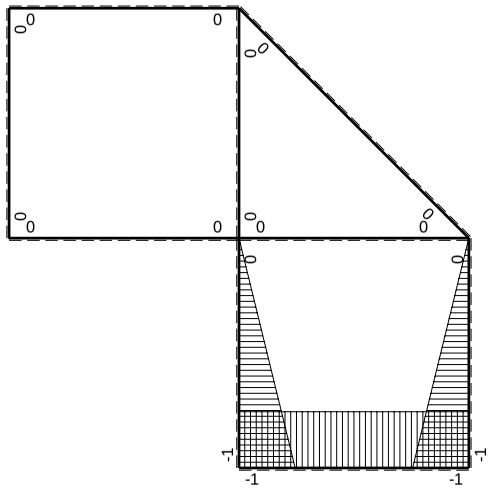
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-Fx-1/2qx^2$	0	0	0	0
BA b	0	$3/2Fb-2Fx+1/2qx^2$	0	0		
BC b	-x/b	$-3/2Fb+1/2Fx$	$3/2Fx-1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	$Fb+1/2Fx$	$Fb-1/2Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	$-1/2Fx$	$1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
DC b	1	$1/2Fb-1/2Fx$	$1/2Fb-1/2Fx$	1		
DE 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
ED b	x/b	$Fb-1/2Fx$	$Fx-1/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	$3/2Fb-Fx-1/2qx^2$	0	0	0	0
BF b	0	$-2Fx+1/2qx^2$	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$1/6Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-1/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b)\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (1/2\ x/b\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = [1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (1/4\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -3/4\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (1/2 -1/2\ x/b\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = [1/2\ x -1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/E$

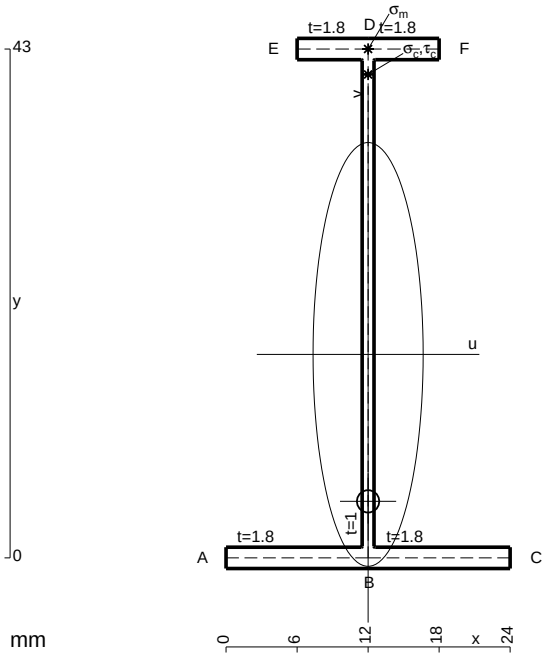
$= (1/2\ b -1/4\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -3/4\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2 -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/2\ x -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/3\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (\ x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

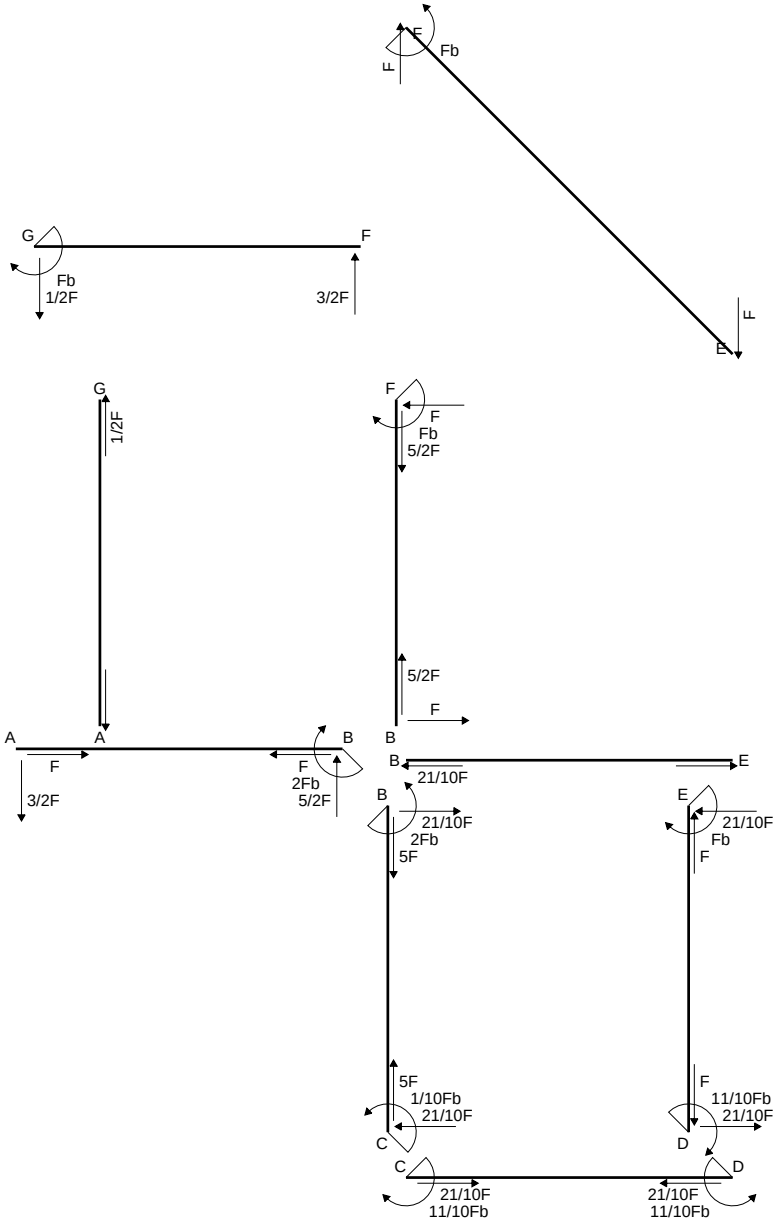
$= (1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/3\ \ Fb^2/EJ$

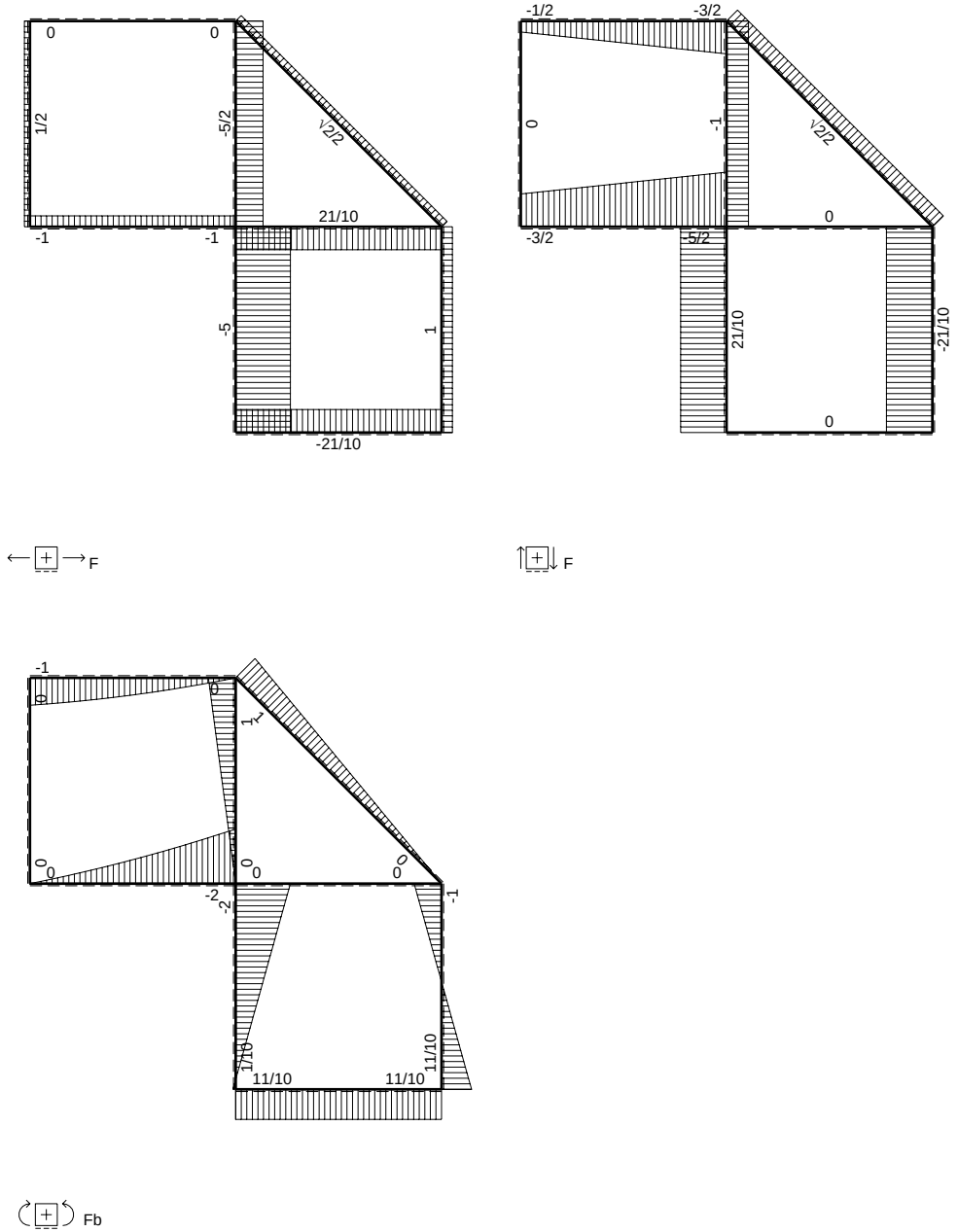


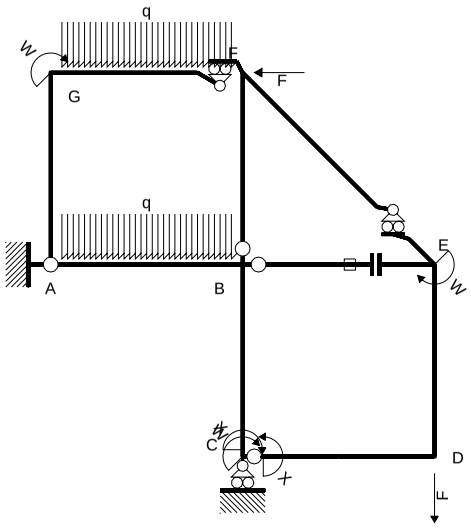
A = 107.8 mm^2
J_u = 34579. mm^4
J_v = 2333. mm^4
J_t = 84.32 mm^4
y_o = -12.41 mm
y_g = 17.19 mm
N = -600. N
T_y = -600. N
M_x = -274500. Nmm
x_m = 12. mm
y_m = 43. mm
v_m = 25.81 mm
$\sigma_m = N/A - Mv/J_u$ = 199.3 N/mm^2
y_c = 2. mm
u_c = -12. mm
v_c = -15.19 mm
$\sigma_c = N/A - Mv/J_u$ = 199.3 N/mm^2
$\tau_c = TS^*/tJ_u$ = 9.673 N/mm^2
$\tau_g = TS^*/tJ_u$ = 9.673 N/mm^2
t_c = 300. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 200. N/mm^2

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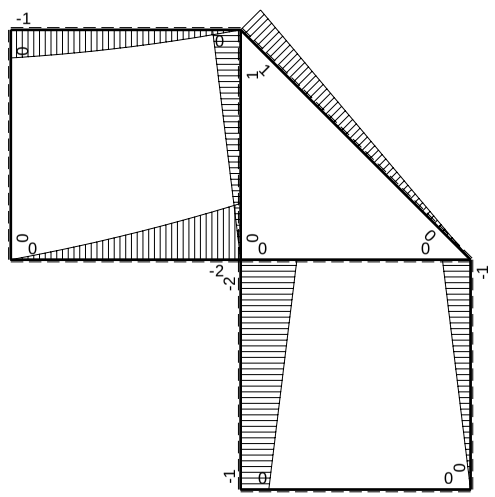
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Fb
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1/2F
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Fb
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A
A
B
B
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2Fb
5/2F
3/2F
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21/10F
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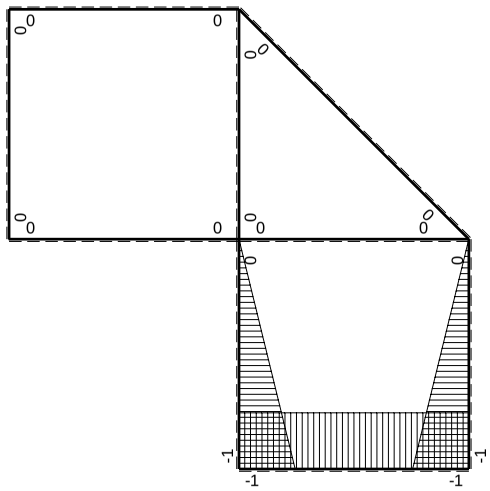

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-3/2
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-5/2
21/10
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0
0
1
1
0
0
0
0
0
0
-2
-2
-1
1/10
11/10
11/10
11/10
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-3/2Fx-1/2qx^2$	0	0	0	0
BA b	0	$2Fb-5/2Fx+1/2qx^2$	0	0		
BC b	-x/b	-2Fb+Fx	$2Fx-Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+Fx	$Fb-Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-3/2Fx+1/2qx^2$	0	0	0	0
GF b	0	$Fb-1/2Fx-1/2qx^2$	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$11/6Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				-11/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (2\ x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

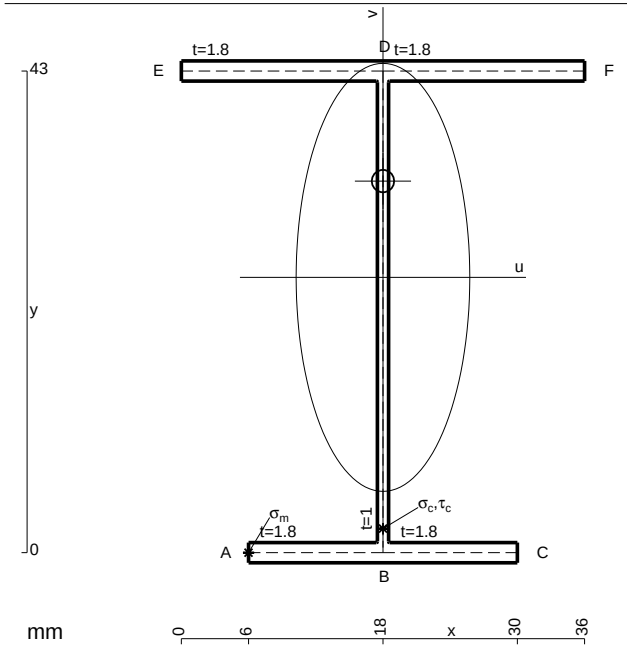
$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

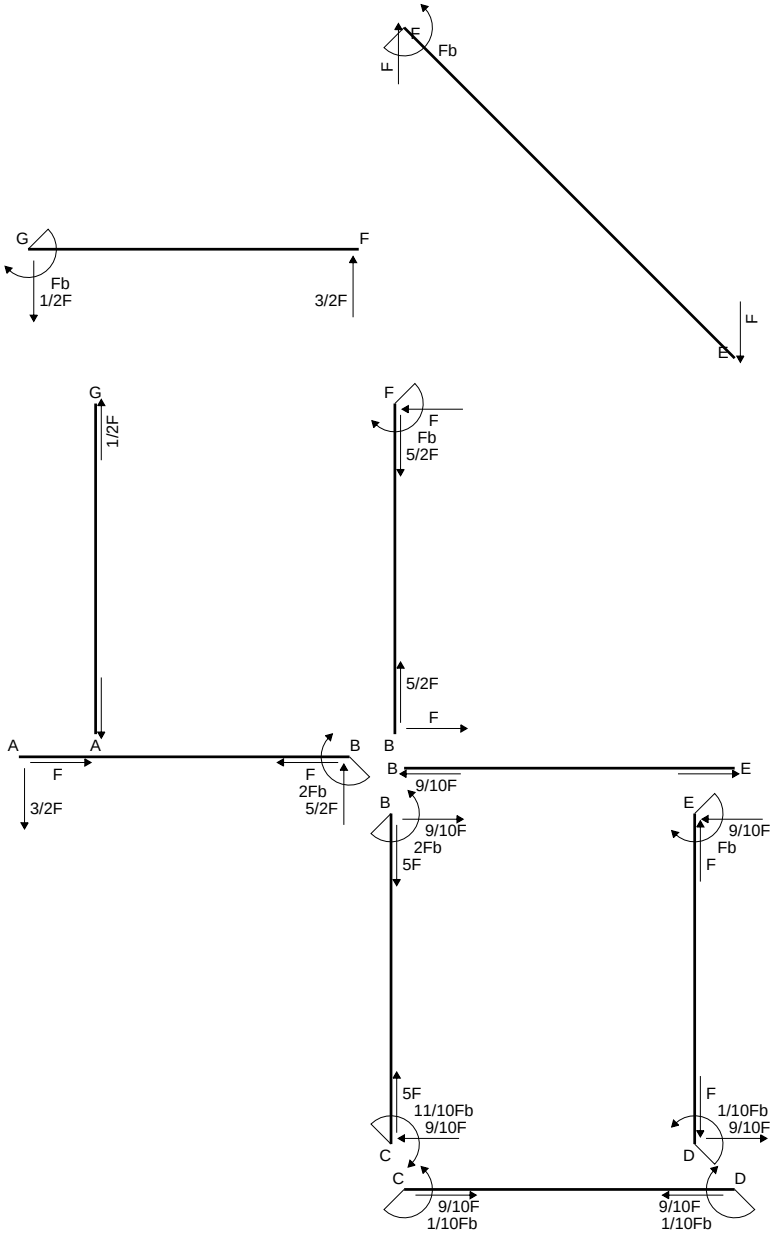
$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

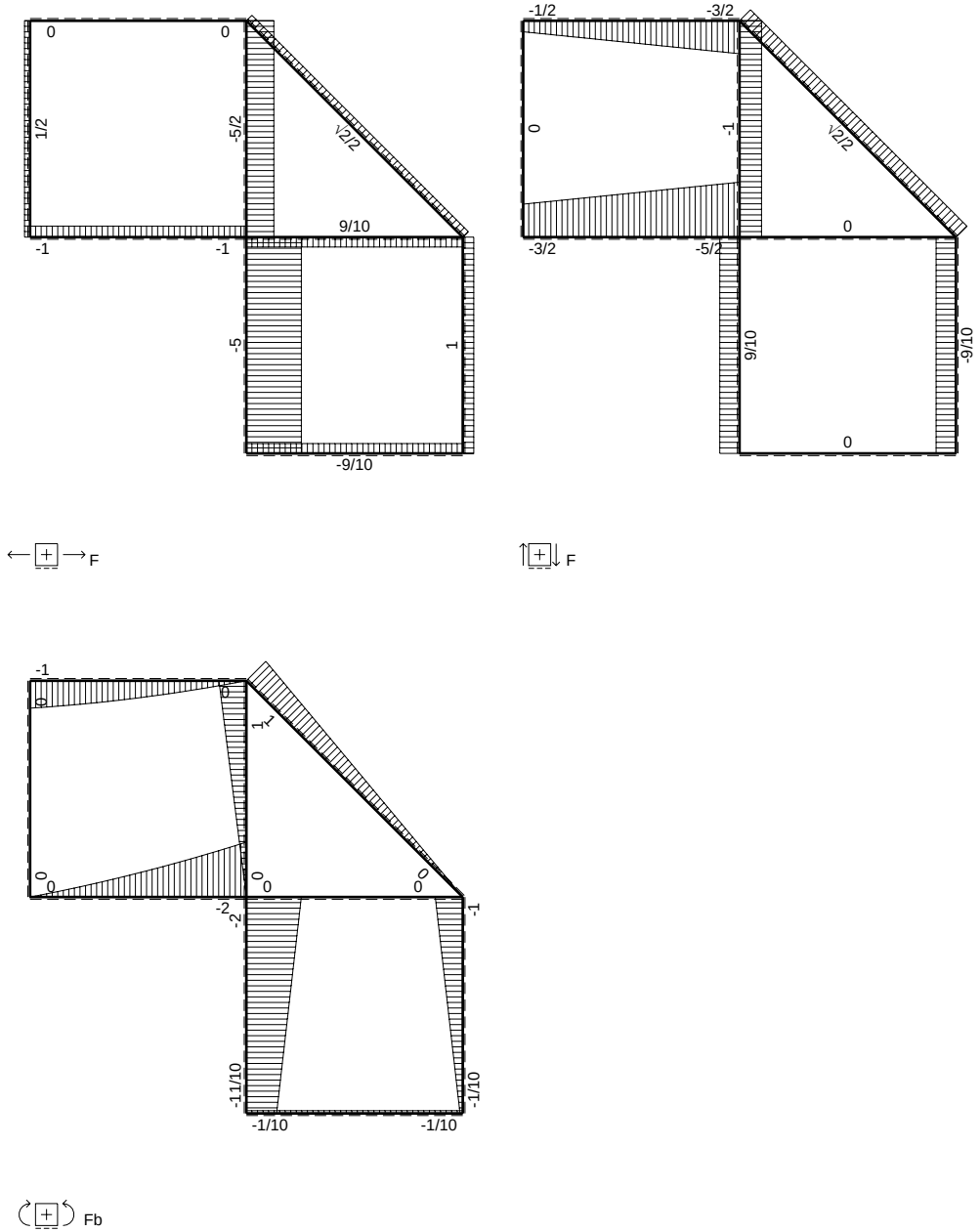


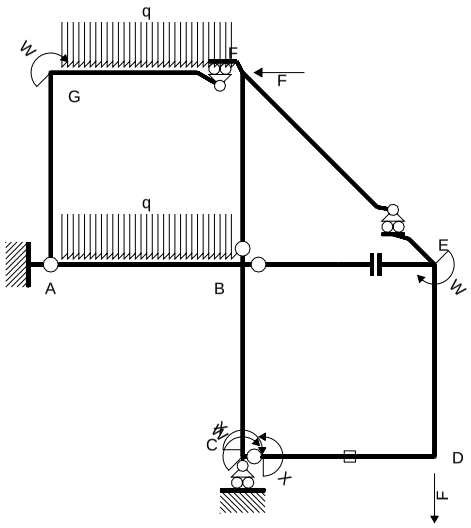
A = 151. mm^2
J_u = 55120. mm^4
J_v = 9072. mm^4
J_t = 131. mm^4
y_o = 8.596 mm
y_g = 24.58 mm
N = -350. N
T_y = -875. N
M_x = -455000. Nmm
x_m = 6. mm
u_m = -12. mm
v_m = -24.58 mm
$\sigma_m = N/A - Mv/J_u$ = -205.2 N/mm^2
x_c = 18. mm
v_c = -24.58 mm
$\sigma_c = N/A - Mv/J_u$ = -205.2 N/mm^2
$\tau_c = TS^*/tJ_u$ = 16.85 N/mm^2
$\tau_g = TS^*/tJ_u$ = 16.85 N/mm^2
t_c = 350. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 207.2 N/mm^2

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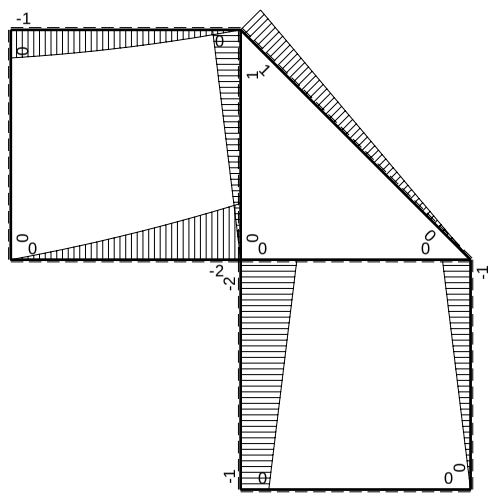
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A
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B
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F
3/2F
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2Fb
5/2F
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9/10F
2Fb
5F
E
9/10F
Fb
F
5F
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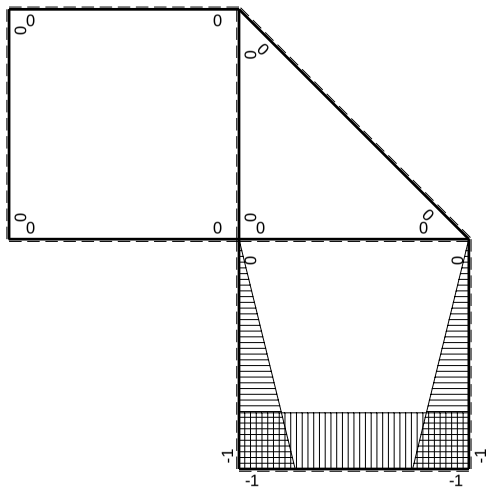

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√2/2
-3/2
-5/2
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9/10
-9/10
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F
-1
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0
0
-2
-2
-1
-11/10
-1/10
-1/10
-1/10
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-3/2Fx-1/2qx^2$	0	0	0	0
BA b	0	$2Fb-5/2Fx+1/2qx^2$	0	0		
BC b	-x/b	-2Fb+Fx	$2Fx-Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+Fx	$Fb-Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-3/2Fx+1/2qx^2$	0	0	0	0
GF b	0	$Fb-1/2Fx-1/2qx^2$	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/6Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				$1/10Fb$	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 - 2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b + 1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b + 1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 - 2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b + 1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b + 1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (2\ x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x^2/b - 1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b - 1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x - 1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

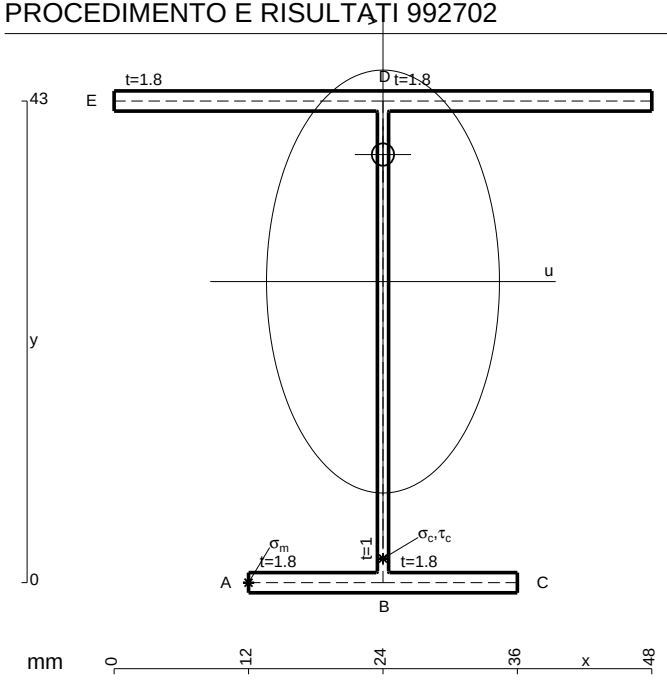
$= (\ b - 1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b - 1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b - 1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b - 1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

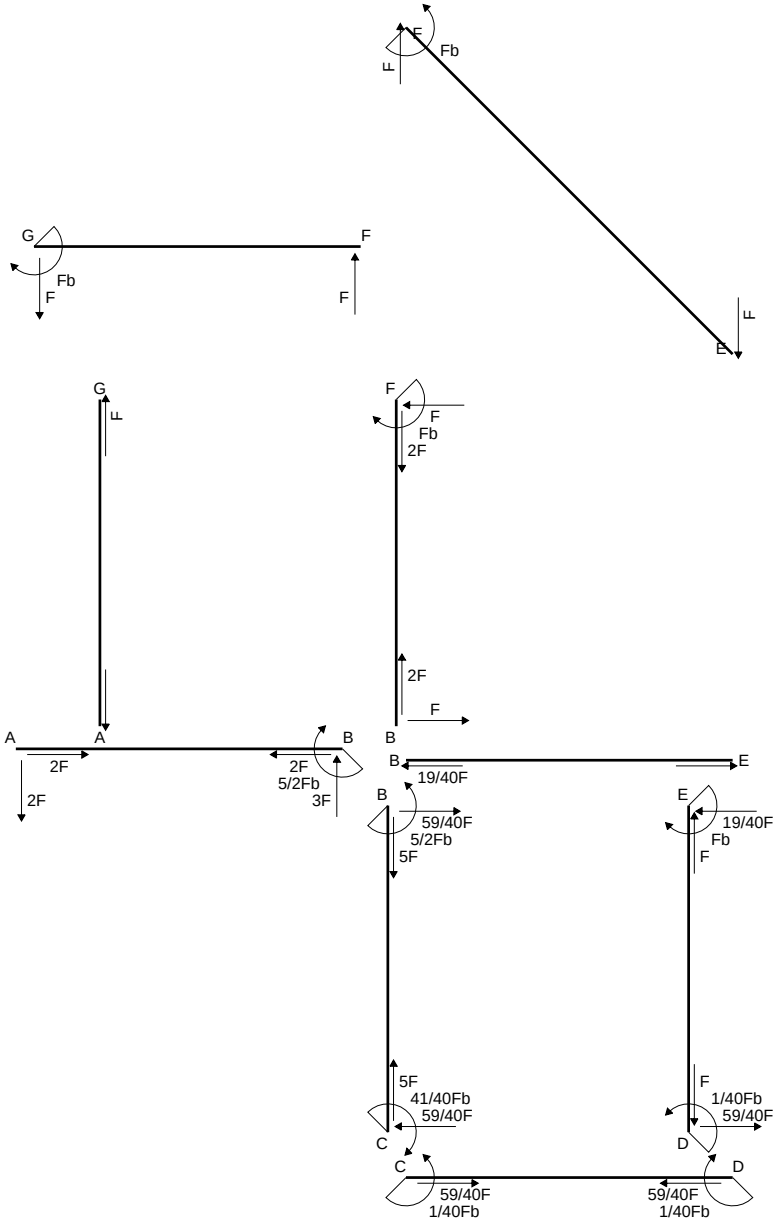
$= (1/2\ b - 1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

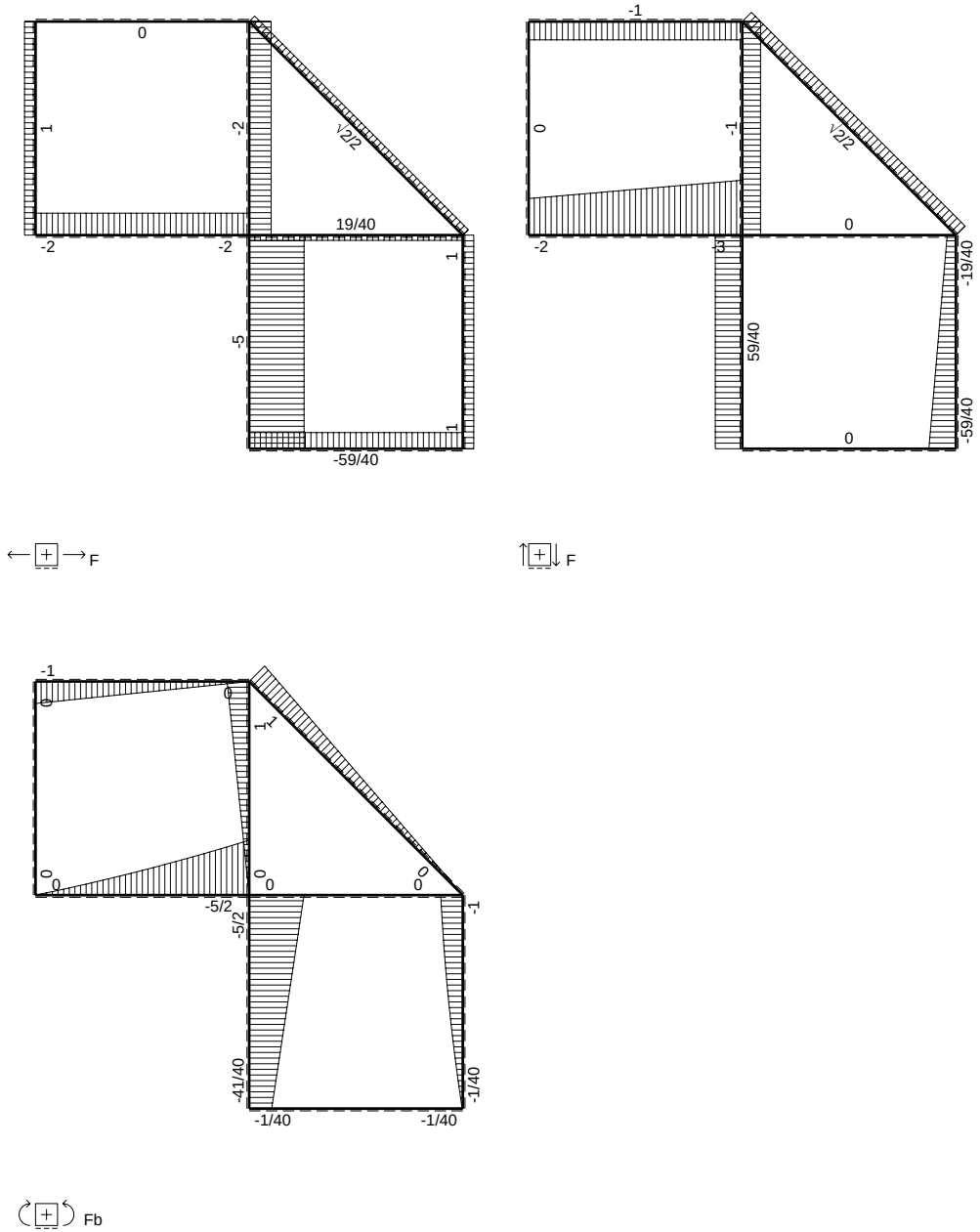


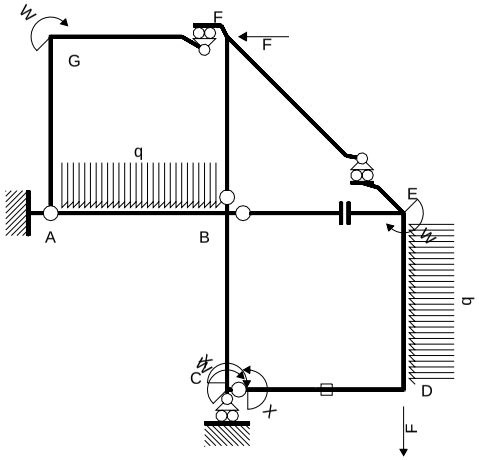
A = 172.6 mm^2
J_u = 61535. mm^4
J_v = 18662. mm^4
J_t = 154.3 mm^4
y_o = 11.34 mm
y_g = 26.88 mm
N = -360. N
T_y = -900. N
M_x = -496800. Nmm
x_m = 12. mm
u_m = -12. mm
v_m = -26.88 mm
$\sigma_m = N/A - Mv/J_u$ = -219.1 N/mm^2
x_c = 24. mm
v_c = -26.88 mm
$\sigma_c = N/A - Mv/J_u$ = -219.1 N/mm^2
$\tau_c = TS^*/tJ_u$ = 16.98 N/mm^2
$\tau_g = TS^*/tJ_u$ = 16.98 N/mm^2
t_c = 360. mm
$\sigma_o = \sqrt{\sigma^2 + 3\tau^2}$ = 221.1 N/mm^2

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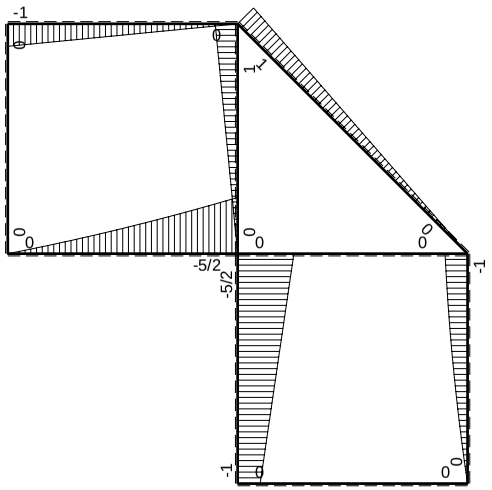
@ Adolfo Zavelani Rossi, Politecnico di Milano, vers.27.03.13 16.04.26


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2F
5/2Fb
3F
19/40F
B
59/40F
5/2Fb
5F
E
19/40F
Fb
F
5F
41/40Fb
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59/40F
1/40Fb

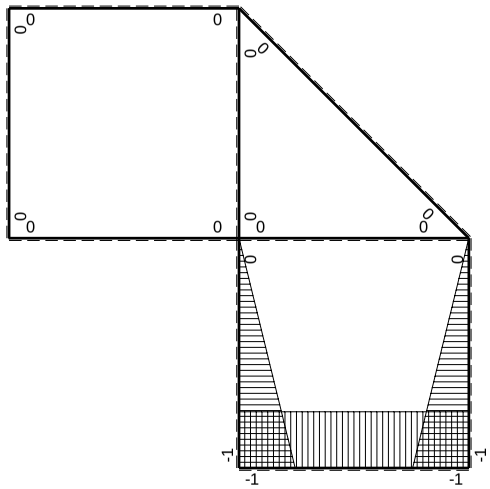

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-1
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-19/40
59/40
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-59/40
F
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0
0
-5/2
-5/2
-1
-41/40
-1/40
-1/40
-1/40
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-2Fx-1/2qx^2$	0	0	0	0
BA b	0	$5/2Fb-3Fx+1/2qx^2$	0	0		
BC b	-x/b	$-5/2Fb+3/2Fx$	$5/2Fx-3/2Fx^2/b$	x^2/b^2	$3/4Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	$Fb+3/2Fx$	$Fb+1/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	$-3/2Fx+1/2qx^2$	$3/2Fx-2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$5/24Fb^2/EJ$	1/3Xb/EJ
ED b	x/b	$Fb-1/2Fx-1/2qx^2$	$Fx-1/2Fx^2/b-1/2qx^3/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/24Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				1/40Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 +1/2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x +1/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

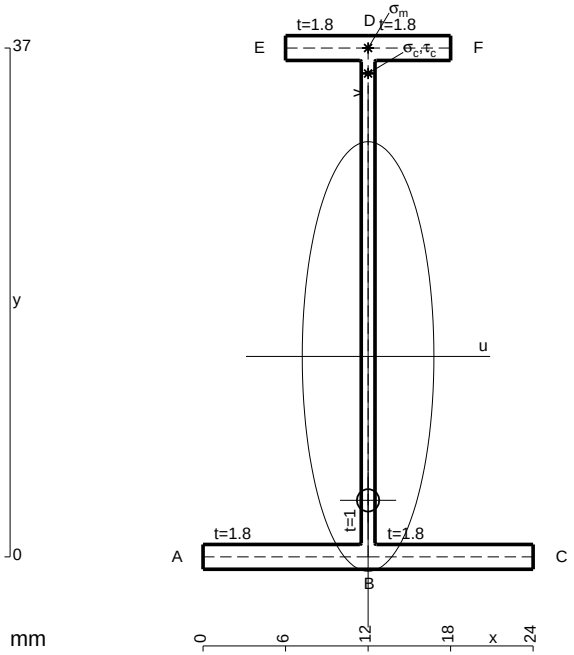
$= (\ b +1/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (3/2\ x/b -2\ x^2/b^2 +1/2\ x^3/b^3)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -2/3\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -2/3\ b +1/8\ b\ )\ Fb\ 1/EJ\ = 5/24\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (\ x/b -1/2\ x^2/b^2 -1/2\ x^3/b^3)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/6\ x^3/b^2 -1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

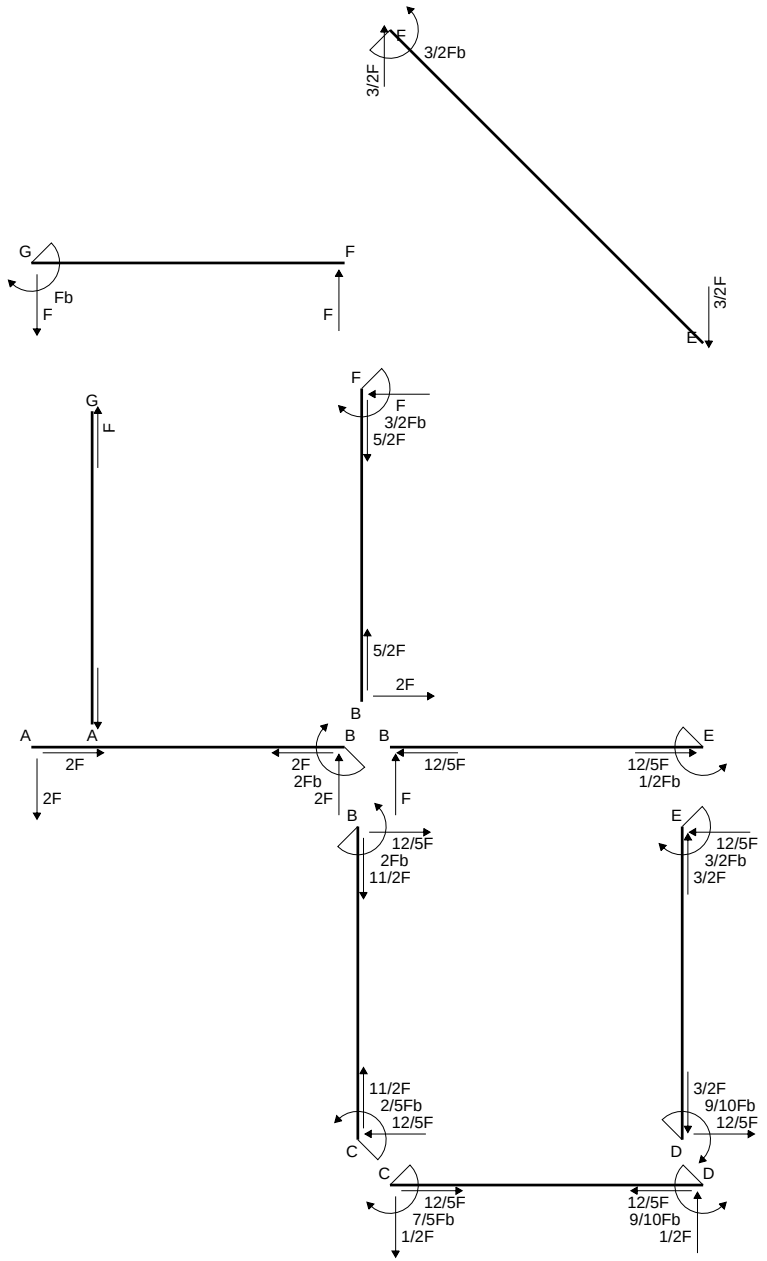
$= (1/2\ b -1/6\ b -1/8\ b\ )\ Fb\ 1/EJ\ = 5/24\ \ Fb^2/EJ$

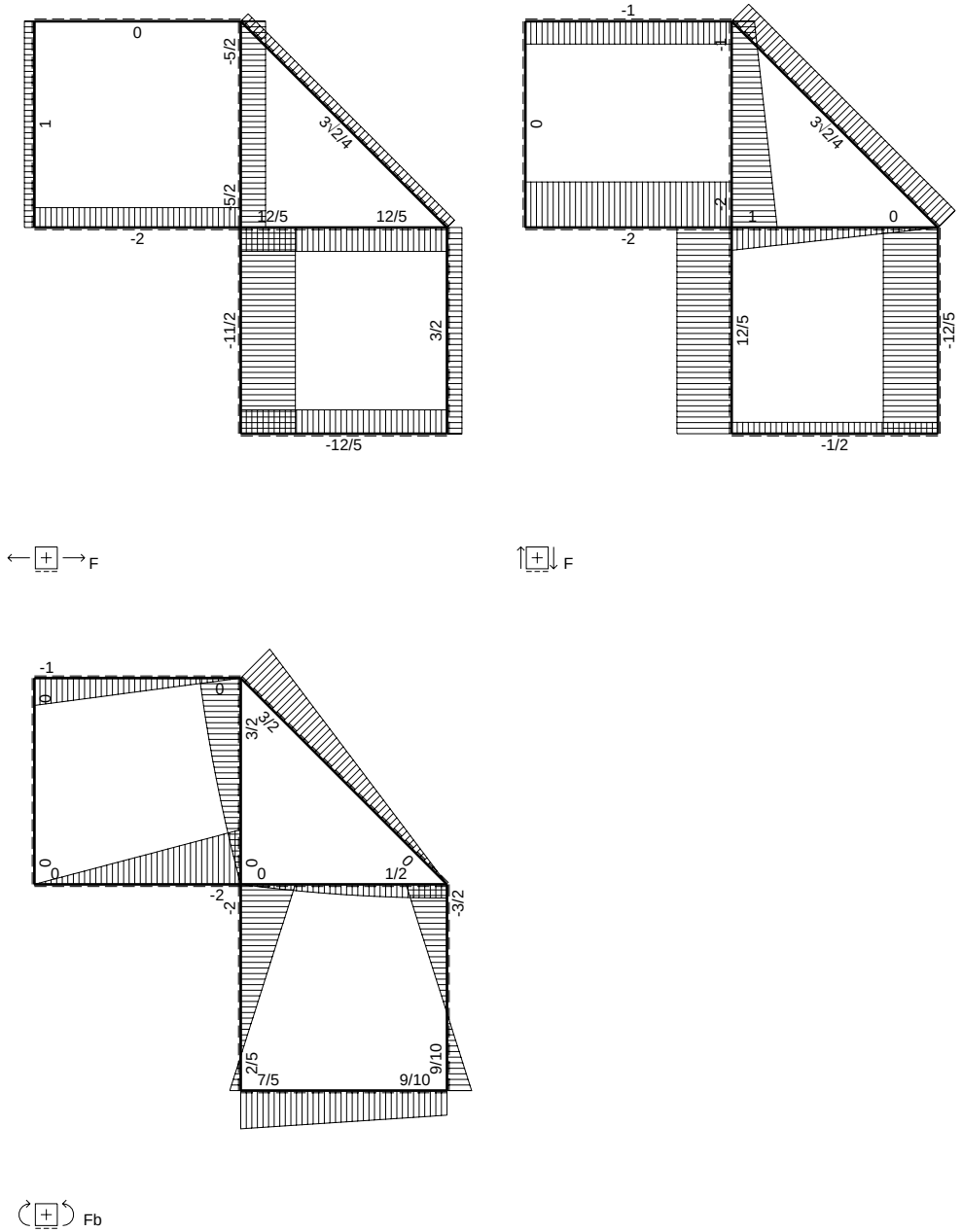


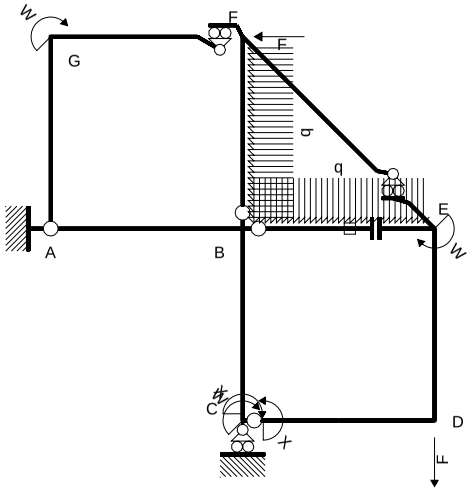
A = 101.8 mm^2
J_u = 24830. mm^4
J_v = 2333. mm^4
J_t = 82.32 mm^4
y_o = -10.46 mm
y_g = 14.57 mm
N = -320. N
T_y = -480. N
M_x = -252000. Nmm
x_m = 12. mm
y_m = 37. mm
v_m = 22.43 mm
$\sigma_m = N/A - Mv/J_u$ = 224.4 N/mm^2
y_c = 2. mm
u_c = -12. mm
v_c = -12.57 mm
$\sigma_c = N/A - Mv/J_u$ = 224.4 N/mm^2
$\tau_c = TS^*/tJ_u$ = 9.364 N/mm^2
$\tau_g = TS^*/tJ_u$ = 9.364 N/mm^2
t_c = 160. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 225. N/mm^2

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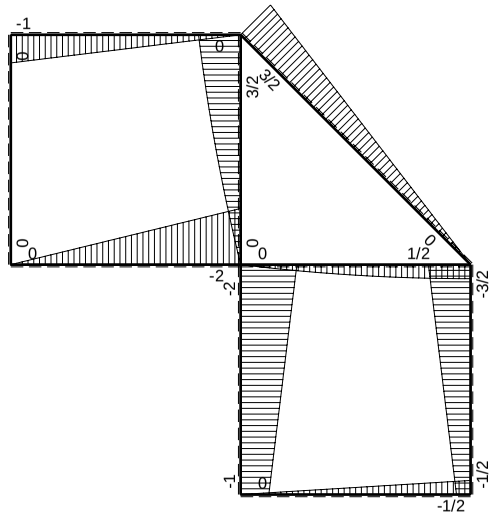
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F
3/2Fb
3/2F
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Fb
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F
3/2F
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G
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3/2Fb
5/2F
5/2F
2F
B
A
A
B
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E
2F
2F
2Fb
2F
12/5F
12/5F
1/2Fb
2F
B
F
B
12/5F
2Fb
11/2F
E
12/5F
3/2Fb
3/2F
11/2F
2/5Fb
12/5F
C
3/2F
9/10Fb
12/5F
D
C
D
12/5F
7/5Fb
1/2F
12/5F
9/10Fb
1/2F

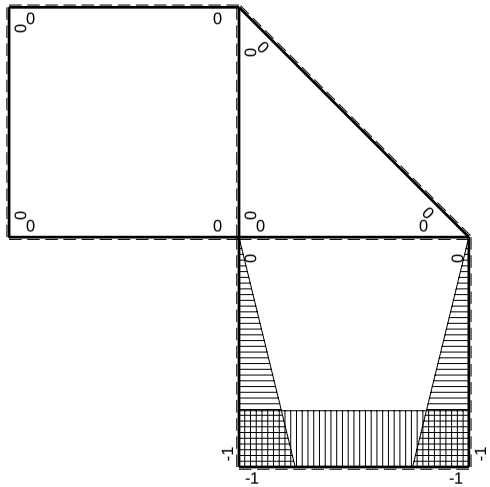

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0
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1
0
-2
12/5
-12/5
-1/2
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F
-1
0
3/2
3/2
0
0
0
0
1/2
-2
-2
-3/2
2/5
7/5
9/10
9/10
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_o	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0		
BC b	-x/b	-2Fb+Fx	2Fx-Fx^2/b	x^2/b^2	$2/3Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	-1/2Fx	1/2Fx	1	$1/4Fb^2/EJ$	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE b	-1+x/b	-1/2Fb-Fx	1/2Fb+1/2Fx-Fx^2/b	1-2x/b+x^2/b^2	$5/12Fb^2/EJ$	1/3Xb/EJ
ED b	x/b	3/2Fb-Fx	3/2Fx-Fx^2/b	x^2/b^2		
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	3/2Fb-Fx-1/2qx^2	0	0	0	0
BF b	0	-2Fx+1/2qx^2	0	0		
BE b	0	Fx-1/2qx^2	0	0	0	0
EB b	0	-1/2Fb+1/2qx^2	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$7/3Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-7/5Fb	

Sviluppi di calcolo iperstatica

PROCEDIMENTO E RISULTATI 266797 CI02.xxxx.059

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$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (2\ x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (1/2\ x/b\ )\ Fb\ 1/EJ\ dx = [1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b\ )\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (1/2 -1/2\ x/b\ )\ Fb\ 1/EJ\ dx = [1/2\ x -1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

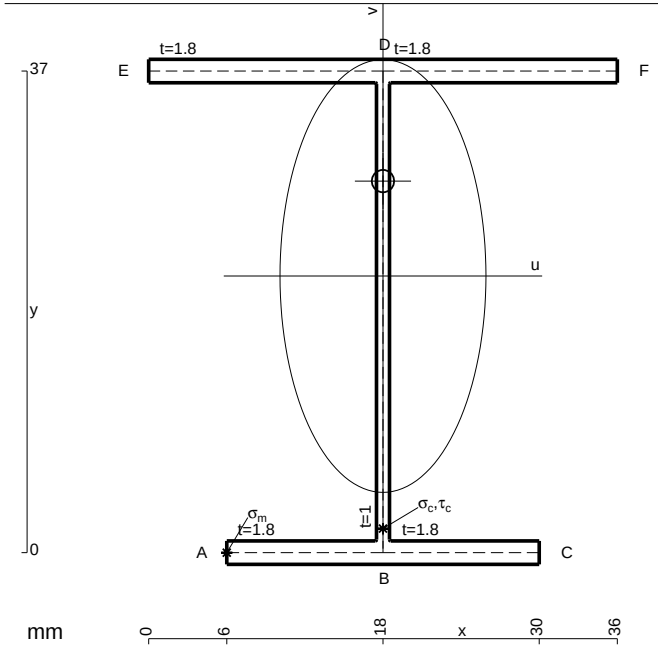
$= (1/2\ b -1/4\ b\ )\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2 +1/2\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x +1/4\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b +1/4\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 5/12\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (3/2\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

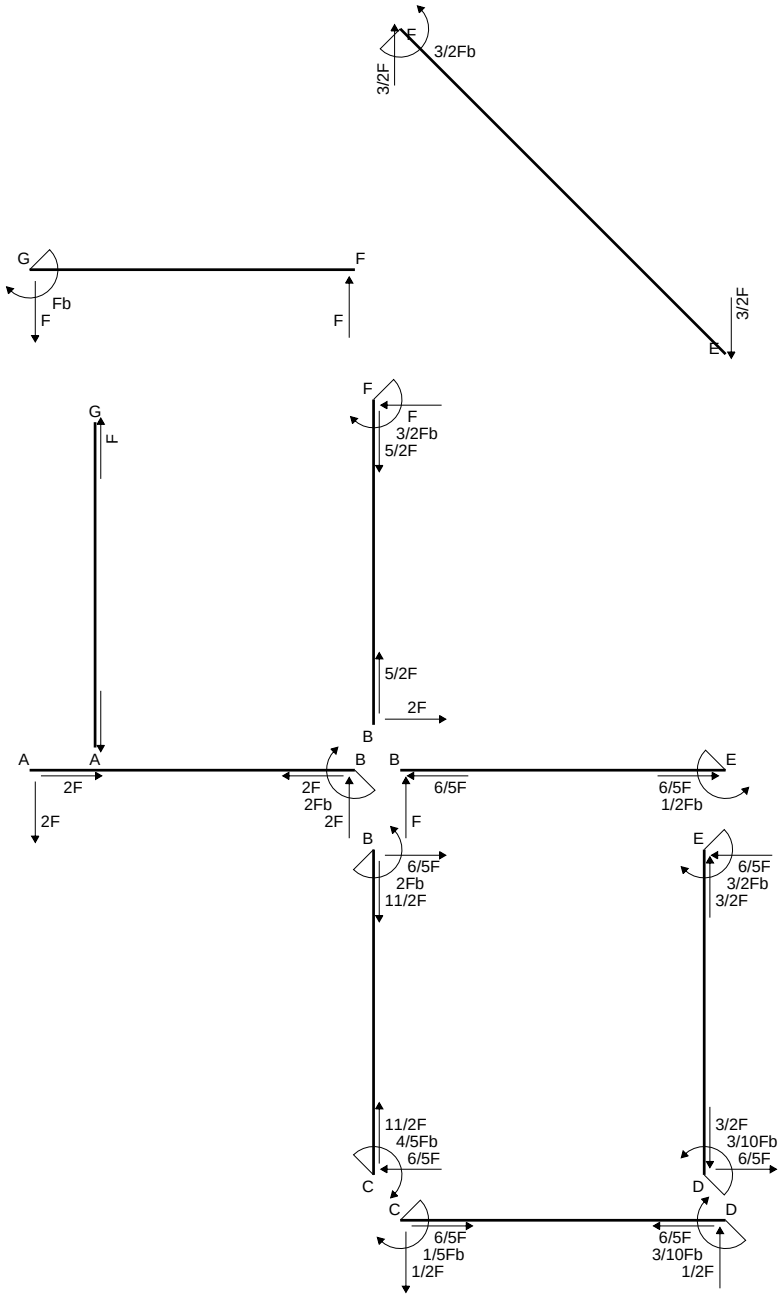
$= (3/4\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 5/12\ Fb^2/EJ$

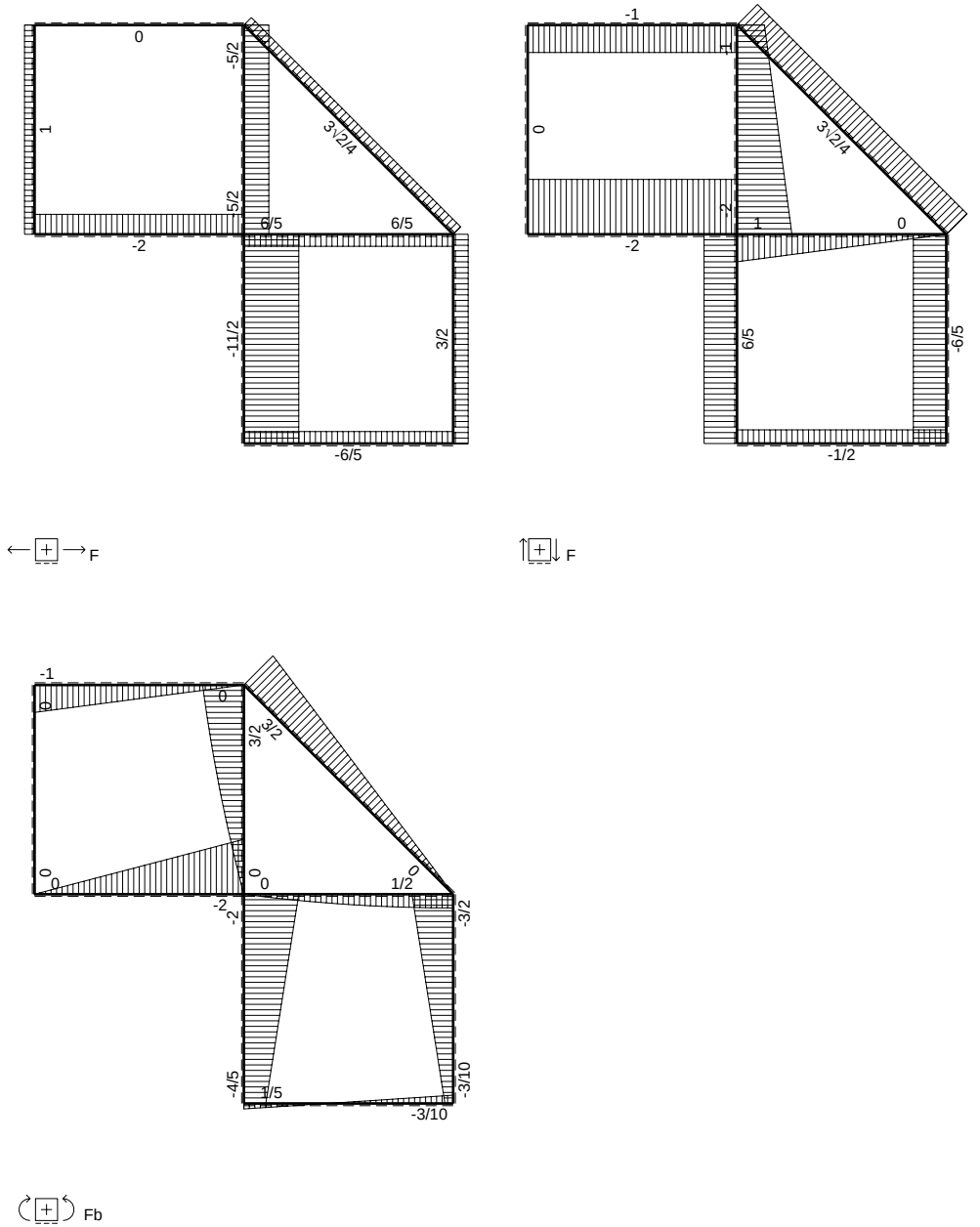


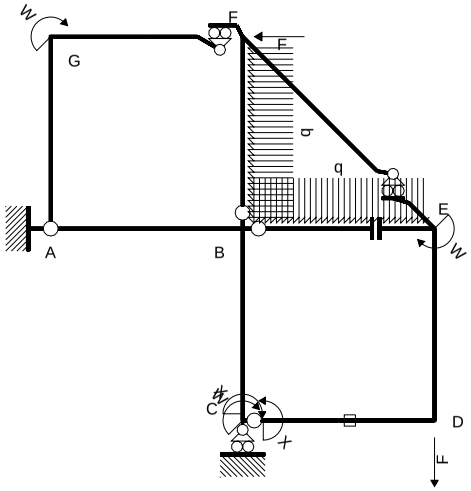
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J_u = 40083. mm^4
J_v = 9072. mm^4
J_t = 129. mm^4
y_o = 7.287 mm
y_g = 21.26 mm
N = -660. N
T_y = -660. N
M_x = -435600. Nmm
x_m = 6. mm
u_m = -12. mm
v_m = -21.26 mm
$\sigma_m = N/A - Mv/J_u$ = -235.6 N/mm^2
x_c = 18. mm
v_c = -21.26 mm
$\sigma_c = N/A - Mv/J_u$ = -235.6 N/mm^2
$\tau_c = TS^*/tJ_u$ = 15.12 N/mm^2
$\tau_g = TS^*/tJ_u$ = 15.12 N/mm^2
t_c = 330. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 237. N/mm^2

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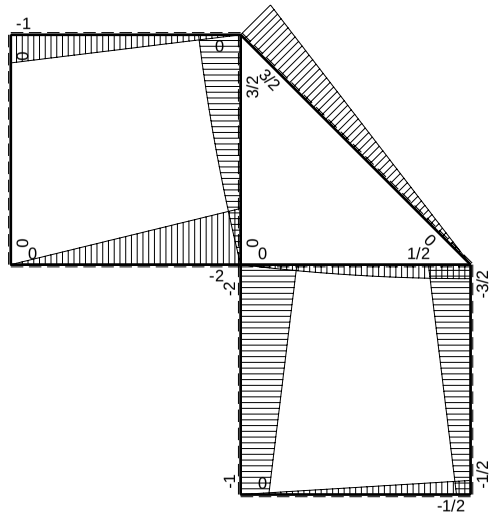
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E
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F
E
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4/5Fb
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6/5F
3/10Fb
1/2F

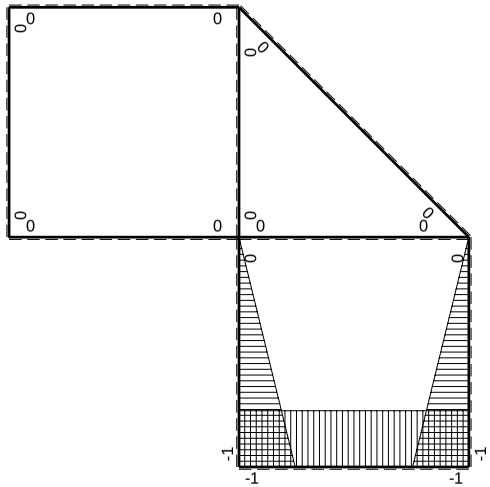

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3√2/4
2
1
0
-2
6/5
-6/5
-1/2
F
-1
0
0
3/2
√2
0
0
0
0
1/2
-2
-2
-3/2
-4/5
1/5
-3/10
-3/10
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0		
BC b	-x/b	-2Fb+Fx	2Fx-Fx^2/b	x^2/b^2	2/3Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb^2/EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE b	-1+x/b	-1/2Fb-Fx	1/2Fb+1/2Fx-Fx^2/b	1-2x/b+x^2/b^2	5/12Fb^2/EJ	1/3Xb/EJ
ED b	x/b	3/2Fb-Fx	3/2Fx-Fx^2/b	x^2/b^2		
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	3/2Fb-Fx-1/2qx^2	0	0	0	0
BF b	0	-2Fx+1/2qx^2	0	0		
BE b	0	Fx-1/2qx^2	0	0	0	0
EB b	0	-1/2Fb+1/2qx^2	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				-Fb^2/EJ	
	totali				1/3Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-1/5Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (2\ x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ \ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (1/2\ x/b\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = [1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (1/4\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -3/4\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (1/2 -1/2\ x/b\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = [1/2\ x -1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/E$

$= (1/2\ b -1/4\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -3/4\ \ Fb^2/EJ$

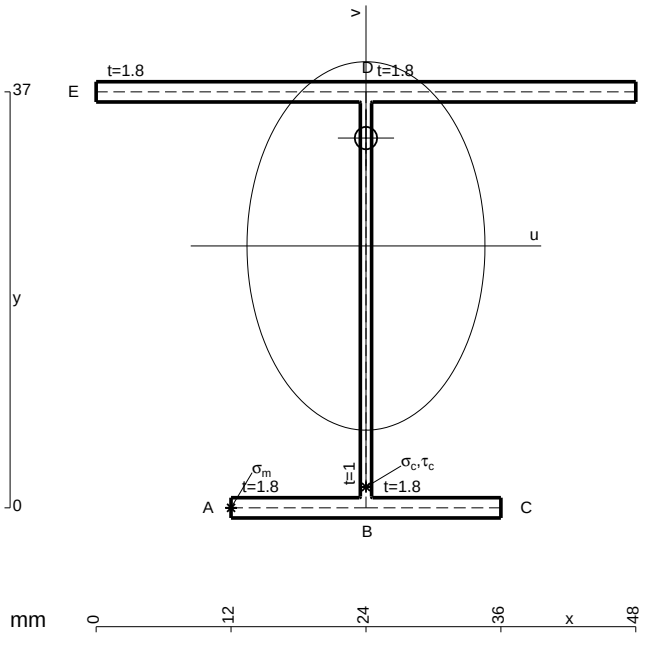
$L^{Xo}_{DE} = \int_o^b (1/2 +1/2\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x +1/4\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b +1/4\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 5/12\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (3/2\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 5/12\ \ Fb^2/EJ$

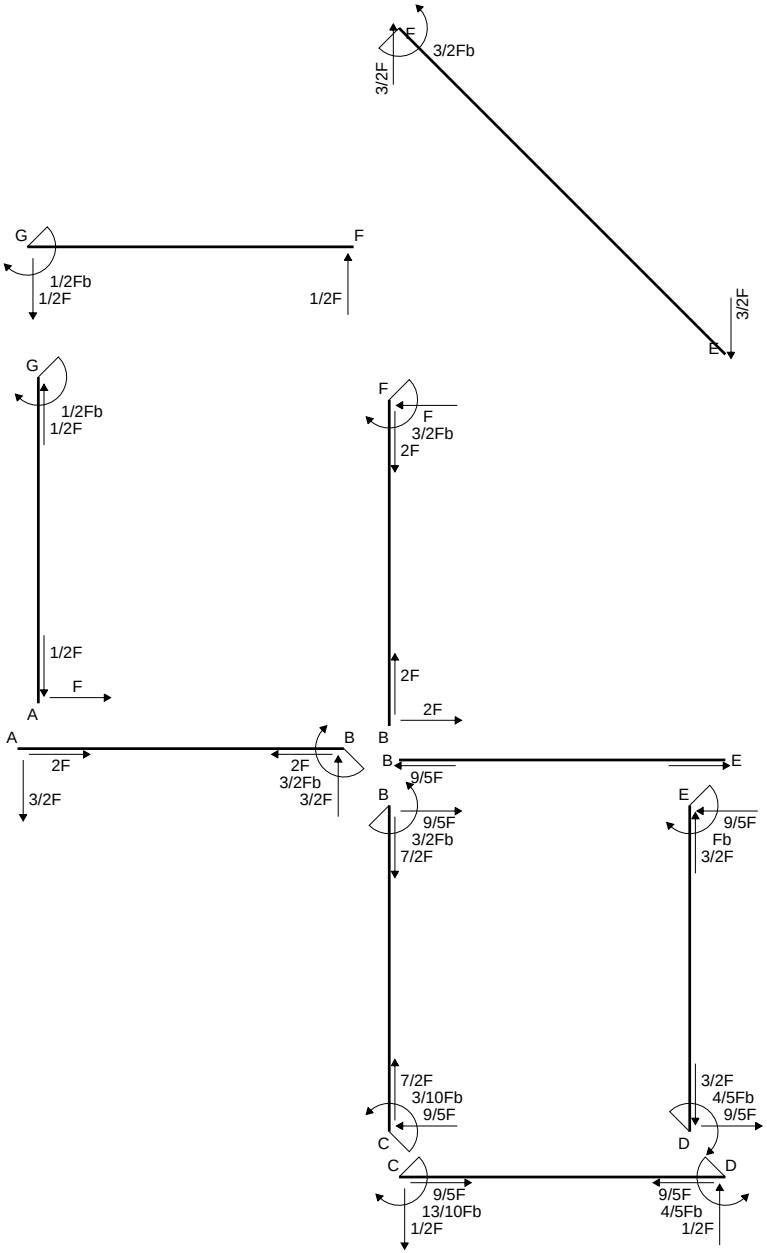
PROCEDIMENTO E RISULTATI 268175 CI02.xxxx.060

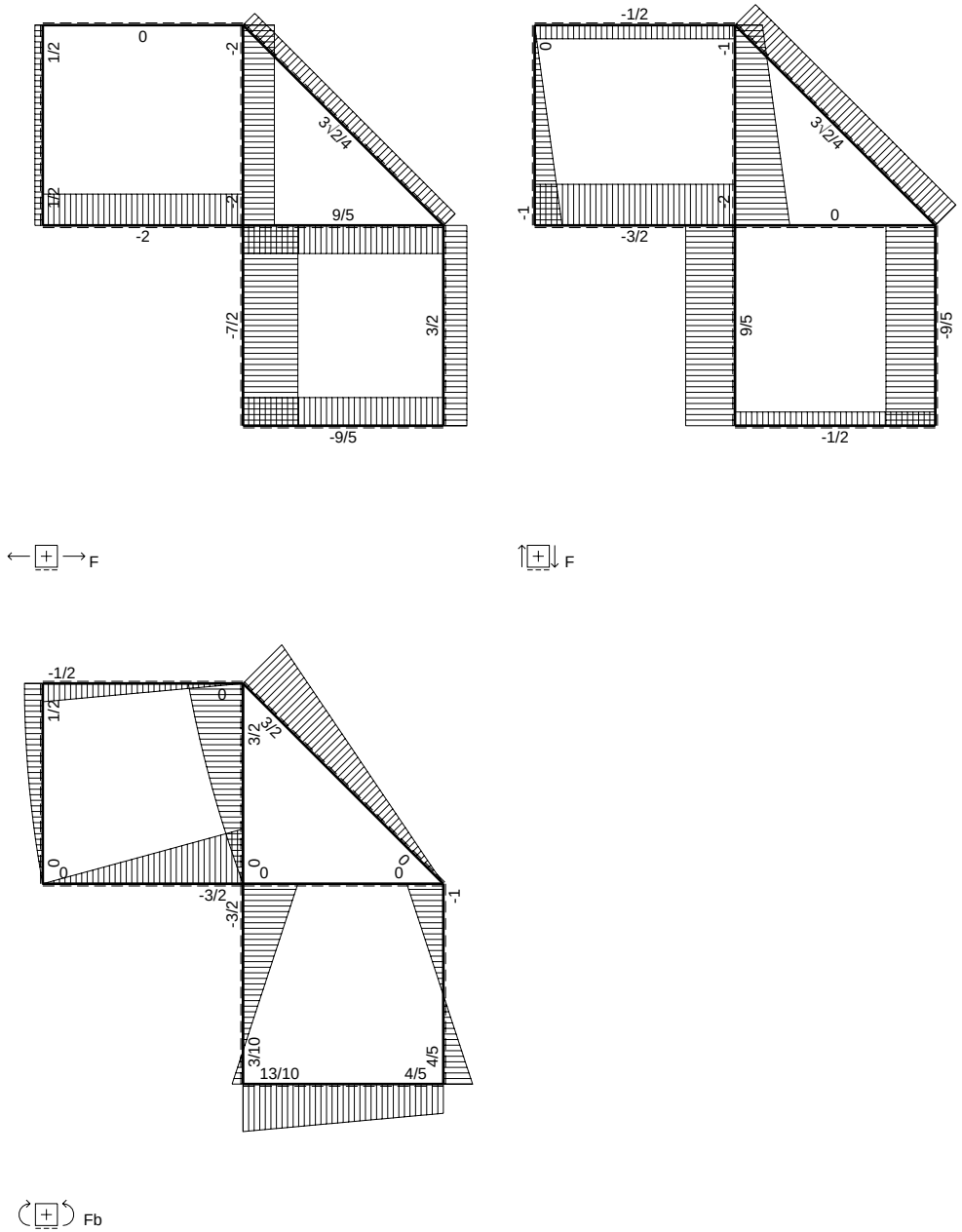


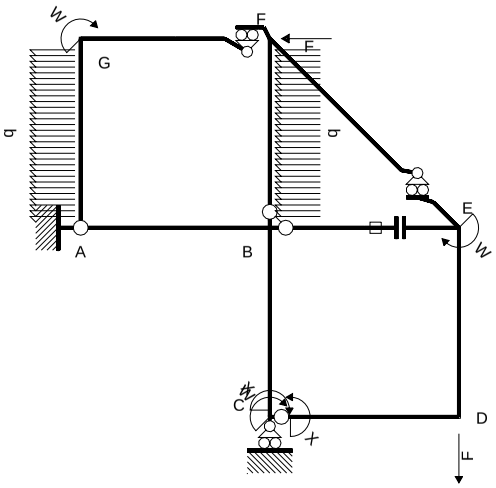
A = 166.6 mm^2
J_u = 44743. mm^4
J_v = 18662. mm^4
J_t = 152.3 mm^4
y_o = 9.592 mm
y_g = 23.3 mm
N = -1060. N
T_y = -1060. N
M_x = -371000. Nmm
x_m = 12. mm
u_m = -12. mm
v_m = -23.3 mm
$\sigma_m = N/A - Mv/J_u$ = -199.5 N/mm^2
x_c = 24. mm
v_c = -23.3 mm
$\sigma_c = N/A - Mv/J_u$ = -199.5 N/mm^2
$\tau_c = TS^*/tJ_u$ = 23.84 N/mm^2
$\tau_g = TS^*/tJ_u$ = 23.84 N/mm^2
t_c = 530. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 203.8 N/mm^2

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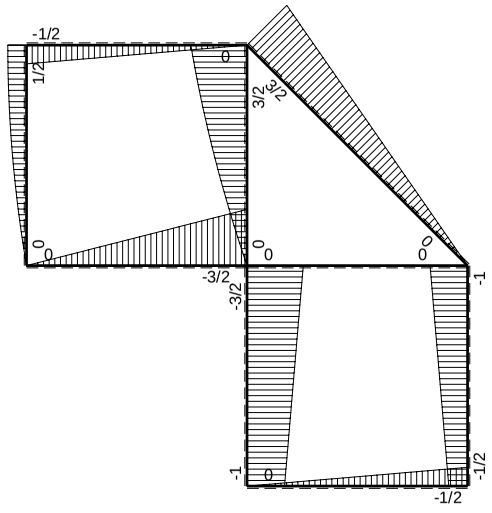
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F
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G
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1/2Fb
1/2F
1/2F
3/2F
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G
1/2Fb
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9/5F
3/2Fb
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7/2F
3/10Fb
9/5F
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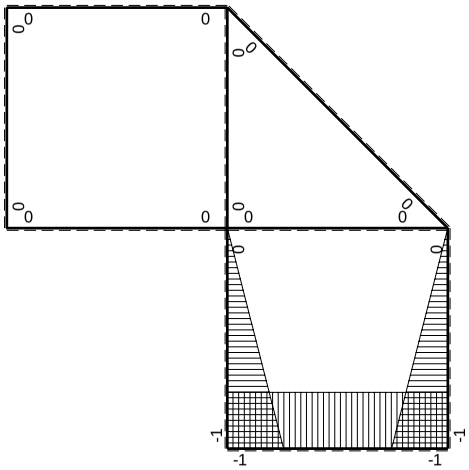

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-2
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1/2
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F
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3√2/4
-1
2
0
-3/2
9/5
-9/5
-1/2
F
-1/2
1/2
0
3/2
3/2
0
0
0
0
-3/2
-3/2
-1
3/10
13/10
4/5
4/5
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0		
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx^2/b	x^2/b^2	7/12Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb^2/EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE 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
ED b	x/b	Fb-1/2Fx	Fx-1/2Fx^2/b	x^2/b^2		
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-1/2Fx	0	0	0	0
GF b	0	1/2Fb-1/2Fx	0	0		
GA b	0	1/2Fb-1/2qx^2	0	0	0	0
AG b	0	-Fx+1/2qx^2	0	0		
FB b	0	3/2Fb-Fx-1/2qx^2	0	0	0	0
BF b	0	-2Fx+1/2qx^2	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				13/6Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-13/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2\ )\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (1/2\ x/b\ )\ Fb\ 1/EJ\ dx = [1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b\ )\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (1/2 -1/2\ x/b\ )\ Fb\ 1/EJ\ dx = [1/2\ x -1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

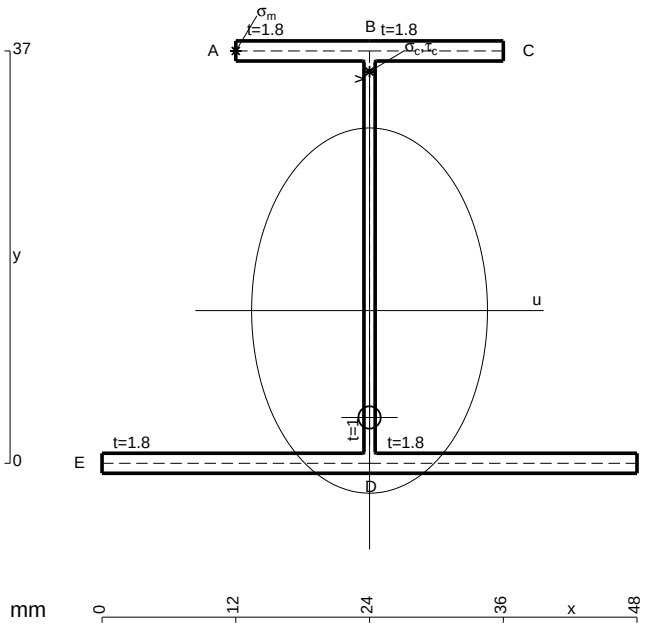
$= (1/2\ b -1/4\ b\ )\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2 -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/3\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (\ x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/3\ Fb^2/EJ$



$A = 166.6\ mm^2$

$J_u = 44743.\ mm^4$

$J_v = 18662.\ mm^4$

$J_t = 152.3\ mm^4$

$y_o = -9.592\ mm$

$y_g = 13.7\ mm$

$N = -1460.\ N$

$T_y = -1095.\ N$

$M_x = -416100.\ Nmm$

$x_m = 12.\ mm$

$y_m = 37.\ mm$

$u_m = -12.\ mm$

$v_m = 23.3\ mm$

$\sigma_m = N/A - Mv/J_u = 207.9\ N/mm^2$

$x_c = 24.\ mm$

$y_c = 37.\ mm$

$v_c = 23.3\ mm$

$\sigma_c = N/A - Mv/J_u = 207.9\ N/mm^2$

$\tau_c = TS^*/tJ_u = 24.63\ N/mm^2$

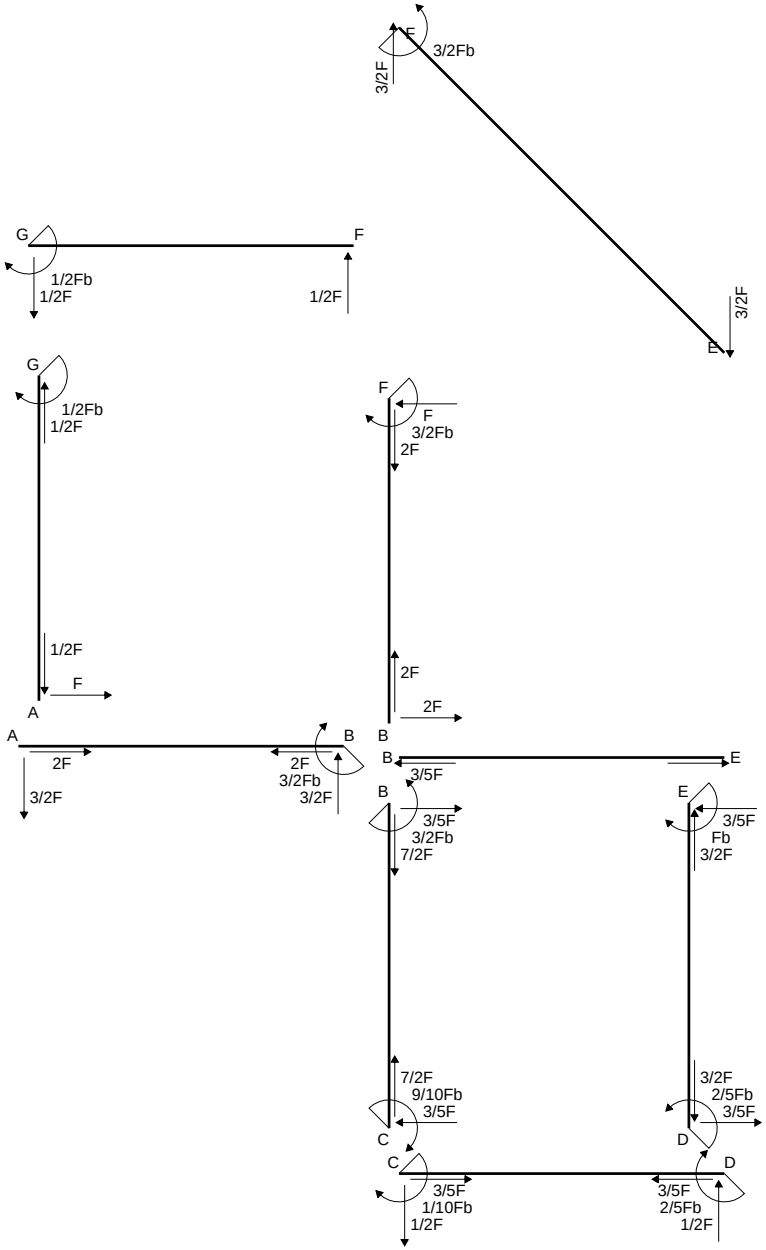
$\tau_g = TS^*/tJ_u = 24.63\ N/mm^2$

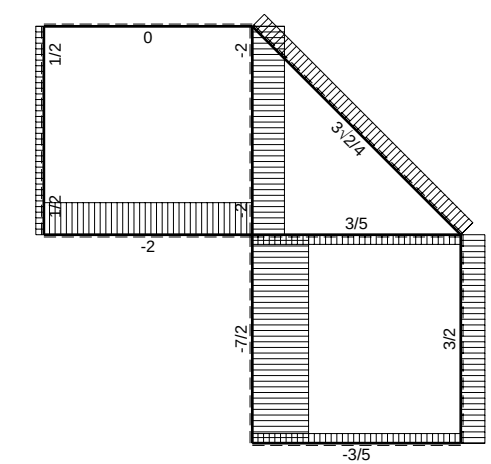
$t_c = 730.\ mm$

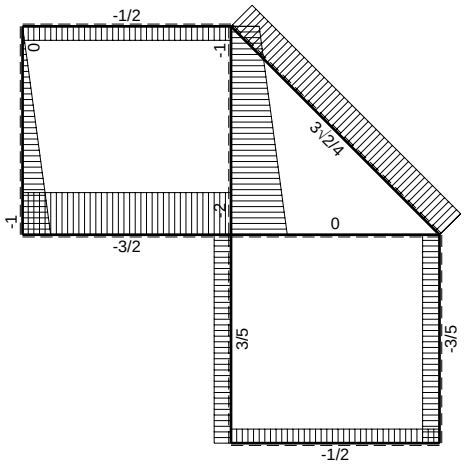
$\sigma_o = \sqrt{\sigma^2 + 3\tau^2} = 212.2\ N/mm^2$

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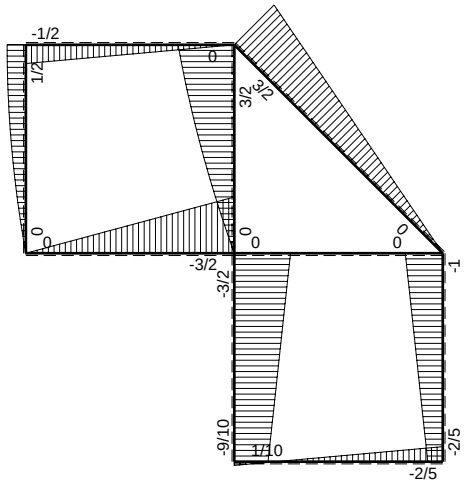

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3/2F
G
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1/2Fb
1/2F
1/2F
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3/5F
Fb
3/2F
7/2F
9/10Fb
3/5F
3/2F
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3/5F
C
D
C
D
3/5F
1/10Fb
1/2F
3/5F
2/5Fb
1/2F


1/2
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-2
3√2/4
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-2
-2
3/5
-7/2
3/2
-3/5

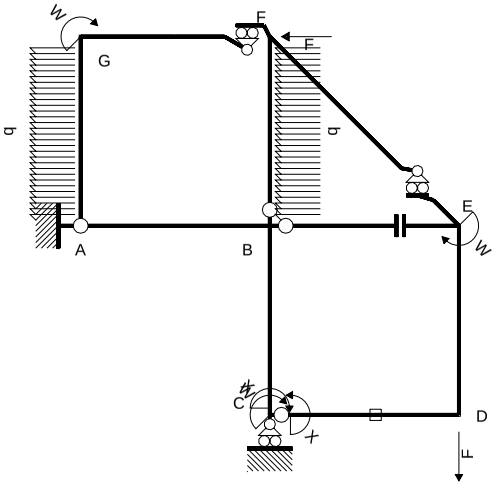

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-1
3√2/4
-1
2
0
-3/2
3/5
-3/5
-1/2

F

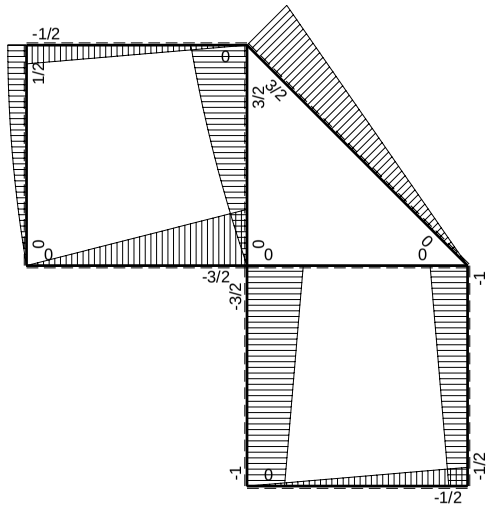
F


-1/2
1/2
0
3/2
3√2/4
0
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0
0
0
-3/2
-3/2
-1
-9/10
1/10
-2/5
-2/5

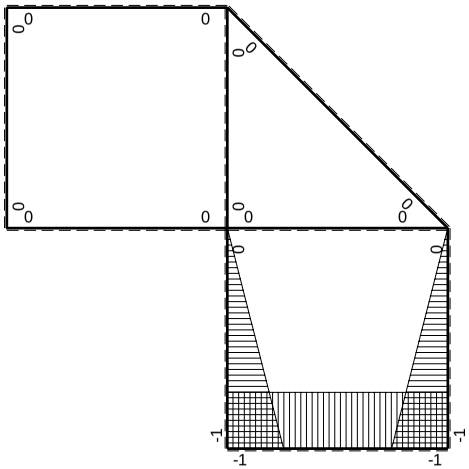
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0		
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx^2/b	x^2/b^2	7/12Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb^2/EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE 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
ED b	x/b	Fb-1/2Fx	Fx-1/2Fx^2/b	x^2/b^2		
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-1/2Fx	0	0	0	0
GF b	0	1/2Fb-1/2Fx	0	0		
GA b	0	1/2Fb-1/2qx^2	0	0	0	0
AG b	0	-Fx+1/2qx^2	0	0		
FB b	0	3/2Fb-Fx-1/2qx^2	0	0	0	0
BF b	0	-2Fx+1/2qx^2	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				-Fb^2/EJ	
	totali				1/6Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-1/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2\ )\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (1/2\ x/b\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = [1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (1/4\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -3/4\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (1/2 -1/2\ x/b\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = [1/2\ x -1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/E$

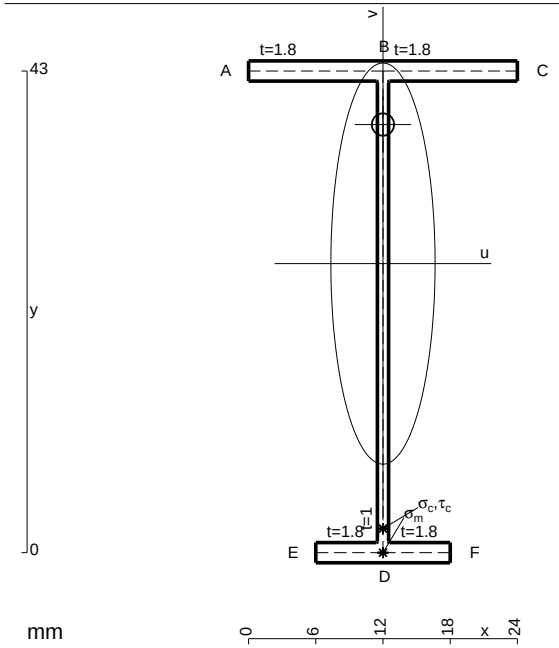
$= (1/2\ b -1/4\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -3/4\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2 -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/3\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (\ x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

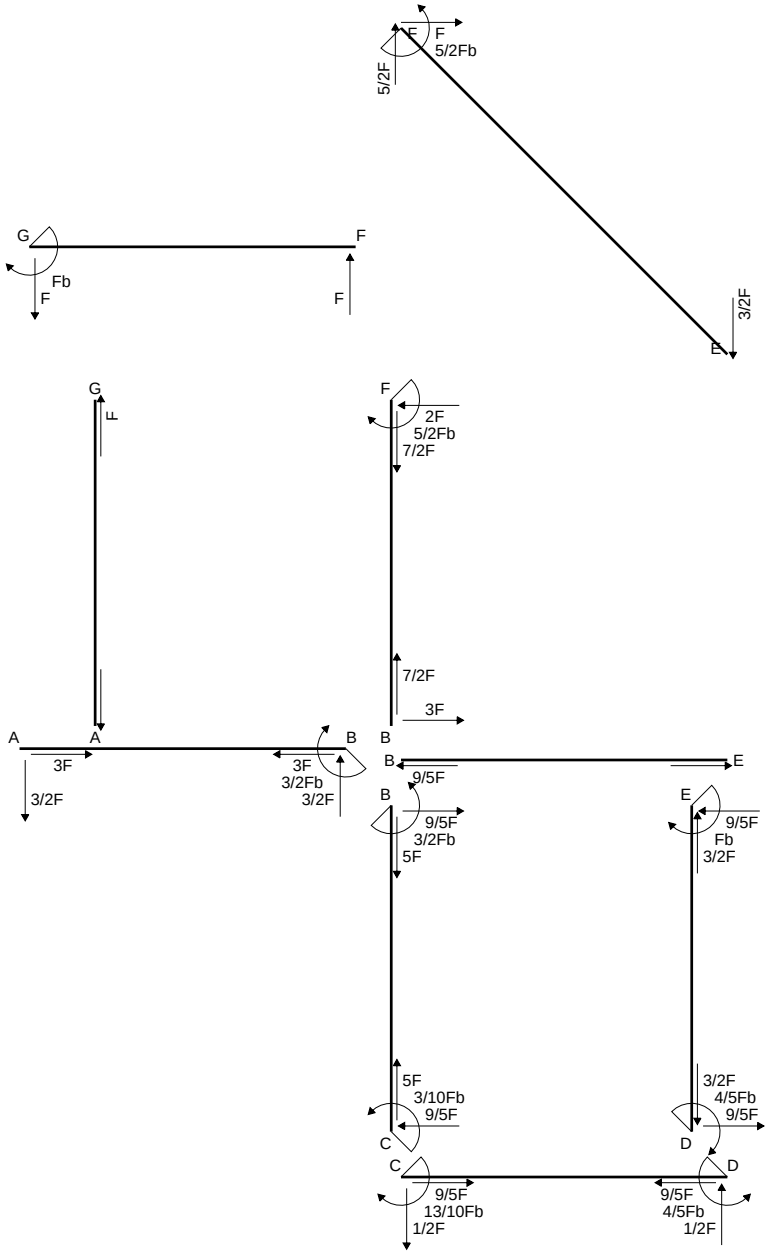
$= (1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/3\ \ Fb^2/EJ$

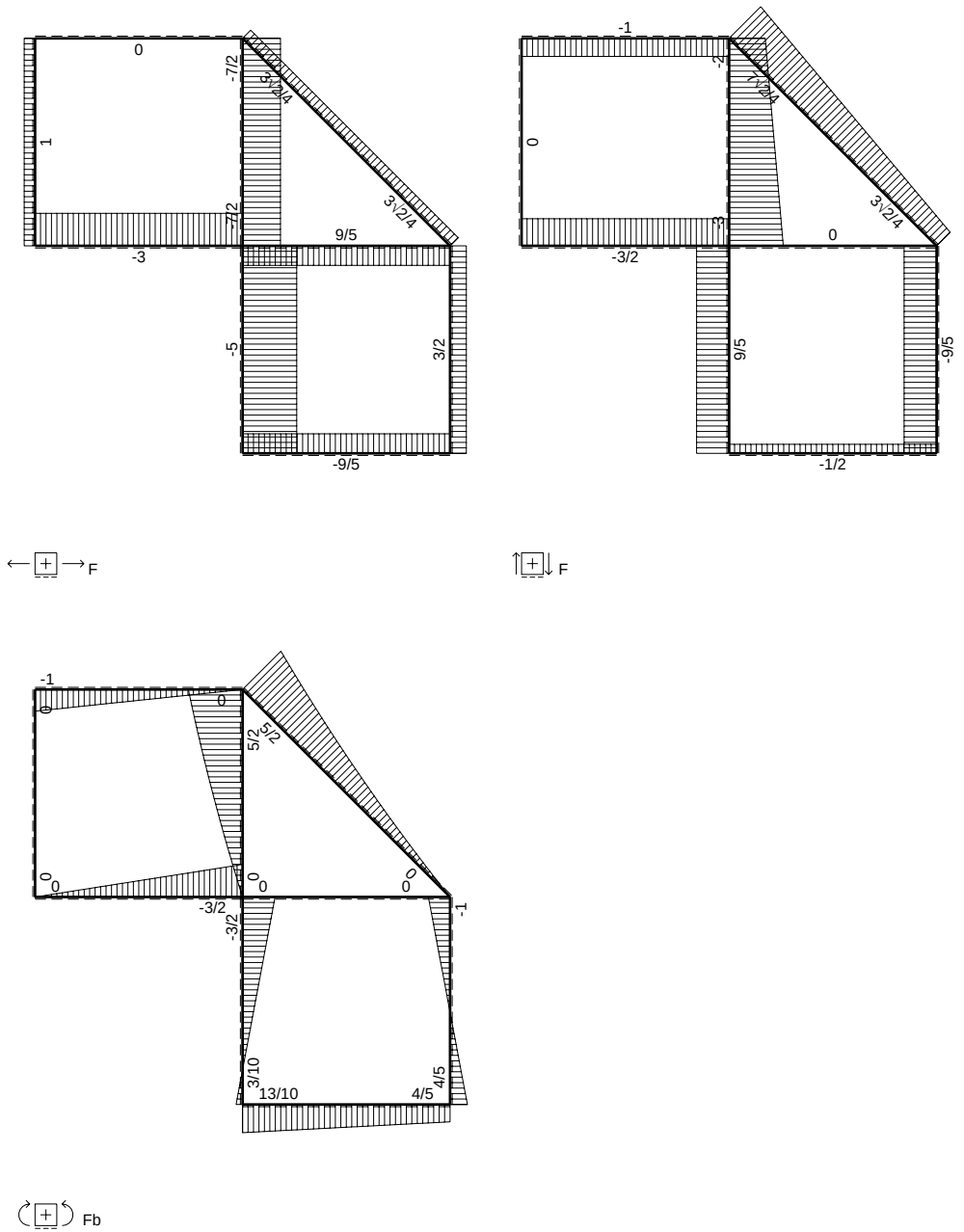


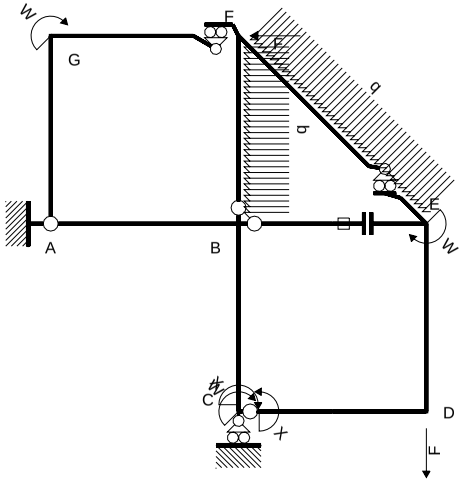
A = 107.8 mm^2
J_u = 34579. mm^4
J_v = 2333. mm^4
J_t = 84.32 mm^4
y_o = 12.41 mm
y_g = 25.81 mm
N = -760. N
T_y = -570. N
M_x = -279300. Nmm
x_m = 12. mm
v_m = -25.81 mm
$\sigma_m = N/A - Mv/J_u$ = -215.5 N/mm^2
y_c = 3. mm
u_c = -12. mm
v_c = -22.81 mm
$\sigma_c = N/A - Mv/J_u$ = -215.5 N/mm^2
$\tau_c = TS^*/tJ_u$ = 9.189 N/mm^2
$\tau_g = TS^*/tJ_u$ = 9.189 N/mm^2
t_c = 380. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 216.1 N/mm^2

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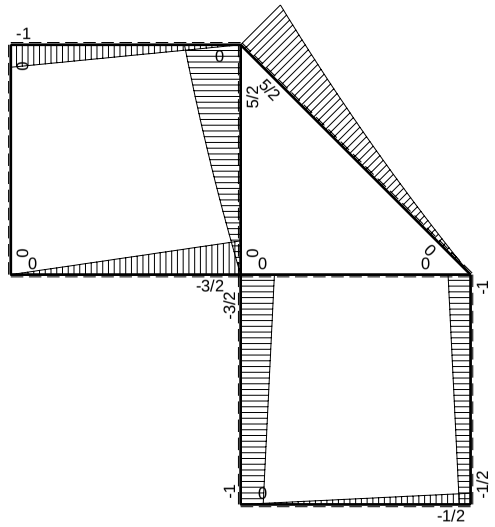
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F
F
5/2Fb
5/2F
G
F
Fb
F
F
3/2F
E
G
F
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2F
5/2Fb
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7/2F
3F
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B
B
3F
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1/2F

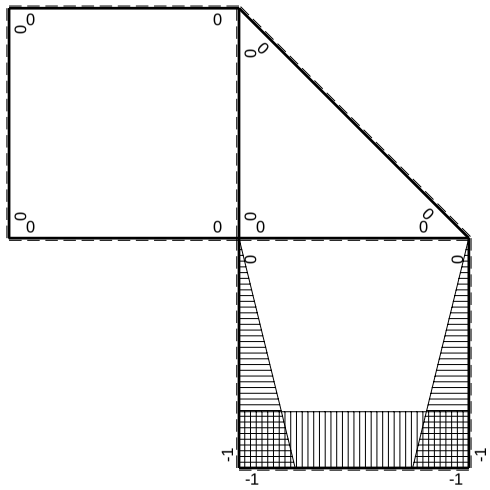

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3√2/4
0
-3/2
9/5
-9/5
-1/2
F
F
-1
0
5/2
5/2
0
0
0
0
0
-3/2
-3/2
-1
3/10
13/10
4/5
4/5
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0		
BC b	-x/b	-3/2Fb+1/2Fx	$3/2Fx-1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+1/2Fx	$Fb-1/2Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	-1/2Fx	1/2Fx	1	$1/4Fb^2/EJ$	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE b	-1+x/b	-1/2Fb-1/2Fx	$1/2Fb-1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/3Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	Fb-1/2Fx	$Fx-1/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$3\sqrt{2}/4Fx+1/2qx^2$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	$5/2Fb-2Fx-1/2qx^2$	0	0	0	0
BF b	0	$-3Fx+1/2qx^2$	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$13/6Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				-13/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (1/2\ x/b\ )\ Fb\ 1/EJ\ dx = [1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b\ )\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (1/2 -1/2\ x/b\ )\ Fb\ 1/EJ\ dx = [1/2\ x -1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

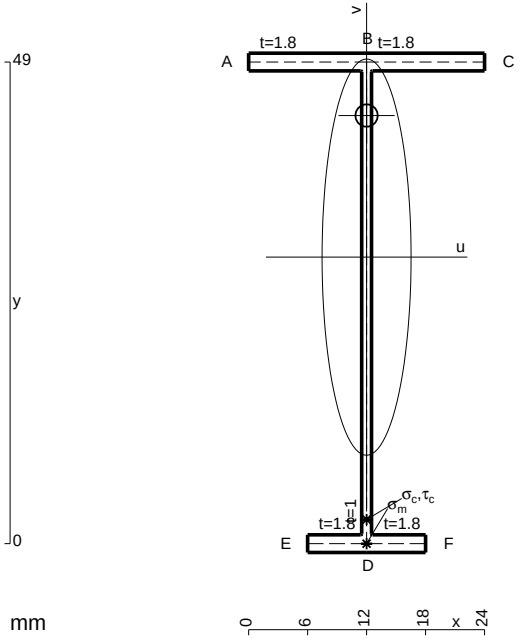
$= (1/2\ b -1/4\ b\ )\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2 -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/2\ x -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/3\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

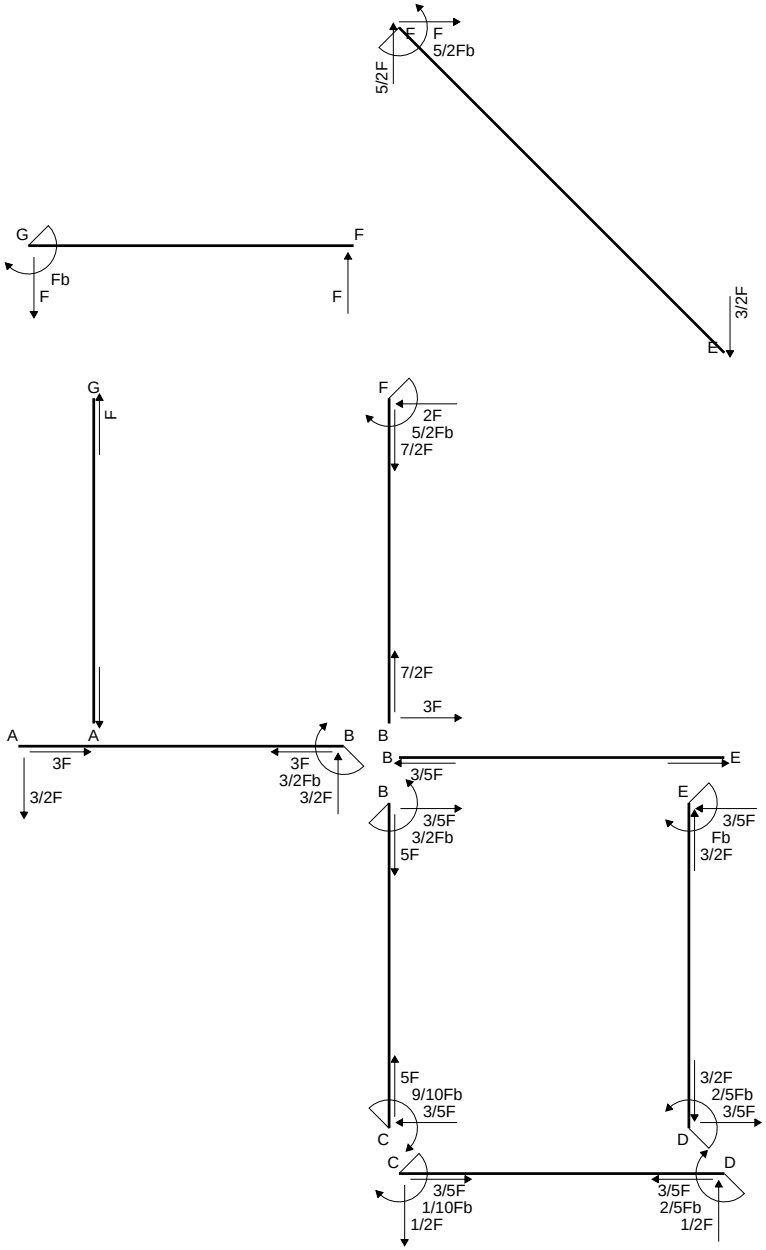
$= (1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/3\ Fb^2/EJ$

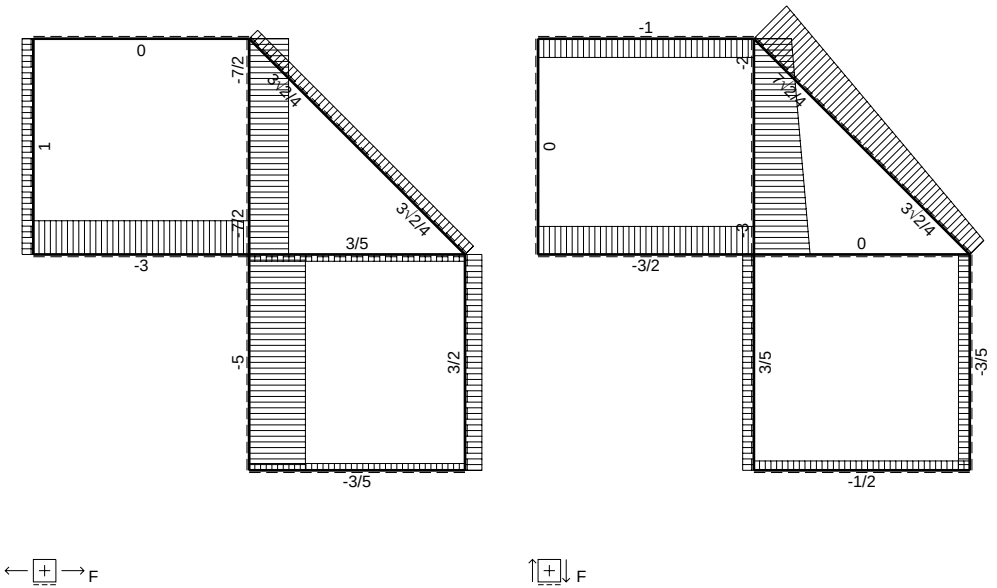


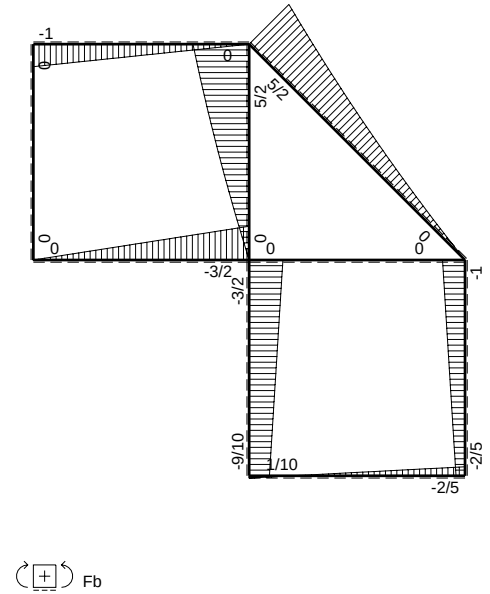
A = 113.8 mm^2
J_u = 46239. mm^4
J_v = 2333. mm^4
J_t = 86.32 mm^4
y_o = 14.41 mm
y_g = 29.15 mm
N = 254.6 N
T_y = 594. N
M_x = 354000. Nmm
x_m = 12. mm
v_m = -29.15 mm
$\sigma_m = N/A - Mv/J_u$ = 225.4 N/mm^2
y_c = 3. mm
u_c = -12. mm
v_c = -26.15 mm
$\sigma_c = N/A - Mv/J_u$ = 225.4 N/mm^2
$\tau_c = TS^*/tJ_u$ = 8.088 N/mm^2
$\tau_g = TS^*/tJ_u$ = 8.088 N/mm^2
t_c = 240. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 225.8 N/mm^2

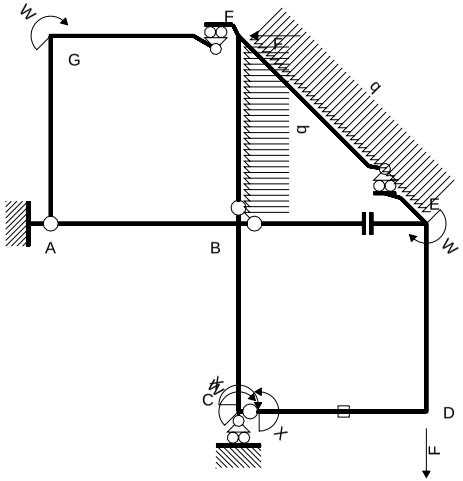
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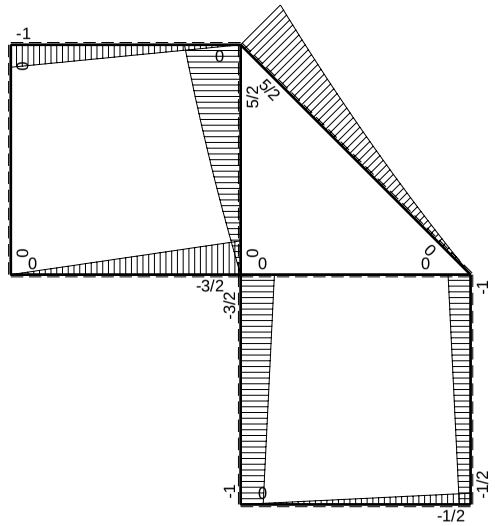

F F
5/2Fb
5/2F
G
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3/2F
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7/2F
3F
A A
B B
3F
3F
3/2Fb
3/2F
3/2F
B
E
3/5F
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3/5F
3/2Fb
5F
E
3/5F
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3/2F
5F
9/10Fb
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C
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2/5Fb
3/5F
D
C
D
3/5F
1/10Fb
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3/5F
2/5Fb
1/2F


0
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3√2/4
1
-7/2
3√2/4
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-3
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3/5
-3/5
-1/2
F

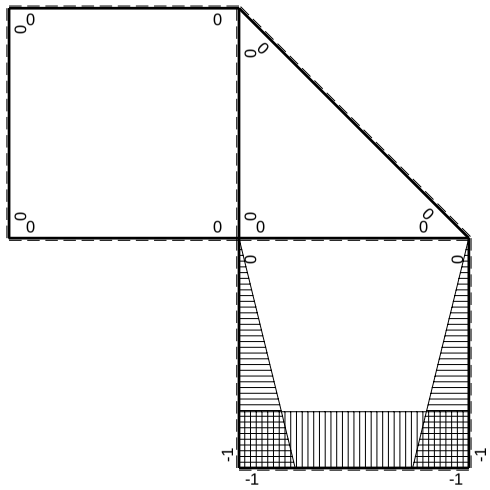

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5/2
0
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0
0
0
-3/2
-3/2
-1
-9/10
1/10
-2/5
-2/5
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0		
BC b	-x/b	-3/2Fb+1/2Fx	$3/2Fx-1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+1/2Fx	$Fb-1/2Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	-1/2Fx	1/2Fx	1	$1/4Fb^2/EJ$	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE b	-1+x/b	-1/2Fb-1/2Fx	$1/2Fb-1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/3Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	Fb-1/2Fx	$Fx-1/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$3\sqrt{2}/4Fx+1/2qx^2$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	$5/2Fb-2Fx-1/2qx^2$	0	0	0	0
BF b	0	$-3Fx+1/2qx^2$	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$1/6Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				-1/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (1/2\ x/b\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = [1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (1/4\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -3/4\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (1/2 -1/2\ x/b\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = [1/2\ x -1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/E$

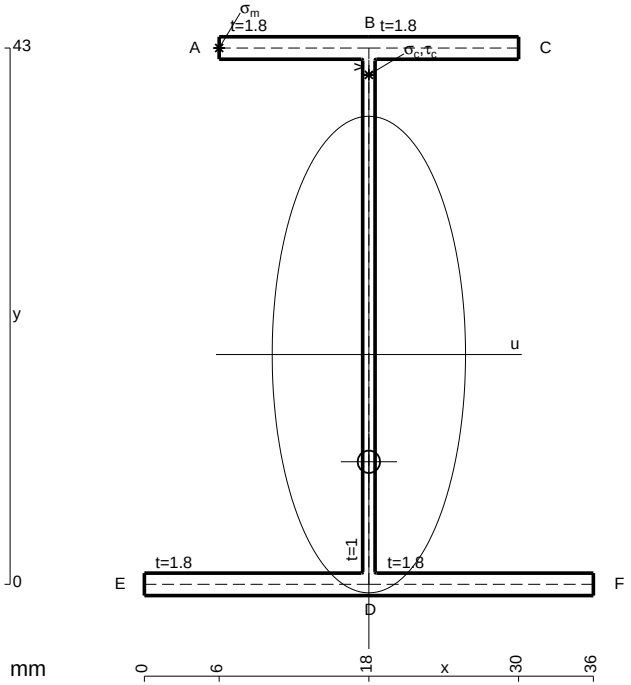
$= (1/2\ b -1/4\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -3/4\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2 -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/2\ x -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/3\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (\ x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

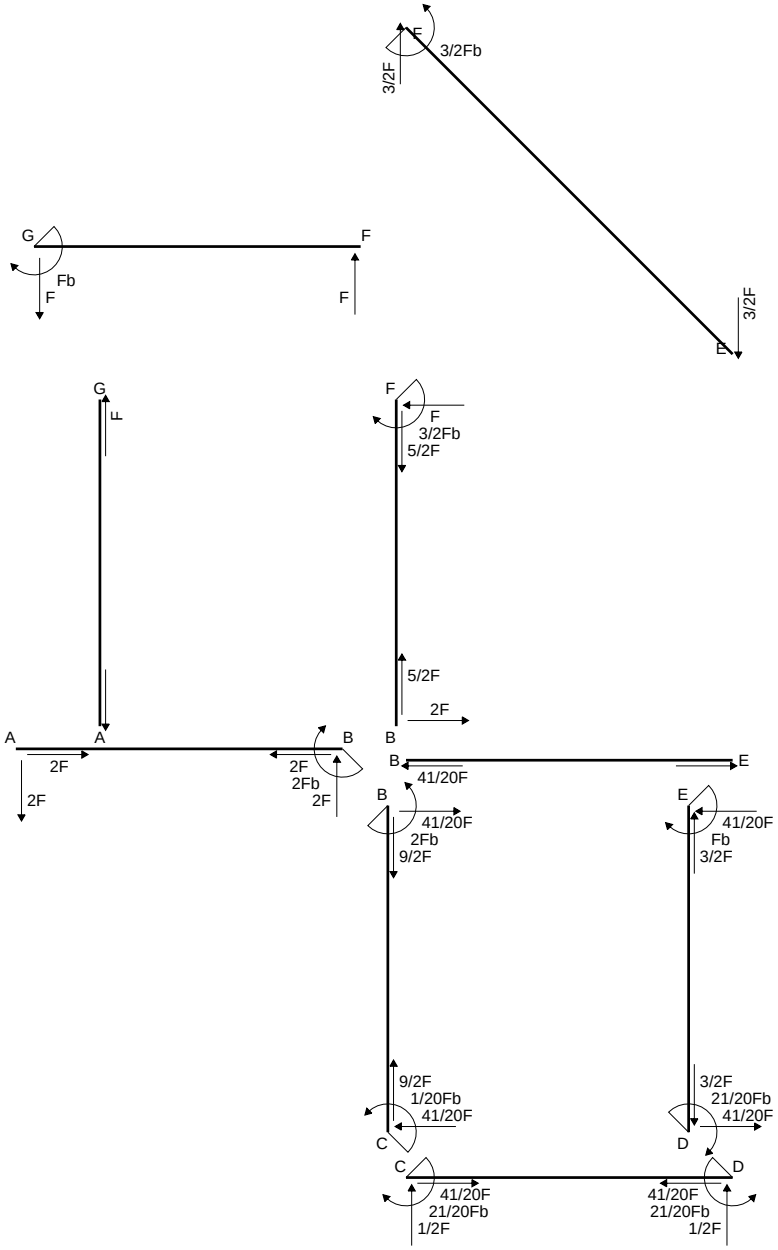
$= (1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/3\ \ Fb^2/EJ$

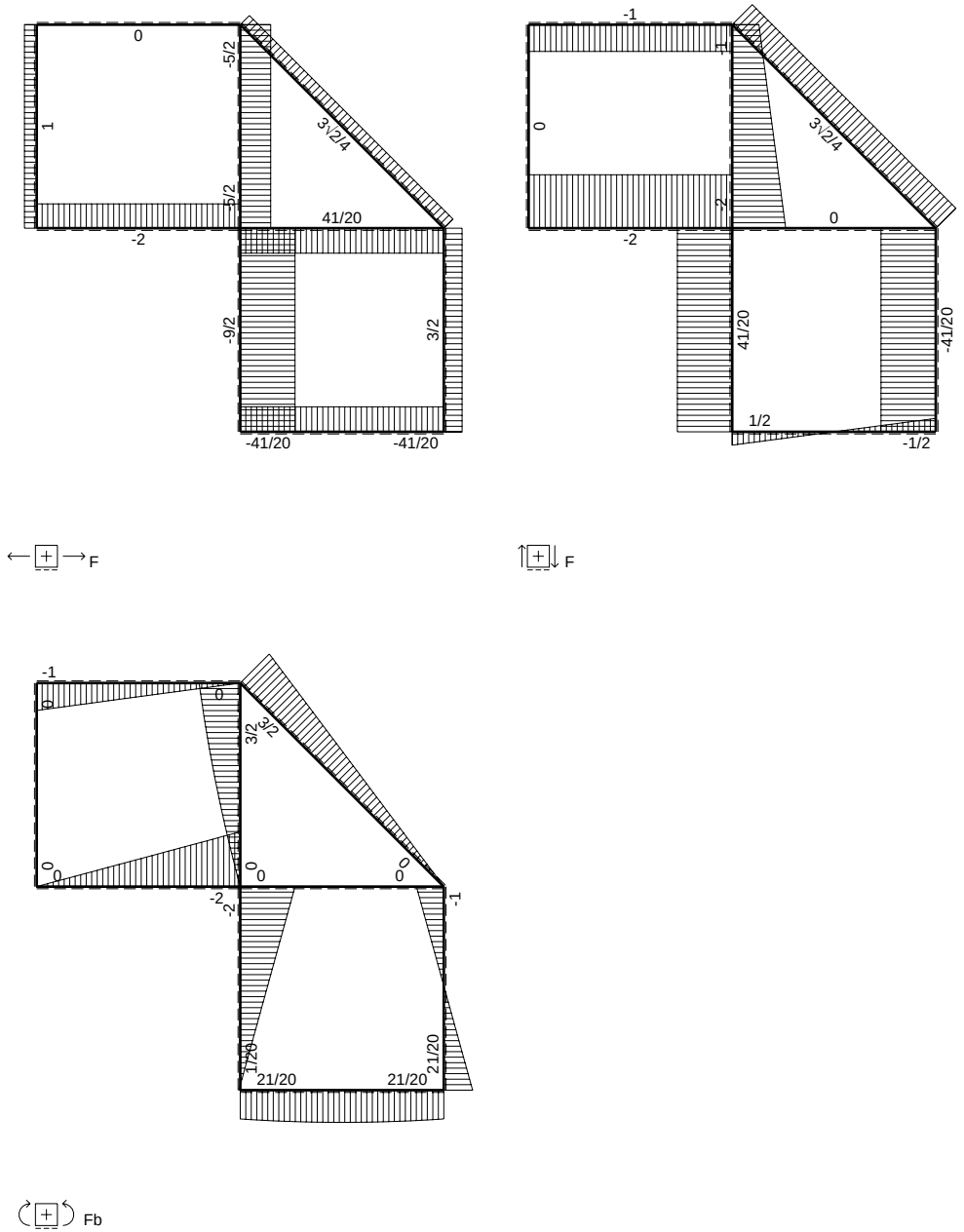


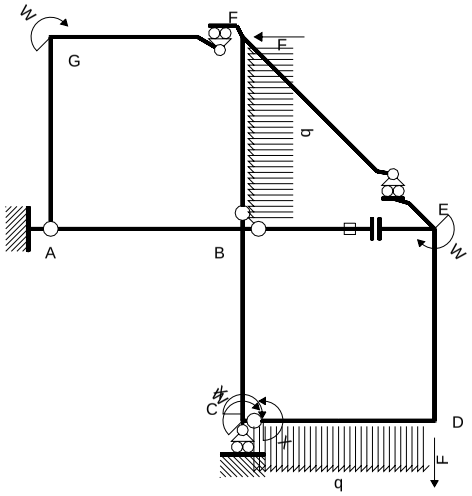
A = 151. mm^2
J_u = 55120. mm^4
J_v = 9072. mm^4
J_t = 131. mm^4
y_o = -8.596 mm
y_g = 18.42 mm
N = 403.1 N
T_y = 940.5 N
M_x = 541500. Nmm
x_m = 6. mm
y_m = 43. mm
u_m = -12. mm
v_m = 24.58 mm
$\sigma_m = N/A - Mv/J_u$ = -238.8 N/mm^2
x_c = 18. mm
y_c = 43. mm
v_c = 24.58 mm
$\sigma_c = N/A - Mv/J_u$ = -238.8 N/mm^2
$\tau_c = TS^*/tJ_u$ = 18.11 N/mm^2
$\tau_g = TS^*/tJ_u$ = 18.11 N/mm^2
t_c = 380. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 240.8 N/mm^2

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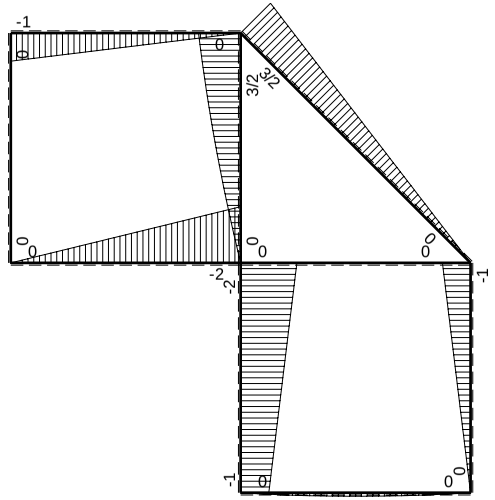
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F
3/2Fb
3/2F
G
F
Fb
F
F
3/2F
E
G
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F
3/2Fb
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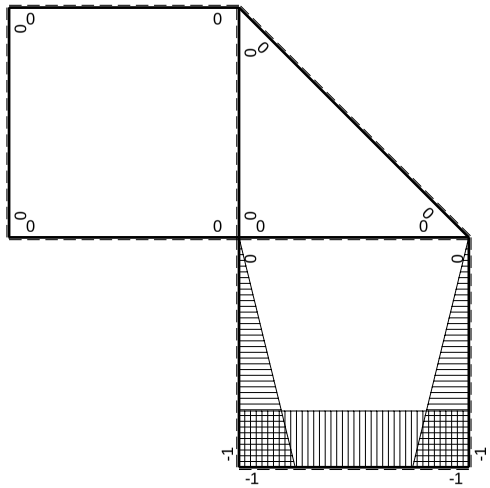

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-41/20
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3√2/4
2
0
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41/20
-41/20
1/2
-1/2
F
-1
0
0
3/2
2
0
0
0
0
0
-2
-2
-1
1/20
21/20
21/20
21/20
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0		
BC b	-x/b	-2Fb+Fx	2Fx-Fx^2/b	x^2/b^2	$2/3Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	1/2Fx-1/2qx^2	-1/2Fx+1/2Fx^2/b	1	$-1/12Fb^2/EJ$	Xb/EJ
DC b	1	-1/2Fx+1/2qx^2	-1/2Fx+1/2Fx^2/b	1		
DE b	-1+x/b	-Fx	Fx-Fx^2/b	1-2x/b+x^2/b^2	$1/6Fb^2/EJ$	1/3Xb/EJ
ED b	x/b	Fb-Fx	Fx-Fx^2/b	x^2/b^2		
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	3/2Fb-Fx-1/2qx^2	0	0	0	0
BF b	0	-2Fx+1/2qx^2	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$7/4Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-21/20Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (2\ x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-1/2\ x/b +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/4\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/12\ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2\ x/b +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

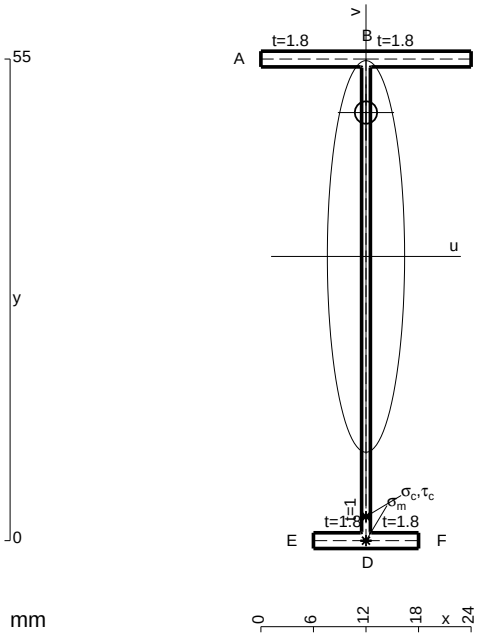
$= (-1/4\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/12\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

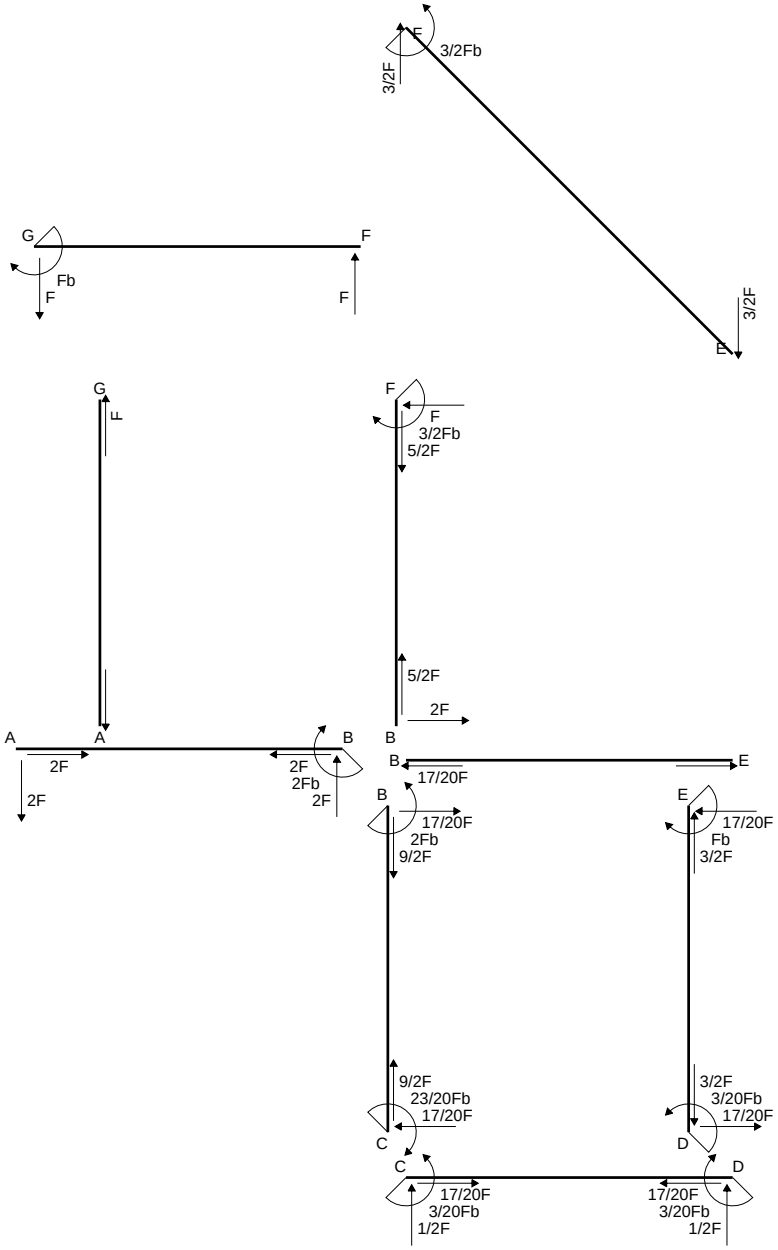
$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

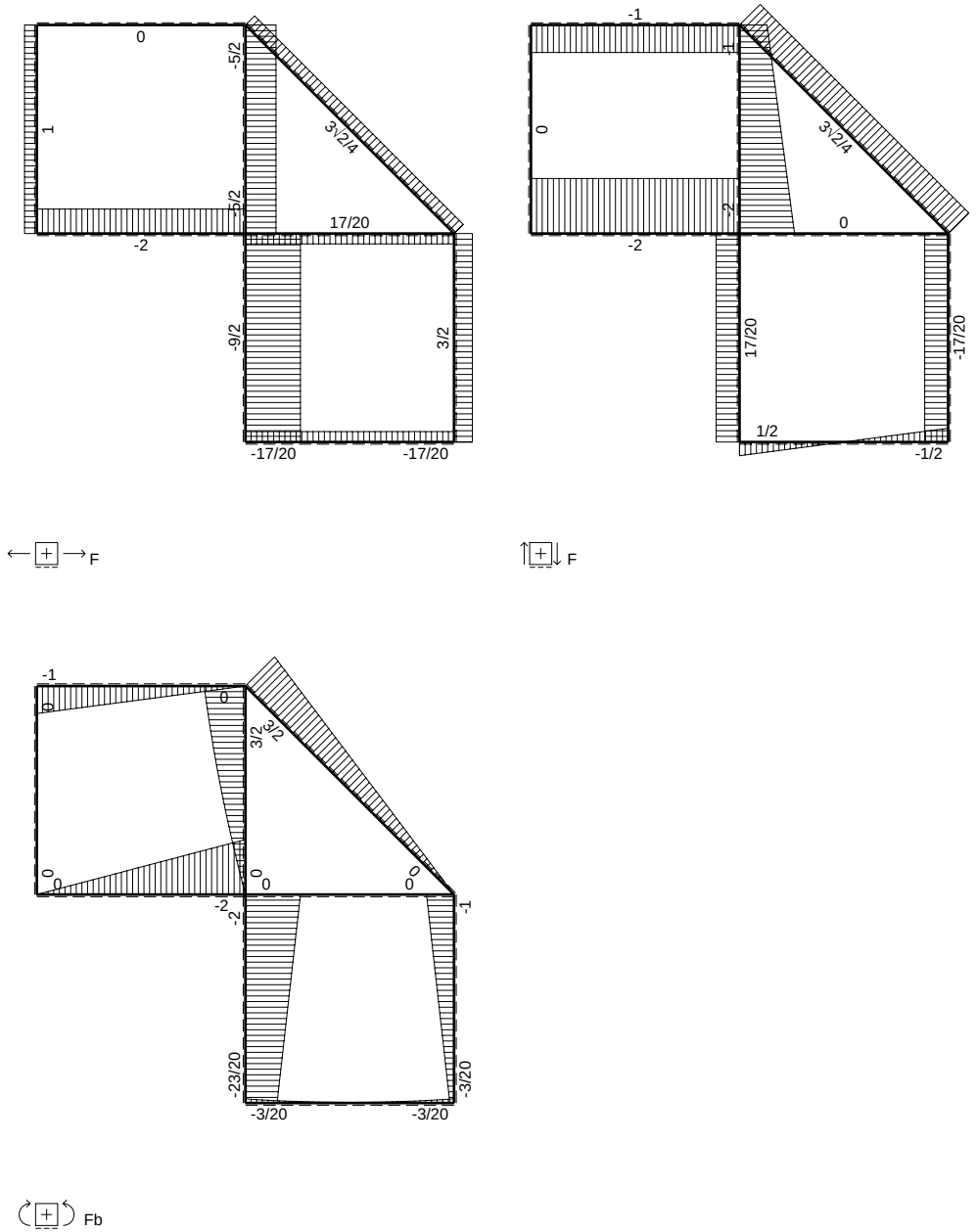


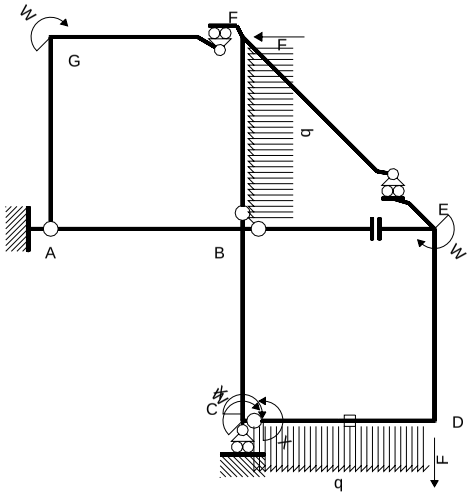
A = 119.8 mm^2
J_u = 59924. mm^4
J_v = 2333. mm^4
J_t = 88.32 mm^4
y_o = 16.43 mm
y_g = 32.46 mm
N = -460. N
T_y = -460. N
M_x = -358800. Nmm
x_m = 12. mm
v_m = -32.46 mm
$\sigma_m = N/A - Mv/J_u$ = -198.2 N/mm^2
y_c = 3. mm
u_c = -12. mm
v_c = -29.46 mm
$\sigma_c = N/A - Mv/J_u$ = -198.2 N/mm^2
$\tau_c = TS^*/tJ_u$ = 5.382 N/mm^2
$\tau_g = TS^*/tJ_u$ = 5.382 N/mm^2
t_c = 230. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 198.4 N/mm^2

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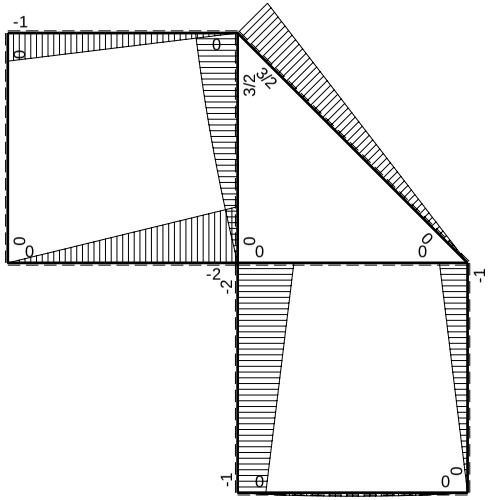
@ Adolfo Zavelani Rossi, Politecnico di Milano, vers.27.03.13 16.04.26


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3/2Fb
3/2F
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5/2F
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A
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2F
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2Fb
2F
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B
E
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B
17/20F
2Fb
9/2F
E
17/20F
Fb
3/2F
9/2F
23/20Fb
17/20F
3/2F
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17/20F
3/20Fb
1/2F

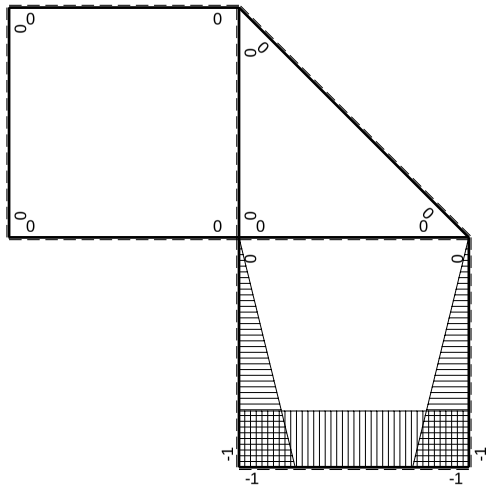

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-17/20
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3√2/4
2
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1/2
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F
-1
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0
3/2
3/2
0
0
0
0
0
-2
-2
-1
-23/20
-3/20
-3/20
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0		
BC b	-x/b	-2Fb+Fx	2Fx-Fx^2/b	x^2/b^2	2/3Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	1/2Fx-1/2qx^2	-1/2Fx+1/2Fx^2/b	1	-1/12Fb^2/EJ	Xb/EJ
DC b	1	-1/2Fx+1/2qx^2	-1/2Fx+1/2Fx^2/b	1		
DE b	-1+x/b	-Fx	Fx-Fx^2/b	1-2x/b+x^2/b^2	1/6Fb^2/EJ	1/3Xb/EJ
ED b	x/b	Fb-Fx	Fx-Fx^2/b	x^2/b^2		
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	3/2Fb-Fx-1/2qx^2	0	0	0	0
BF b	0	-2Fx+1/2qx^2	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				-Fb^2/EJ	
	totali				-1/4Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				3/20Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2\ )\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (2\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ \ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-1/2\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (-1/4\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -13/12\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

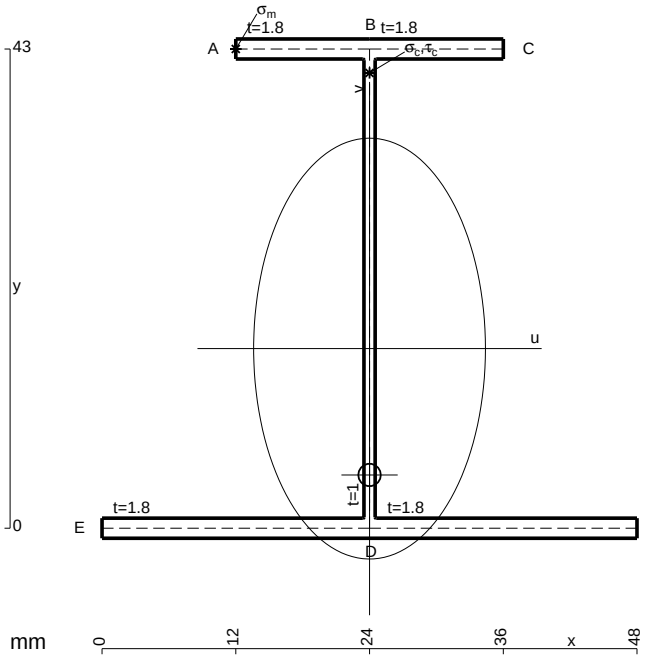
$= (-1/4\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -13/12\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ \ Fb^2/EJ$



$A = 172.6\ mm^2$

$J_u = 61535.\ mm^4$

$J_v = 18662.\ mm^4$

$J_t = 154.3\ mm^4$

$y_o = -11.34\ mm$

$y_g = 16.12\ mm$

$N = -740.\ N$

$T_y = -740.\ N$

$M_x = -481000.\ Nmm$

$x_m = 12.\ mm$

$y_m = 43.\ mm$

$u_m = -12.\ mm$

$v_m = 26.88\ mm$

$\sigma_m = N/A - Mv/J_u = 205.8\ N/mm^2$

$x_c = 24.\ mm$

$y_c = 43.\ mm$

$v_c = 26.88\ mm$

$\sigma_c = N/A - Mv/J_u = 205.8\ N/mm^2$

$\tau_c = TS^*/tJ_u = 13.97\ N/mm^2$

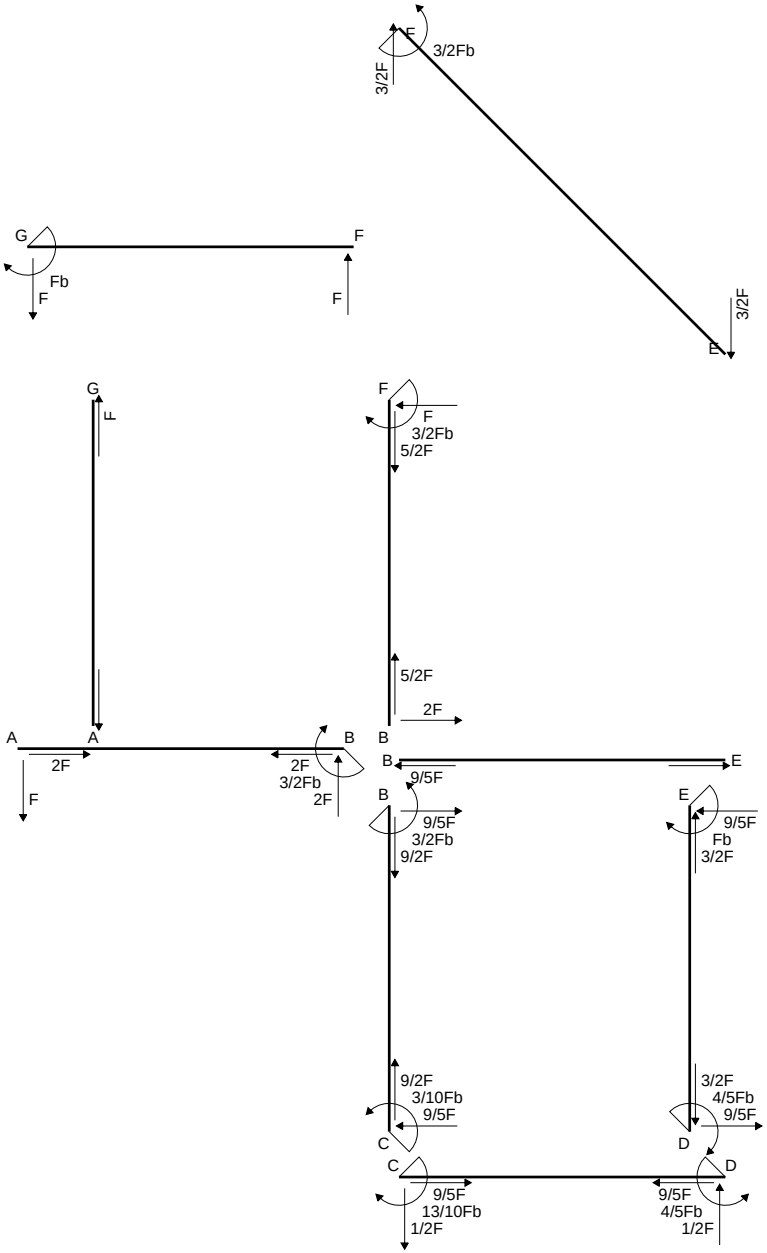
$\tau_g = TS^*/tJ_u = 13.97\ N/mm^2$

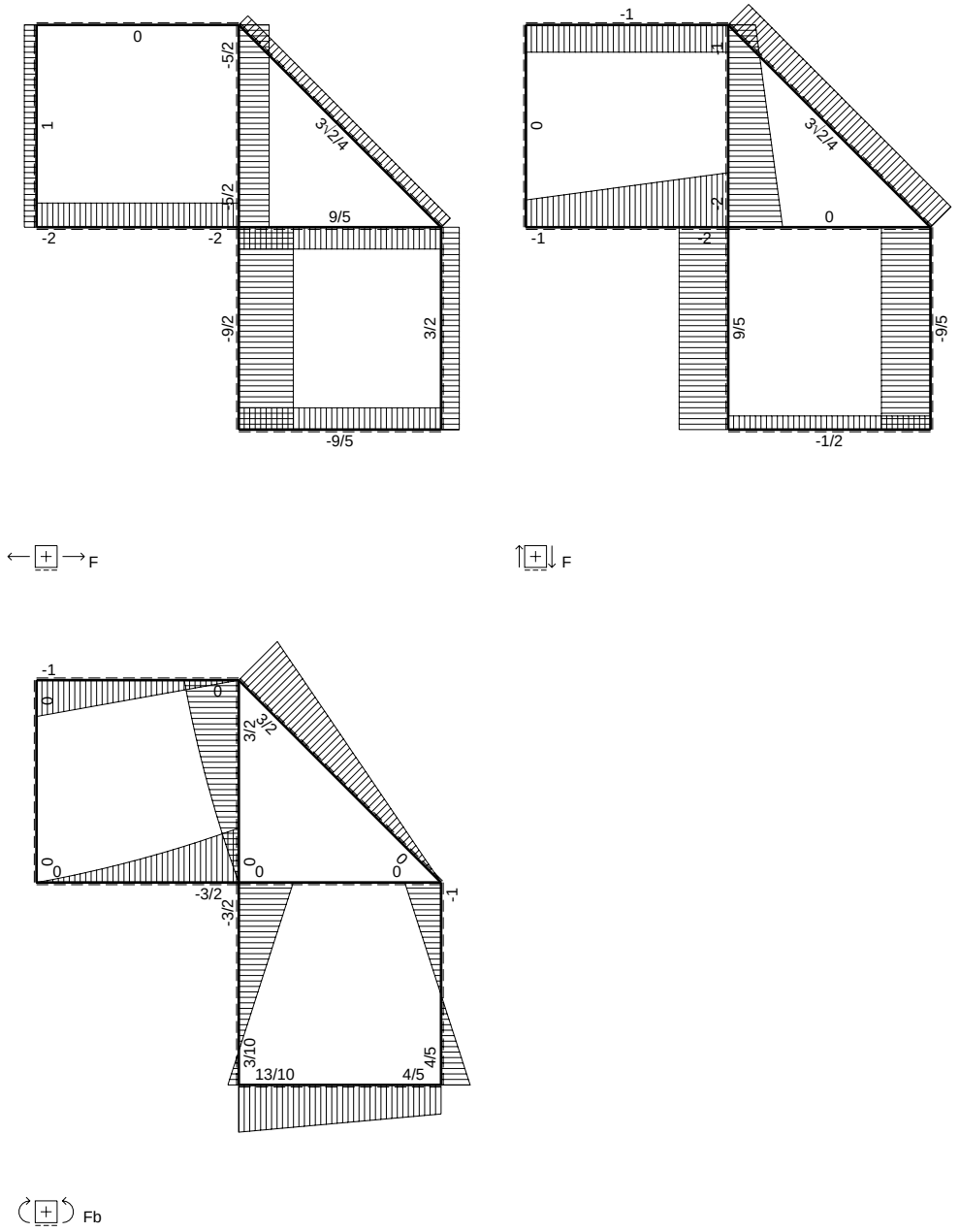
$t_c = 370.\ mm$

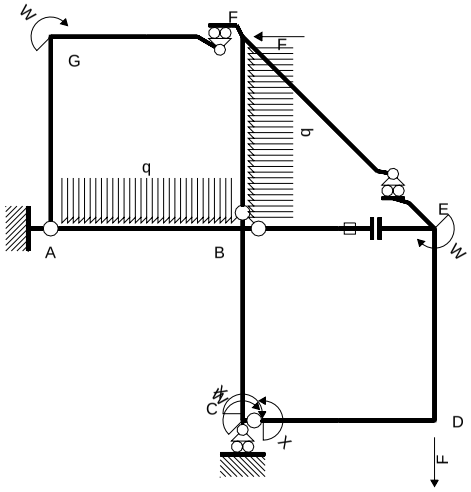
$\sigma_o = \sqrt{\sigma^2 + 3\tau^2} = 207.3\ N/mm^2$

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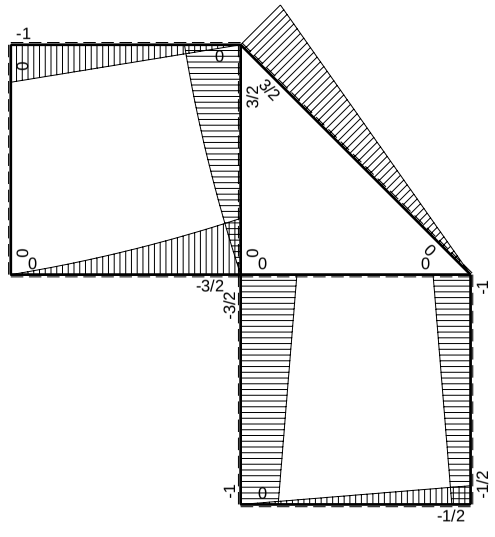
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3/10Fb
9/5F
3/2F
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9/5F
4/5Fb
1/2F

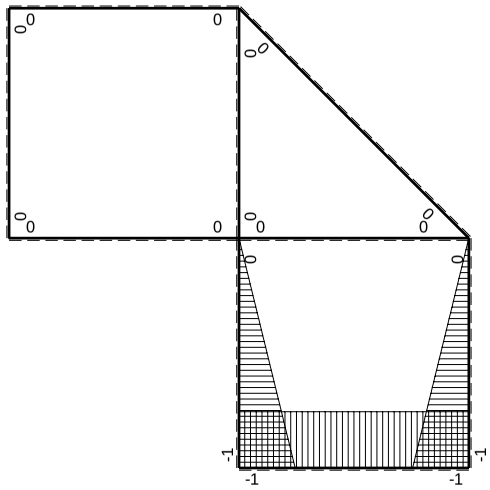

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3/2
3/2
0
0
0
0
0
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-3/2
-1
3/10
13/10
4/5
4/5
Fb



Schema di calcolo iperstatico



M_o flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-Fx-1/2qx^2$	0	0	0	0
BA b	0	$3/2Fb-2Fx+1/2qx^2$	0	0		
BC b	-x/b	$-3/2Fb+1/2Fx$	$3/2Fx-1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	$Fb+1/2Fx$	$Fb-1/2Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	$-1/2Fx$	$1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
DC b	1	$1/2Fb-1/2Fx$	$1/2Fb-1/2Fx$	1		
DE 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
ED b	x/b	$Fb-1/2Fx$	$Fx-1/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	$3/2Fb-Fx-1/2qx^2$	0	0	0	0
BF b	0	$-2Fx+1/2qx^2$	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$13/6Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-13/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b)\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (1/2\ x/b\ )\ Fb\ 1/EJ\ dx = [1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b\ )\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (1/2 -1/2\ x/b\ )\ Fb\ 1/EJ\ dx = [1/2\ x -1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

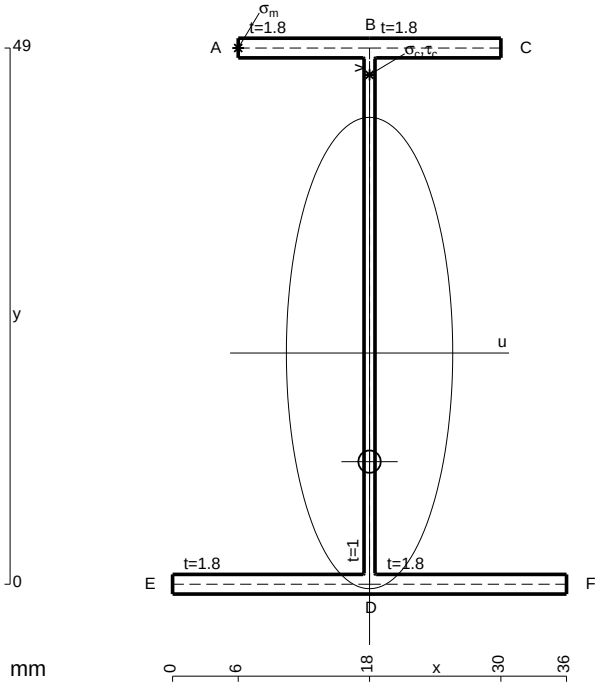
$= (1/2\ b -1/4\ b\ )\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2 -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/2\ x -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/3\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

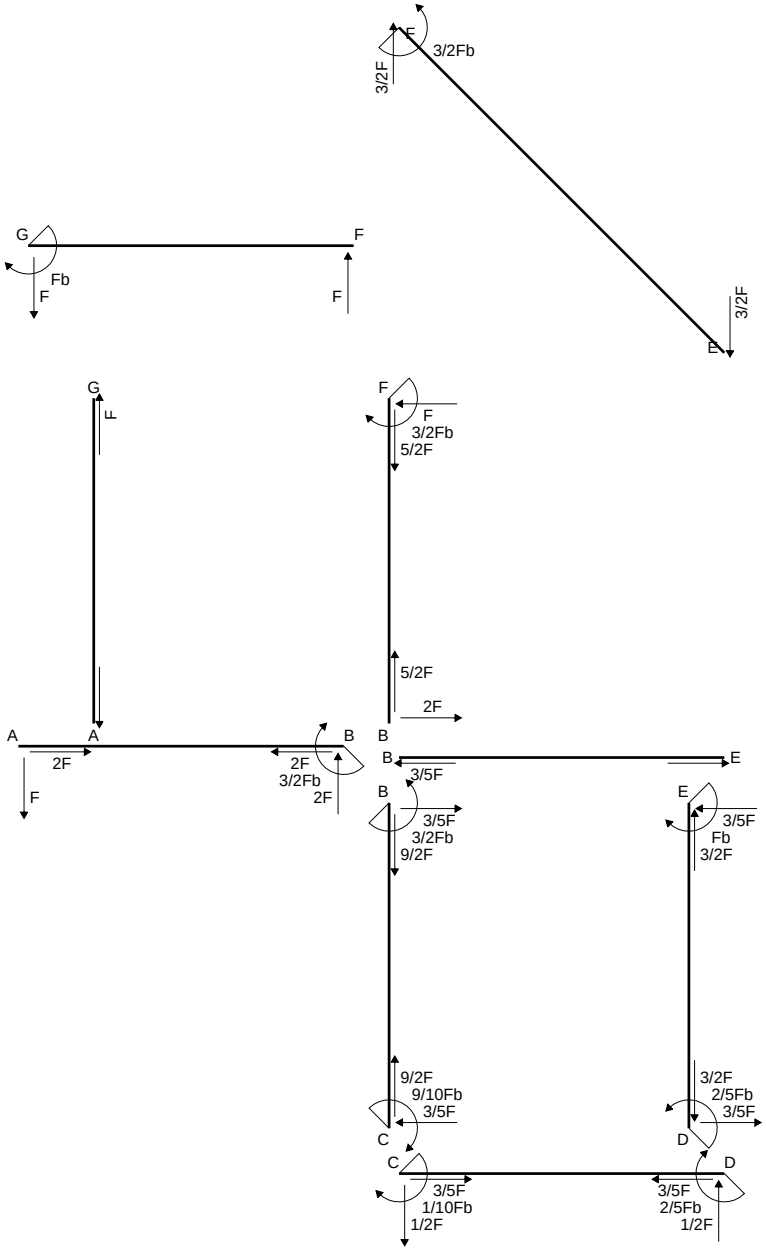
$= (1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/3\ Fb^2/EJ$

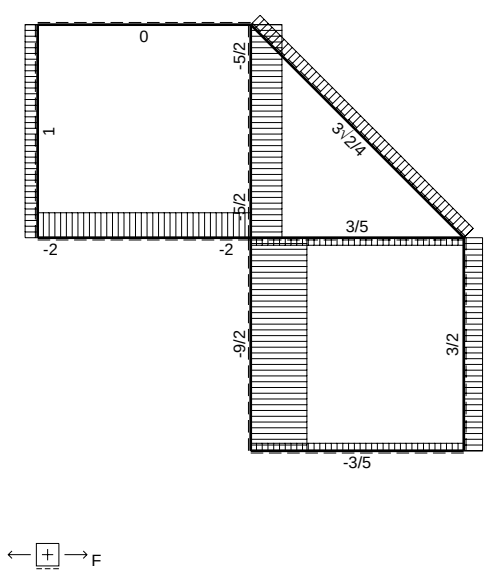


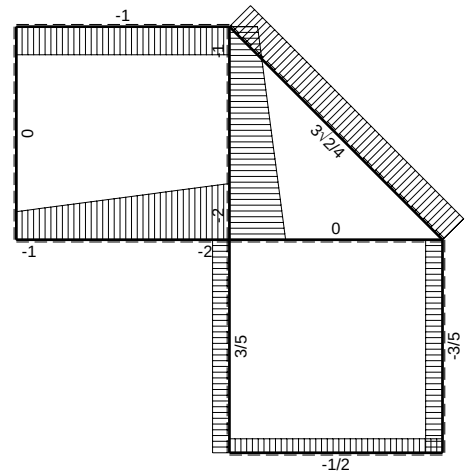
A = 157. mm^2
J_u = 72847. mm^4
J_v = 9072. mm^4
J_t = 133. mm^4
y_o = -9.929 mm
y_g = 21.13 mm
N = -1000. N
T_y = -1000. N
M_x = -585000. Nmm
x_m = 6. mm
y_m = 49. mm
u_m = -12. mm
v_m = 27.87 mm
$\sigma_m = N/A - Mv/J_u$ = 217.4 N/mm^2
x_c = 18. mm
y_c = 49. mm
v_c = 27.87 mm
$\sigma_c = N/A - Mv/J_u$ = 217.4 N/mm^2
$\tau_c = TS^*/tJ_u$ = 16.53 N/mm^2
$\tau_g = TS^*/tJ_u$ = 16.53 N/mm^2
t_c = 500. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 219.3 N/mm^2

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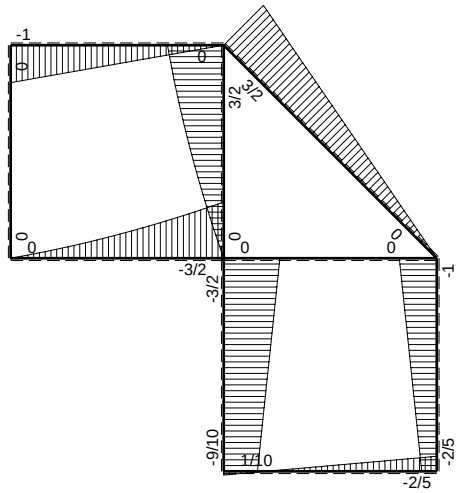
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1/2F

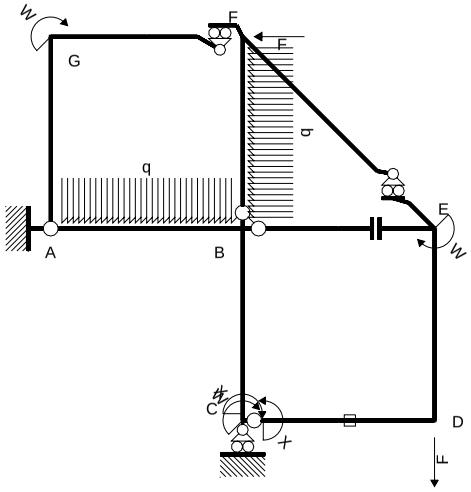

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-2
-2
-9/2
3/2
-3/5


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-1
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3√2/4
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-1
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-1/2

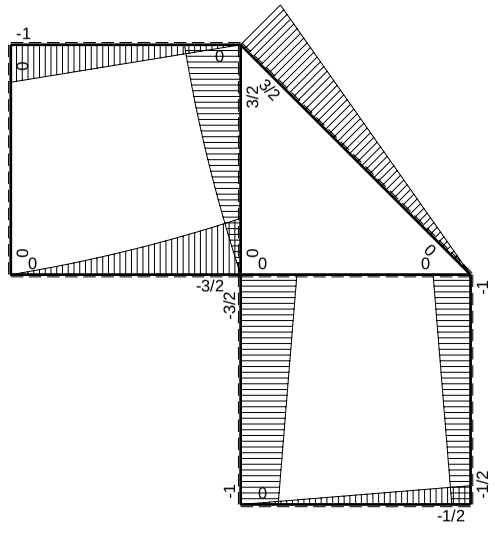
F F


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-9/10
1/10
-2/5
-2/5

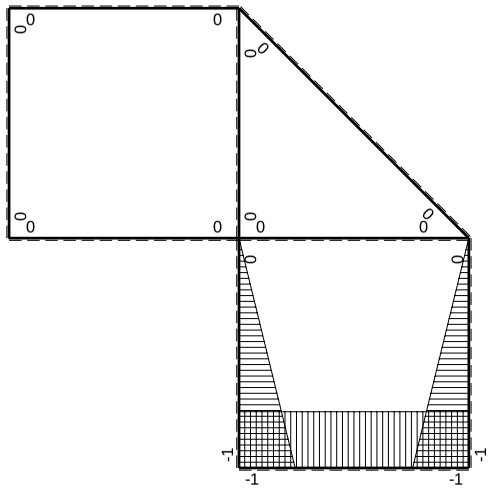
Fb



Schema di calcolo iperstatico



M_o flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-Fx-1/2qx^2$	0	0	0	0
BA b	0	$3/2Fb-2Fx+1/2qx^2$	0	0		
BC b	-x/b	$-3/2Fb+1/2Fx$	$3/2Fx-1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	$Fb+1/2Fx$	$Fb-1/2Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	$-1/2Fx$	$1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
DC b	1	$1/2Fb-1/2Fx$	$1/2Fb-1/2Fx$	1		
DE 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
ED b	x/b	$Fb-1/2Fx$	$Fx-1/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	$3/2Fb-Fx-1/2qx^2$	0	0	0	0
BF b	0	$-2Fx+1/2qx^2$	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$1/6Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-1/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b)\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (1/2\ x/b\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = [1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (1/4\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -3/4\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (1/2 -1/2\ x/b\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = [1/2\ x -1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/E$

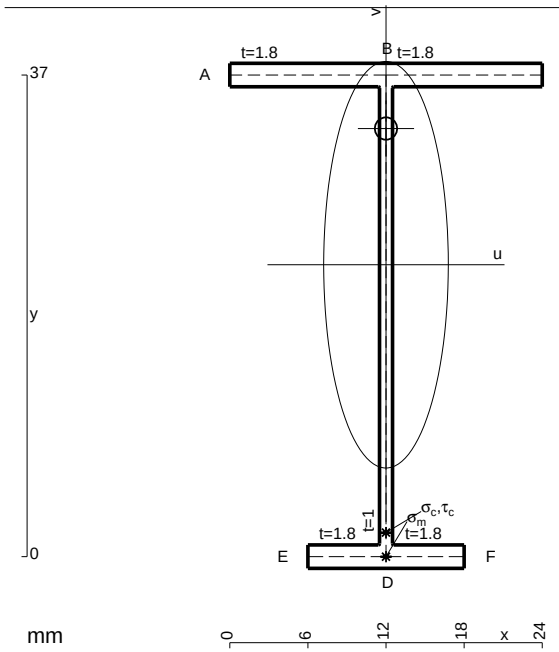
$= (1/2\ b -1/4\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -3/4\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2 -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/2\ x -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/3\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (\ x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

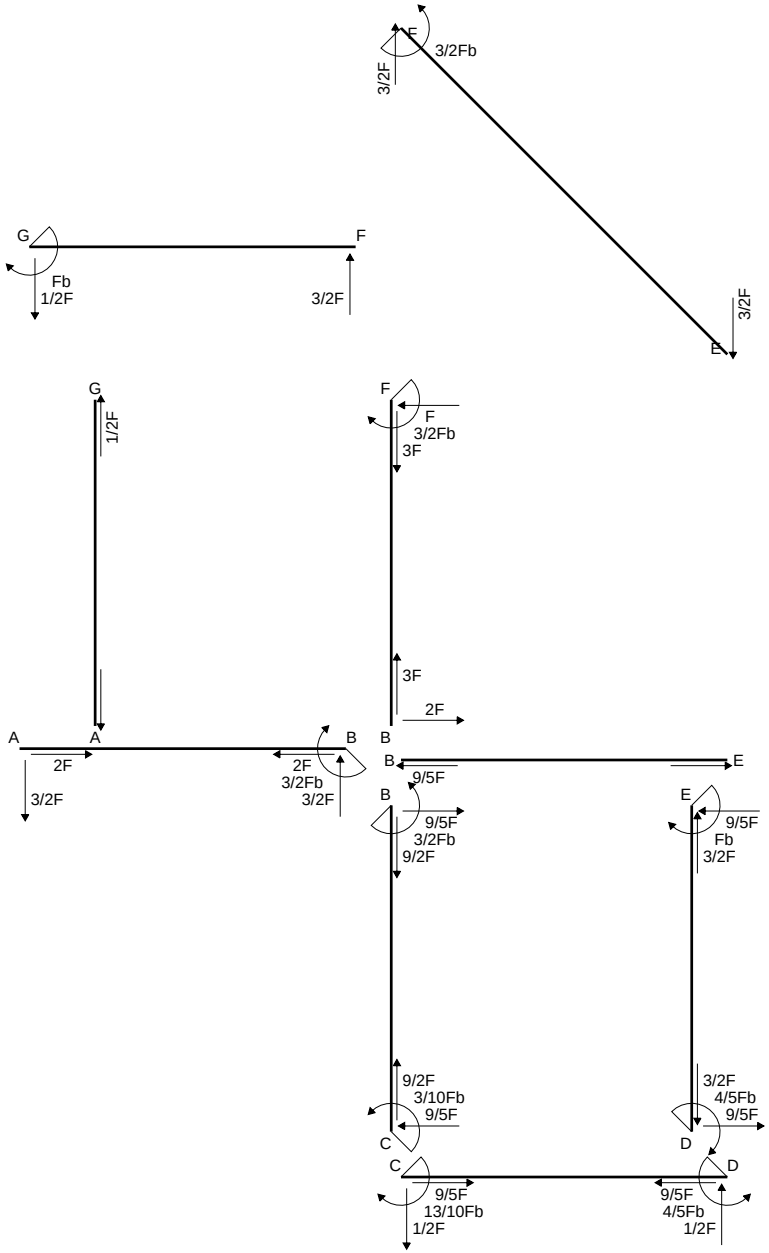
$= (1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/3\ \ Fb^2/EJ$

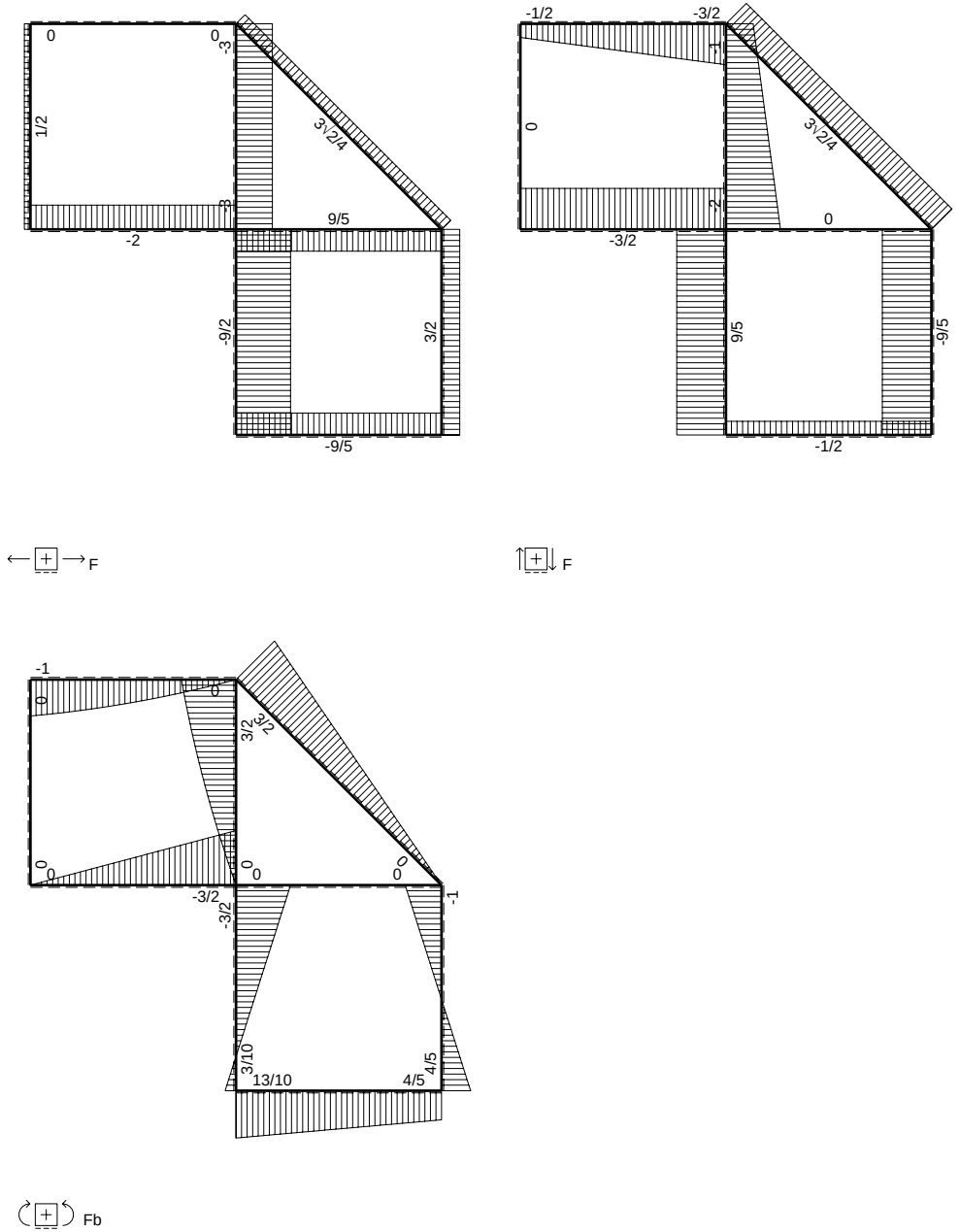


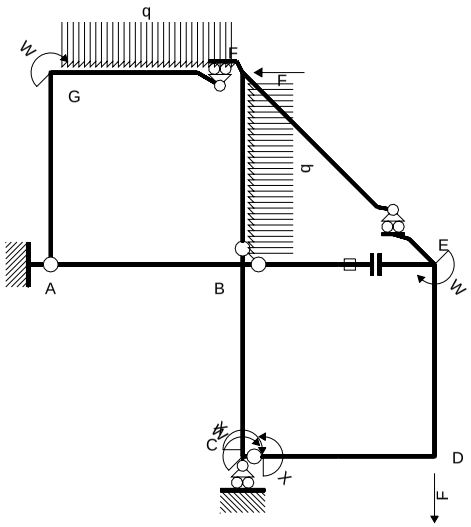
A = 101.8 mm^2
J_u = 24830. mm^4
J_v = 2333. mm^4
J_t = 82.32 mm^4
y_o = 10.46 mm
y_g = 22.43 mm
N = -520. N
T_y = -520. N
M_x = -245700. Nmm
x_m = 12. mm
v_m = -22.43 mm
$\sigma_m = N/A - Mv/J_u$ = -227. N/mm^2
y_c = 3. mm
u_c = -12. mm
v_c = -19.43 mm
$\sigma_c = N/A - Mv/J_u$ = -227. N/mm^2
$\tau_c = TS^*/tJ_u$ = 10.14 N/mm^2
$\tau_g = TS^*/tJ_u$ = 10.14 N/mm^2
t_c = 260. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 227.7 N/mm^2

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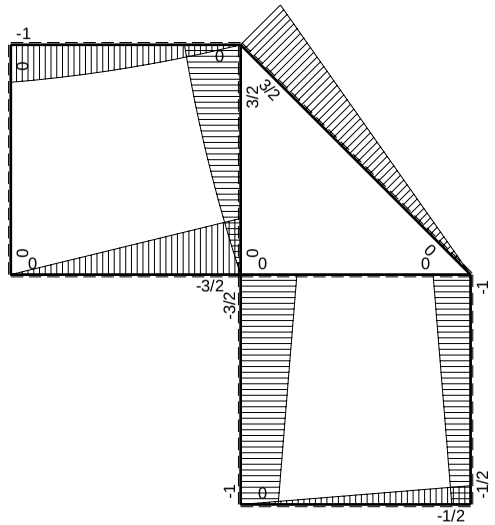
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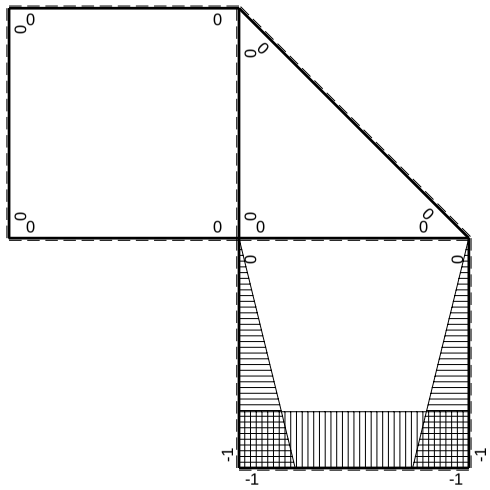

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Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0		
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx^2/b	x^2/b^2	7/12Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb^2/EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE 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
ED b	x/b	Fb-1/2Fx	Fx-1/2Fx^2/b	x^2/b^2		
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-3/2Fx+1/2qx^2	0	0	0	0
GF b	0	Fb-1/2Fx-1/2qx^2	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	3/2Fb-Fx-1/2qx^2	0	0	0	0
BF b	0	-2Fx+1/2qx^2	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				13/6Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-13/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (1/2\ x/b\ )\ Fb\ 1/EJ\ dx = [1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b\ )\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (1/2 -1/2\ x/b\ )\ Fb\ 1/EJ\ dx = [1/2\ x -1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

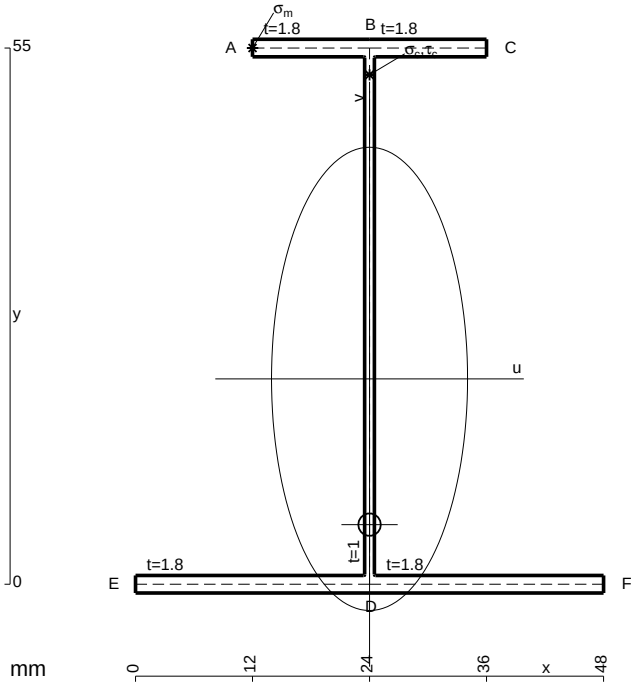
$= (1/2\ b -1/4\ b\ )\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2 -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/2\ x -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/3\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (\ x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

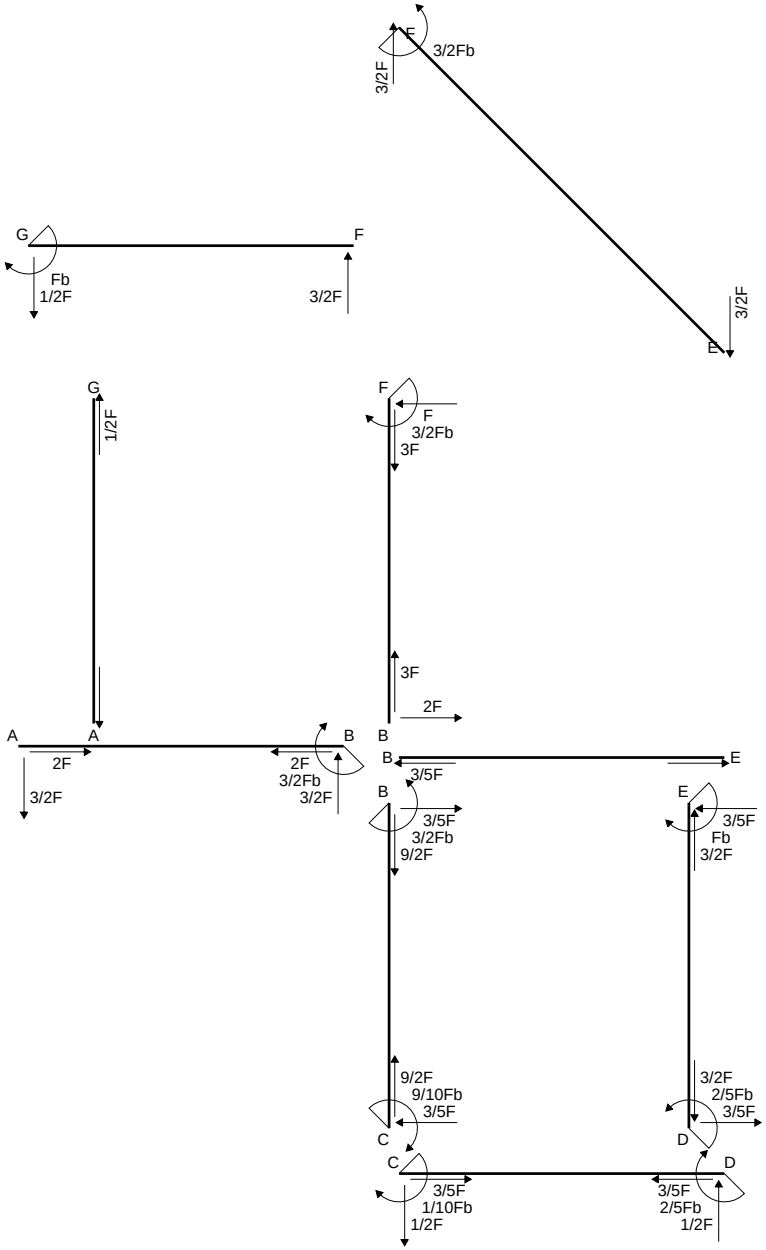
$= (1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/3\ Fb^2/EJ$

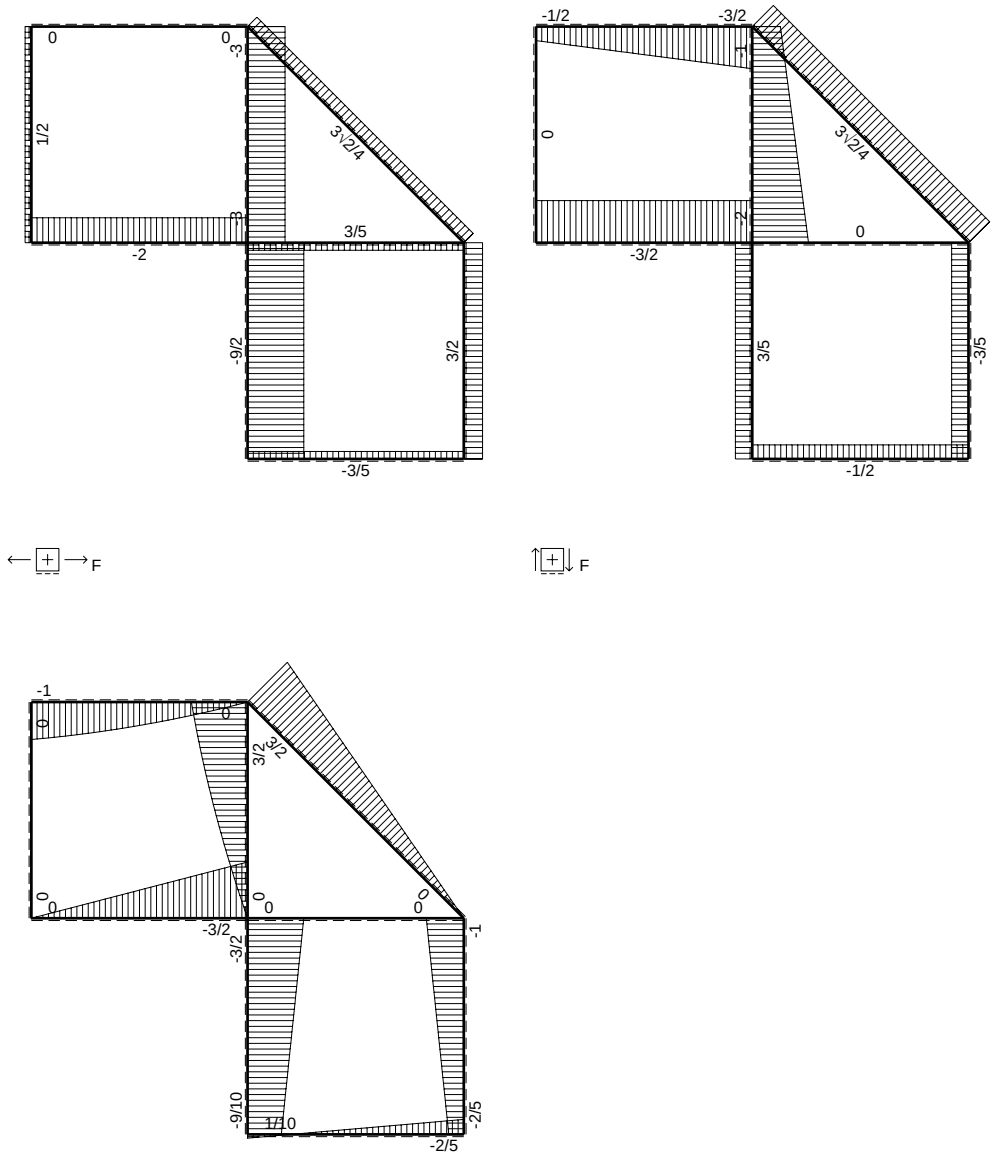


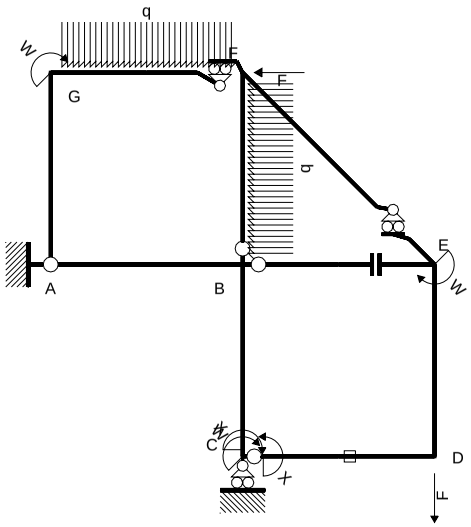
A = 184.6 mm^2
J_u = 104229. mm^4
J_v = 18662. mm^4
J_t = 158.3 mm^4
y_o = -14.95 mm
y_g = 21.06 mm
N = -1020. N
T_y = -765. N
M_x = -749700. Nmm
x_m = 12. mm
y_m = 55. mm
u_m = -12. mm
v_m = 33.94 mm
$\sigma_m = N/A - Mv/J_u$ = 238.6 N/mm^2
x_c = 24. mm
y_c = 55. mm
v_c = 33.94 mm
$\sigma_c = N/A - Mv/J_u$ = 238.6 N/mm^2
$\tau_c = TS^*/tJ_u$ = 10.76 N/mm^2
$\tau_g = TS^*/tJ_u$ = 10.76 N/mm^2
t_c = 510. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 239.3 N/mm^2

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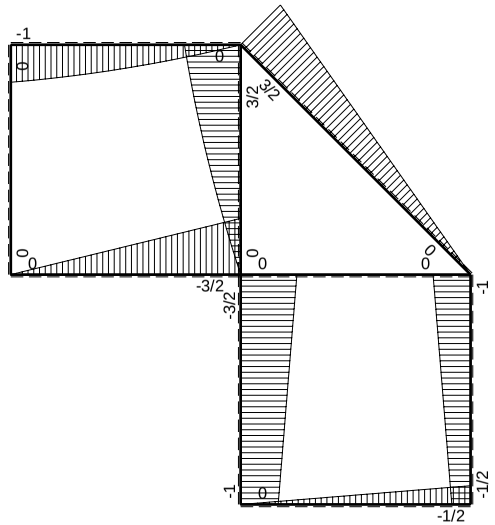
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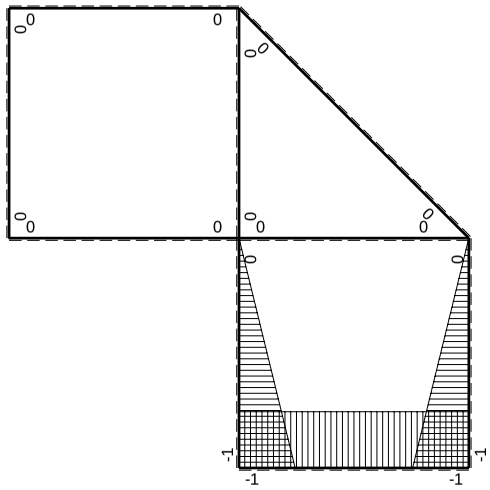

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-3
1/2
3√2/4
3/5
-2
-9/2
3/2
-3/5
F
-1/2
-3/2
1
0
3√2/4
2
0
-3/2
3/5
-3/5
-1/2
F
-1
0
3/2
3√2/2
0
0
0
0
0
-3/2
-3/2
-1
-9/10
1/10
-2/5
-2/5
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0		
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx^2/b	x^2/b^2	7/12Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb^2/EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE 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
ED b	x/b	Fb-1/2Fx	Fx-1/2Fx^2/b	x^2/b^2		
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-3/2Fx+1/2qx^2	0	0	0	0
GF b	0	Fb-1/2Fx-1/2qx^2	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	3/2Fb-Fx-1/2qx^2	0	0	0	0
BF b	0	-2Fx+1/2qx^2	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				-Fb^2/EJ	
	totali				1/6Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-1/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (1/2\ x/b\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = [1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (1/4\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -3/4\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (1/2 -1/2\ x/b\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = [1/2\ x -1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/E$

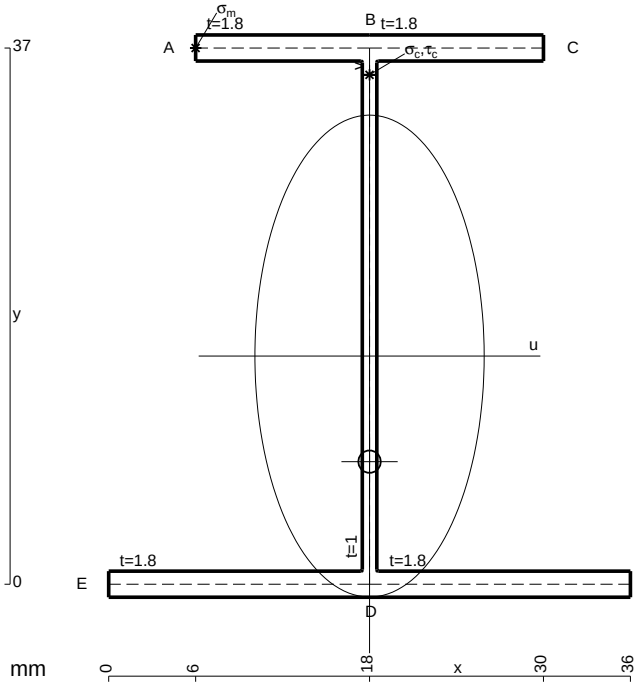
$= (1/2\ b -1/4\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -3/4\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2 -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/2\ x -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/3\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (\ x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

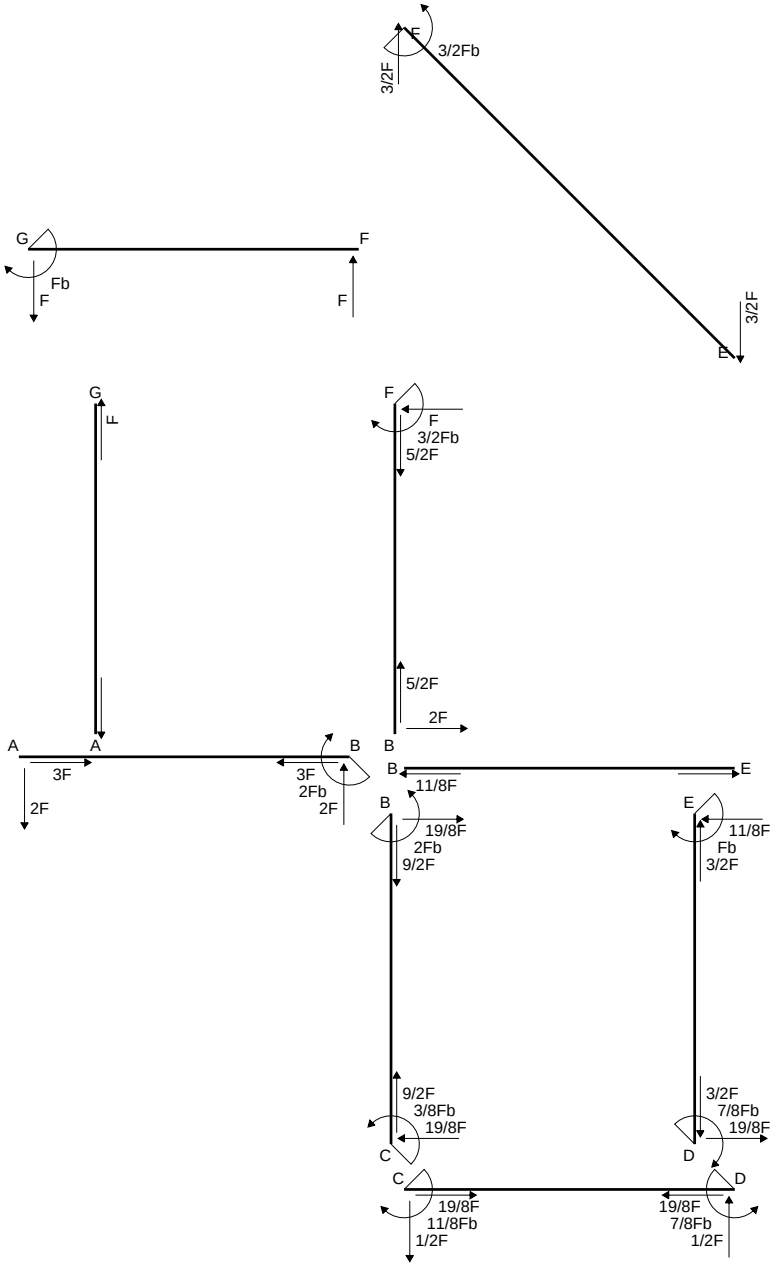
$= (1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/3\ \ Fb^2/EJ$

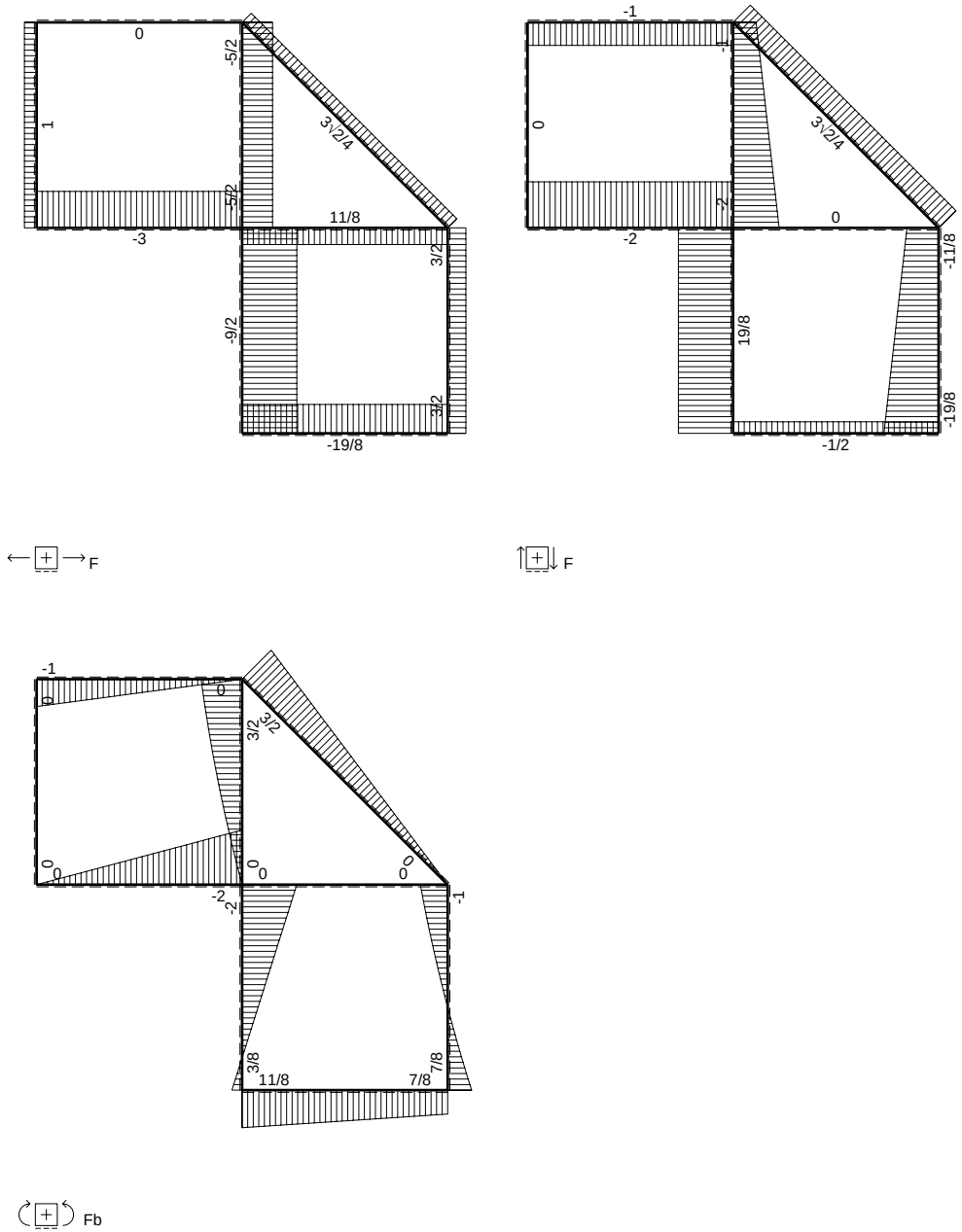


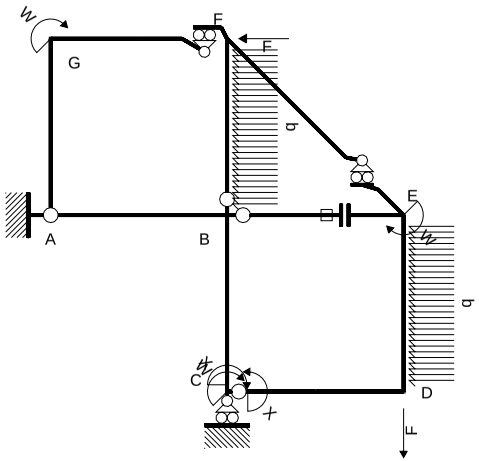
A = 145. mm^2
J_u = 40083. mm^4
J_v = 9072. mm^4
J_t = 129. mm^4
y_o = -7.287 mm
y_g = 15.74 mm
N = -1500. N
T_y = -1125. N
M_x = -393750. Nmm
x_m = 6. mm
y_m = 37. mm
u_m = -12. mm
v_m = 21.26 mm
$\sigma_m = N/A - Mv/J_u$ = 198.5 N/mm^2
x_c = 18. mm
y_c = 37. mm
v_c = 21.26 mm
$\sigma_c = N/A - Mv/J_u$ = 198.5 N/mm^2
$\tau_c = TS^*/tJ_u$ = 25.77 N/mm^2
$\tau_g = TS^*/tJ_u$ = 25.77 N/mm^2
t_c = 750. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 203.4 N/mm^2

CI02.xxxx.070

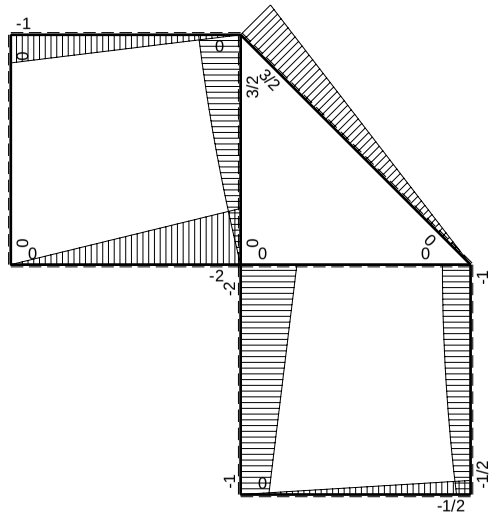
@ Adolfo Zavelani Rossi, Politecnico di Milano, vers.27.03.13 16.04.26


F
3/2Fb
3/2F
G
F
Fb
F
F
3/2F
E
G
F
F
F
3/2Fb
5/2F
5/2F
2F
A
A
B
B
3F
3F
2Fb
2F
2F
B
E
11/8F
B
19/8F
2Fb
9/2F
E
11/8F
Fb
3/2F
9/2F
3/8Fb
19/8F
C
3/2F
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19/8F
7/8Fb
1/2F

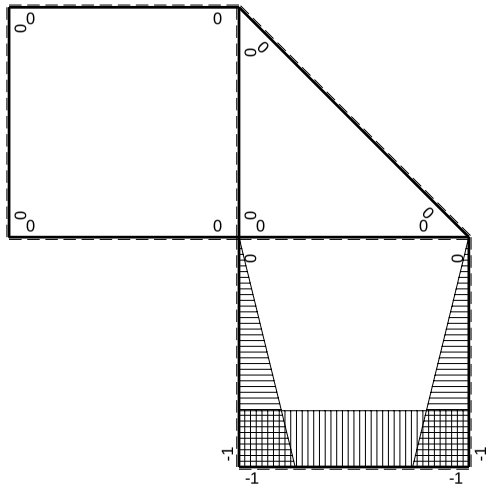

0
-5/2
1
3√2/4
5/2
11/8
-3
3/2
-9/2
3/2
-19/8
-1
-1
0
3√2/4
2
0
-2
-11/8
19/8
-19/8
-1/2
F
F
-1
-1
0
0
3/2
3/2
0
0
0
0
-2
-2
-1
3/8
11/8
7/8
7/8
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

PROCEDIMENTO E RISULTATI 216391 CI02.xxxx.071

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Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0		
BC b	-x/b	-2Fb+Fx	$2Fx-Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	$Fb-Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	-1/2Fx	1/2Fx	1	$1/4Fb^2/EJ$	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE b	-1+x/b	$-1/2Fb-Fx+1/2qx^2$	$1/2Fb+1/2Fx-3/2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$3/8Fb^2/EJ$	1/3Xb/EJ
ED b	x/b	$Fb-1/2qx^2$	$Fx-1/2qx^3/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	$3/2Fb-Fx-1/2qx^2$	0	0	0	0
BF b	0	$-2Fx+1/2qx^2$	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$55/24Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-11/8Fb	

PROCEDIMENTO E RISULTATI 216391 CI02.xxxx.071

Sviluppi di calcolo iperstatica

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$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (2\ x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (1/2\ x/b\ )\ Fb\ 1/EJ\ dx = [1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b\ )\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (1/2 -1/2\ x/b\ )\ Fb\ 1/EJ\ dx = [1/2\ x -1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/4\ b\ )\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

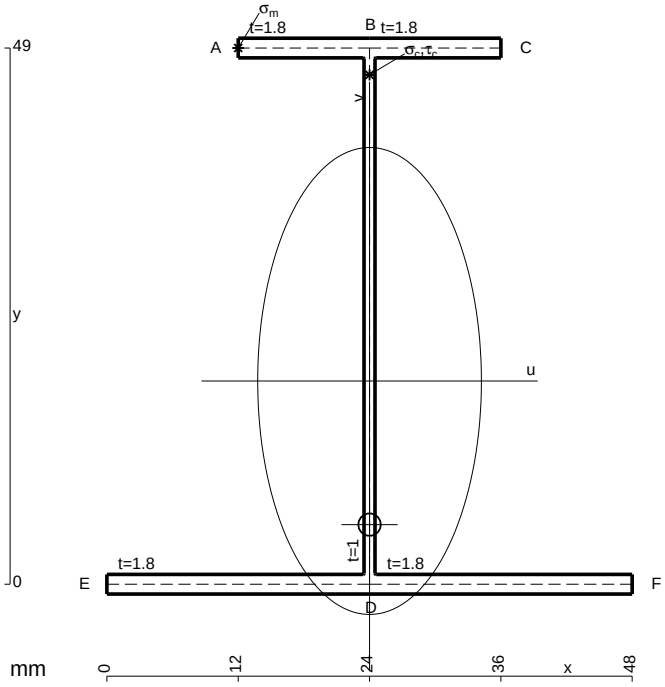
$L^{Xo}_{DE} = \int_o^b (1/2 +1/2\ x/b -3/2\ x^2/b^2 +1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx$

$= [1/2\ x +1/4\ x^2/b -1/2\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

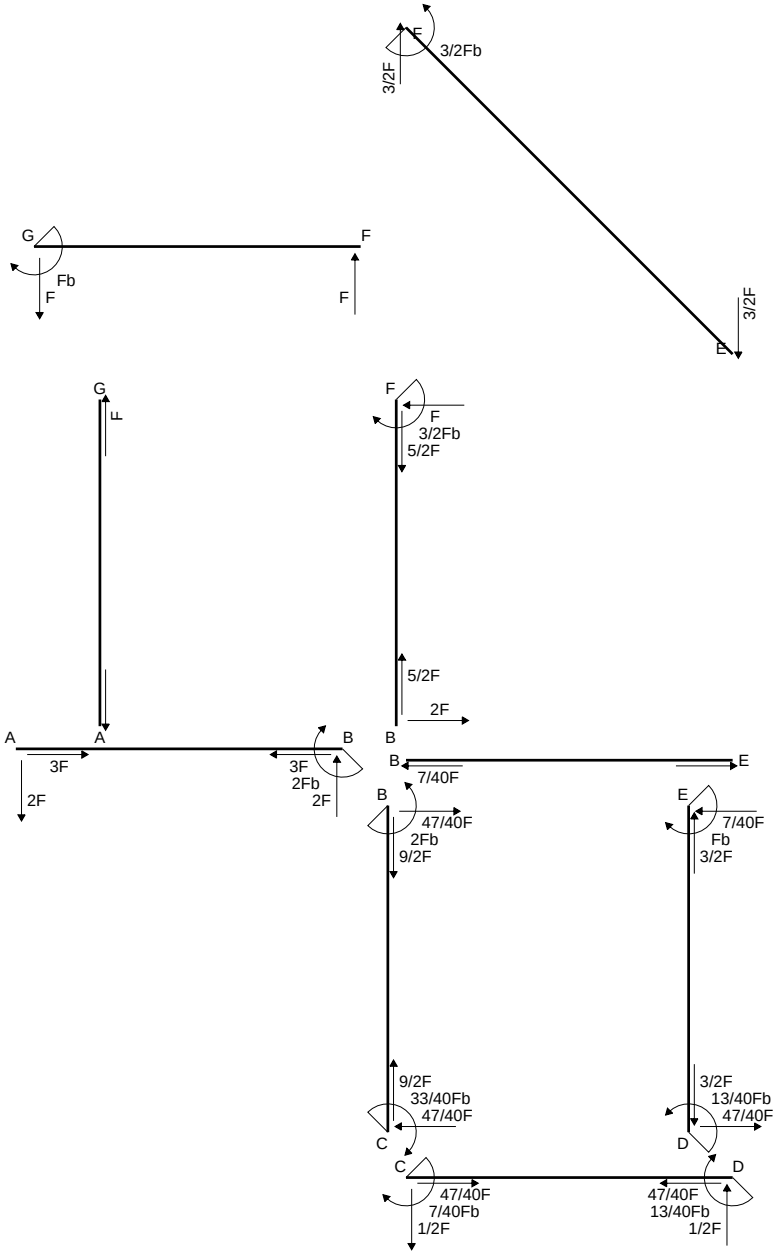
$= (1/2\ b +1/4\ b -1/2\ b +1/8\ b\ )\ Fb\ 1/EJ\ = 3/8\ Fb^2/EJ$

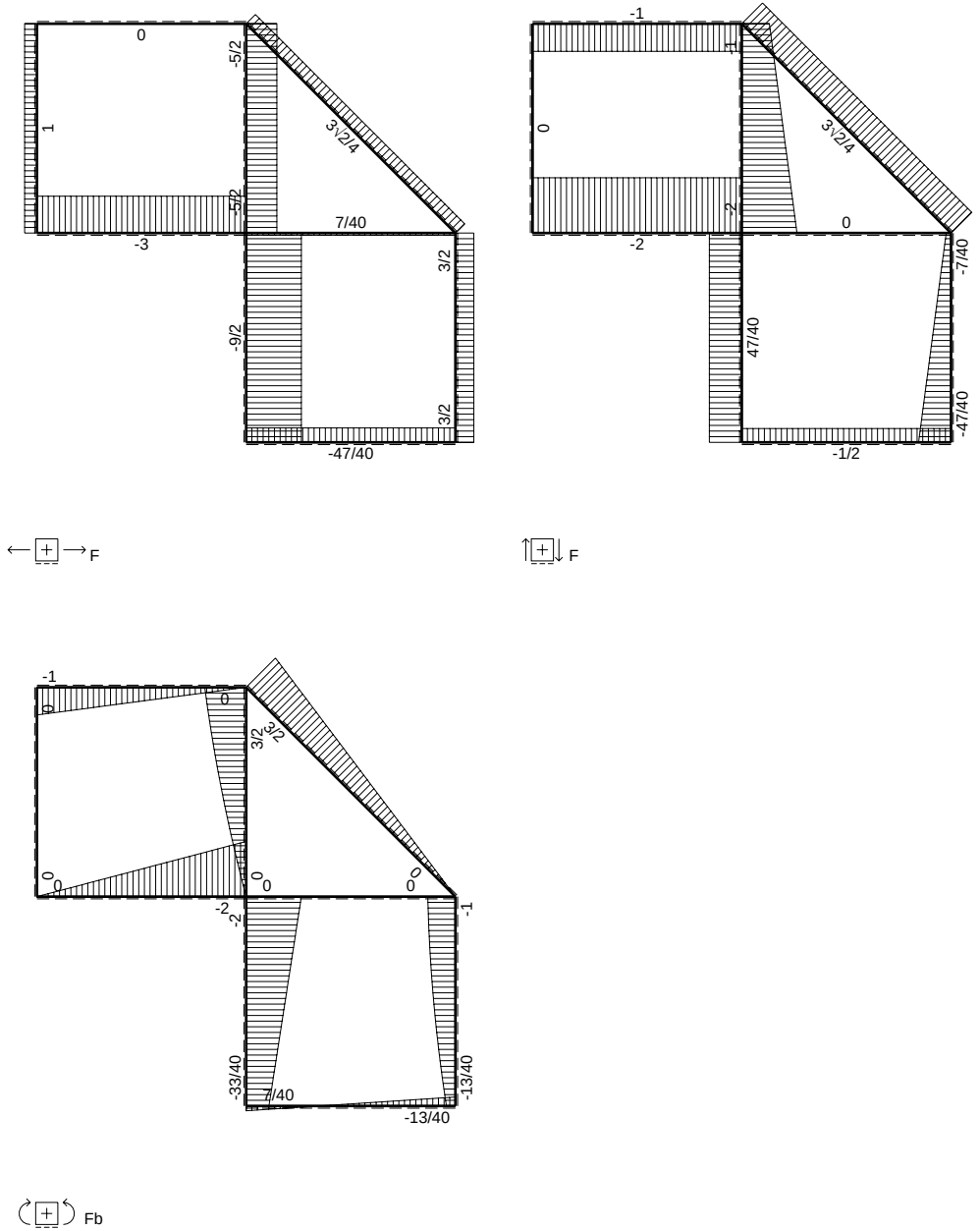
$L^{Xo}_{ED} = \int_o^b (\ x/b -1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

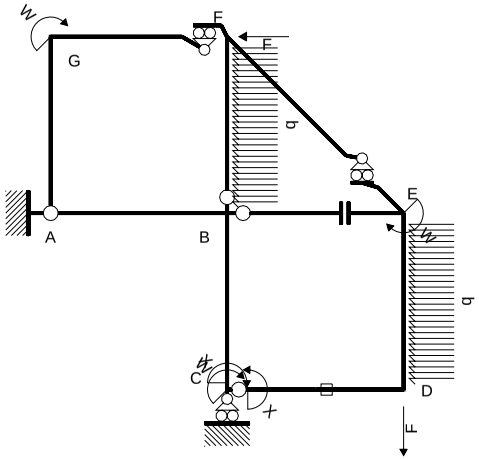
$= (1/2\ b -1/8\ b\ )\ Fb\ 1/EJ\ = 3/8\ Fb^2/EJ$



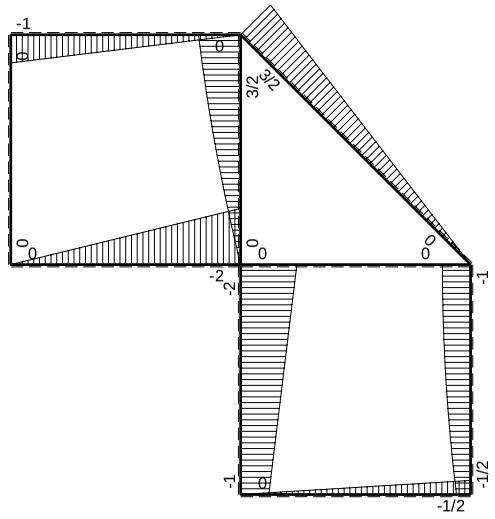
A = 178.6 mm^2
J_u = 81324. mm^4
J_v = 18662. mm^4
J_t = 156.3 mm^4
y_o = -13.13 mm
y_g = 18.57 mm
N = -1740. N
T_y = -1160. N
M_x = -580000. Nmm
x_m = 12. mm
y_m = 49. mm
u_m = -12. mm
v_m = 30.43 mm
$\sigma_m = N/A - Mv/J_u$ = 207.3 N/mm^2
x_c = 24. mm
y_c = 49. mm
v_c = 30.43 mm
$\sigma_c = N/A - Mv/J_u$ = 207.3 N/mm^2
$\tau_c = TS^*/tJ_u$ = 18.75 N/mm^2
$\tau_g = TS^*/tJ_u$ = 18.75 N/mm^2
t_c = 580. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 209.8 N/mm^2


F
3/2Fb
3/2F
G
F
Fb
F
F
3/2F
E
G
F
F
3/2Fb
5/2F
5/2F
2F
A
A
B
B
3F
3F
2Fb
2F
2F
B
E
7/40F
B
47/40F
2Fb
9/2F
E
7/40F
Fb
3/2F
9/2F
33/40Fb
47/40F
3/2F
13/40Fb
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47/40F
13/40Fb
1/2F

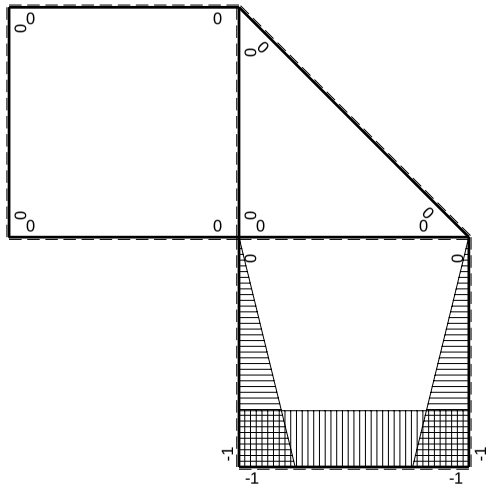

0
-5/2
1
3√2/4
-5/2
7/40
-3
3/2
-9/2
3/2
-47/40
F
-1
1
0
3√2/4
2
0
-2
-7/40
47/40
-47/40
-1/2
F
-1
0
3/2
3√2/4
0
0
0
0
-2
-2
-1
-33/40
7/40
-13/40
-13/40
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

PROCEDIMENTO E RISULTATI 939077 CI02.xxxx.072

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Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0		
BC b	-x/b	-2Fb+Fx	$2Fx-Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	$Fb-Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	-1/2Fx	1/2Fx	1	$1/4Fb^2/EJ$	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE b	-1+x/b	$-1/2Fb-Fx+1/2qx^2$	$1/2Fb+1/2Fx-3/2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$3/8Fb^2/EJ$	1/3Xb/EJ
ED b	x/b	$Fb-1/2qx^2$	$Fx-1/2qx^3/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	$3/2Fb-Fx-1/2qx^2$	0	0	0	0
BF b	0	$-2Fx+1/2qx^2$	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$7/24Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-7/40Fb	

PROCEDIMENTO E RISULTATI 939077 CI02.xxxx.072

Sviluppi di calcolo iperstatica

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$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (2\ x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ \ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (1/2\ x/b\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = [1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (1/4\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -3/4\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (1/2 -1/2\ x/b\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = [1/2\ x -1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/E$

$= (1/2\ b -1/4\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -3/4\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2 +1/2\ x/b -3/2\ x^2/b^2 +1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx$

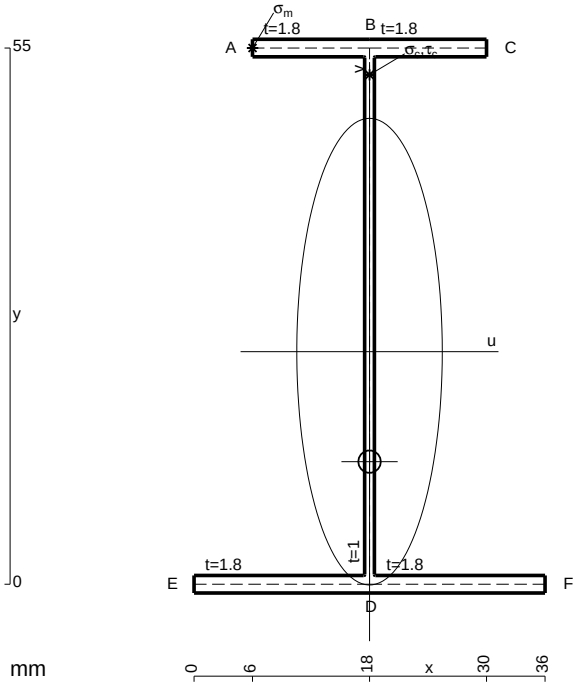
$= [1/2\ x +1/4\ x^2/b -1/2\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b +1/4\ b -1/2\ b +1/8\ b\ )\ Fb\ 1/EJ\ = 3/8\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (\ x/b -1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

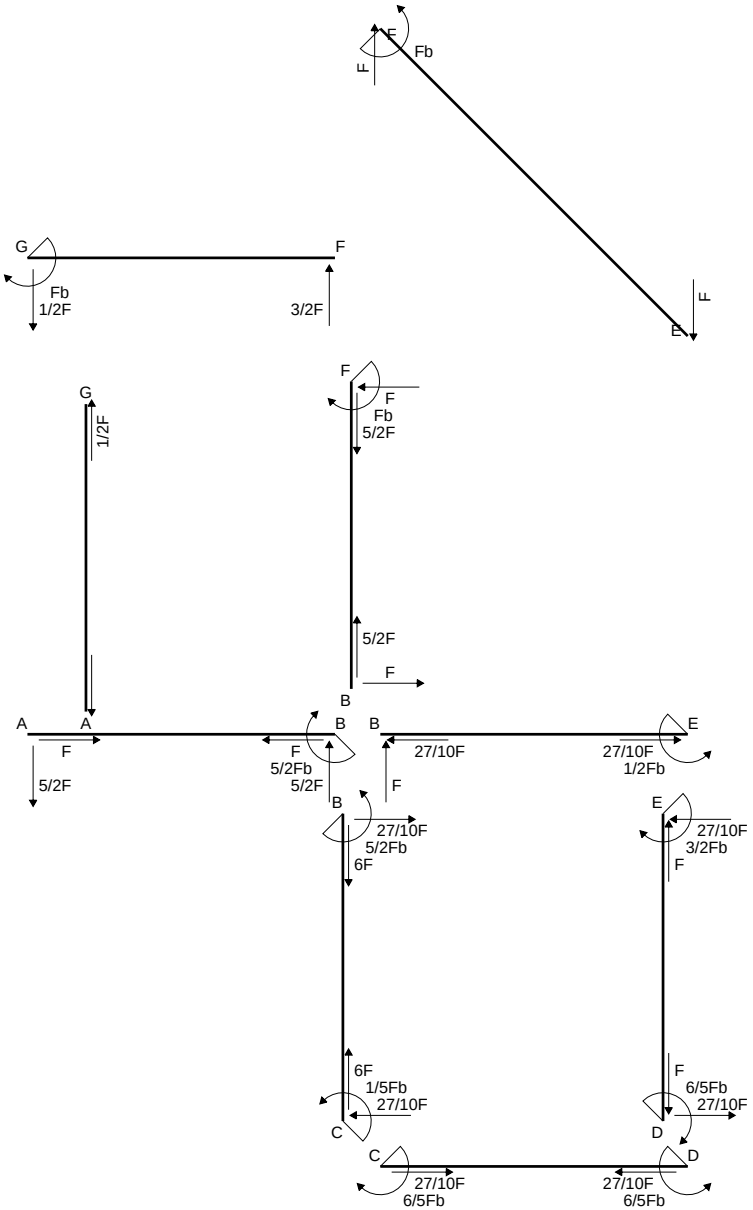
$= (1/2\ b -1/8\ b\ )\ Fb\ 1/EJ\ = 3/8\ \ Fb^2/EJ$

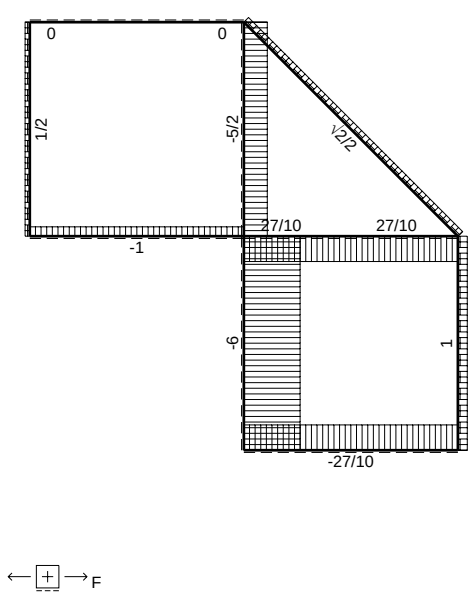
PROCEDIMENTO E RISULTATI 939077 CI02.xxxx.072

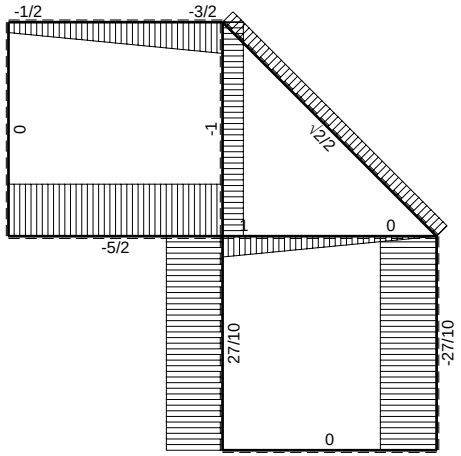


A = 163. mm^2
J_u = 93375. mm^4
J_v = 9072. mm^4
J_t = 135. mm^4
y_o = -11.28 mm
y_g = 23.86 mm
N = -1650. N
T_y = -1100. N
M_x = -682000. Nmm
x_m = 6. mm
y_m = 55. mm
u_m = -12. mm
v_m = 31.14 mm
$\sigma_m = N/A - Mv/J_u$ = 217.4 N/mm^2
x_c = 18. mm
y_c = 55. mm
v_c = 31.14 mm
$\sigma_c = N/A - Mv/J_u$ = 217.4 N/mm^2
$\tau_c = TS^*/tJ_u$ = 15.85 N/mm^2
$\tau_g = TS^*/tJ_u$ = 15.85 N/mm^2
t_c = 550. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 219.1 N/mm^2

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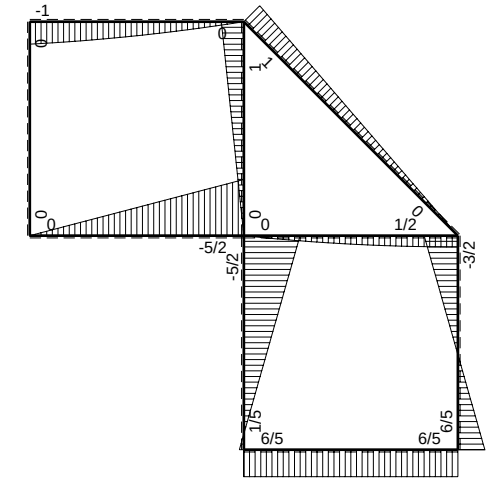

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5/2F
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5/2Fb
5/2F
27/10F
27/10F
1/2Fb
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27/10F
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6F
E
27/10F
3/2Fb
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6F
1/5Fb
27/10F
C
F
6/5Fb
27/10F
D
C
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27/10F
6/5Fb
27/10F
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-1
-6
1
-27/10

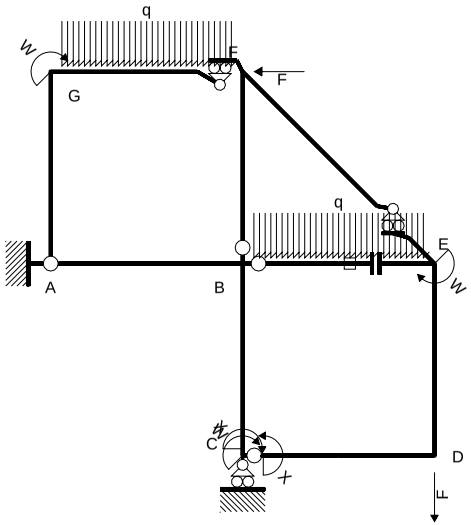

-1/2
-3/2
0
-1
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-5/2
27/10
-27/10
0

←□→ F

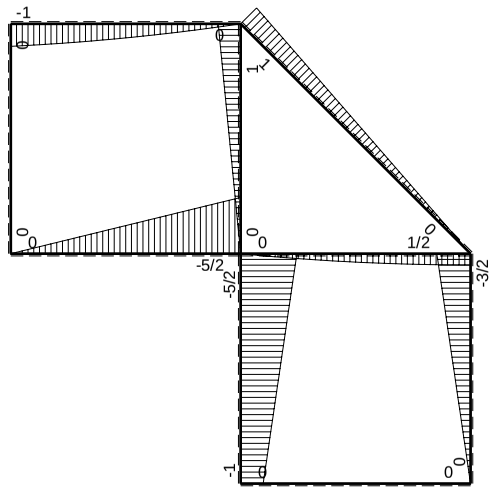
↑□↓ F


-1
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6/5

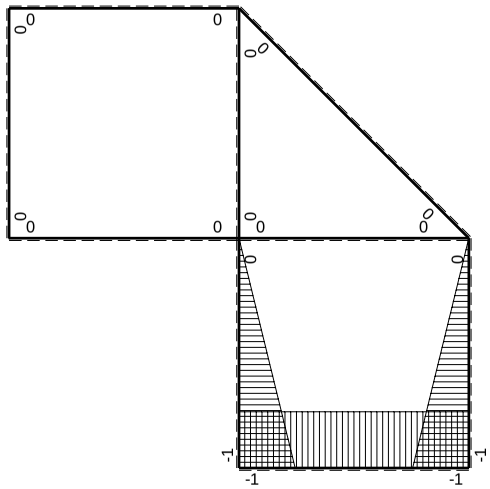
↺□↻ Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0		
BC b	-x/b	-5/2Fb+3/2Fx	5/2Fx-3/2Fx^2/b	x^2/b^2	3/4Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	Fb+1/2Fx-3/2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE 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
ED b	x/b	3/2Fb-3/2Fx	3/2Fx-3/2Fx^2/b	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-3/2Fx+1/2qx^2	0	0	0	0
GF b	0	Fb-1/2Fx-1/2qx^2	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	Fx-1/2qx^2	0	0	0	0
EB b	0	-1/2Fb+1/2qx^2	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				2Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-6/5Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 +1/2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x +1/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

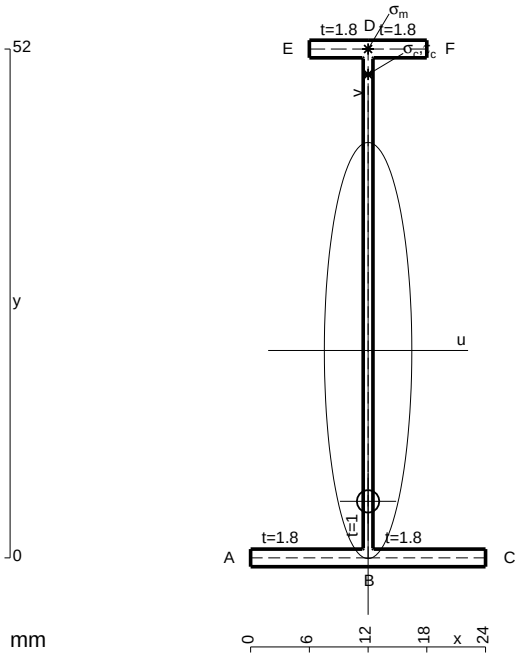
$= (\ b +1/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (3/2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 1/4\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (3/2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

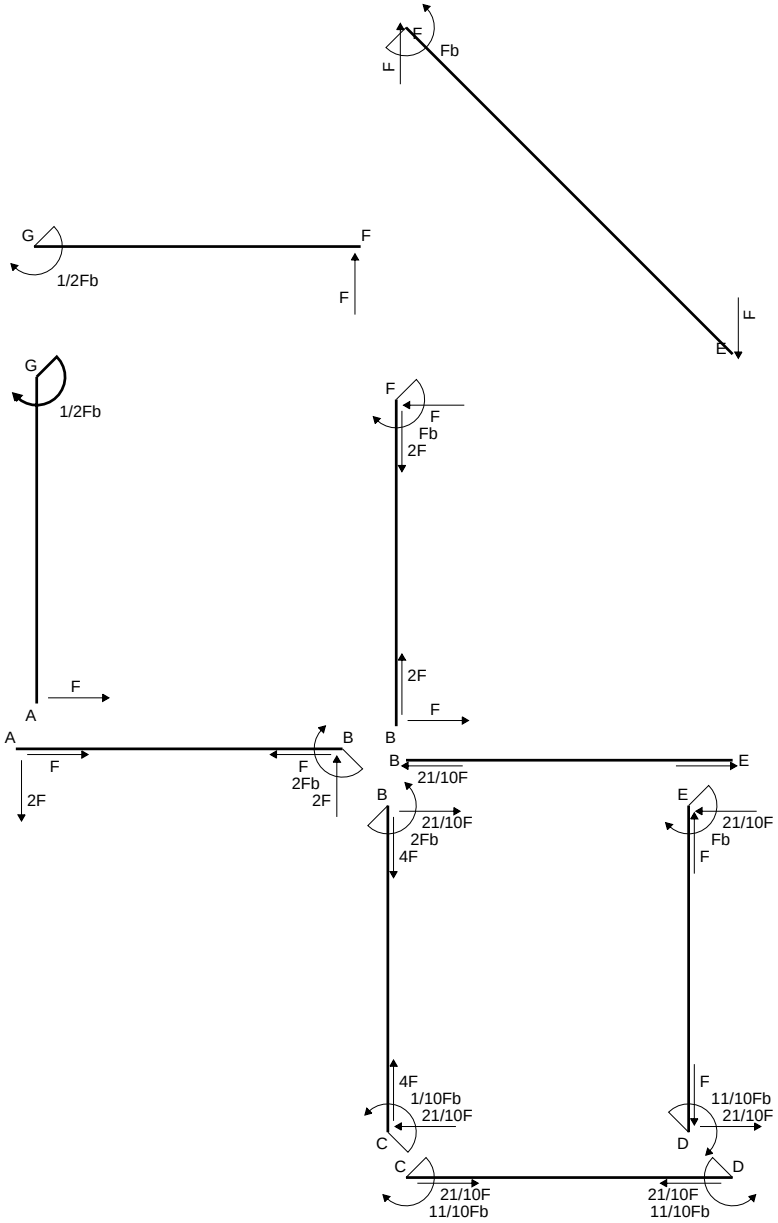
$= (3/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 1/4\ \ Fb^2/EJ$

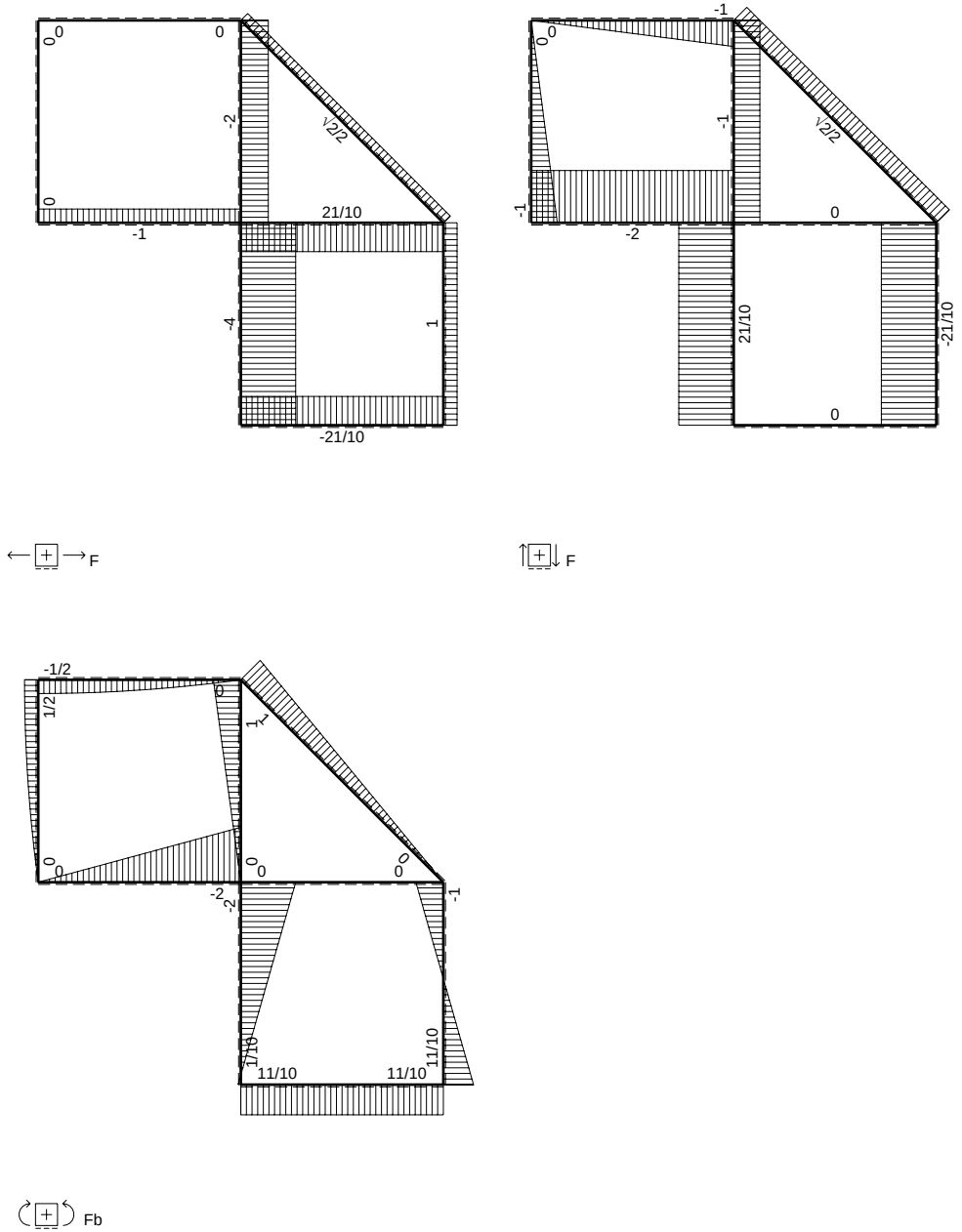


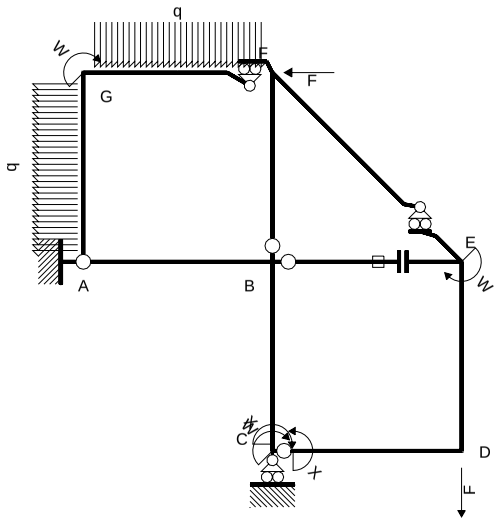
A = 116.8 mm^2
J_u = 52822. mm^4
J_v = 2333. mm^4
J_t = 87.32 mm^4
y_o = -15.41 mm
y_g = 21.19 mm
N = -250. N
T_y = -625. N
M_x = -393750. Nmm
x_m = 12. mm
y_m = 52. mm
v_m = 30.81 mm
$\sigma_m = N/A - Mv/J_u$ = 227.5 N/mm^2
y_c = 2. mm
u_c = -12. mm
v_c = -19.19 mm
$\sigma_c = N/A - Mv/J_u$ = 227.5 N/mm^2
$\tau_c = TS^*/tJ_u$ = 7.874 N/mm^2
$\tau_g = TS^*/tJ_u$ = 7.874 N/mm^2
t_c = 250. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 227.9 N/mm^2

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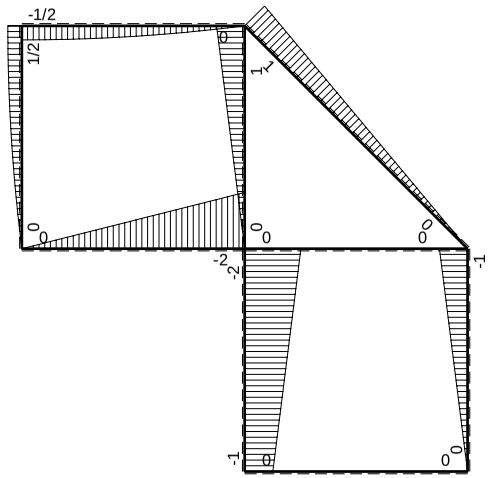
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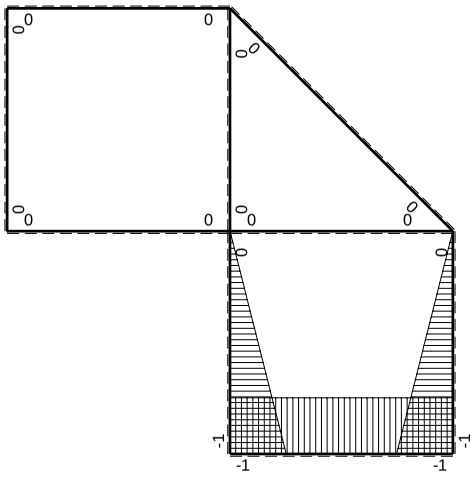

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1
1
0
0
0
0
0
-2
-2
-1
1/10
11/10
11/10
11/10
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0		
BC b	-x/b	-2Fb+Fx	2Fx-Fx^2/b	x^2/b^2	2/3Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	-Fx	Fx-Fx^2/b	1-2x/b+x^2/b^2	1/6Fb^2/EJ	1/3Xb/EJ
ED b	x/b	Fb-Fx	Fx-Fx^2/b	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-Fx+1/2qx^2	0	0	0	0
GF b	0	1/2Fb-1/2qx^2	0	0		
GA b	0	1/2Fb-1/2qx^2	0	0	0	0
AG b	0	-Fx+1/2qx^2	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				11/6Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-11/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (2\ x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

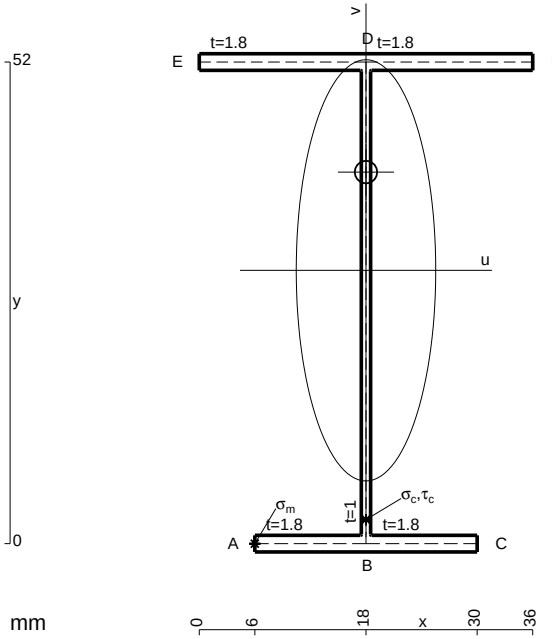
$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

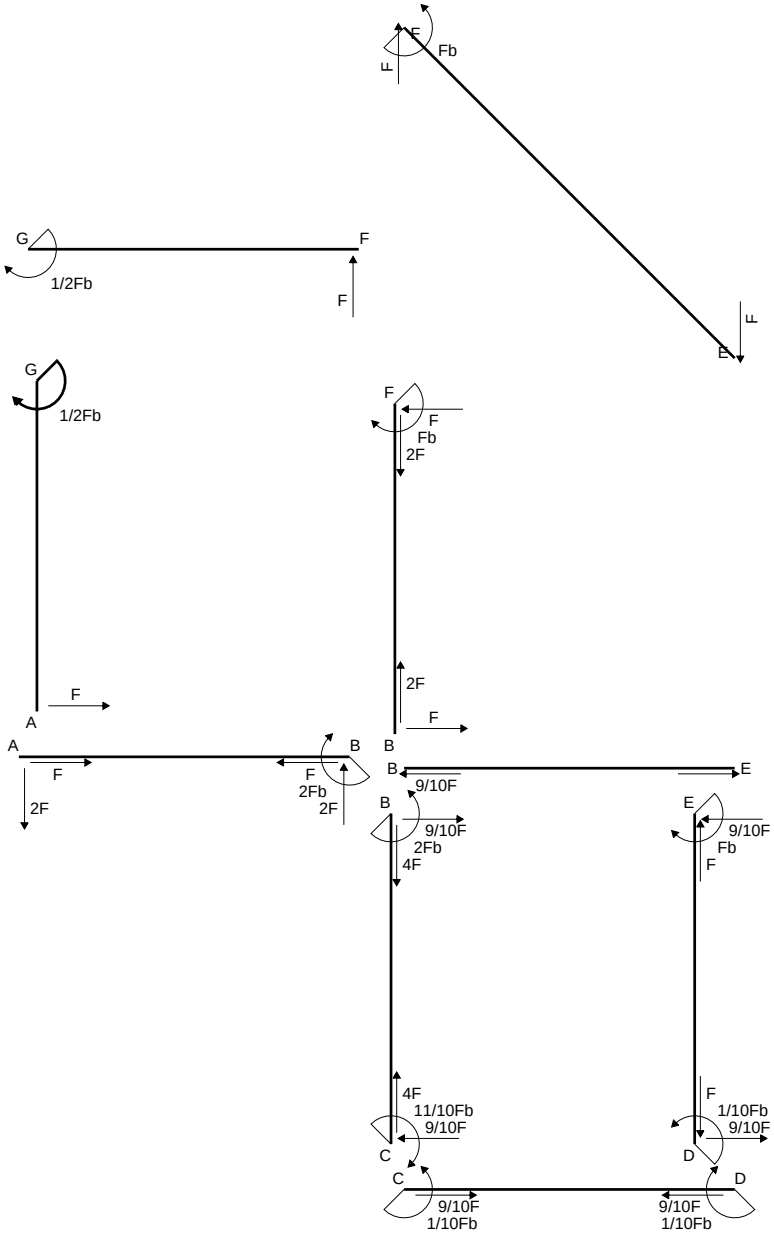
$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

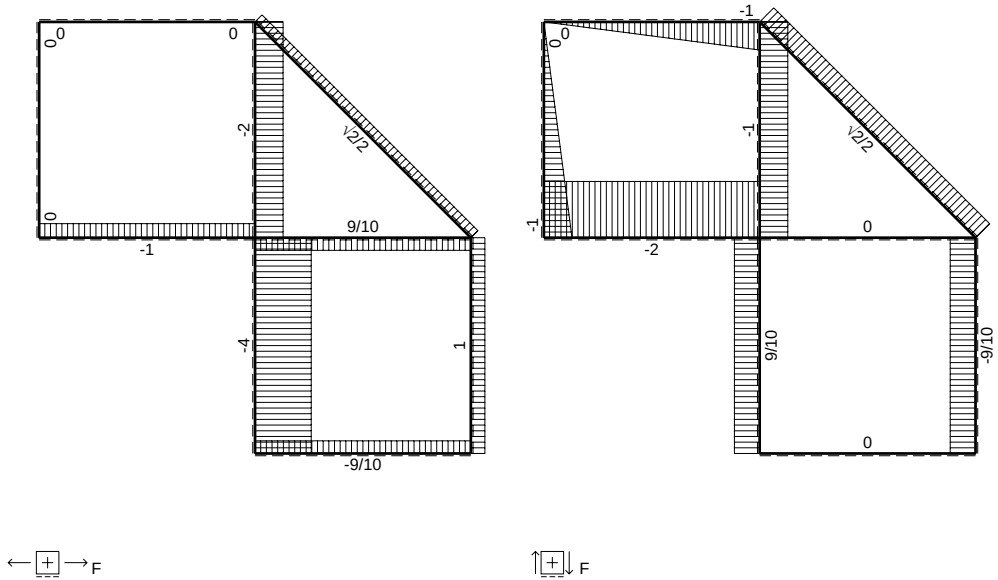


A = 160. mm^2
J_u = 82754. mm^4
J_v = 9072. mm^4
J_t = 134. mm^4
y_o = 10.6 mm
y_g = 29.51 mm
N = -480. N
T_y = -960. N
M_x = -652800. Nmm
x_m = 6. mm
u_m = -12. mm
v_m = -29.51 mm
$\sigma_m = N/A - Mv/J_u$ = -235.8 N/mm^2
x_c = 18. mm
v_c = -29.51 mm
$\sigma_c = N/A - Mv/J_u$ = -235.8 N/mm^2
$\tau_c = TS^*/tJ_u$ = 14.79 N/mm^2
$\tau_g = TS^*/tJ_u$ = 14.79 N/mm^2
t_c = 480. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 237.2 N/mm^2

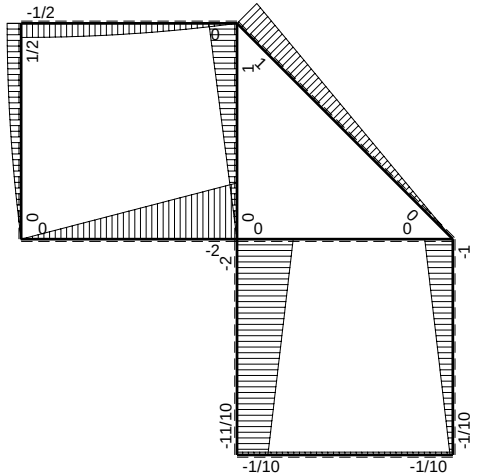
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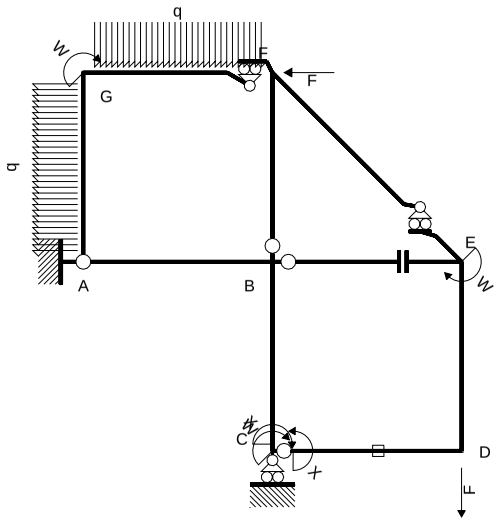

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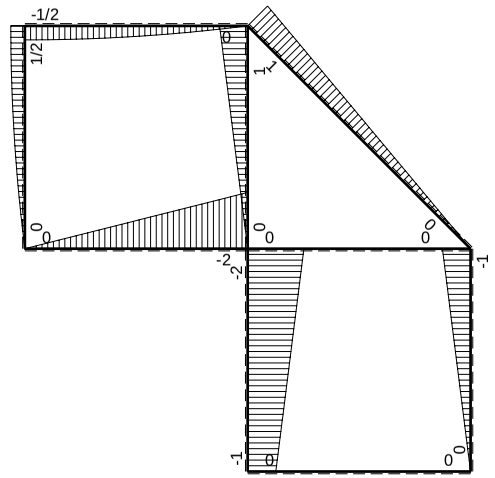
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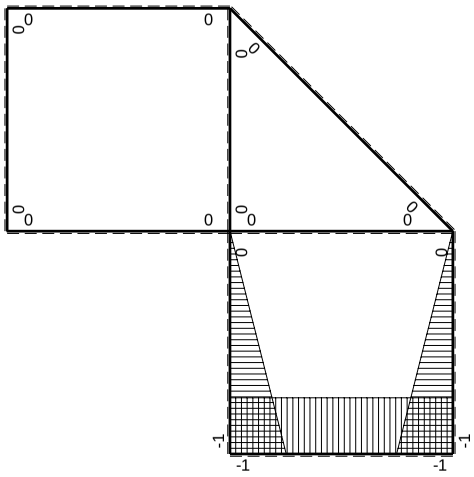
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

PROCEDIMENTO E RISULTATI 263877 CI02.xxxx.075

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0		
BC b	-x/b	-2Fb+Fx	2Fx-Fx^2/b	x^2/b^2	2/3Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	-Fx	Fx-Fx^2/b	1-2x/b+x^2/b^2	1/6Fb^2/EJ	1/3Xb/EJ
ED b	x/b	Fb-Fx	Fx-Fx^2/b	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-Fx+1/2qx^2	0	0	0	0
GF b	0	1/2Fb-1/2qx^2	0	0		
GA b	0	1/2Fb-1/2qx^2	0	0	0	0
AG b	0	-Fx+1/2qx^2	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				-Fb^2/EJ	
	totali				-1/6Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				1/10Fb	

Sviluppi di calcolo iperstatica

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$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (2\ x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

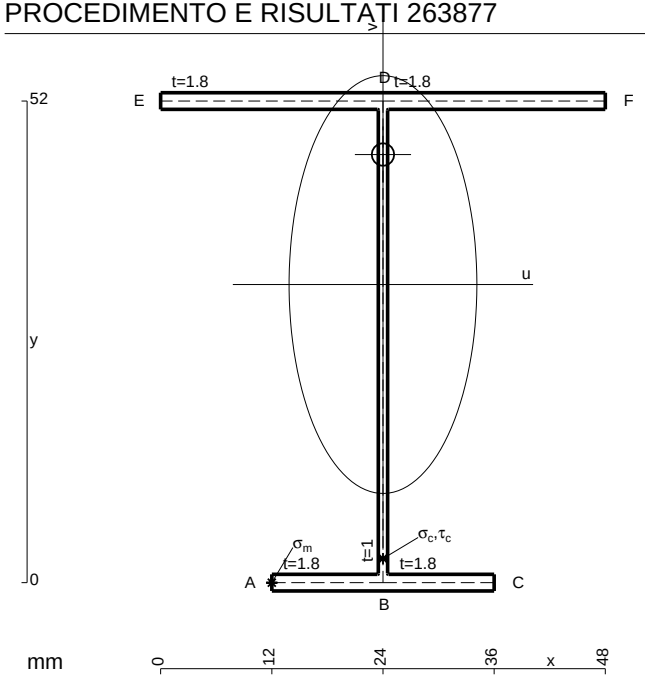
$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

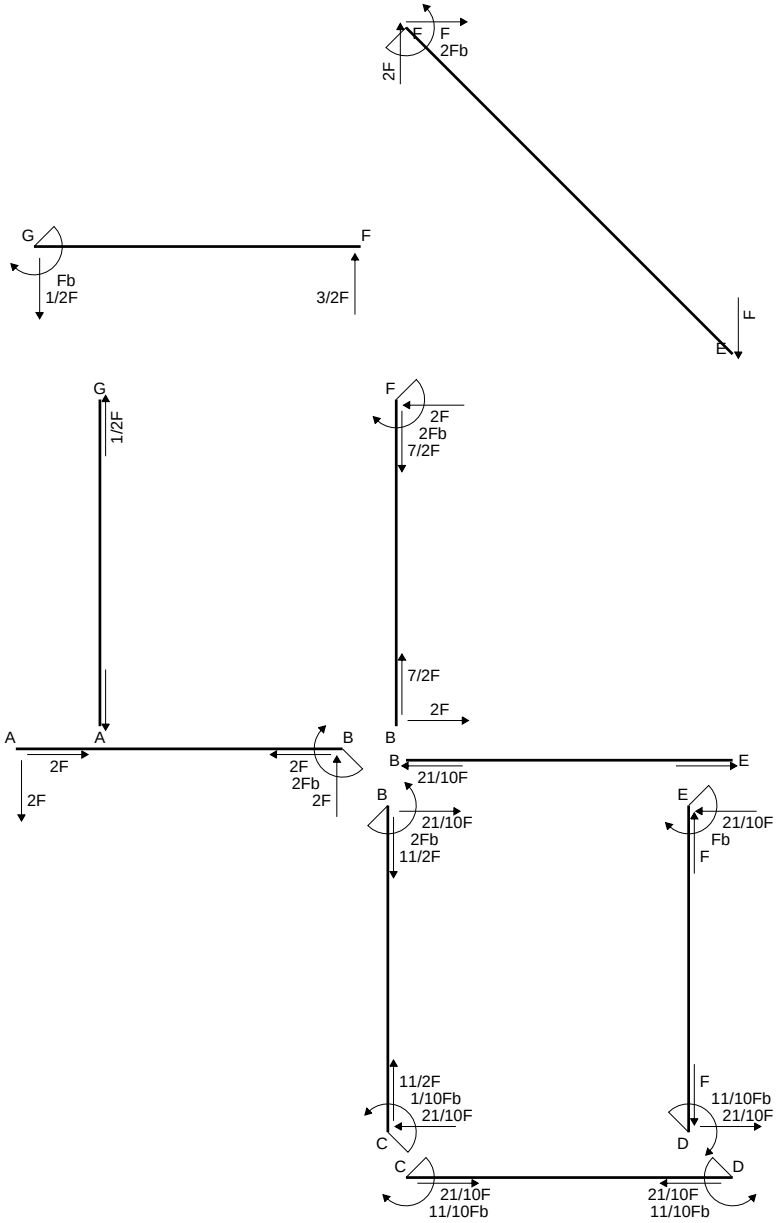
$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

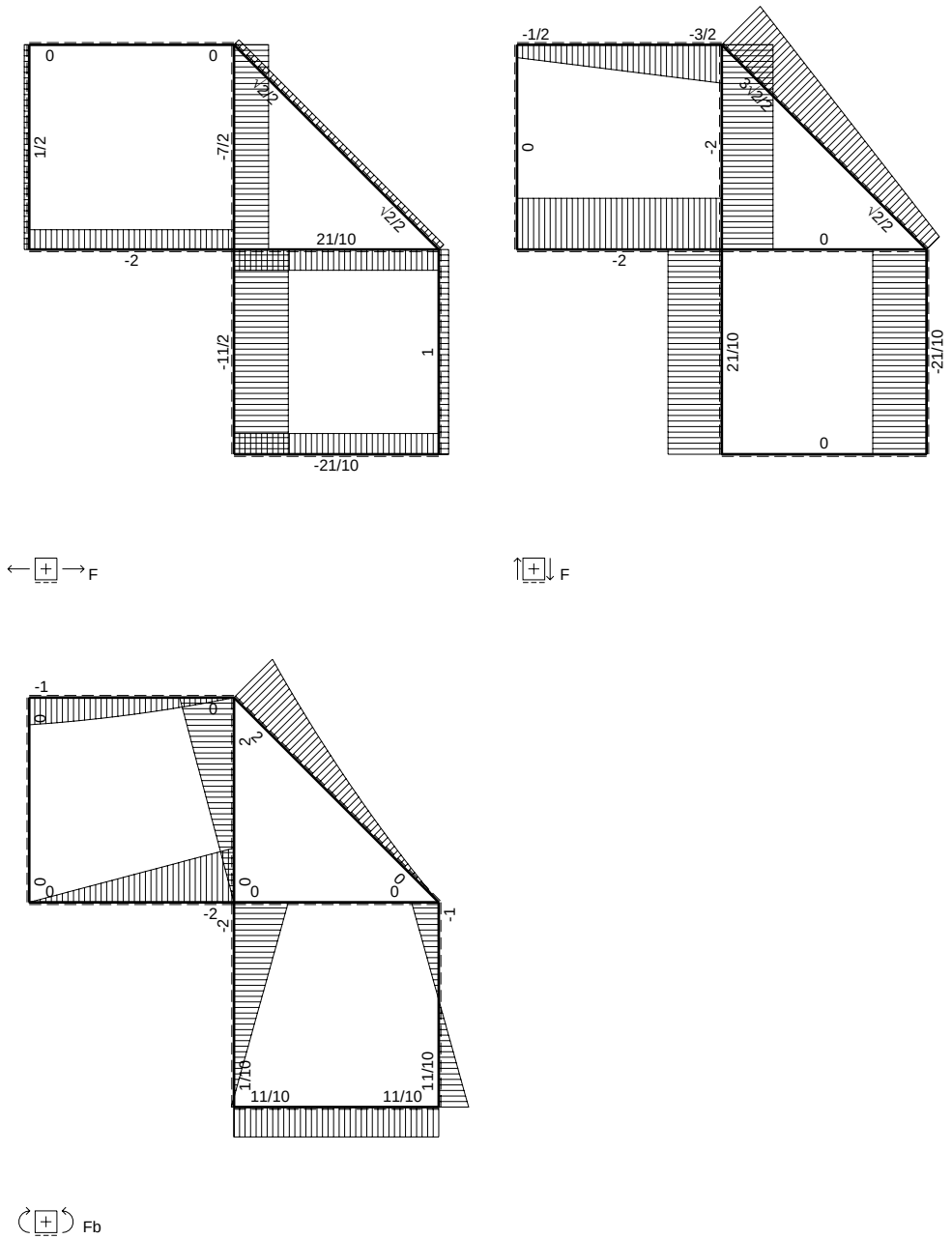


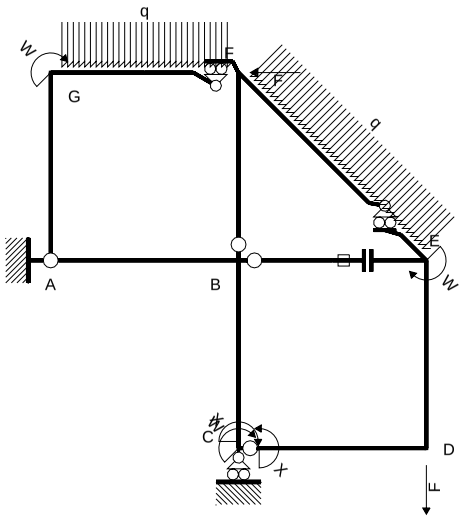
A = 181.6 mm^2
J_u = 92380. mm^4
J_v = 18662. mm^4
J_t = 157.3 mm^4
y_o = 14.04 mm
y_g = 32.19 mm
N = -380. N
T_y = -760. N
M_x = -554800. Nmm
x_m = 12. mm
u_m = -12. mm
v_m = -32.19 mm
$\sigma_m = N/A - Mv/J_u$ = -195.4 N/mm^2
x_c = 24. mm
v_c = -32.19 mm
$\sigma_c = N/A - Mv/J_u$ = -195.4 N/mm^2
$\tau_c = TS^*/tJ_u$ = 11.44 N/mm^2
$\tau_g = TS^*/tJ_u$ = 11.44 N/mm^2
t_c = 380. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 196.4 N/mm^2

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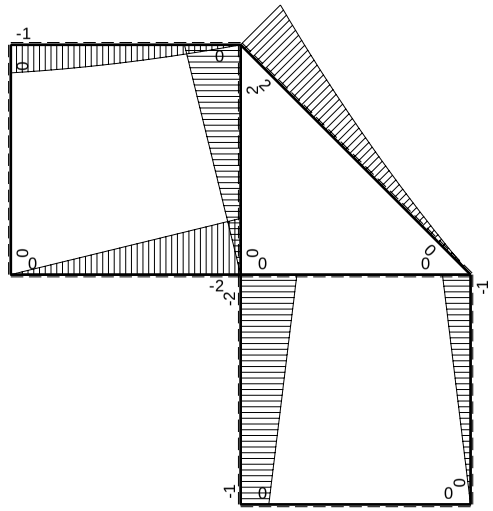
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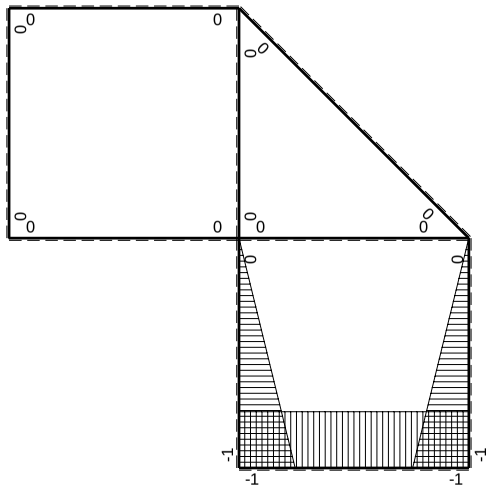

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Fb



Schema di calcolo iperstatico



M_o flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0		
BC b	-x/b	-2Fb+Fx	2Fx-Fx^2/b	x^2/b^2	2/3Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	-Fx	Fx-Fx^2/b	1-2x/b+x^2/b^2	1/6Fb^2/EJ	1/3Xb/EJ
ED b	x/b	Fb-Fx	Fx-Fx^2/b	x^2/b^2		
EF √2b	0	√2/2Fx+1/2qx^2	0	0	0	0
FG b	0	-3/2Fx+1/2qx^2	0	0	0	0
GF b	0	Fb-1/2Fx-1/2qx^2	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				11/6Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-11/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 - 2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b + 1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b + 1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 - 2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b + 1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b + 1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (2\ x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x^2/b - 1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b - 1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x - 1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

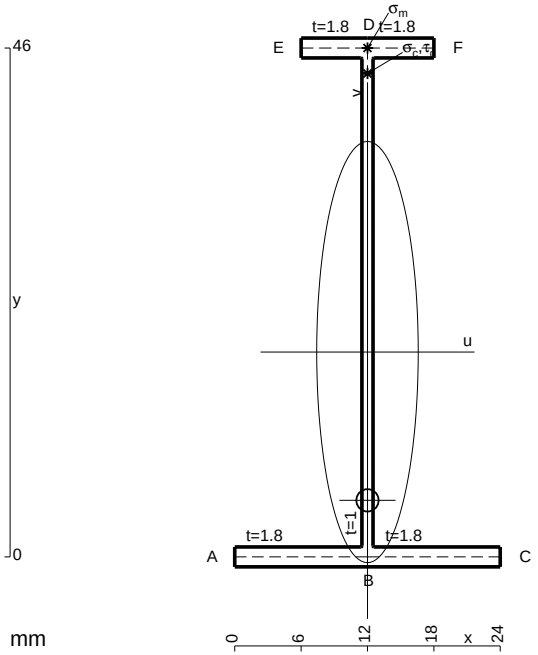
$= (\ b - 1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b - 1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b - 1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b - 1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

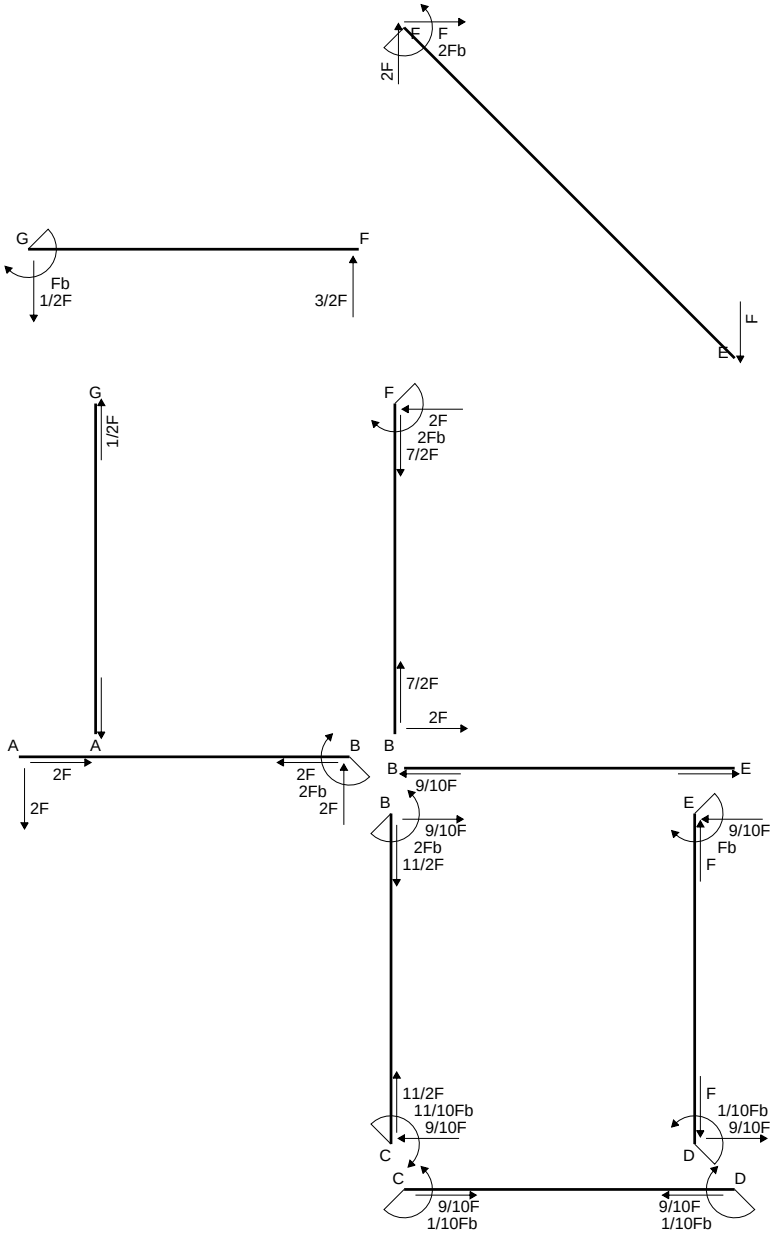
$= (1/2\ b - 1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

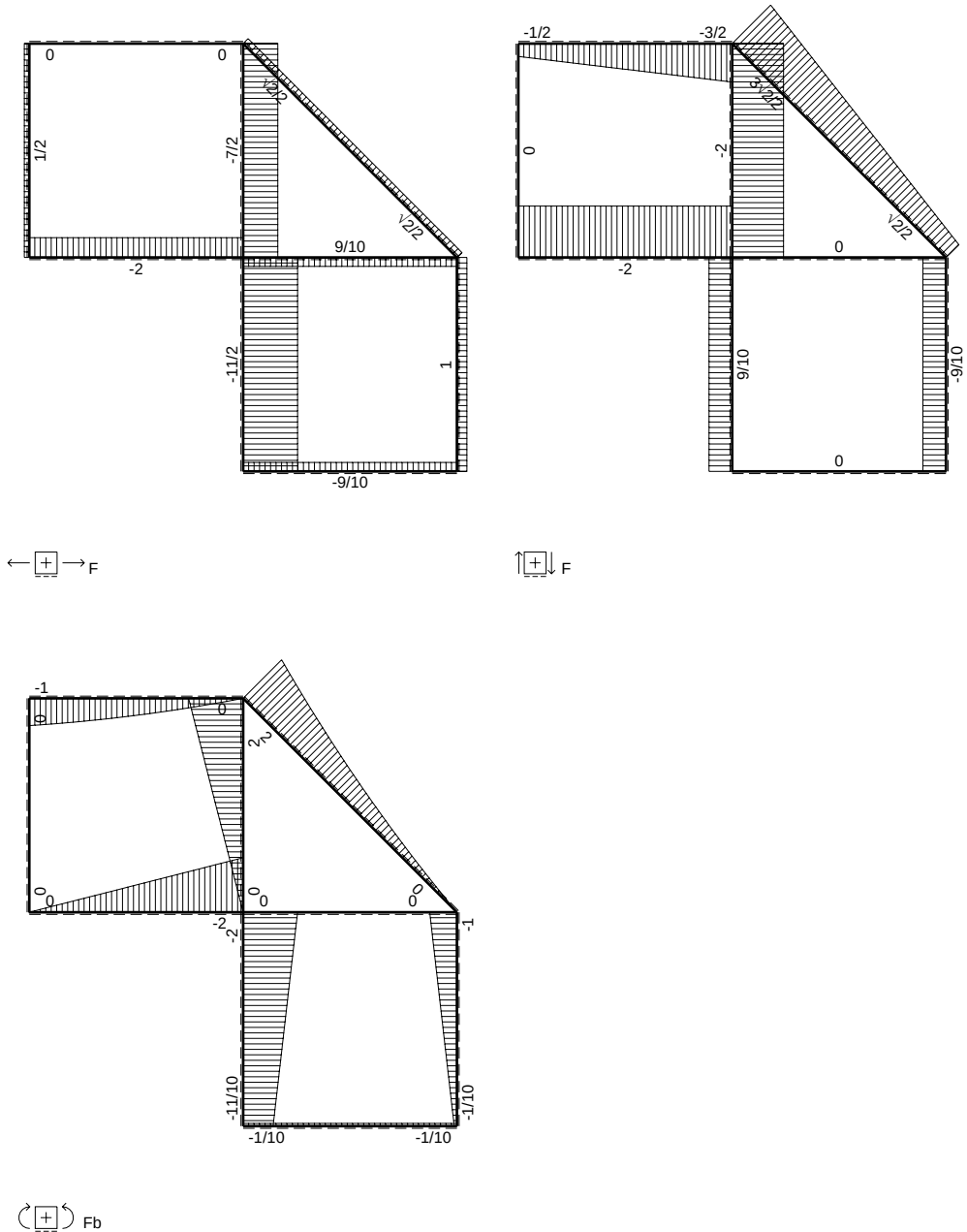


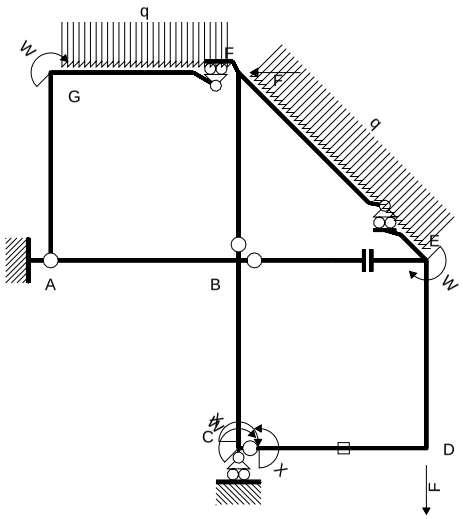
A = 110.8 mm^2
J_u = 40163. mm^4
J_v = 2333. mm^4
J_t = 85.32 mm^4
y_o = -13.41 mm
y_g = 18.52 mm
N = 155.6 N
T_y = 466.7 N
M_x = 299200. Nmm
x_m = 12. mm
y_m = 46. mm
v_m = 27.48 mm
$\sigma_m = N/A - Mv/J_u$ = -203.3 N/mm^2
y_c = 2. mm
u_c = -12. mm
v_c = -16.52 mm
$\sigma_c = N/A - Mv/J_u$ = -203.3 N/mm^2
$\tau_c = TS^*/tJ_u$ = 6.898 N/mm^2
$\tau_g = TS^*/tJ_u$ = 6.898 N/mm^2
t_c = 220. mm
$\sigma_o = \sqrt{\sigma^2 + 3\tau^2}$ = 203.7 N/mm^2

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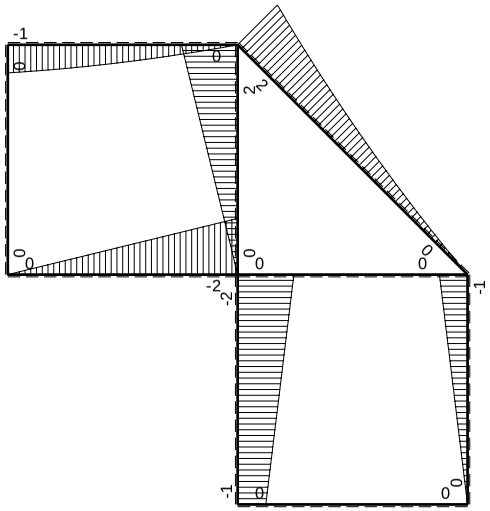
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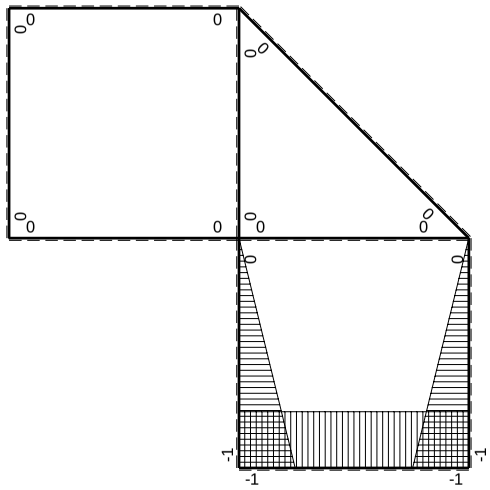

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-2
-1
-11/10
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-1/10
-1/10
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0		
BC b	-x/b	-2Fb+Fx	2Fx-Fx^2/b	x^2/b^2	2/3Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	-Fx	Fx-Fx^2/b	1-2x/b+x^2/b^2	1/6Fb^2/EJ	1/3Xb/EJ
ED b	x/b	Fb-Fx	Fx-Fx^2/b	x^2/b^2		
EF √2b	0	√2/2Fx+1/2qx^2	0	0	0	0
FG b	0	-3/2Fx+1/2qx^2	0	0	0	0
GF b	0	Fb-1/2Fx-1/2qx^2	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				-Fb^2/EJ	
	totali				-1/6Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				1/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (2\ x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

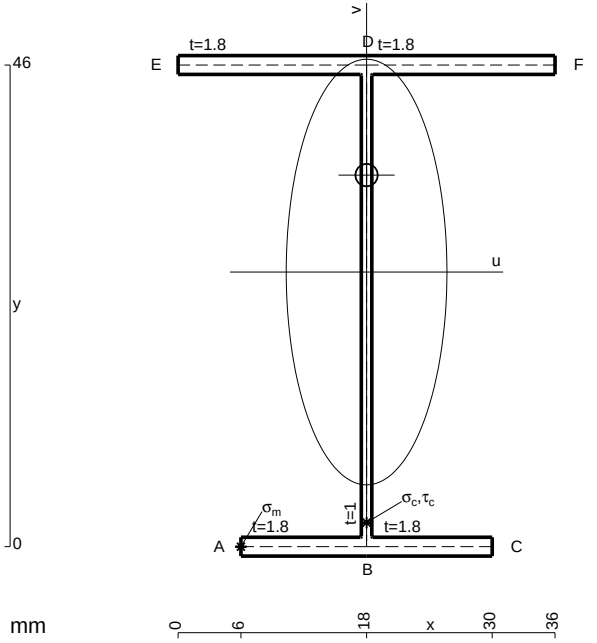
$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

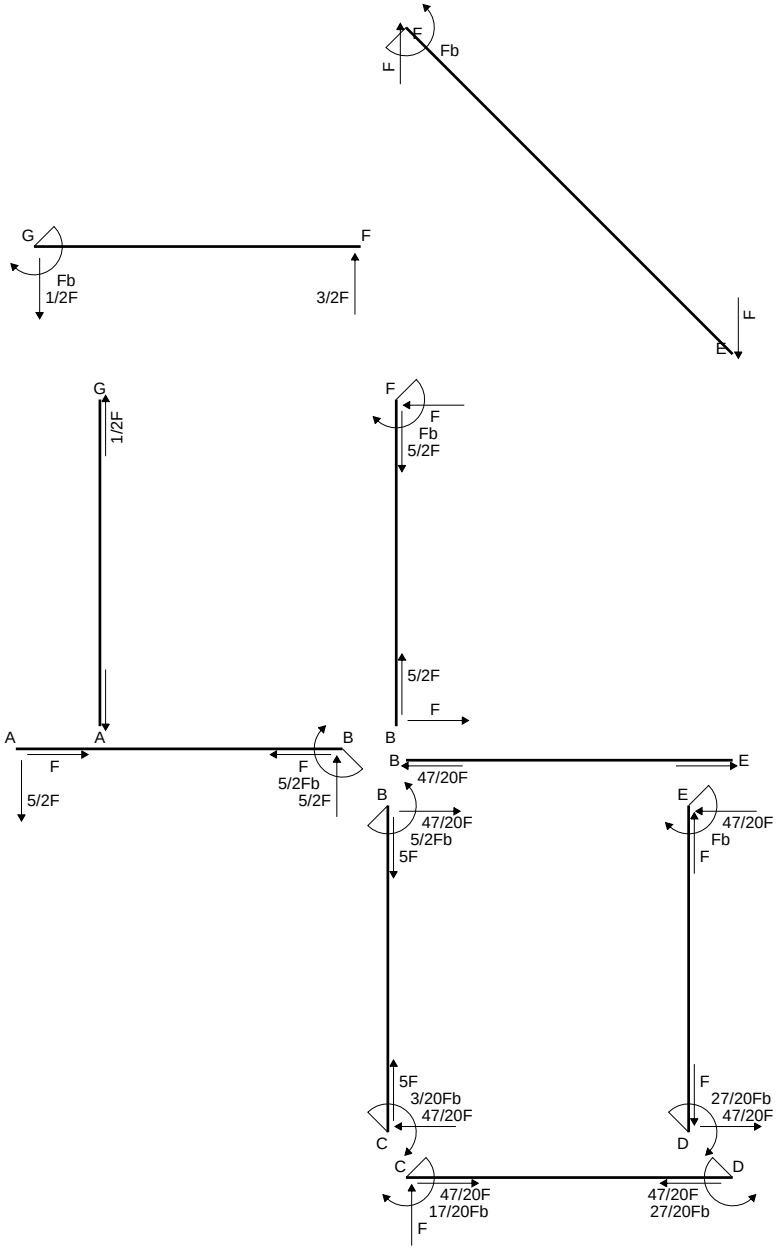
$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

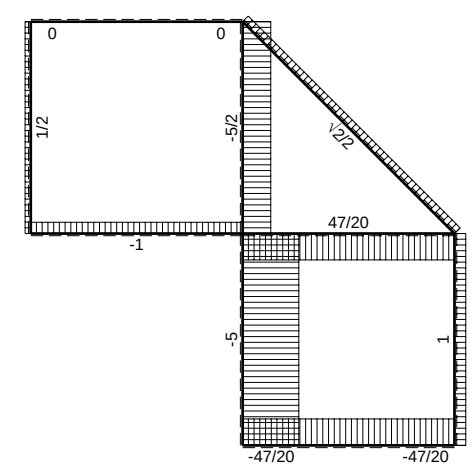


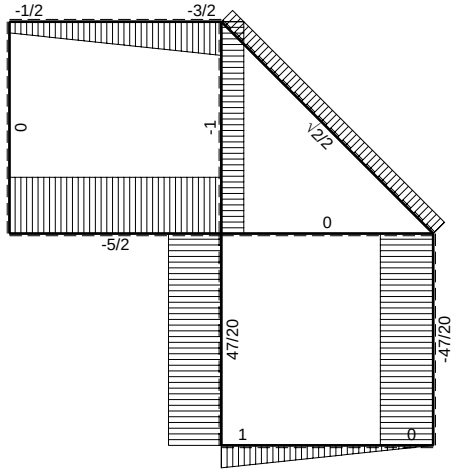
A = 154. mm^2
J_u = 63641. mm^4
J_v = 9072. mm^4
J_t = 132. mm^4
y_o = 9.26 mm
y_g = 26.23 mm
N = 254.6 N
T_y = 763.7 N
M_x = 525600. Nmm
x_m = 6. mm
u_m = -12. mm
v_m = -26.23 mm
$\sigma_m = N/A - Mv/J_u$ = 218.3 N/mm^2
x_c = 18. mm
v_c = -26.23 mm
$\sigma_c = N/A - Mv/J_u$ = 218.3 N/mm^2
$\tau_c = TS^*/tJ_u$ = 13.6 N/mm^2
$\tau_g = TS^*/tJ_u$ = 13.6 N/mm^2
t_c = 360. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 219.5 N/mm^2

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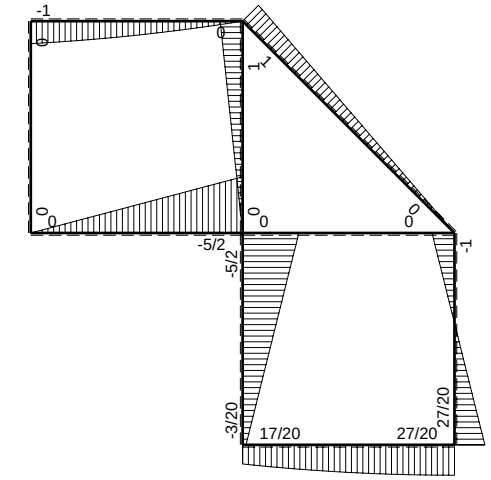

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17/20Fb
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-5
1
-47/20
-47/20

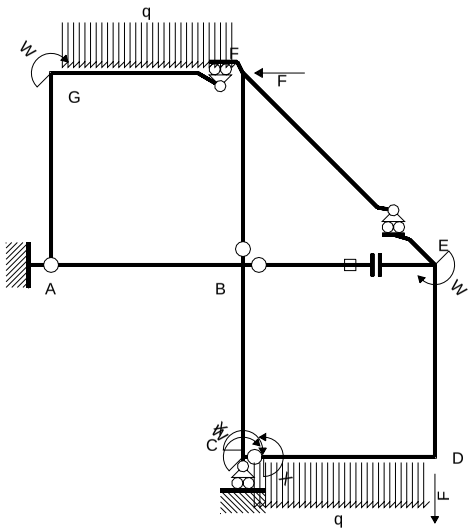

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-47/20
1
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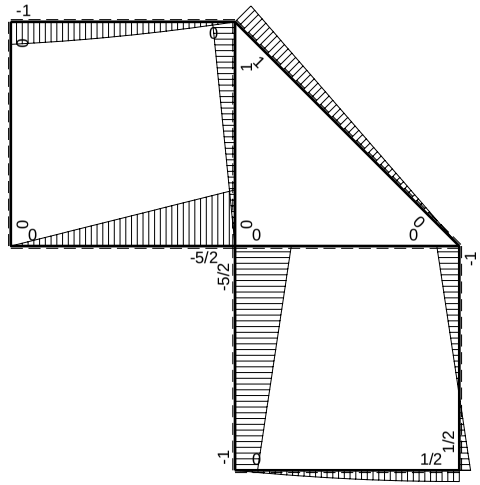
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-1
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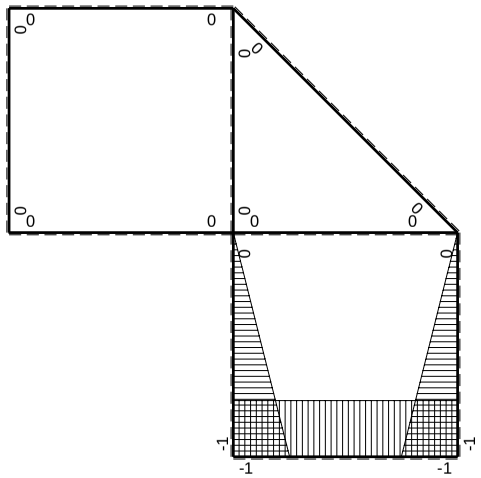
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0		
BC b	-x/b	-5/2Fb+3/2Fx	$5/2Fx-3/2Fx^2/b$	x^2/b^2	$3/4Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	$Fb+1/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	$Fx-1/2qx^2$	$-Fx+1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fb+1/2qx^2$	$-1/2Fb+1/2Fx^2/b$	1		
DE b	-1+x/b	1/2Fb-3/2Fx	$-1/2Fb+2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	0	1/3Xb/EJ
ED b	x/b	Fb-3/2Fx	$Fx-3/2Fx^2/b$	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	$-3/2Fx+1/2qx^2$	0	0	0	0
GF b	0	$Fb-1/2Fx-1/2qx^2$	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$17/12Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-17/20Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 +1/2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x +1/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b +1/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ \ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-\ x/b +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/3\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2 +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

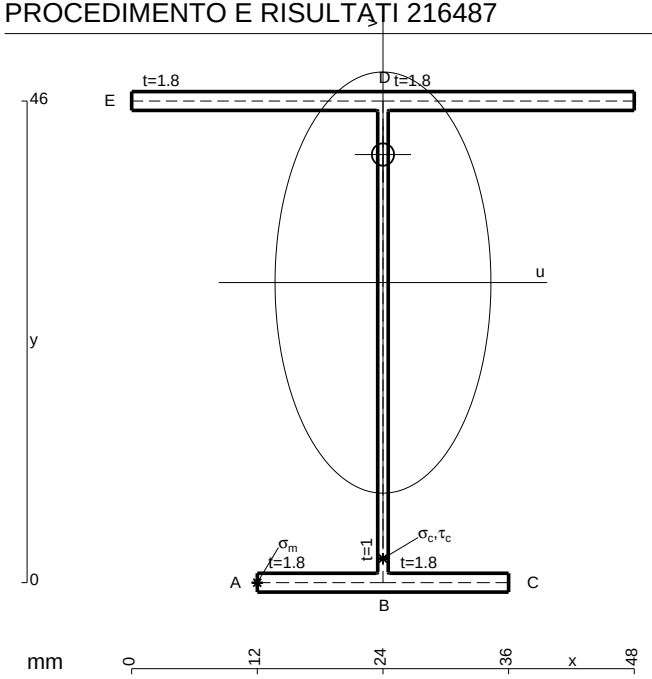
$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/3\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (-1/2 +2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x + x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b + b -1/2\ b\ )\ Fb\ 1/EJ\ = 0$

$L^{Xo}_{ED} = \int_o^b (\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

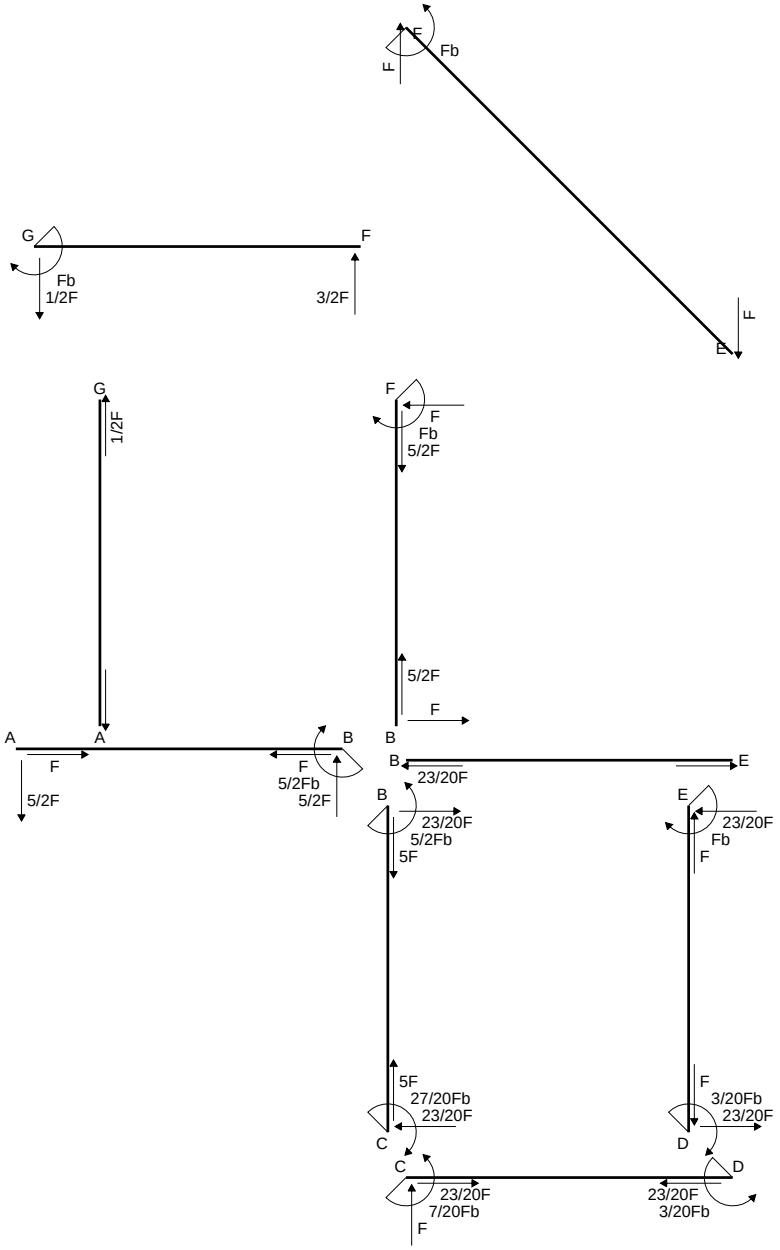
$= (1/2\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 0$

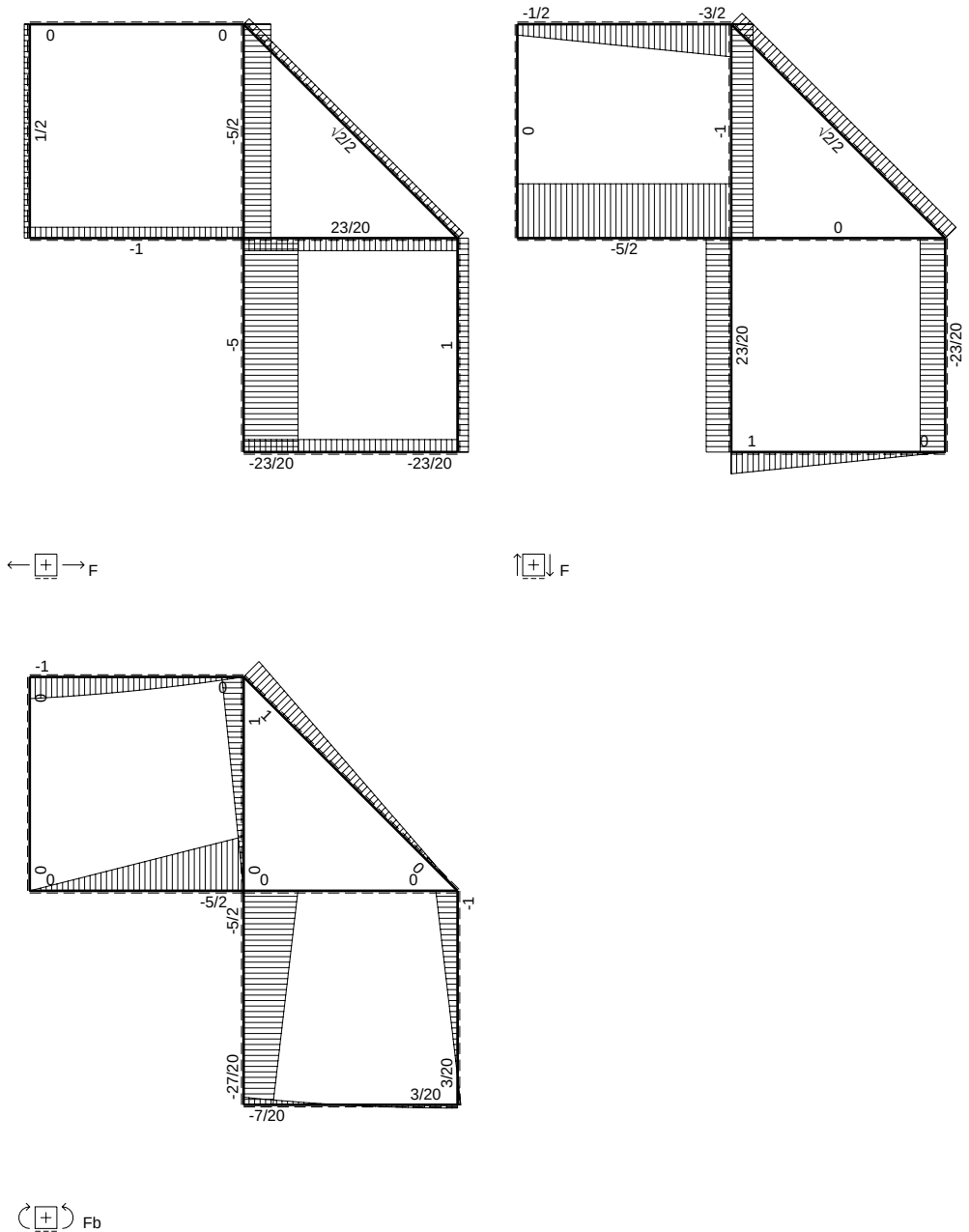


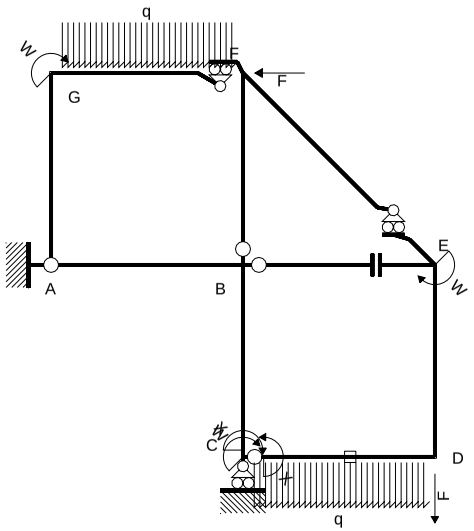
A = 175.6 mm^2
J_u = 71048. mm^4
J_v = 18662. mm^4
J_t = 155.3 mm^4
y_o = 12.23 mm
y_g = 28.66 mm
N = -290. N
T_y = -725. N
M_x = -558250. Nmm
x_m = 12. mm
u_m = -12. mm
v_m = -28.66 mm
$\sigma_m = N/A - Mv/J_u$ = -226.8 N/mm^2
x_c = 24. mm
v_c = -28.66 mm
$\sigma_c = N/A - Mv/J_u$ = -226.8 N/mm^2
$\tau_c = TS^*/tJ_u$ = 12.63 N/mm^2
$\tau_g = TS^*/tJ_u$ = 12.63 N/mm^2
t_c = 290. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 227.9 N/mm^2

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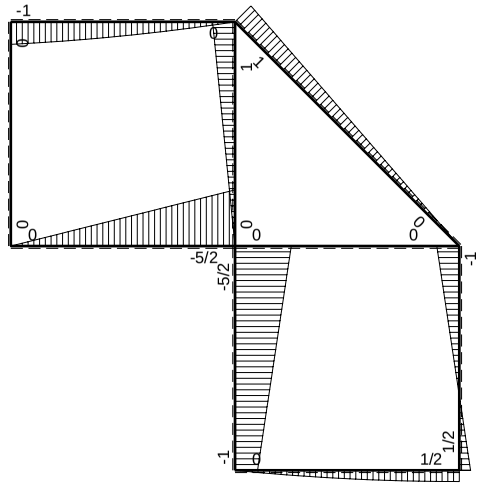
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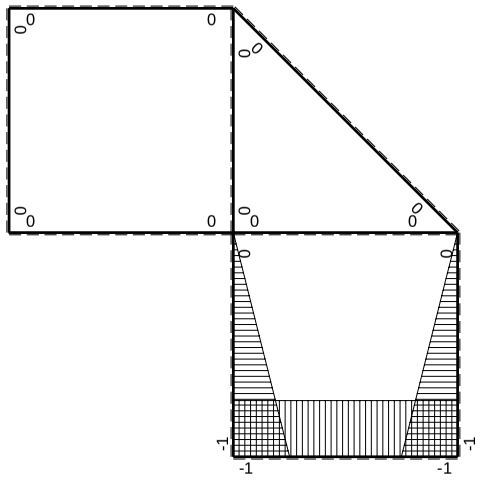

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Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0		
BC b	-x/b	-5/2Fb+3/2Fx	$5/2Fx-3/2Fx^2/b$	x^2/b^2	$3/4Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb+3/2Fx	$Fb+1/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	$Fx-1/2qx^2$	$-Fx+1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fb+1/2qx^2$	$-1/2Fb+1/2Fx^2/b$	1		
DE b	-1+x/b	1/2Fb-3/2Fx	$-1/2Fb+2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	0	1/3Xb/EJ
ED b	x/b	Fb-3/2Fx	$Fx-3/2Fx^2/b$	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	$-3/2Fx+1/2qx^2$	0	0	0	0
GF b	0	$Fb-1/2Fx-1/2qx^2$	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-7/12Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				7/20Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2\ )\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 +1/2\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x +1/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b +1/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -4/3\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2 +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/2\ x +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

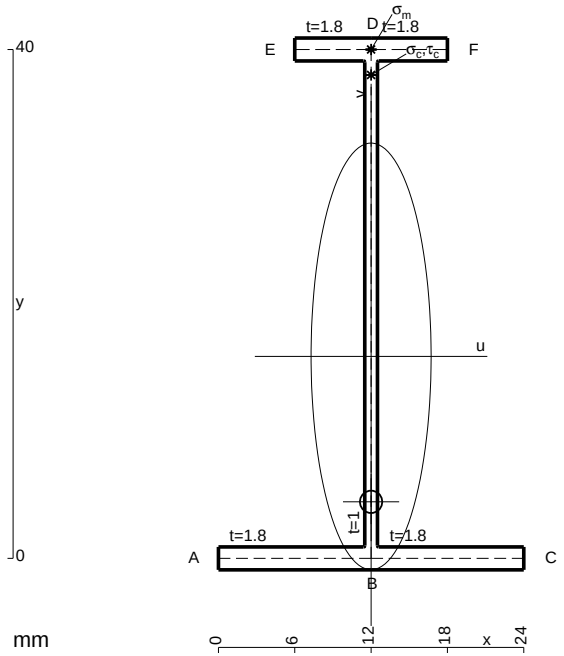
$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -4/3\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (-1/2 +2\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/2\ x + x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b + b -1/2\ b\ )\ Fb\ 1/EJ\ = 0$

$L^{Xo}_{ED} = \int_o^b (\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

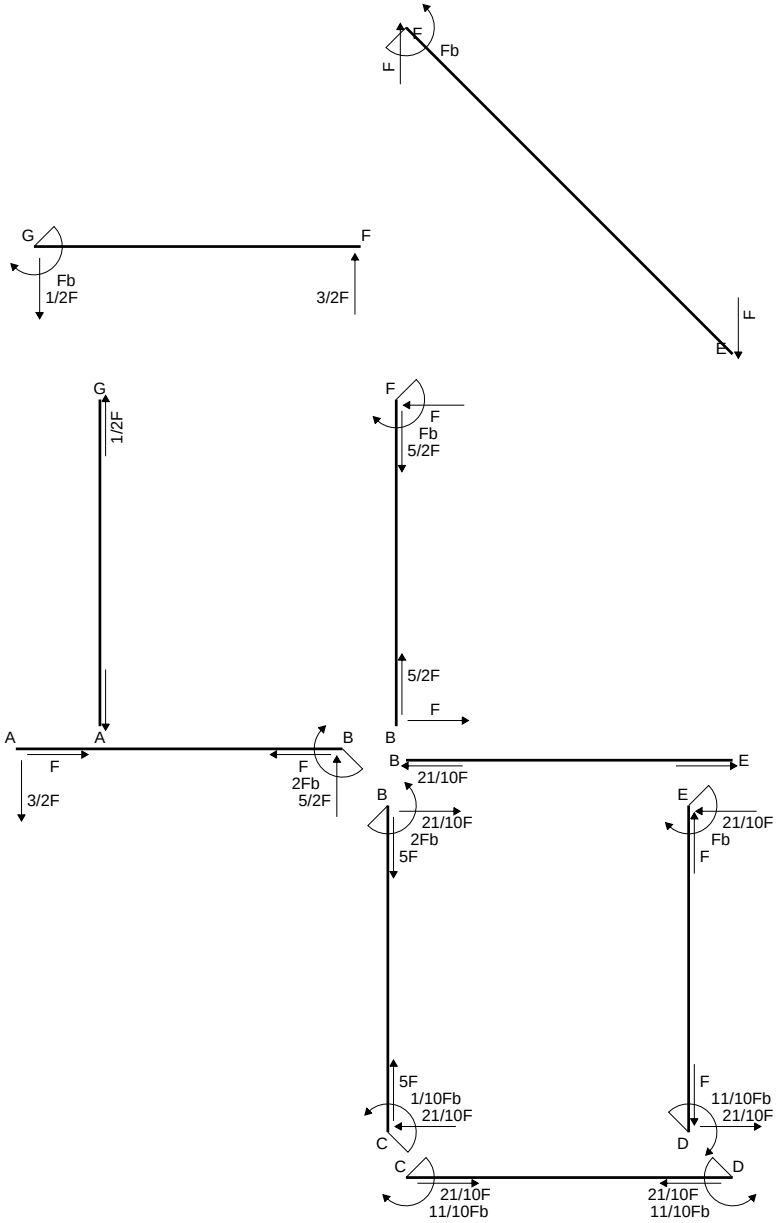
$= (1/2\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 0$

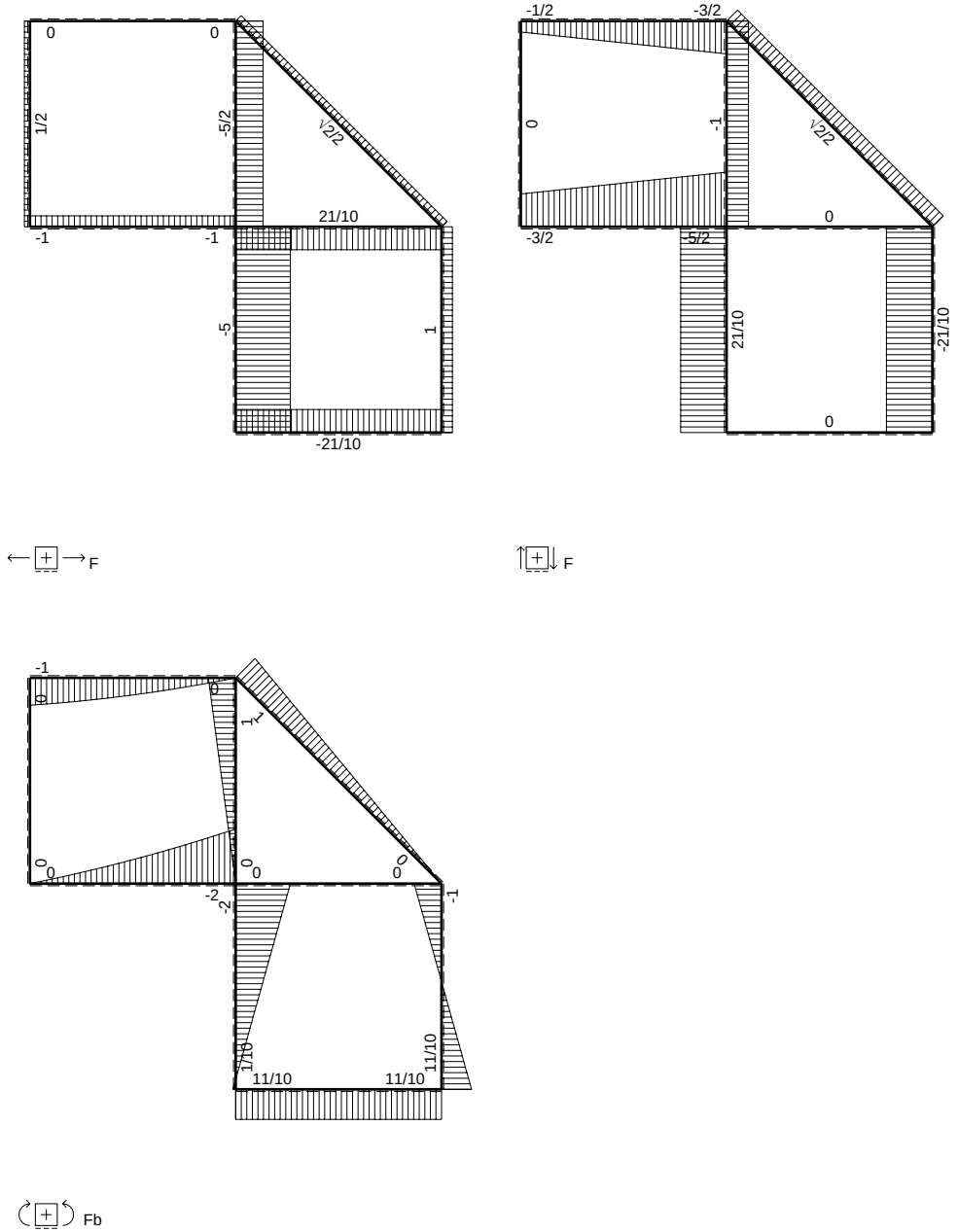


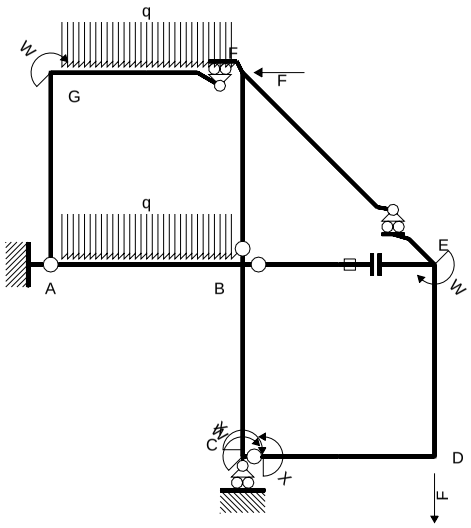
A = 104.8 mm^2
J_u = 29473. mm^4
J_v = 2333. mm^4
J_t = 83.32 mm^4
y_o = -11.43 mm
y_g = 15.88 mm
N = -160. N
T_y = -400. N
M_x = -288000. Nmm
x_m = 12. mm
y_m = 40. mm
v_m = 24.12 mm
$\sigma_m = N/A - Mv/J_u$ = 234.2 N/mm^2
y_c = 2. mm
u_c = -12. mm
v_c = -13.88 mm
$\sigma_c = N/A - Mv/J_u$ = 234.2 N/mm^2
$\tau_c = TS^*/tJ_u$ = 7.071 N/mm^2
$\tau_g = TS^*/tJ_u$ = 7.071 N/mm^2
t_c = 160. mm
$\sigma_o = \sqrt{\sigma^2 + 3\tau^2}$ = 234.5 N/mm^2

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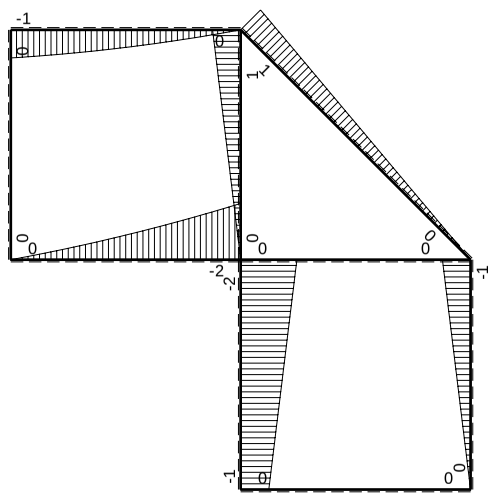
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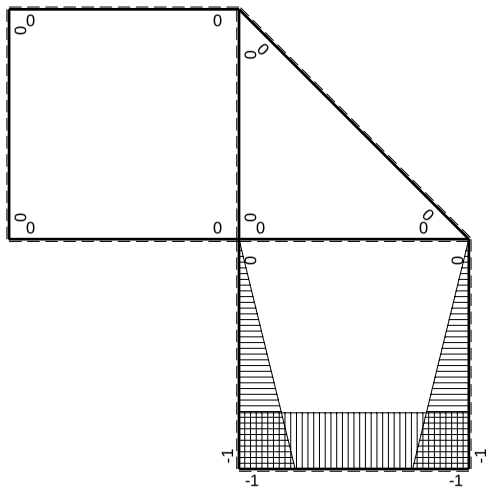

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-1
√2/2
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-5/2
21/10
-21/10
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-2
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-1
1/10
11/10
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Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-3/2Fx-1/2qx^2$	0	0	0	0
BA b	0	$2Fb-5/2Fx+1/2qx^2$	0	0		
BC b	-x/b	-2Fb+Fx	$2Fx-Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	$Fb-Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	1/3Xb/EJ
ED b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-3/2Fx+1/2qx^2$	0	0	0	0
GF b	0	$Fb-1/2Fx-1/2qx^2$	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$11/6Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-11/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 - 2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b + 1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b + 1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 - 2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b + 1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b + 1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (2\ x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x^2/b - 1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b - 1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x - 1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

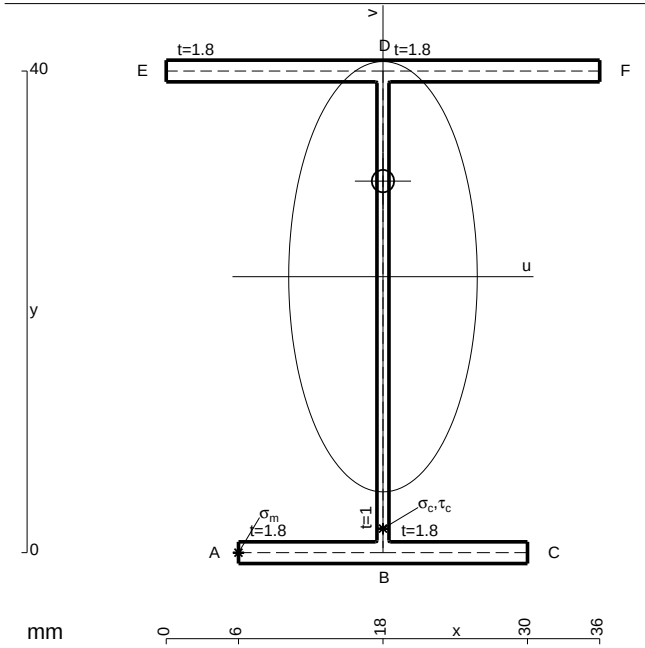
$= (\ b - 1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b - 1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b - 1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b - 1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

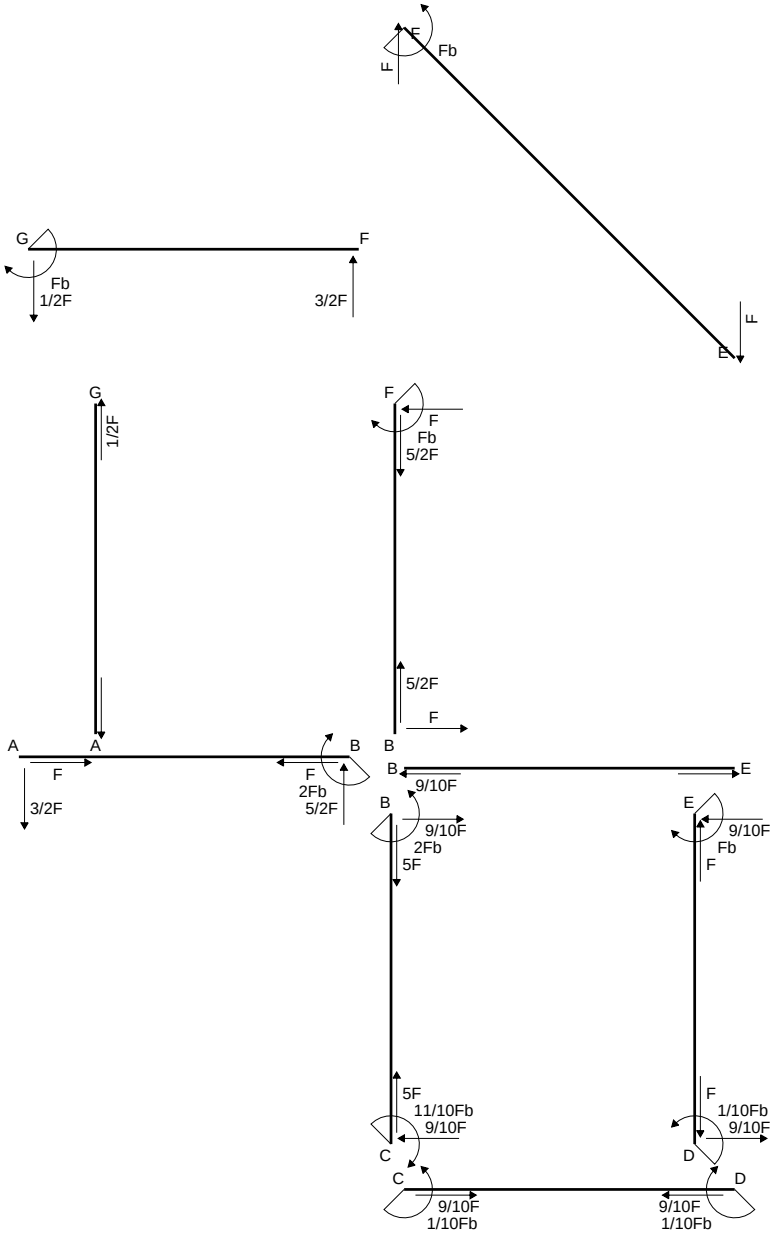
$= (1/2\ b - 1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

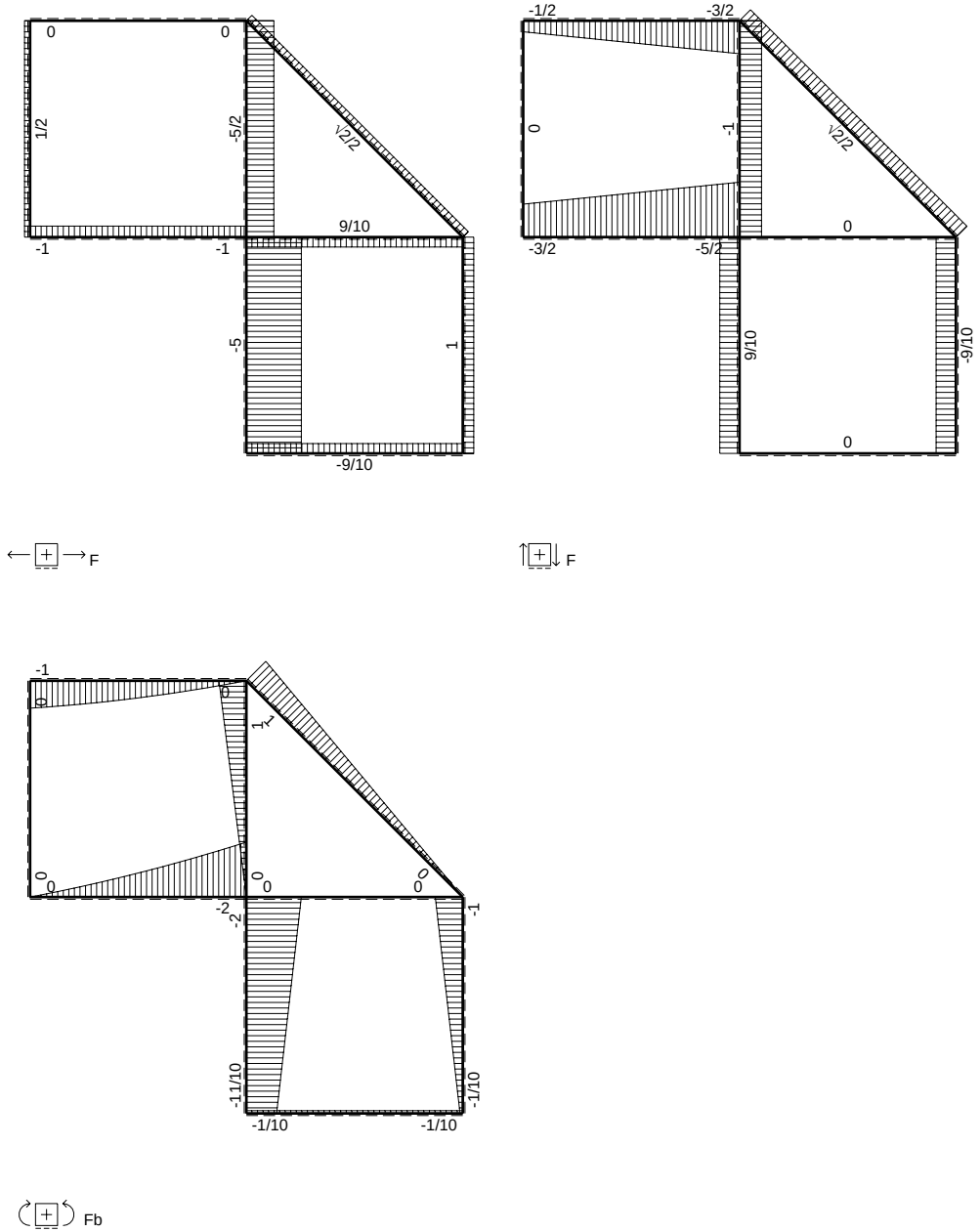


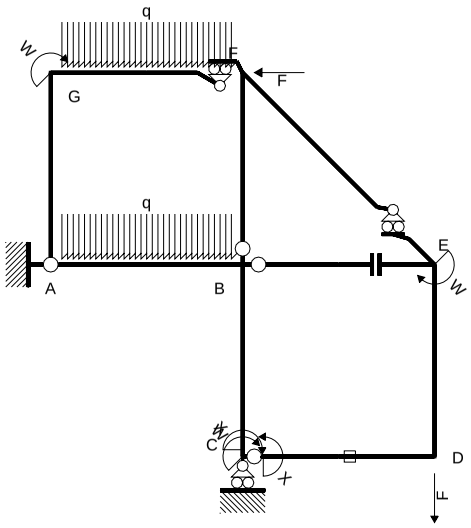
A = 148. mm^2
J_u = 47272. mm^4
J_v = 9072. mm^4
J_t = 130. mm^4
y_o = 7.938 mm
y_g = 22.92 mm
N = -530. N
T_y = -1325. N
M_x = -402800. Nmm
x_m = 6. mm
u_m = -12. mm
v_m = -22.92 mm
$\sigma_m = N/A - Mv/J_u$ = -198.9 N/mm^2
x_c = 18. mm
v_c = -22.92 mm
$\sigma_c = N/A - Mv/J_u$ = -198.9 N/mm^2
$\tau_c = TS^*/tJ_u$ = 27.75 N/mm^2
$\tau_g = TS^*/tJ_u$ = 27.75 N/mm^2
t_c = 530. mm
$\sigma_o = \sqrt{\sigma^2 + 3\tau^2}$ = 204.6 N/mm^2

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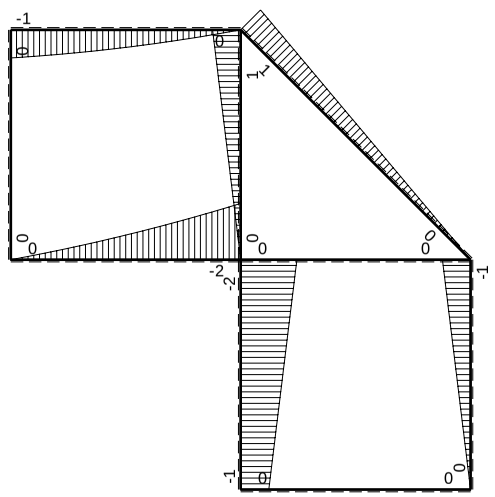
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5F
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9/10F
1/10Fb

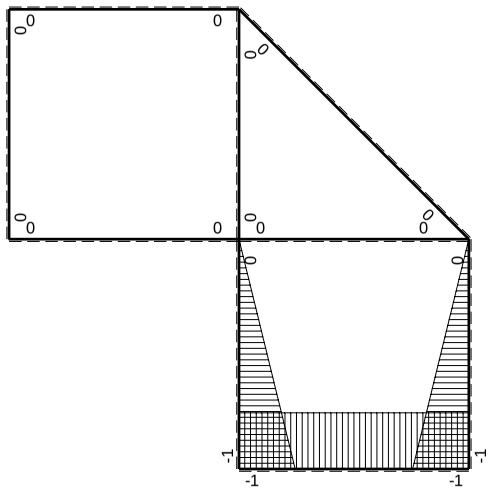

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Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-3/2Fx-1/2qx^2$	0	0	0	0
BA b	0	$2Fb-5/2Fx+1/2qx^2$	0	0		
BC b	-x/b	-2Fb+Fx	$2Fx-Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	$Fb-Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	1/3Xb/EJ
ED b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	$-3/2Fx+1/2qx^2$	0	0	0	0
GF b	0	$Fb-1/2Fx-1/2qx^2$	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/6Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				1/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (2\ x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

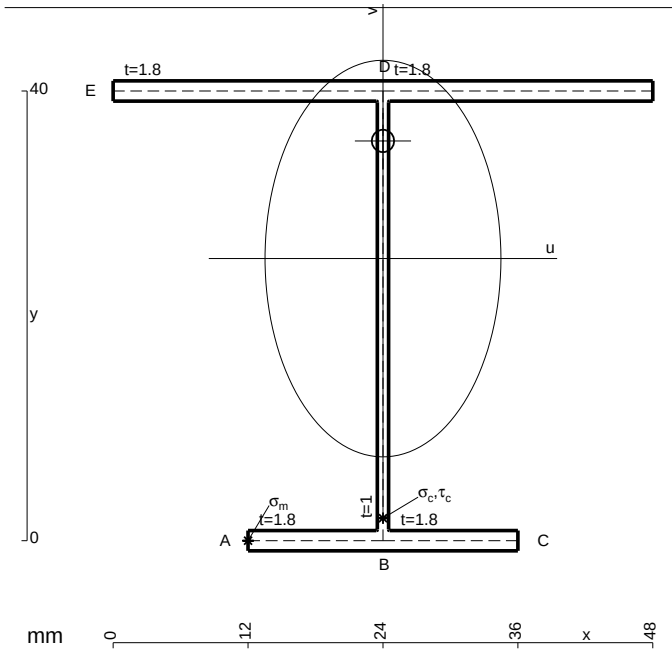
$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

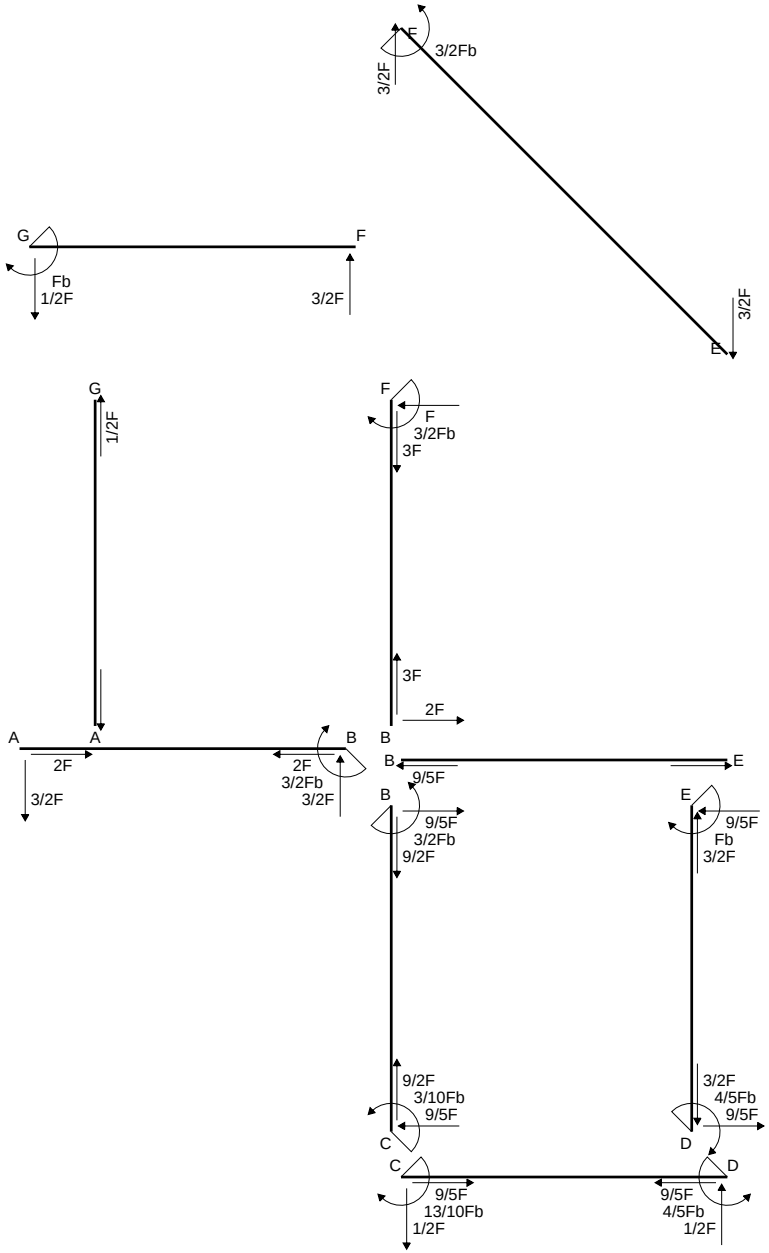
$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

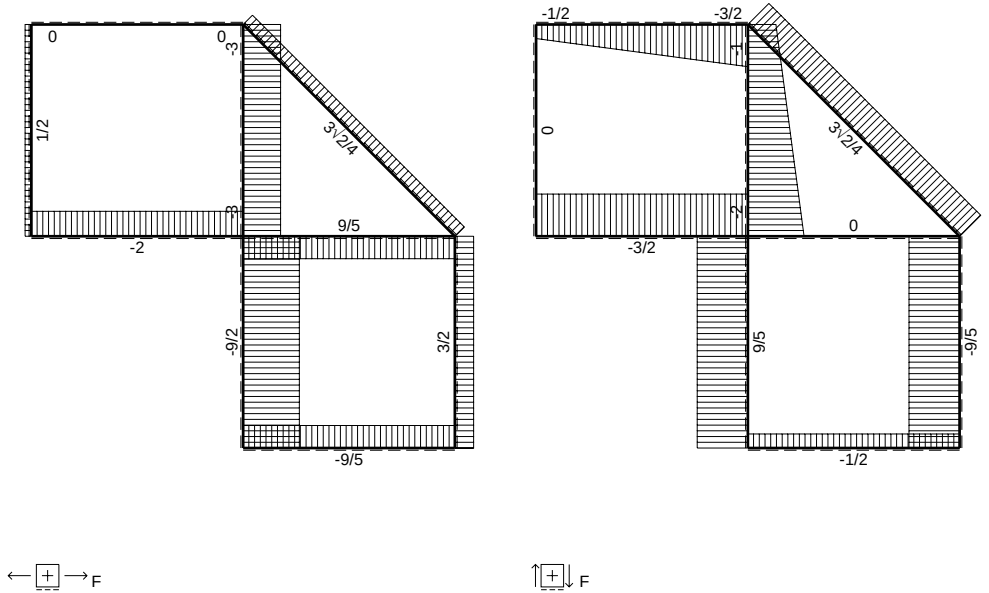


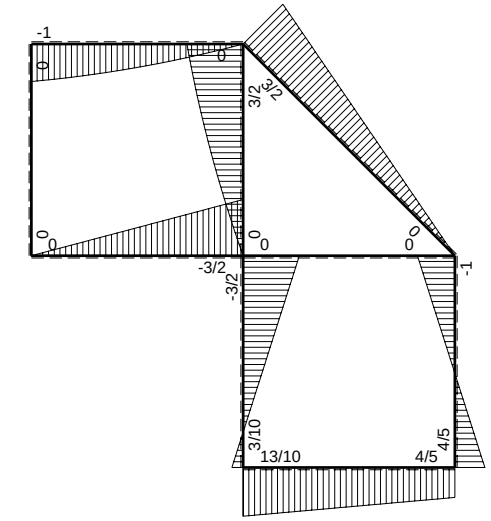
A = 169.6 mm^2
J_u = 52772. mm^4
J_v = 18662. mm^4
J_t = 153.3 mm^4
y_o = 10.46 mm
y_g = 25.09 mm
N = -530. N
T_y = -1325. N
M_x = -434600. Nmm
x_m = 12. mm
u_m = -12. mm
v_m = -25.09 mm
$\sigma_m = N/A - Mv/J_u$ = -209.8 N/mm^2
x_c = 24. mm
v_c = -25.09 mm
$\sigma_c = N/A - Mv/J_u$ = -209.8 N/mm^2
$\tau_c = TS^*/tJ_u$ = 27.22 N/mm^2
$\tau_g = TS^*/tJ_u$ = 27.22 N/mm^2
t_c = 530. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 215. N/mm^2

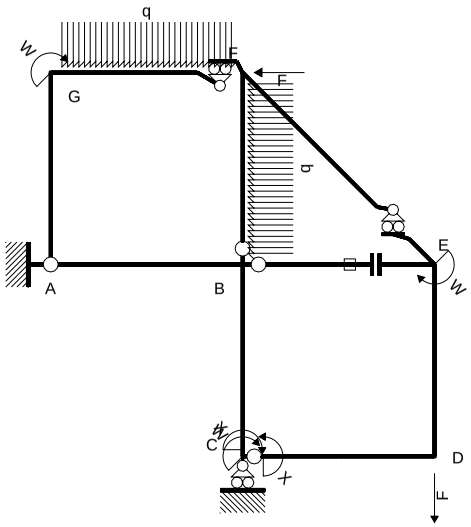
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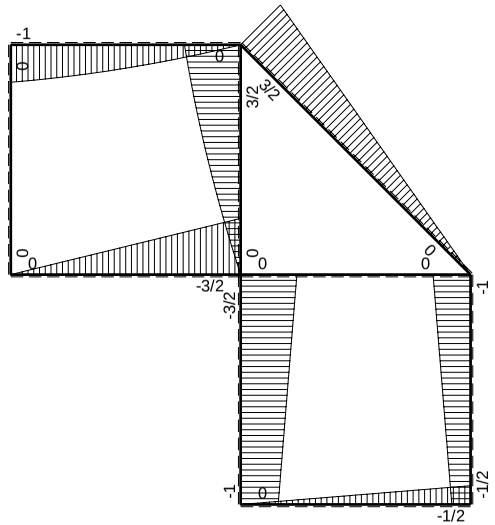

F
3/2Fb
3/2F
G
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Fb
1/2F
3/2F
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3/2F
G
1/2F
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3/2Fb
3F
3F
2F
A
A
B
B
2F
2F
3/2Fb
3/2F
3/2F
B
E
9/5F
B
9/5F
3/2Fb
9/2F
E
9/5F
Fb
3/2F
9/2F
3/10Fb
9/5F
C
3/2F
4/5Fb
9/5F
D
C
D
9/5F
13/10Fb
1/2F
9/5F
4/5Fb
1/2F


0
0
-3
1/2
3√2/4
-3
9/5
-2
-9/2
3/2
-9/5
-1/2
-3/2
-1
0
3√2/4
-2
0
-3/2
9/5
-9/5
-1/2
F
F

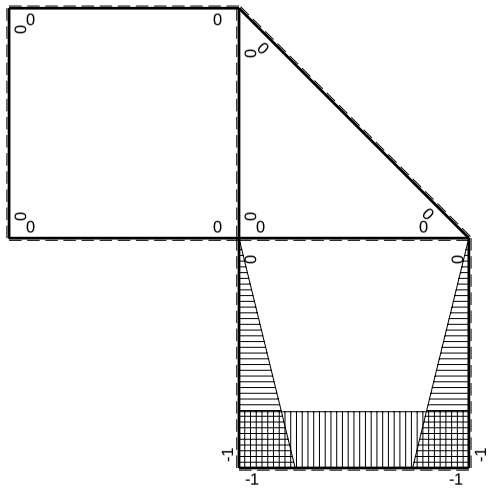

-1
0
0
3/2
3√2
0
0
0
0
0
0
-3/2
-3/2
-1
3/10
13/10
4/5
4/5
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



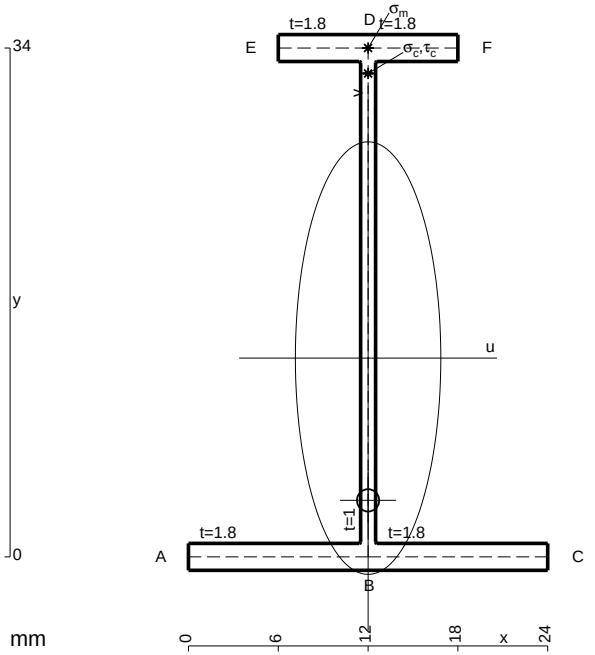
M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0		
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx^2/b	x^2/b^2	7/12Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb^2/EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE 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
ED b	x/b	Fb-1/2Fx	Fx-1/2Fx^2/b	x^2/b^2		
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-3/2Fx+1/2qx^2	0	0	0	0
GF b	0	Fb-1/2Fx-1/2qx^2	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	3/2Fb-Fx-1/2qx^2	0	0	0	0
BF b	0	-2Fx+1/2qx^2	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				13/6Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-13/10Fb	

Sviluppi di calcolo iperstatica

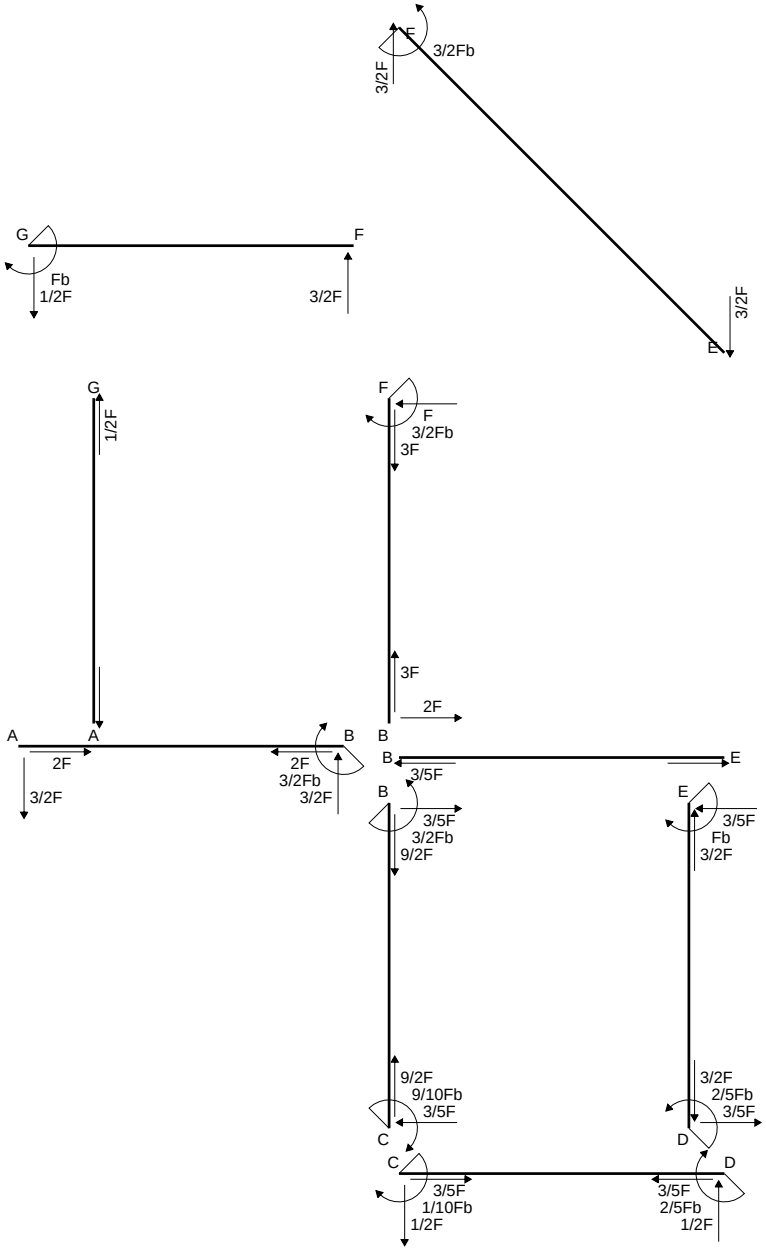
$$L^{XX}_{BC} = \int_o^b \left(x^2/b^2 \right)\ 1/EJ\ dx = \left[1/3\ x^3/b^2 \right]_o^b\ 1/EJ$$
$$= \left(1/3\ b \right)\ 1/EJ\ = 1/3\ b/EJ$$
$$L^{XX}_{CB} = \int_o^b \left(1 -2\ x/b + x^2/b^2 \right)\ 1/EJ\ dx = \left[x - x^2/b +1/3\ x^3/b^2 \right]_o^b\ 1/EJ$$
$$= \left(b - b +1/3\ b \right)\ 1/EJ\ = 1/3\ b/EJ$$
$$L^{XX}_{CD} = \int_o^b \left(1 \right)\ 1/EJ\ dx = \left[x \right]_o^b\ 1/EJ$$
$$= \left(b \right)\ 1/EJ\ =\ b/EJ$$
$$L^{XX}_{DC} = \int_o^b \left(1 \right)\ 1/EJ\ dx = \left[x \right]_o^b\ 1/EJ$$
$$= \left(b \right)\ 1/EJ\ =\ b/EJ$$
$$L^{XX}_{DE} = \int_o^b \left(1 -2\ x/b + x^2/b^2 \right)\ 1/EJ\ dx = \left[x - x^2/b +1/3\ x^3/b^2 \right]_o^b\ 1/EJ$$
$$= \left(b - b +1/3\ b \right)\ 1/EJ\ = 1/3\ b/EJ$$
$$L^{XX}_{ED} = \int_o^b \left(x^2/b^2 \right)\ 1/EJ\ dx = \left[1/3\ x^3/b^2 \right]_o^b\ 1/EJ$$
$$= \left(1/3\ b \right)\ 1/EJ\ = 1/3\ b/EJ$$
$$L^{Xo}_{BC} = \int_o^b \left(3/2\ x/b -1/2\ x^2/b^2 \right)\ Fb\ 1/EJ\ dx = \left[3/4\ x^2/b -1/6\ x^3/b^2 \right]_o^b\ Fb\ 1/EJ$$
$$= \left(3/4\ b -1/6\ b \right)\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$$
$$L^{Xo}_{CB} = \int_o^b \left(1 -1/2\ x/b -1/2\ x^2/b^2 \right)\ Fb\ 1/EJ\ dx = \left[x -1/4\ x^2/b -1/6\ x^3/b^2 \right]_o^b\ Fb\ 1/EJ$$
$$= \left(b -1/4\ b -1/6\ b \right)\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$$
$$L^{Xo}_{CD} = \int_o^b \left(1/2\ x/b \right)\ Fb\ 1/EJ\ dx = \left[1/4\ x^2/b \right]_o^b\ Fb\ 1/EJ$$
$$= \left(1/4\ b \right)\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$$
$$L^{Xo}_{DC} = \int_o^b \left(1/2 -1/2\ x/b \right)\ Fb\ 1/EJ\ dx = \left[1/2\ x -1/4\ x^2/b \right]_o^b\ Fb\ 1/EJ$$
$$= \left(1/2\ b -1/4\ b \right)\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$$
$$L^{Xo}_{DE} = \int_o^b \left(1/2 -1/2\ x^2/b^2 \right)\ Fb\ 1/EJ\ dx = \left[1/2\ x -1/6\ x^3/b^2 \right]_o^b\ Fb\ 1/EJ$$
$$= \left(1/2\ b -1/6\ b \right)\ Fb\ 1/EJ\ = 1/3\ Fb^2/EJ$$
$$L^{Xo}_{ED} = \int_o^b \left(x/b -1/2\ x^2/b^2 \right)\ Fb\ 1/EJ\ dx = \left[1/2\ x^2/b -1/6\ x^3/b^2 \right]_o^b\ Fb\ 1/EJ$$
$$= \left(1/2\ b -1/6\ b \right)\ Fb\ 1/EJ\ = 1/3\ Fb^2/EJ$$

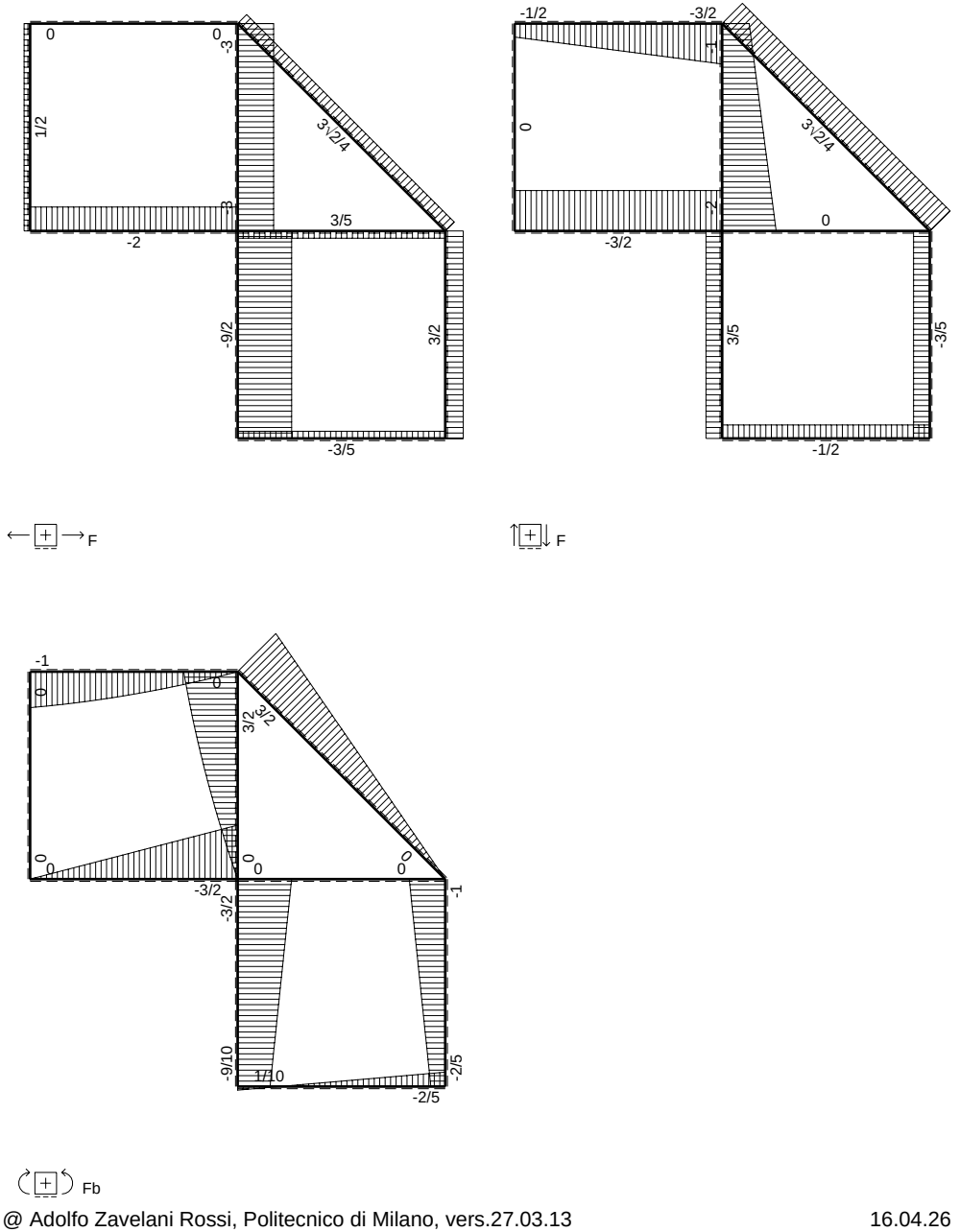


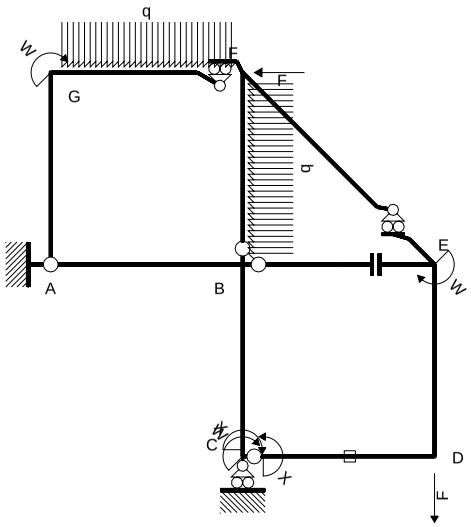
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J_u = 20638. mm^4
J_v = 2333. mm^4
J_t = 81.32 mm^4
y_o = -9.506 mm
y_g = 13.28 mm
N = -780. N
T_y = -585. N
M_x = -222300. Nmm
x_m = 12. mm
y_m = 34. mm
v_m = 20.72 mm
$\sigma_m = N/A - Mv/J_u$ = 215.3 N/mm^2
y_c = 2. mm
u_c = -12. mm
v_c = -11.28 mm
$\sigma_c = N/A - Mv/J_u$ = 215.3 N/mm^2
$\tau_c = TS^*/tJ_u$ = 12.68 N/mm^2
$\tau_g = TS^*/tJ_u$ = 12.68 N/mm^2
t_c = 390. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 216.4 N/mm^2

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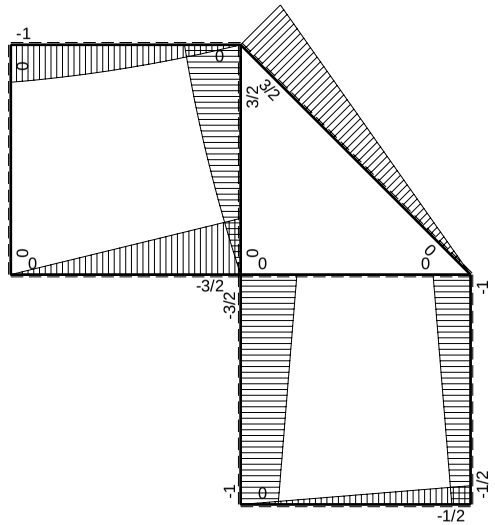
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F
3/2Fb
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Fb
1/2F
3/2F
3/2F
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1/2F
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3/2Fb
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1/2F

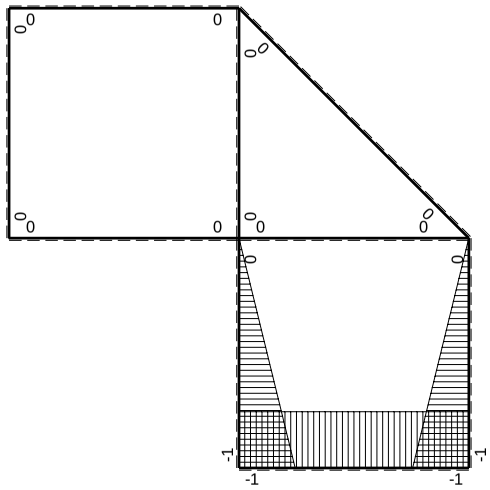

0
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3√2/4
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-3/2
1
0
3√2/4
2
0
-3/2
3/5
-3/5
-1/2
F
-1
0
0
3√2/2
0
0
0
0
0
0
-3/2
-3/2
-1
-9/10
1/10
-2/5
-2/5
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0		
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx^2/b	x^2/b^2	7/12Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb^2/EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE 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
ED b	x/b	Fb-1/2Fx	Fx-1/2Fx^2/b	x^2/b^2		
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-3/2Fx+1/2qx^2	0	0	0	0
GF b	0	Fb-1/2Fx-1/2qx^2	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	3/2Fb-Fx-1/2qx^2	0	0	0	0
BF b	0	-2Fx+1/2qx^2	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				-Fb^2/EJ	
	totali				1/6Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-1/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b)\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (1/2\ x/b\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = [1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (1/4\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -3/4\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (1/2 -1/2\ x/b\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = [1/2\ x -1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/E$

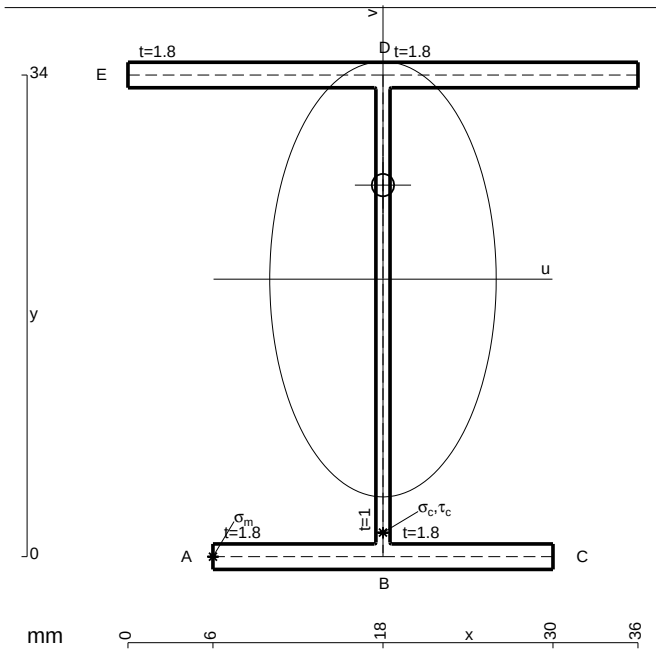
$= (1/2\ b -1/4\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -3/4\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2 -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/2\ x -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/3\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (\ x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

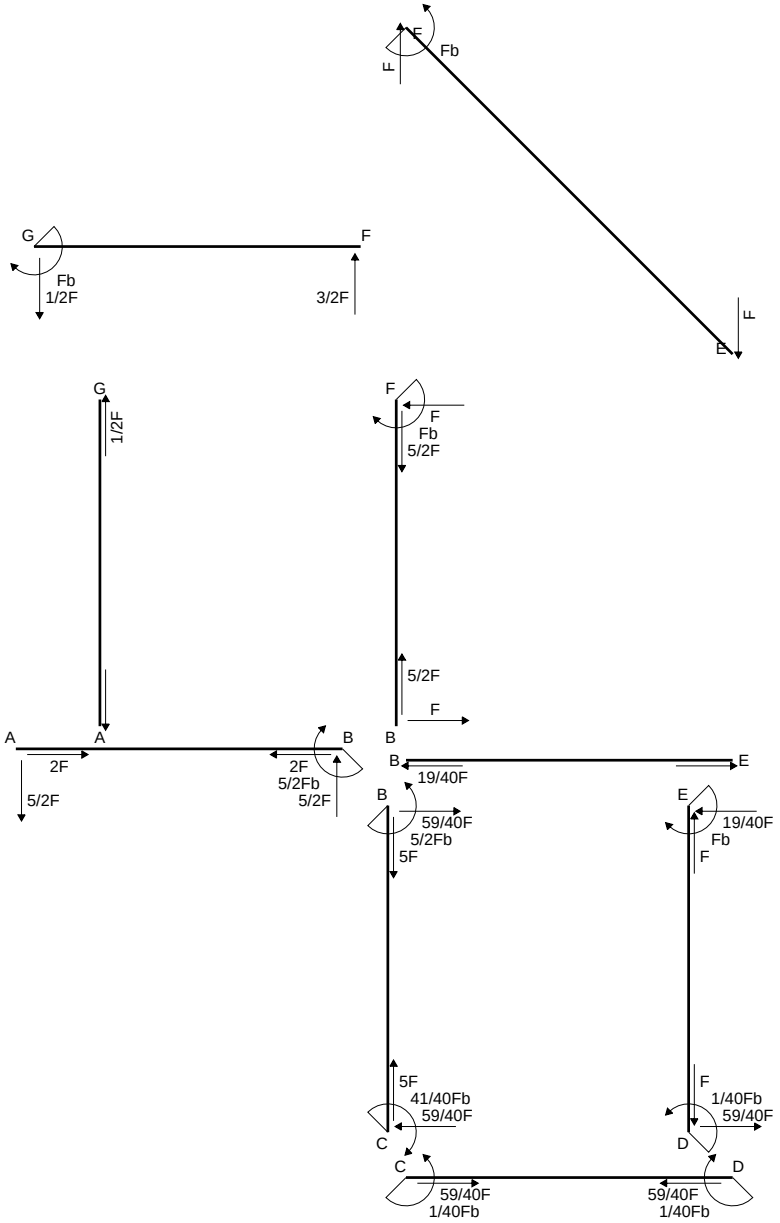
$= (1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/3\ \ Fb^2/EJ$

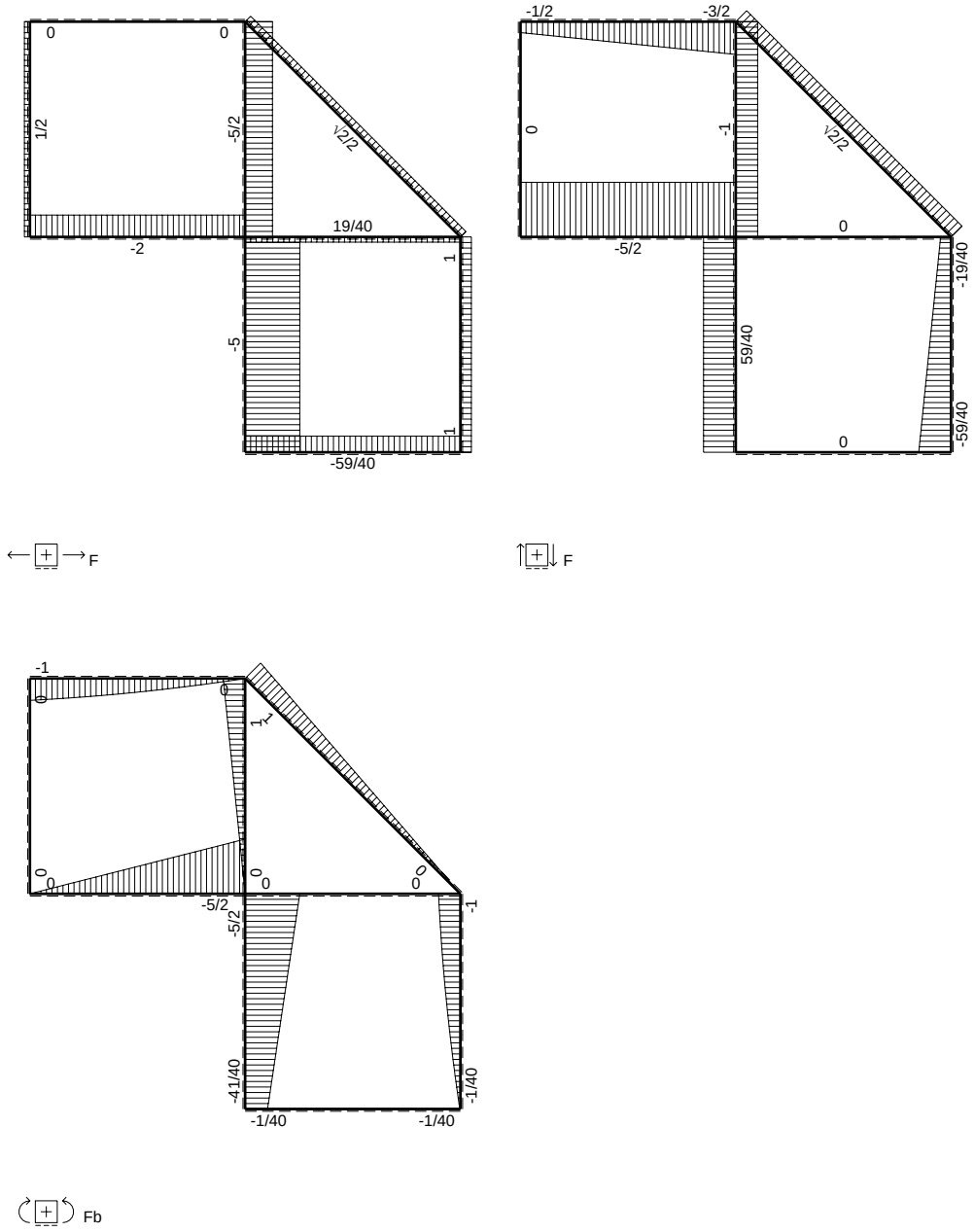


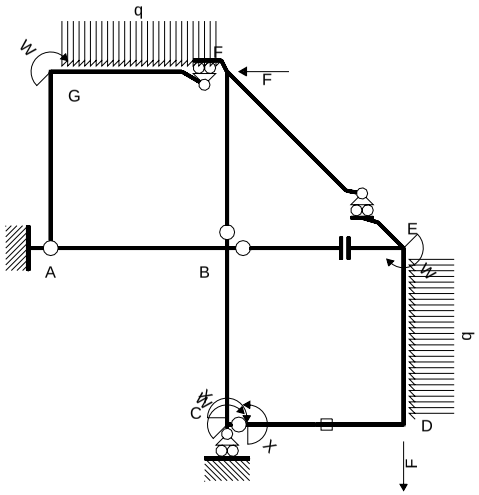
A = 142. mm^2
J_u = 33538. mm^4
J_v = 9072. mm^4
J_t = 128. mm^4
y_o = 6.643 mm
y_g = 19.59 mm
N = -1220. N
T_y = -915. N
M_x = -375150. Nmm
x_m = 6. mm
u_m = -12. mm
v_m = -19.59 mm
$\sigma_m = N/A - Mv/J_u$ = -227.7 N/mm^2
x_c = 18. mm
v_c = -19.59 mm
$\sigma_c = N/A - Mv/J_u$ = -227.7 N/mm^2
$\tau_c = TS^*/tJ_u$ = 23.08 N/mm^2
$\tau_g = TS^*/tJ_u$ = 23.08 N/mm^2
t_c = 610. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 231.2 N/mm^2

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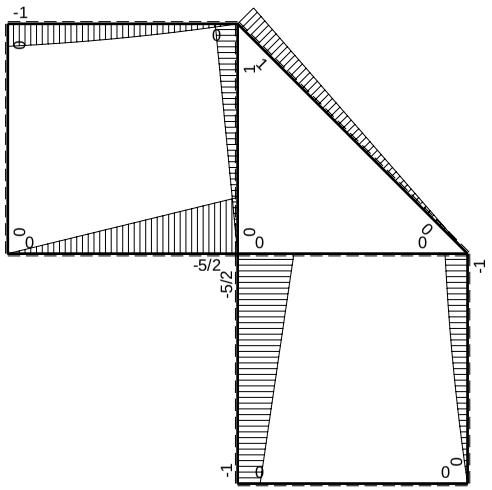
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F
Fb
F
G
F
Fb
1/2F
3/2F
F
E
G
1/2F
F
F
Fb
5/2F
5/2F
F
A
A
B
B
B
E
2F
2F
5/2Fb
5/2F
5/2F
19/40F
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19/40F
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1/40Fb

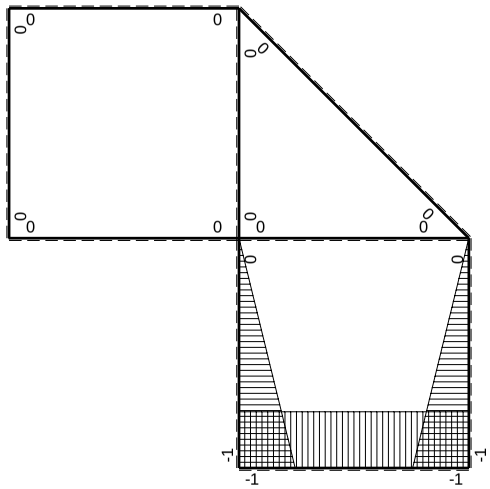

0
0
1/2
-5/2
√2/2
19/40
-2
1
-5
1
-59/40
-1/2
-3/2
0
-1
√2/2
0
-5/2
-19/40
59/40
-59/40
0
F
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-1
0
0
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1
0
0
0
0
0
0
0
-5/2
-5/2
-1
-41/40
-1/40
-1/40
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0		
BC b	-x/b	-5/2Fb+3/2Fx	$5/2Fx-3/2Fx^2/b$	x^2/b^2	$3/4Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+3/2Fx	$Fb+1/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	$-3/2Fx+1/2qx^2$	$3/2Fx-2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$5/24Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$Fb-1/2Fx-1/2qx^2$	$Fx-1/2Fx^2/b-1/2qx^3/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-3/2Fx+1/2qx^2$	0	0	0	0
GF b	0	$Fb-1/2Fx-1/2qx^2$	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/24Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				$1/40Fb$	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -1/2\ b)\ Fb\ 1/EJ\ = 3/4\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 +1/2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x +1/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

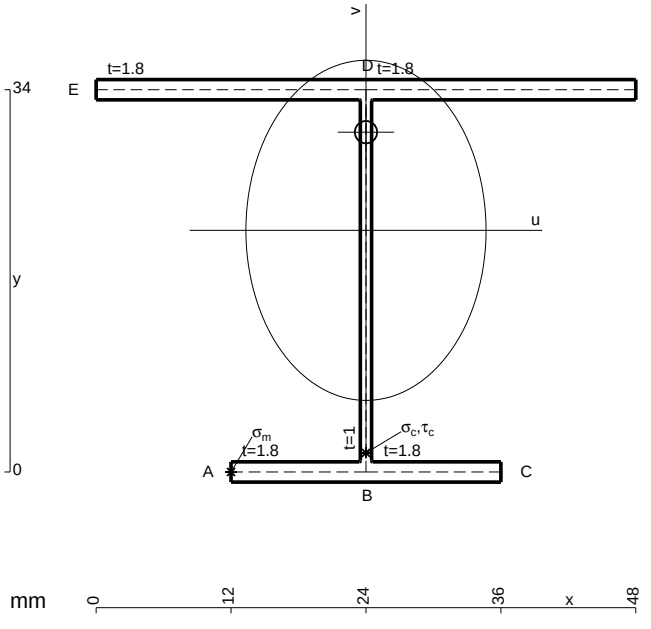
$= (\ b +1/4\ b -1/2\ b)\ Fb\ 1/EJ\ = 3/4\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (3/2\ x/b -2\ x^2/b^2 +1/2\ x^3/b^3)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -2/3\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -2/3\ b +1/8\ b)\ Fb\ 1/EJ\ = 5/24\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (\ x/b -1/2\ x^2/b^2 -1/2\ x^3/b^3)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/6\ x^3/b^2 -1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/6\ b -1/8\ b)\ Fb\ 1/EJ\ = 5/24\ \ Fb^2/EJ$



$A = 163.6\ mm^2$

$J_u = 37433.\ mm^4$

$J_v = 18662.\ mm^4$

$J_t = 151.3\ mm^4$

$y_o = 8.733\ mm$

$y_g = 21.49\ mm$

$N = -740.\ N$

$T_y = -925.\ N$

$M_x = -407000.\ Nmm$

$x_m = 12.\ mm$

$u_m = -12.\ mm$

$v_m = -21.49\ mm$

$\sigma_m = N/A - Mv/J_u = -238.2\ N/mm^2$

$x_c = 24.\ mm$

$v_c = -21.49\ mm$

$\sigma_c = N/A - Mv/J_u = -238.2\ N/mm^2$

$\tau_c = TS^*/tJ_u = 22.94\ N/mm^2$

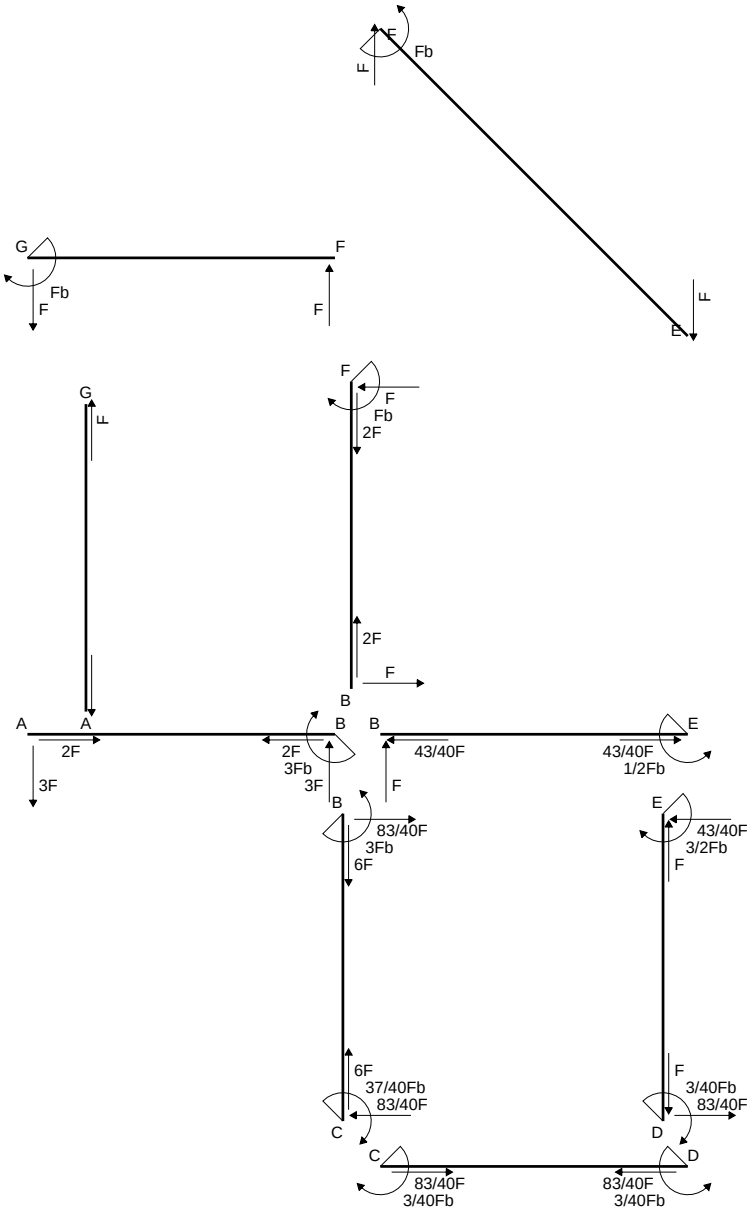
$\tau_g = TS^*/tJ_u = 22.94\ N/mm^2$

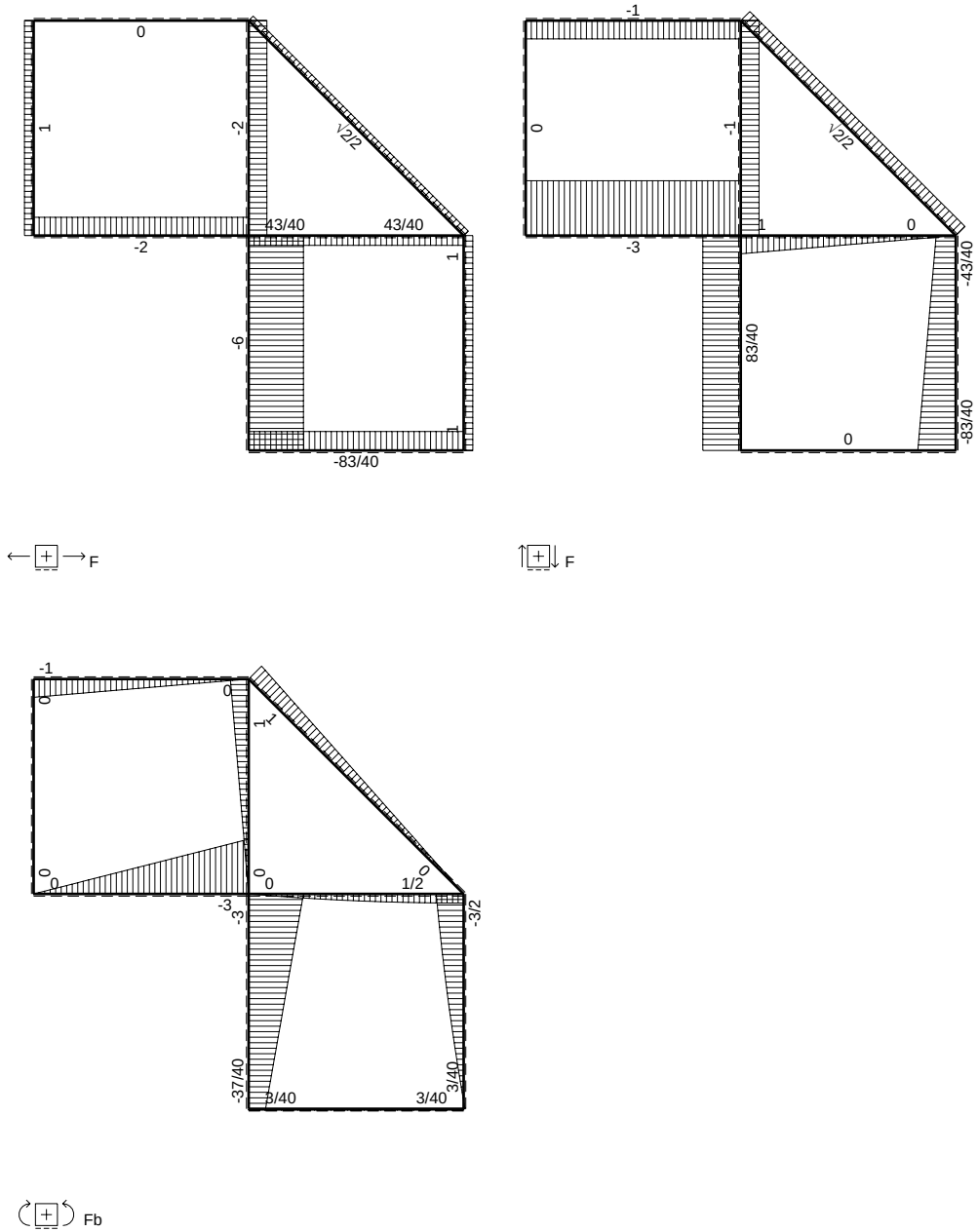
$t_c = 370.\ mm$

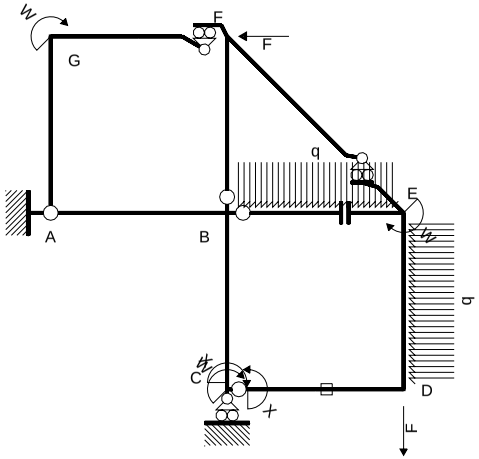
$\sigma_o = \sqrt{\sigma^2+3\tau^2} = 241.5\ N/mm^2$

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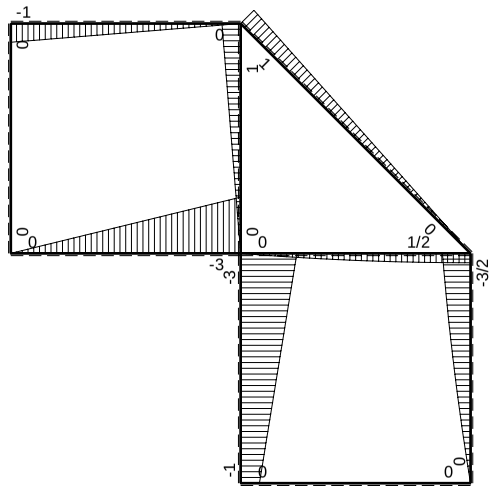
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3/40Fb

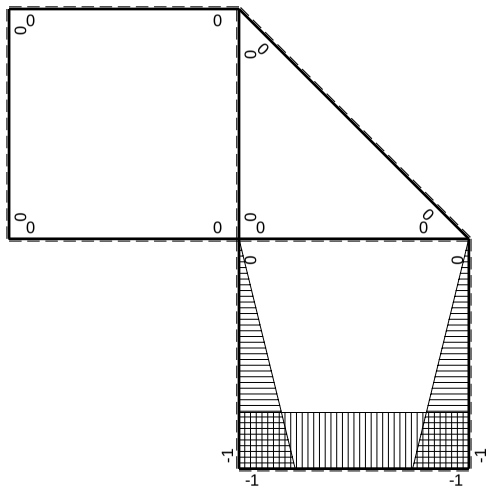

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-43/40
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-83/40
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-3
-3
-3/2
-37/40
3/40
3/40
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3Fx	0	0	0	0
BA b	0	3Fb-3Fx	0	0		
BC b	-x/b	-3Fb+2Fx	3Fx-2Fx^2/b	x^2/b^2	5/6Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+2Fx	Fb+Fx-2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	-2Fx+1/2qx^2	2Fx-5/2Fx^2/b+1/2qx^3/b	1-2x/b+x^2/b^2	7/24Fb^2/EJ	1/3Xb/EJ
ED b	x/b	3/2Fb-Fx-1/2qx^2	3/2Fx-Fx^2/b-1/2qx^3/b	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	Fx-1/2qx^2	0	0	0	0
EB b	0	-1/2Fb+1/2qx^2	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				-Fb^2/EJ	
	totali				1/8Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-3/40Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3\ x/b -2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/2\ x^2/b -2/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/2\ b -2/3\ b\ )\ Fb\ 1/EJ\ = 5/6\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 + x/b -2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x +1/2\ x^2/b -2/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

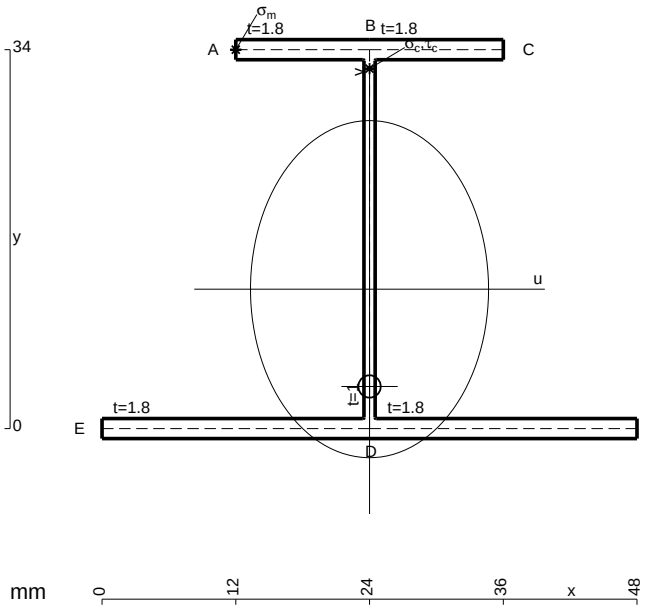
$= (\ b +1/2\ b -2/3\ b\ )\ Fb\ 1/EJ\ = 5/6\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (2\ x/b -5/2\ x^2/b^2 +1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [\ x^2/b -5/6\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -5/6\ b +1/8\ b\ )\ Fb\ 1/EJ\ = 7/24\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (3/2\ x/b - x^2/b^2 -1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/3\ x^3/b^2 -1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/3\ b -1/8\ b\ )\ Fb\ 1/EJ\ = 7/24\ \ Fb^2/EJ$



$A = 163.6\ mm^2$

$J_u = 37433.\ mm^4$

$J_v = 18662.\ mm^4$

$J_t = 151.3\ mm^4$

$y_o = -8.733\ mm$

$y_g = 12.51\ mm$

$N = -480.\ N$

$T_y = -720.\ N$

$M_x = -345600.\ Nmm$

$x_m = 12.\ mm$

$y_m = 34.\ mm$

$u_m = -12.\ mm$

$v_m = 21.49\ mm$

$\sigma_m = N/A - Mv/J_u = 195.5\ N/mm^2$

$x_c = 24.\ mm$

$y_c = 34.\ mm$

$v_c = 21.49\ mm$

$\sigma_c = N/A - Mv/J_u = 195.5\ N/mm^2$

$\tau_c = TS^*/tJ_u = 17.86\ N/mm^2$

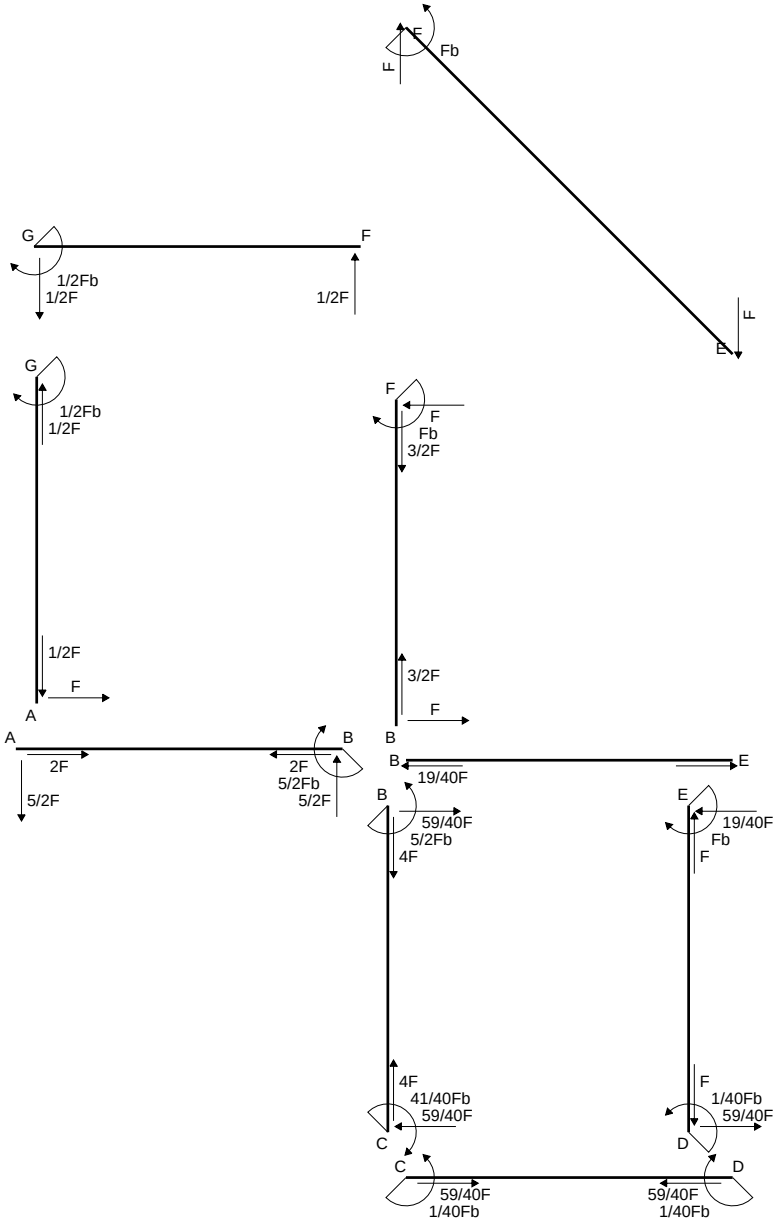
$\tau_g = TS^*/tJ_u = 17.86\ N/mm^2$

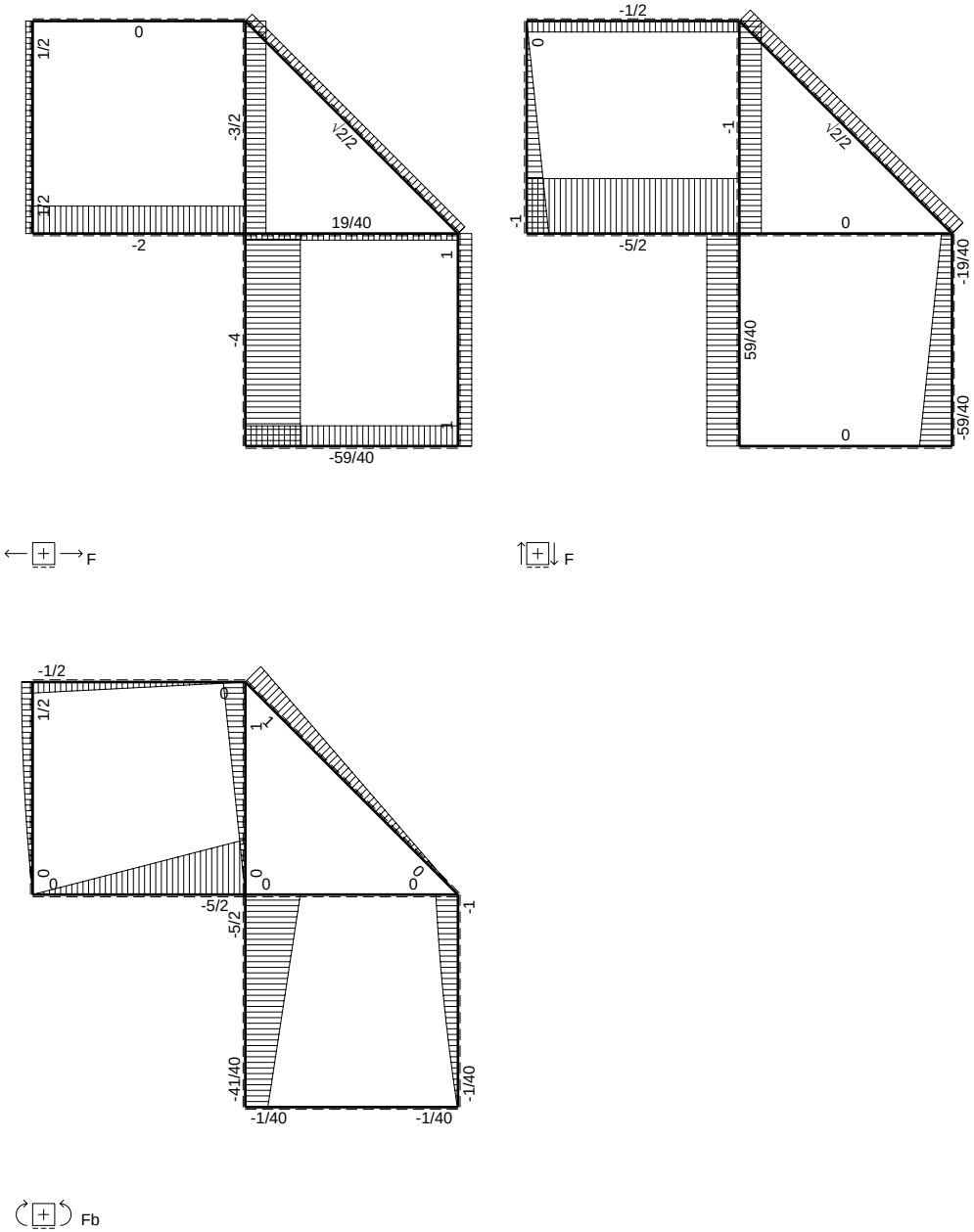
$t_c = 240.\ mm$

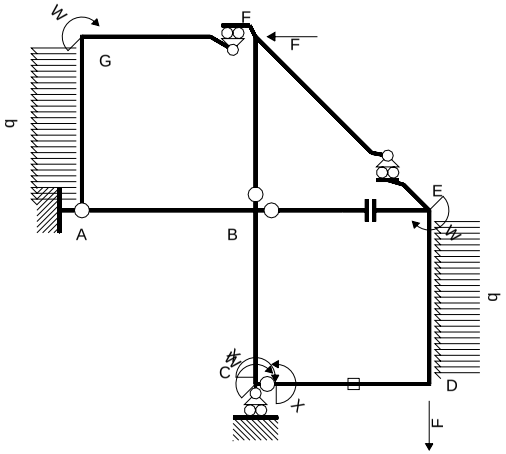
$\sigma_o = \sqrt{\sigma^2 + 3\tau^2} = 197.9\ N/mm^2$

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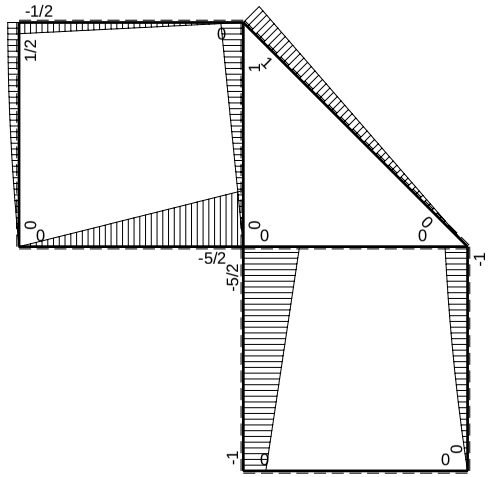
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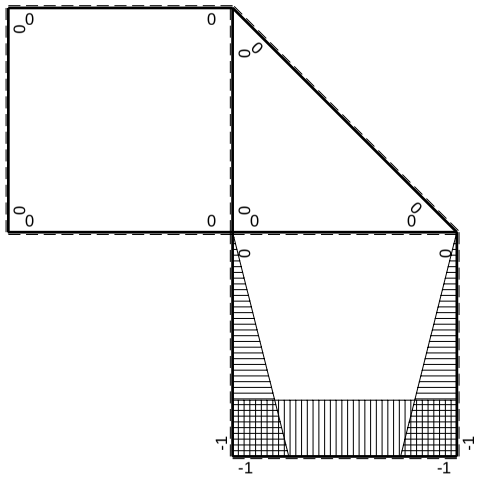

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Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0		
BC b	-x/b	-5/2Fb+3/2Fx	$5/2Fx-3/2Fx^2/b$	x^2/b^2	$3/4Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+3/2Fx	$Fb+1/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	$-3/2Fx+1/2qx^2$	$3/2Fx-2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$5/24Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$Fb-1/2Fx-1/2qx^2$	$Fx-1/2Fx^2/b-1/2qx^3/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-1/2Fx	0	0	0	0
GF b	0	1/2Fb-1/2Fx	0	0		
GA b	0	$1/2Fb-1/2qx^2$	0	0	0	0
AG b	0	$-Fx+1/2qx^2$	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/24Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				1/40Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 +1/2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x +1/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b +1/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ \ Fb^2/EJ$

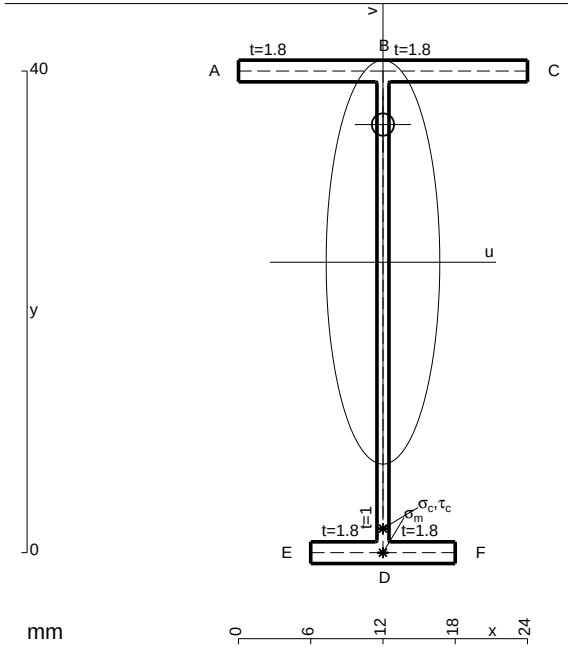
$L^{Xo}_{DE} = \int_o^b (3/2\ x/b -2\ x^2/b^2 +1/2\ x^3/b^3)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -2/3\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -2/3\ b +1/8\ b\ )\ Fb\ 1/EJ\ = 5/24\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (\ x/b -1/2\ x^2/b^2 -1/2\ x^3/b^3)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/6\ x^3/b^2 -1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/6\ b -1/8\ b\ )\ Fb\ 1/EJ\ = 5/24\ \ Fb^2/EJ$

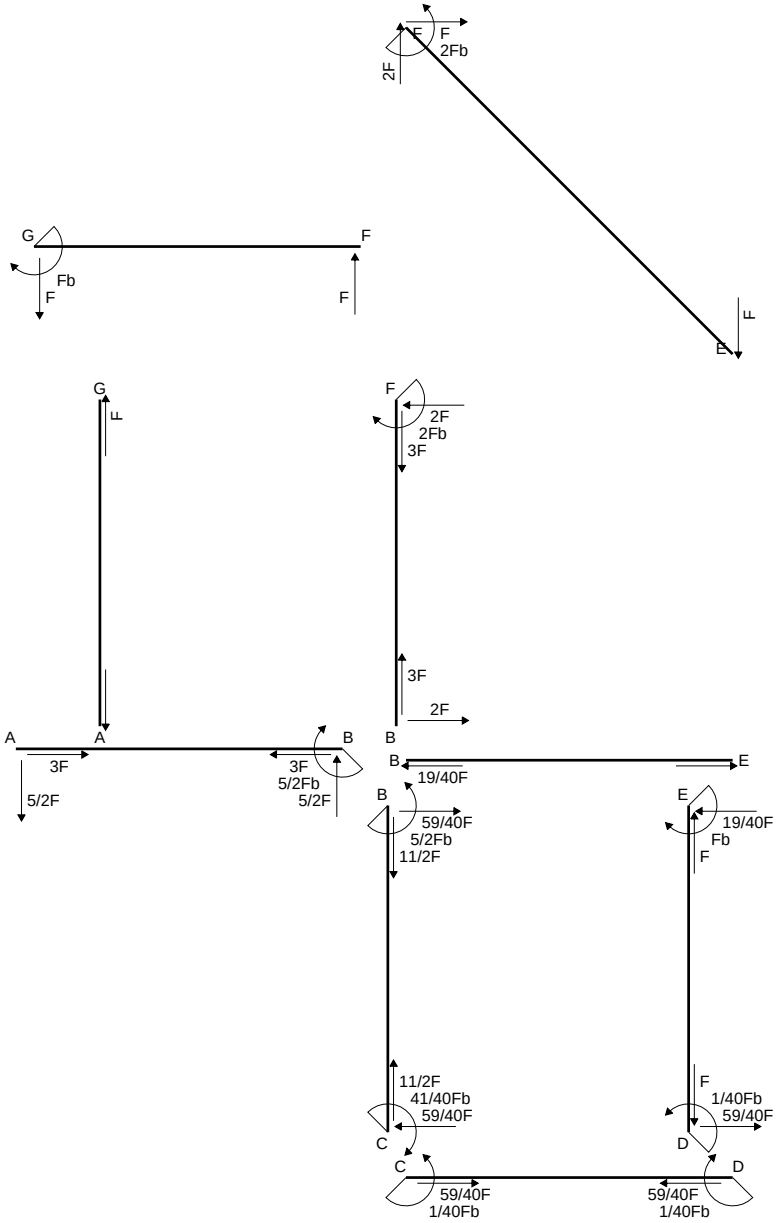
PROCEDIMENTO E RISULTATI 265477 CI02.xxxx.086

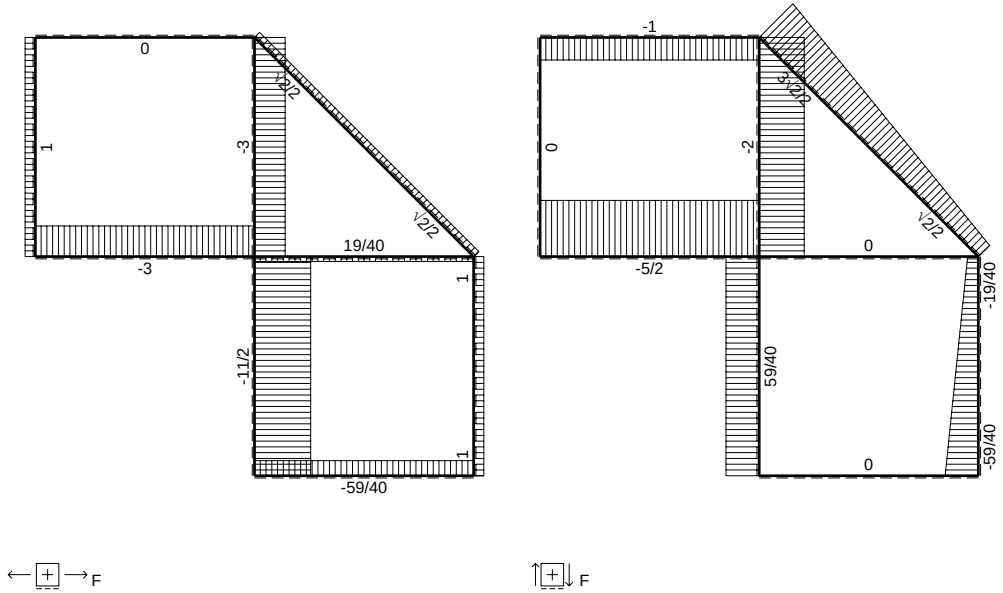


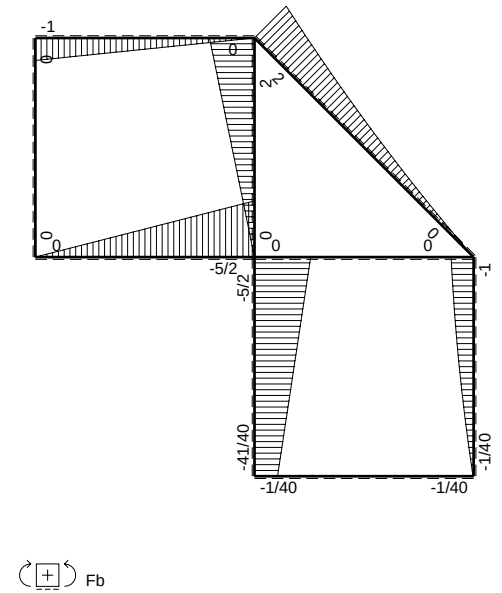
A = 104.8 mm^2
J_u = 29473. mm^4
J_v = 2333. mm^4
J_t = 83.32 mm^4
y_o = 11.43 mm
y_g = 24.12 mm
N = -320. N
T_y = -400. N
M_x = -240000. Nmm
x_m = 12. mm
v_m = -24.12 mm
$\sigma_m = N/A - Mv/J_u$ = -199.5 N/mm^2
y_c = 3. mm
u_c = -12. mm
v_c = -21.12 mm
$\sigma_c = N/A - Mv/J_u$ = -199.5 N/mm^2
$\tau_c = TS^*/tJ_u$ = 7.071 N/mm^2
$\tau_g = TS^*/tJ_u$ = 7.071 N/mm^2
t_c = 160. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 199.9 N/mm^2

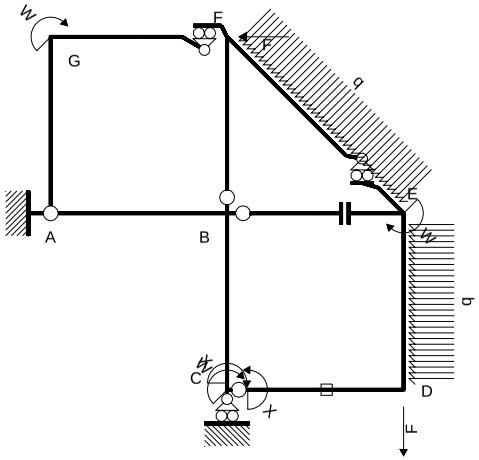
CI02.xxxx.086

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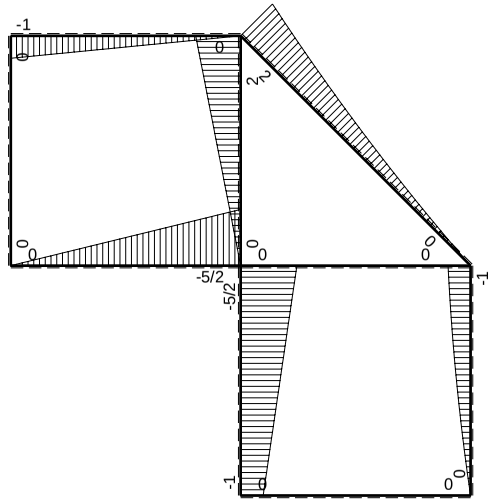

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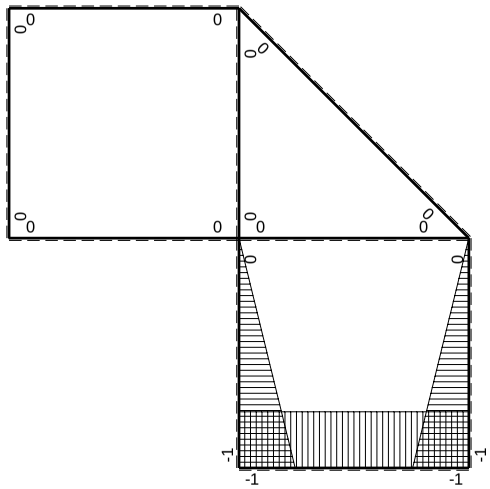

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-1/40
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0		
BC b	-x/b	-5/2Fb+3/2Fx	$5/2Fx-3/2Fx^2/b$	x^2/b^2	$3/4Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+3/2Fx	$Fb+1/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	$-3/2Fx+1/2qx^2$	$3/2Fx-2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$5/24Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$Fb-1/2Fx-1/2qx^2$	$Fx-1/2Fx^2/b-1/2qx^3/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx+1/2qx^2$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/24Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				$1/40Fb$	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 +1/2\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x +1/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

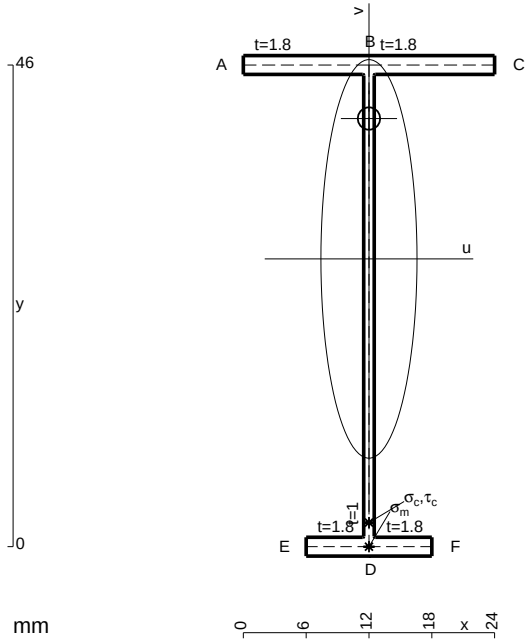
$= (\ b +1/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (3/2\ x/b -2\ x^2/b^2 +1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -2/3\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -2/3\ b +1/8\ b\ )\ Fb\ 1/EJ\ = 5/24\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (\ x/b -1/2\ x^2/b^2 -1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/6\ x^3/b^2 -1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

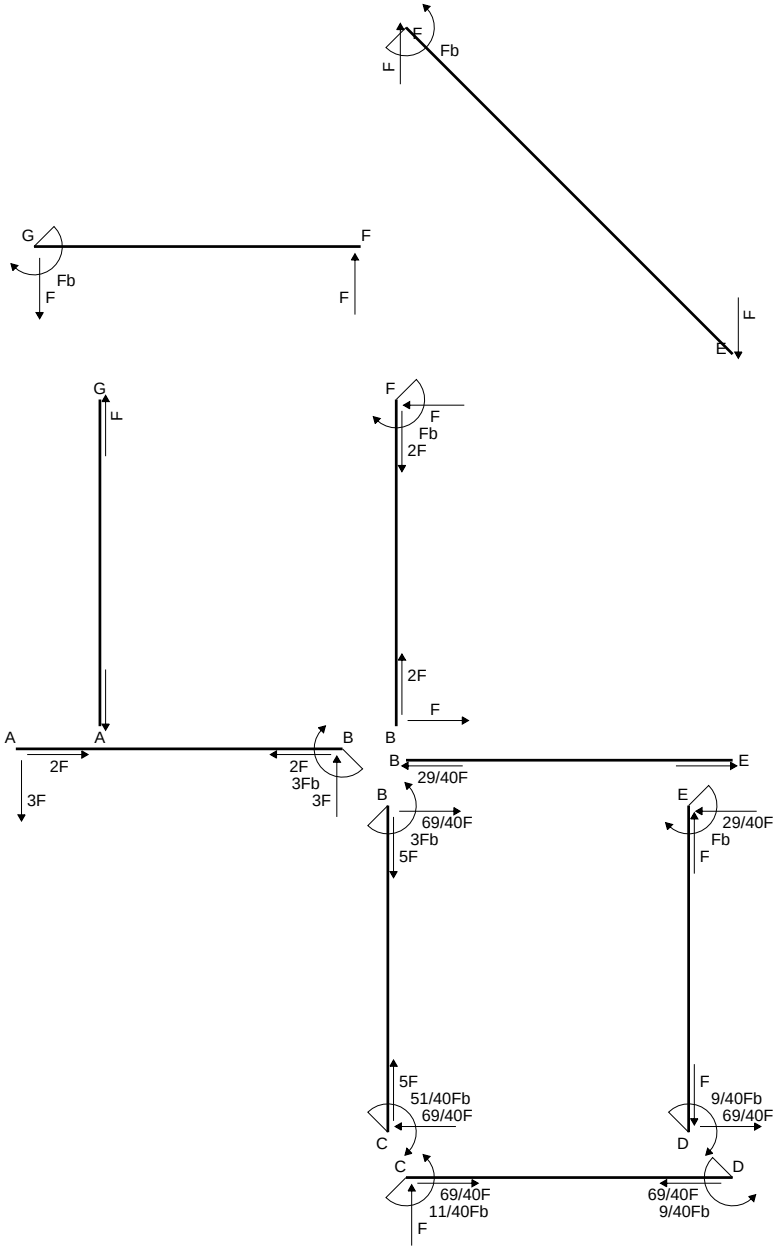
$= (1/2\ b -1/6\ b -1/8\ b\ )\ Fb\ 1/EJ\ = 5/24\ \ Fb^2/EJ$

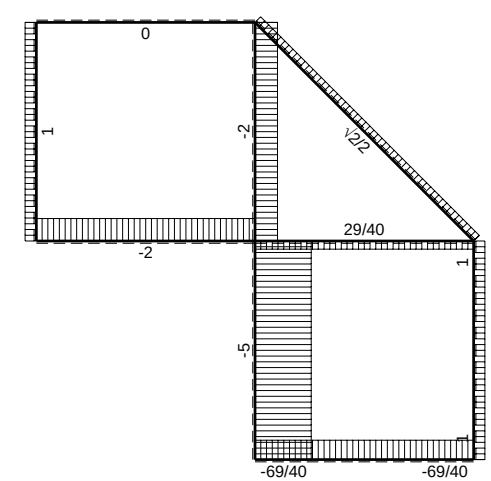


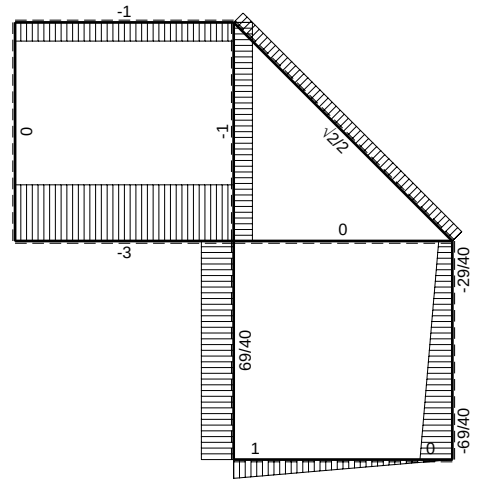
A = 110.8 mm^2
J_u = 40163. mm^4
J_v = 2333. mm^4
J_t = 85.32 mm^4
y_o = 13.41 mm
y_g = 27.48 mm
N = -510. N
T_y = -425. N
M_x = -310250. Nmm
x_m = 12. mm
v_m = -27.48 mm
$\sigma_m = N/A - Mv/J_u$ = -216.9 N/mm^2
y_c = 3. mm
u_c = -12. mm
v_c = -24.48 mm
$\sigma_c = N/A - Mv/J_u$ = -216.9 N/mm^2
$\tau_c = TS^*/tJ_u$ = 6.282 N/mm^2
$\tau_g = TS^*/tJ_u$ = 6.282 N/mm^2
t_c = 170. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 217.2 N/mm^2

CI02.xxxx.087

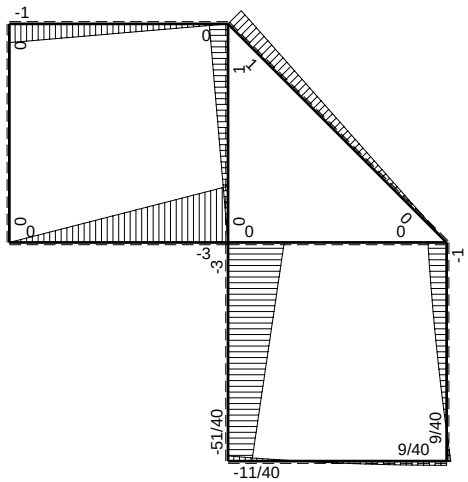
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2F
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3F
3F
29/40F
B
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5F
E
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9/40Fb

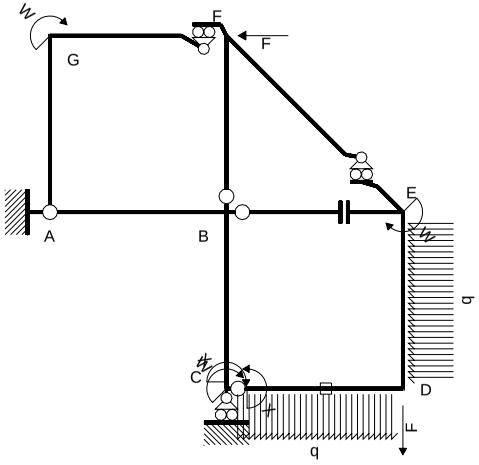

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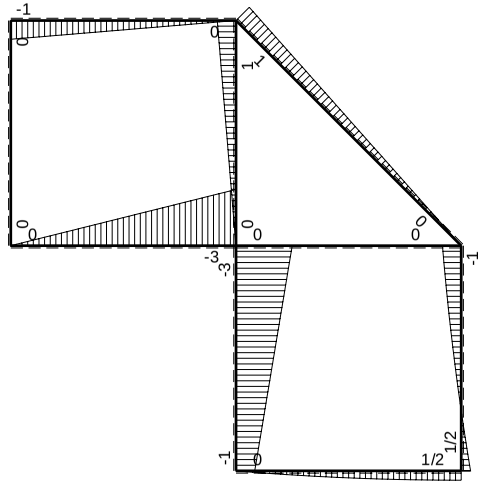
F F


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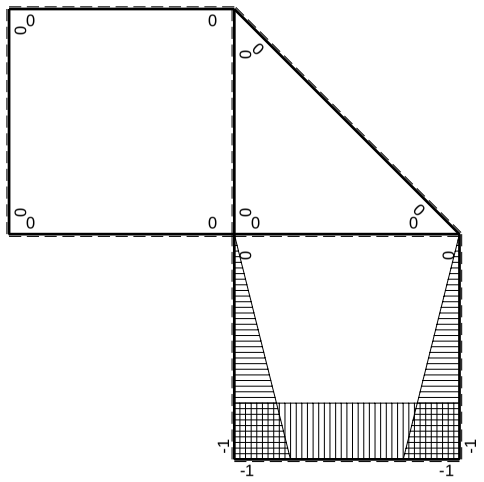
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

PROCEDIMENTO E RISULTATI 263194 CI02.xxxx.088

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Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3Fx	0	0	0	0
BA b	0	3Fb-3Fx	0	0		
BC b	-x/b	-3Fb+2Fx	$3Fx-2Fx^2/b$	x^2/b^2	$5/6Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb+2Fx	$Fb+Fx-2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	$Fx-1/2qx^2$	$-Fx+1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fb+1/2qx^2$	$-1/2Fb+1/2Fx^2/b$	1		
DE b	-1+x/b	$1/2Fb-2Fx+1/2qx^2$	$-1/2Fb+5/2Fx-5/2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$1/24Fb^2/EJ$	1/3Xb/EJ
ED b	x/b	$Fb-Fx-1/2qx^2$	$Fx-Fx^2/b-1/2qx^3/b$	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-11/24Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				11/40Fb	

PROCEDIMENTO E RISULTATI 263194 CI02.xxxx.088

Sviluppi di calcolo iperstatica

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$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2\ )\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3\ x/b -2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [3/2\ x^2/b -2/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/2\ b -2/3\ b\ )\ Fb\ 1/EJ\ = 5/6\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 + x/b -2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x +1/2\ x^2/b -2/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b +1/2\ b -2/3\ b\ )\ Fb\ 1/EJ\ = 5/6\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -4/3\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2 +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/2\ x +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -4/3\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (-1/2 +5/2\ x/b -5/2\ x^2/b^2 +1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx$

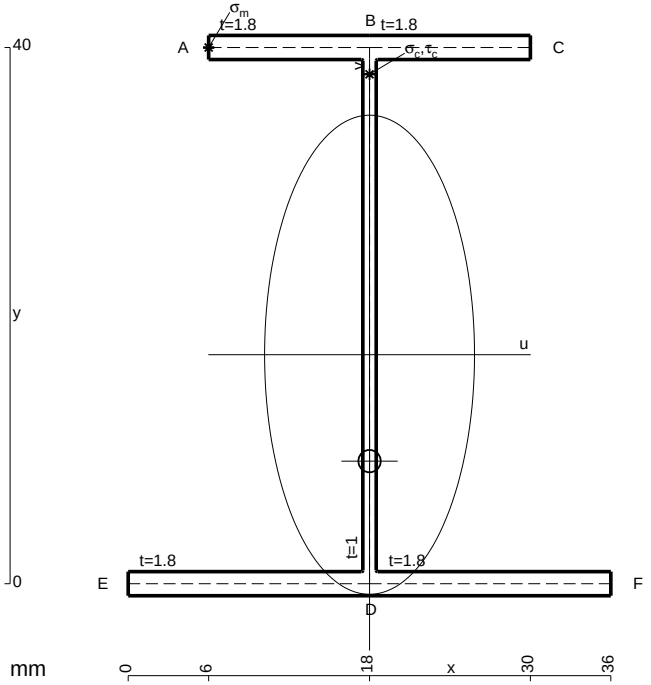
$= [-1/2\ x +5/4\ x^2/b -5/6\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +5/4\ b -5/6\ b +1/8\ b\ )\ Fb\ 1/EJ\ = 1/24\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (\ x/b - x^2/b^2 -1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2 -1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

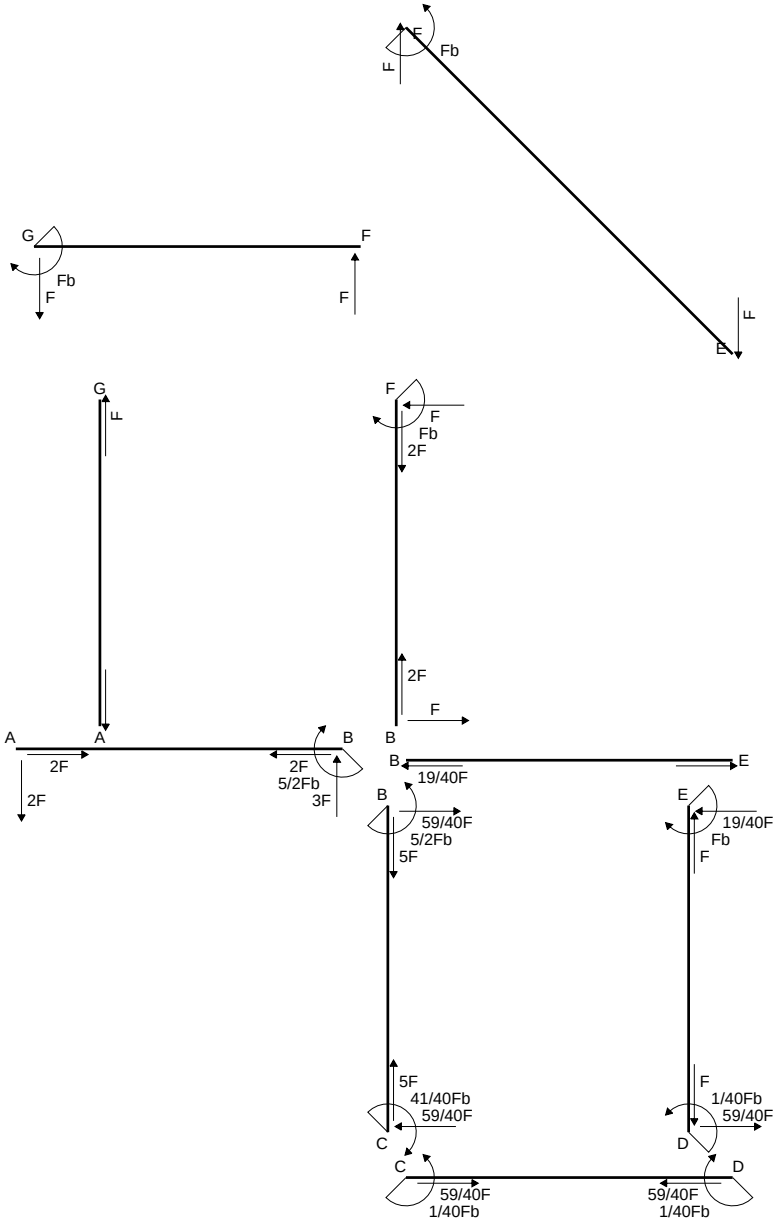
$= (1/2\ b -1/3\ b -1/8\ b\ )\ Fb\ 1/EJ\ = 1/24\ \ Fb^2/EJ$

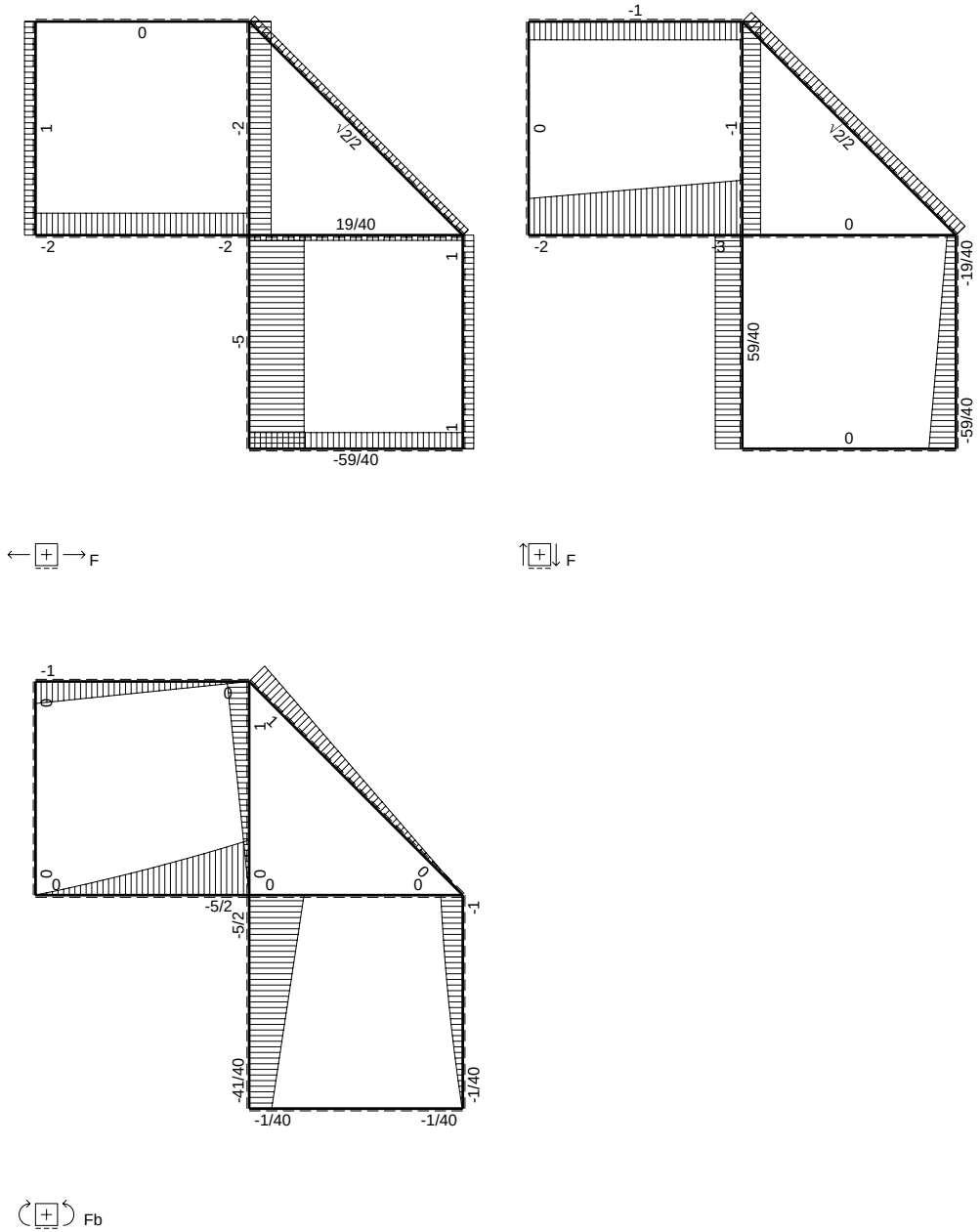
PROCEDIMENTO E RISULTATI 263194 CI02.xxxx.088



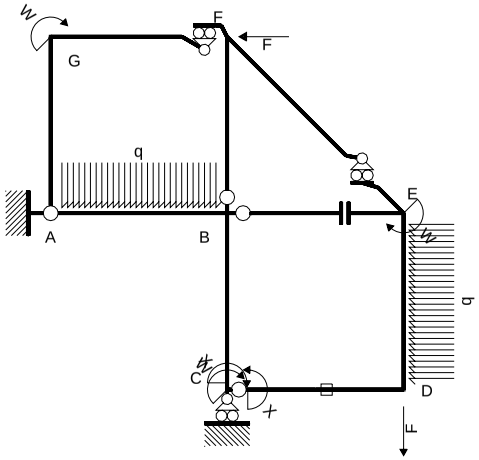
A = 148. mm^2
J_u = 47272. mm^4
J_v = 9072. mm^4
J_t = 130. mm^4
y_o = -7.938 mm
y_g = 17.08 mm
N = -460. N
T_y = -690. N
M_x = -469200. Nmm
x_m = 6. mm
y_m = 40. mm
u_m = -12. mm
v_m = 22.92 mm
$\sigma_m = N/A - Mv/J_u$ = 224.4 N/mm^2
x_c = 18. mm
y_c = 40. mm
v_c = 22.92 mm
$\sigma_c = N/A - Mv/J_u$ = 224.4 N/mm^2
$\tau_c = TS^*/tJ_u$ = 14.45 N/mm^2
$\tau_g = TS^*/tJ_u$ = 14.45 N/mm^2
t_c = 230. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 225.8 N/mm^2

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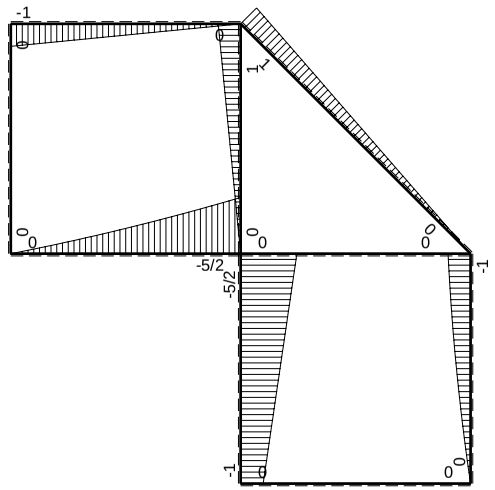




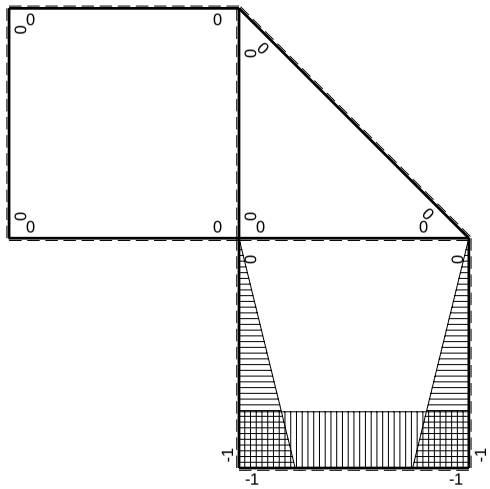
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Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-2Fx-1/2qx^2$	0	0	0	0
BA b	0	$5/2Fb-3Fx+1/2qx^2$	0	0		
BC b	-x/b	$-5/2Fb+3/2Fx$	$5/2Fx-3/2Fx^2/b$	x^2/b^2	$3/4Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	$Fb+3/2Fx$	$Fb+1/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	$-3/2Fx+1/2qx^2$	$3/2Fx-2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$5/24Fb^2/EJ$	1/3Xb/EJ
ED b	x/b	$Fb-1/2Fx-1/2qx^2$	$Fx-1/2Fx^2/b-1/2qx^3/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/24Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				1/40Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 +1/2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x +1/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

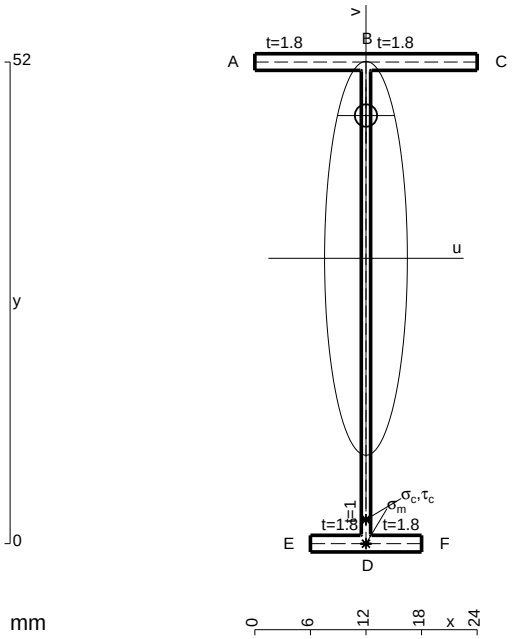
$= (\ b +1/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (3/2\ x/b -2\ x^2/b^2 +1/2\ x^3/b^3)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -2/3\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -2/3\ b +1/8\ b\ )\ Fb\ 1/EJ\ = 5/24\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (\ x/b -1/2\ x^2/b^2 -1/2\ x^3/b^3)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/6\ x^3/b^2 -1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

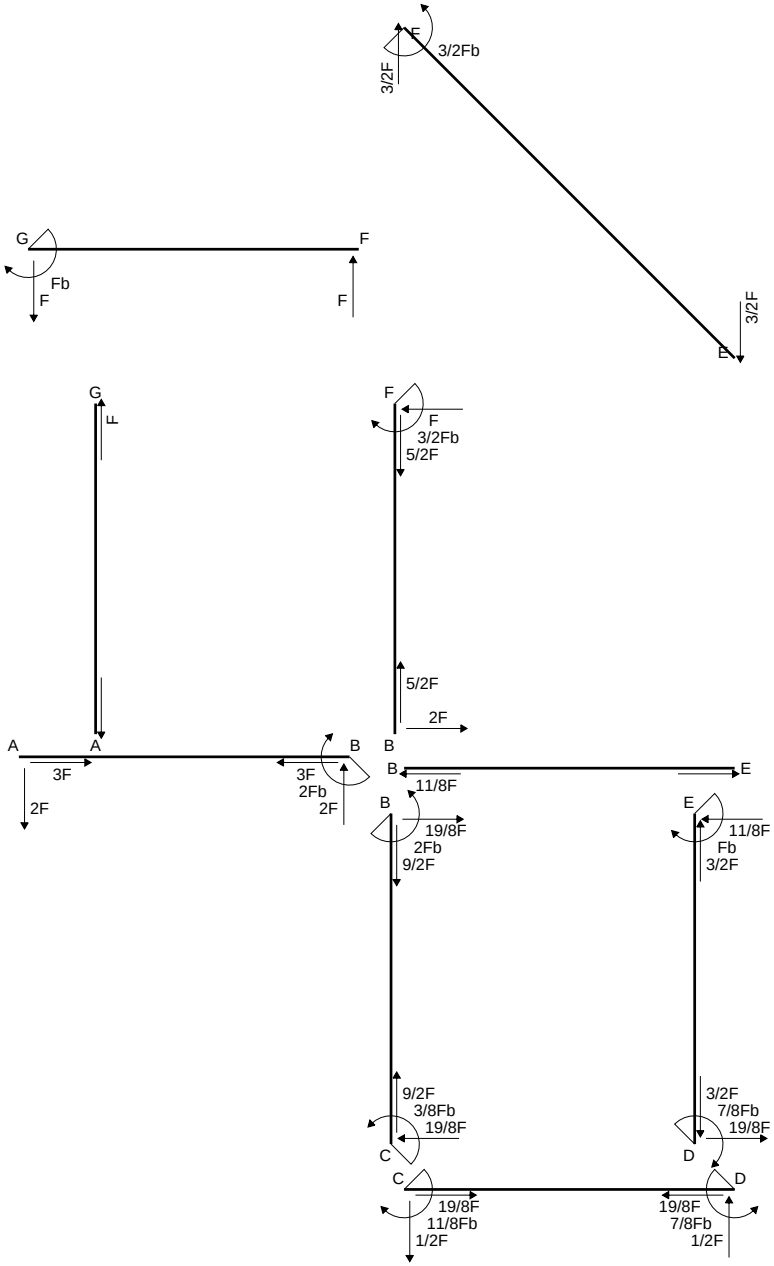
$= (1/2\ b -1/6\ b -1/8\ b\ )\ Fb\ 1/EJ\ = 5/24\ \ Fb^2/EJ$

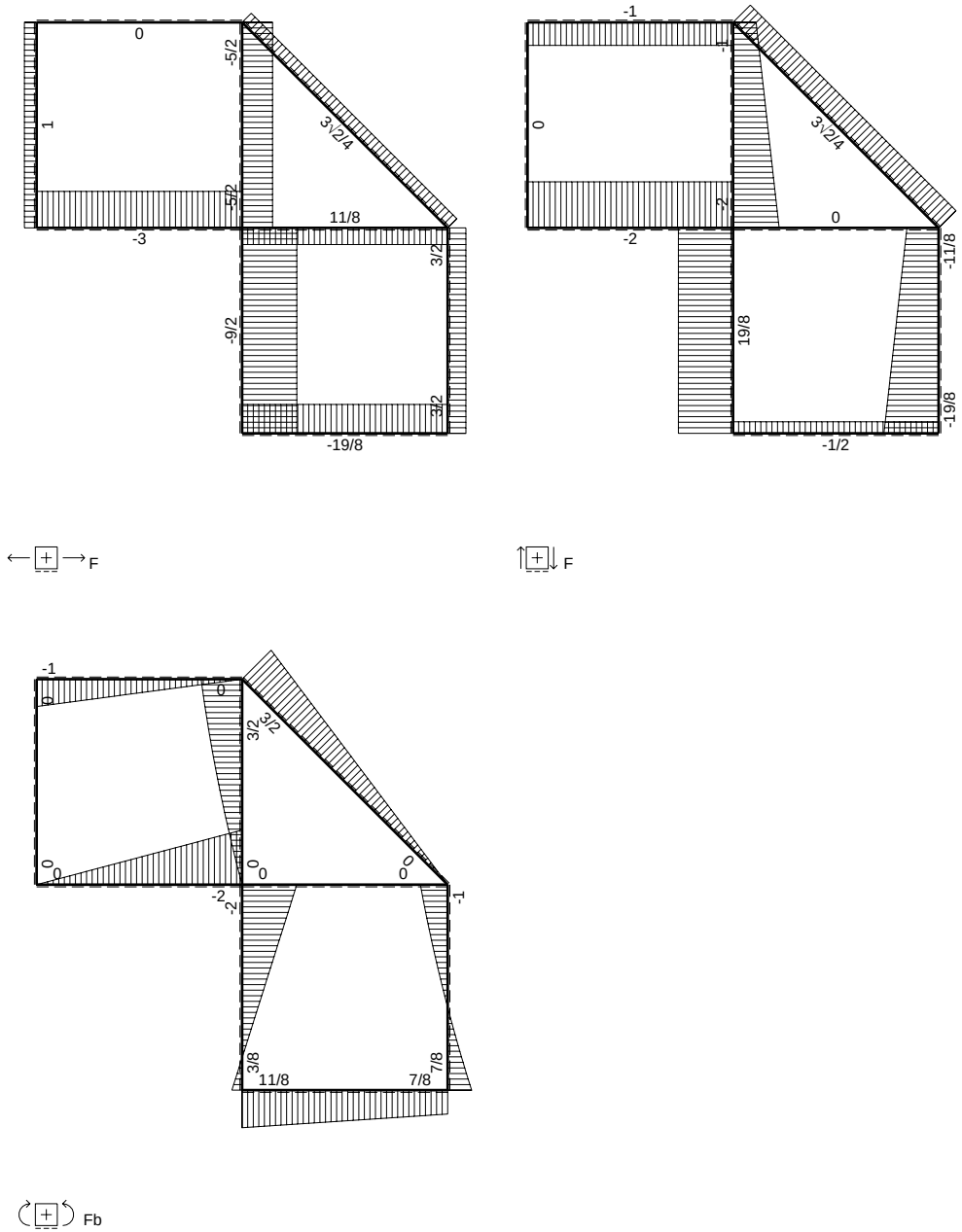


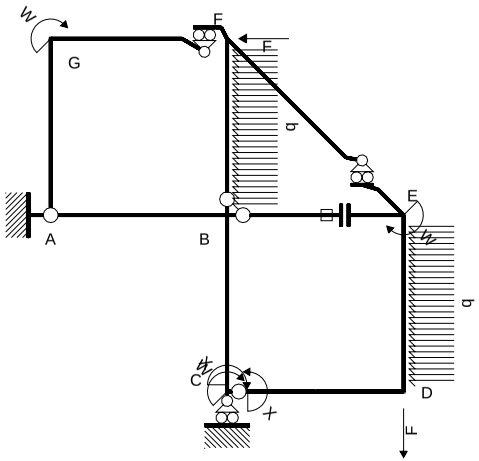
A = 116.8 mm^2
J_u = 52822. mm^4
J_v = 2333. mm^4
J_t = 87.32 mm^4
y_o = 15.41 mm
y_g = 30.81 mm
N = -340. N
T_y = -510. N
M_x = -395250. Nmm
x_m = 12. mm
v_m = -30.81 mm
$\sigma_m = N/A - Mv/J_u$ = -233.4 N/mm^2
y_c = 3. mm
u_c = -12. mm
v_c = -27.81 mm
$\sigma_c = N/A - Mv/J_u$ = -233.4 N/mm^2
$\tau_c = TS^*/tJ_u$ = 6.425 N/mm^2
$\tau_g = TS^*/tJ_u$ = 6.425 N/mm^2
t_c = 170. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 233.7 N/mm^2

CI02.xxxx.089

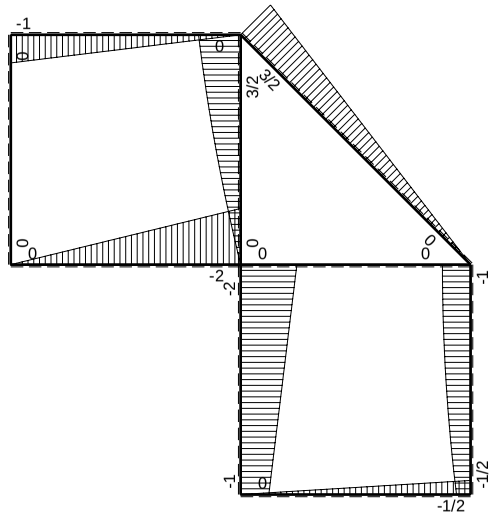
@ Adolfo Zavelani Rossi, Politecnico di Milano, vers.27.03.13 16.04.26


F
3/2Fb
3/2F
G
F
Fb
F
F
3/2F
E
G
F
F
F
3/2Fb
5/2F
5/2F
2F
A
A
B
B
3F
3F
2Fb
2F
2F
B
E
11/8F
B
19/8F
2Fb
9/2F
E
11/8F
Fb
3/2F
9/2F
3/8Fb
19/8F
C
3/2F
7/8Fb
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C
D
19/8F
11/8Fb
1/2F
19/8F
7/8Fb
1/2F

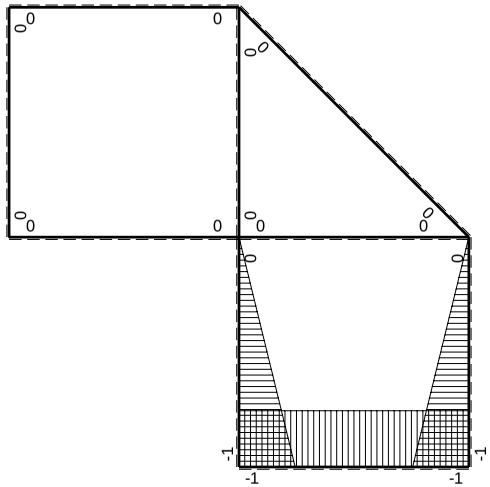

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3√2/4
5/2
11/8
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3/2
-9/2
3/2
-19/8
F
-1
-1
0
3√2/4
2
0
-2
-11/8
19/8
-19/8
-1/2
F
-1
0
0
3/2
3/2
0
0
0
0
-2
-2
-1
3/8
11/8
7/8
7/8
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

PROCEDIMENTO E RISULTATI 214608 CI02.xxxx.090

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Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0		
BC b	-x/b	-2Fb+Fx	$2Fx-Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+Fx	$Fb-Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	-1/2Fx	1/2Fx	1	$1/4Fb^2/EJ$	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE b	-1+x/b	$-1/2Fb-Fx+1/2qx^2$	$1/2Fb+1/2Fx-3/2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$3/8Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$Fb-1/2qx^2$	$Fx-1/2qx^3/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	$3/2Fb-Fx-1/2qx^2$	0	0	0	0
BF b	0	$-2Fx+1/2qx^2$	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$55/24Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				-11/8Fb	

PROCEDIMENTO E RISULTATI 214608 CI02.xxxx.090

Sviluppi di calcolo iperstatica

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$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (2\ x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (1/2\ x/b\ )\ Fb\ 1/EJ\ dx = [1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b\ )\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (1/2 -1/2\ x/b\ )\ Fb\ 1/EJ\ dx = [1/2\ x -1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/4\ b\ )\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

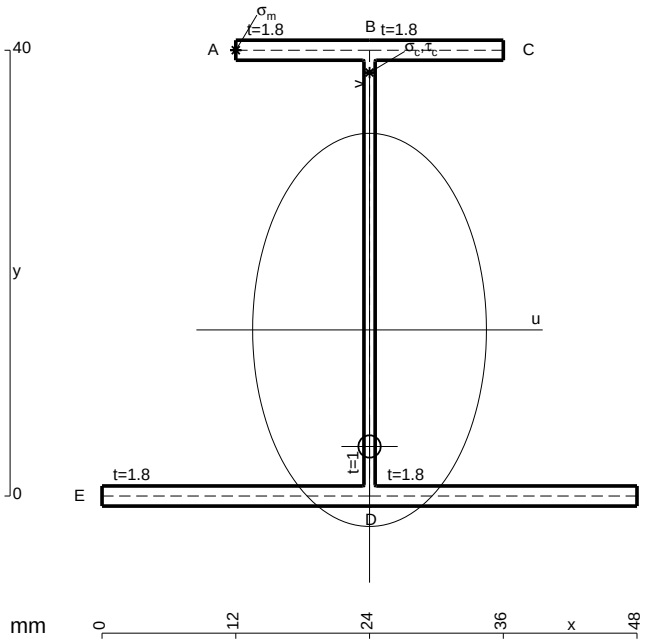
$L^{Xo}_{DE} = \int_o^b (1/2 +1/2\ x/b -3/2\ x^2/b^2 +1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx$

$= [1/2\ x +1/4\ x^2/b -1/2\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

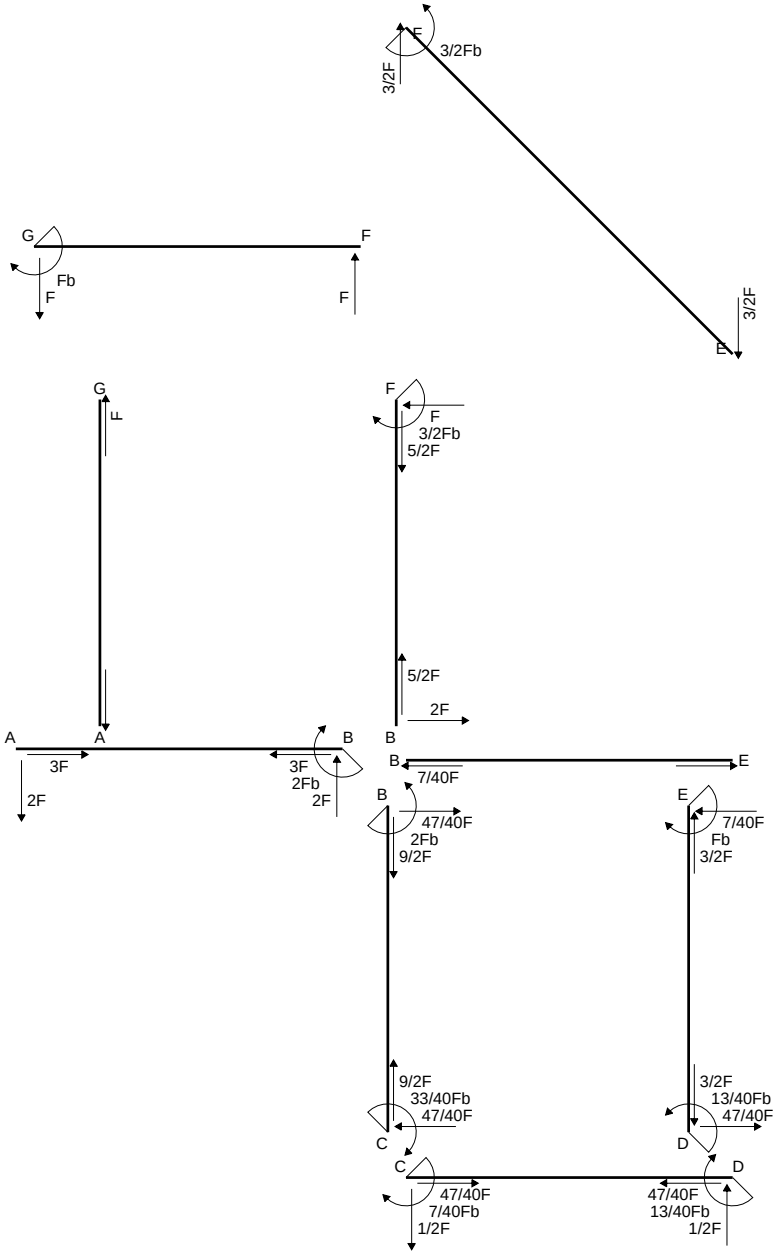
$= (1/2\ b +1/4\ b -1/2\ b +1/8\ b\ )\ Fb\ 1/EJ\ = 3/8\ Fb^2/EJ$

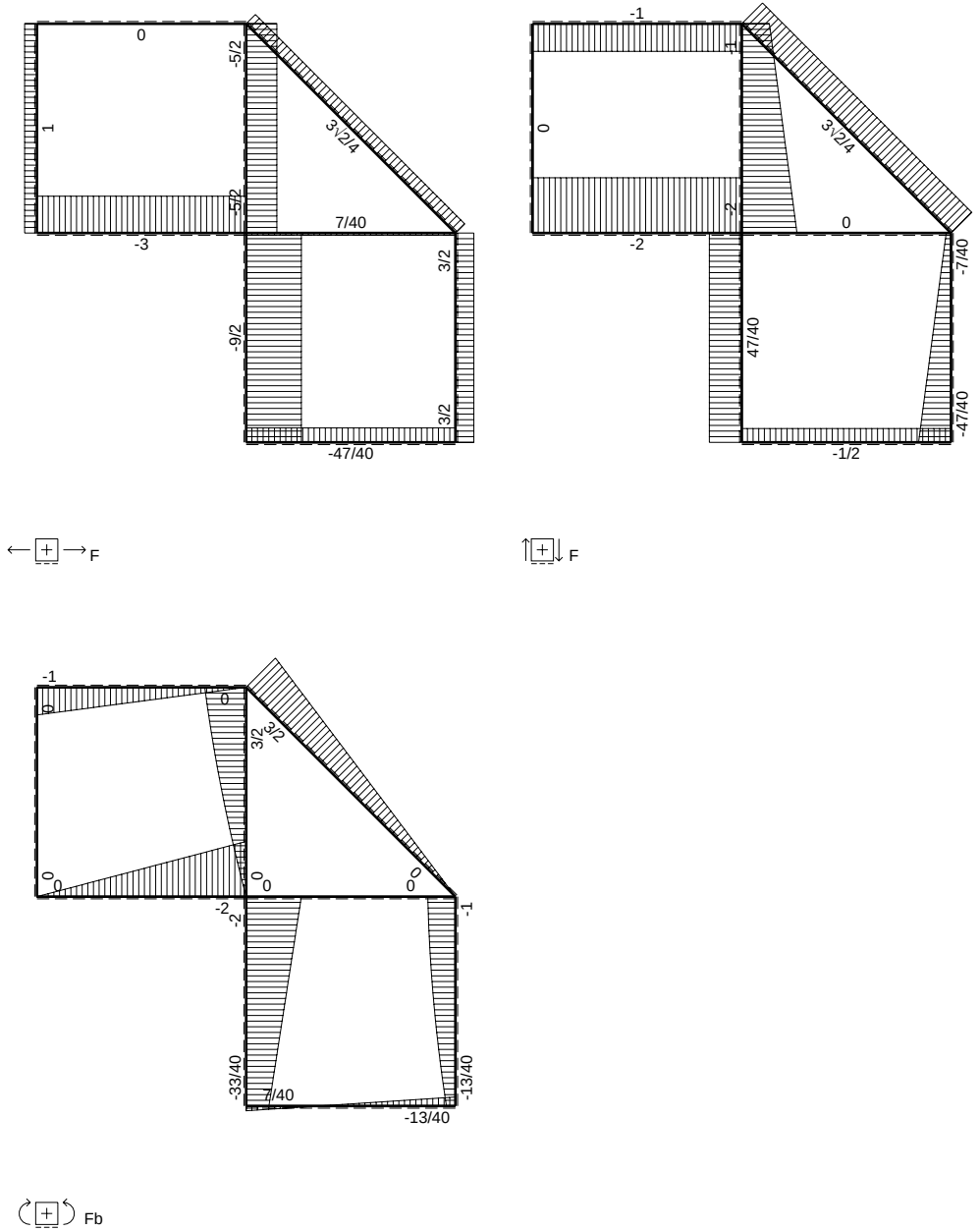
$L^{Xo}_{ED} = \int_o^b (\ x/b -1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

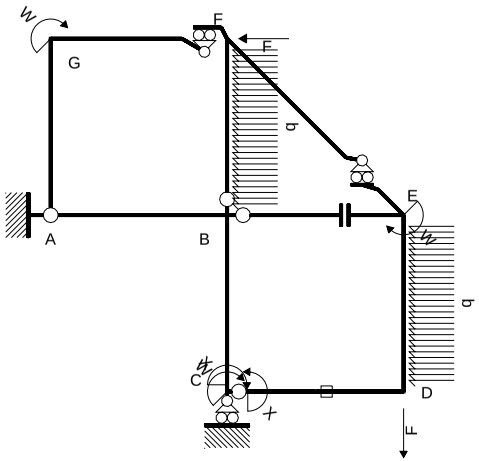
$= (1/2\ b -1/8\ b\ )\ Fb\ 1/EJ\ = 3/8\ Fb^2/EJ$



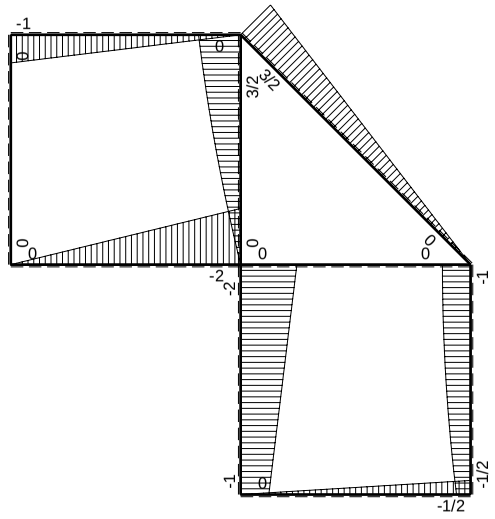
A = 169.6 mm^2
J_u = 52772. mm^4
J_v = 18662. mm^4
J_t = 153.3 mm^4
y_o = -10.46 mm
y_g = 14.91 mm
N = -1740. N
T_y = -1160. N
M_x = -440800. Nmm
x_m = 12. mm
y_m = 40. mm
u_m = -12. mm
v_m = 25.09 mm
$\sigma_m = N/A - Mv/J_u$ = 199.4 N/mm^2
x_c = 24. mm
y_c = 40. mm
v_c = 25.09 mm
$\sigma_c = N/A - Mv/J_u$ = 199.4 N/mm^2
$\tau_c = TS^*/tJ_u$ = 23.83 N/mm^2
$\tau_g = TS^*/tJ_u$ = 23.83 N/mm^2
t_c = 580. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 203.6 N/mm^2


F
3/2Fb
3/2F
G
F
Fb
F
F
3/2F
E
G
F
F
3/2Fb
5/2F
5/2F
2F
A
A
B
B
3F
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2Fb
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2Fb
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7/40F
Fb
3/2F
9/2F
33/40Fb
47/40F
3/2F
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47/40F
13/40Fb
1/2F

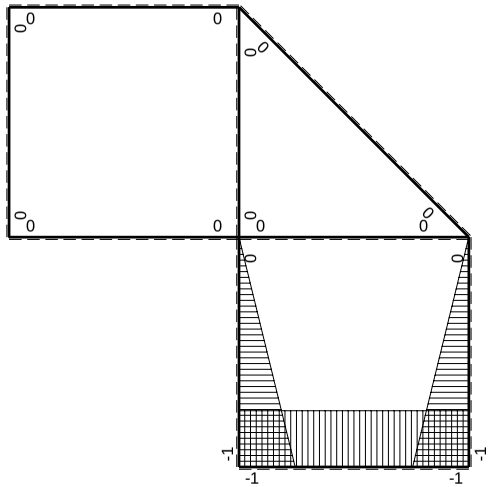

0
-5/2
1
3√2/4
5/2
7/40
-3
3/2
-9/2
3/2
-47/40
F
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1
0
3√2/4
2
0
-2
-7/40
47/40
-47/40
-1/2
F
-1
0
3/2
3√2/4
0
0
0
0
-2
-2
-1
-33/40
7/40
-13/40
-13/40
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

PROCEDIMENTO E RISULTATI 248683 CI02.xxxx.091

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Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0		
BC b	-x/b	-2Fb+Fx	$2Fx-Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	$Fb-Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	-1/2Fx	1/2Fx	1	$1/4Fb^2/EJ$	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE b	-1+x/b	$-1/2Fb-Fx+1/2qx^2$	$1/2Fb+1/2Fx-3/2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$3/8Fb^2/EJ$	1/3Xb/EJ
ED b	x/b	$Fb-1/2qx^2$	$Fx-1/2qx^3/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	$3/2Fb-Fx-1/2qx^2$	0	0	0	0
BF b	0	$-2Fx+1/2qx^2$	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$7/24Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-7/40Fb	

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Sviluppi di calcolo iperstatica

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$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (2\ x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ \ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (1/2\ x/b\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = [1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (1/4\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -3/4\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (1/2\ -1/2\ x/b\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = [1/2\ x\ -1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/E$

$= (1/2\ b\ -1/4\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -3/4\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2\ +1/2\ x/b\ -3/2\ x^2/b^2\ +1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx$

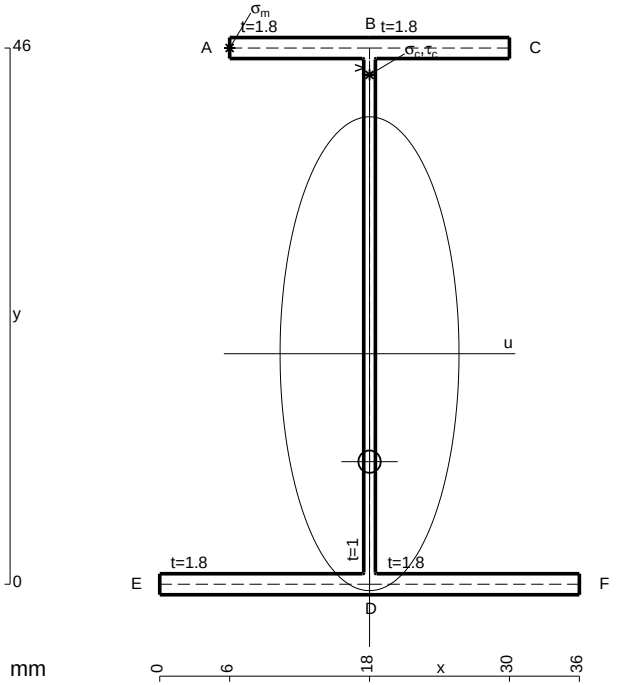
$= [1/2\ x\ +1/4\ x^2/b\ -1/2\ x^3/b^2\ +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b\ +1/4\ b\ -1/2\ b\ +1/8\ b\ )\ Fb\ 1/EJ\ = 3/8\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (\ x/b\ -1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b\ -1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

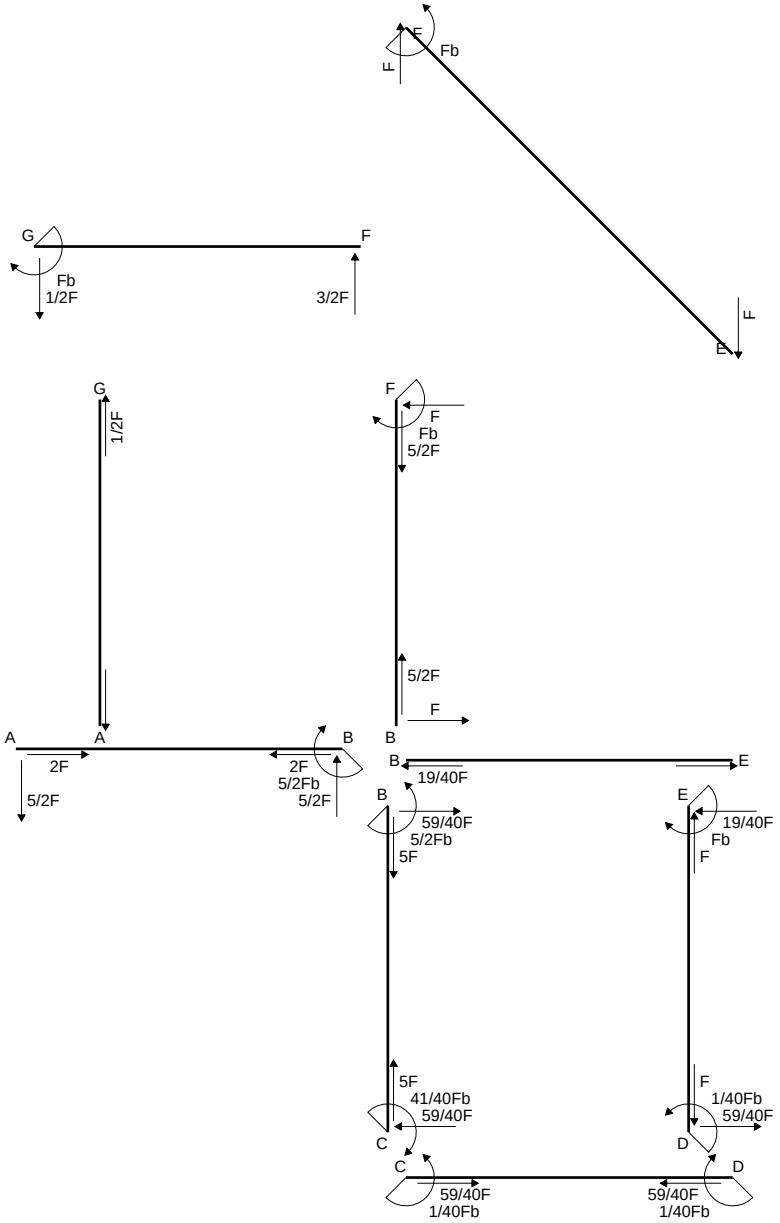
$= (1/2\ b\ -1/8\ b\ )\ Fb\ 1/EJ\ = 3/8\ \ Fb^2/EJ$

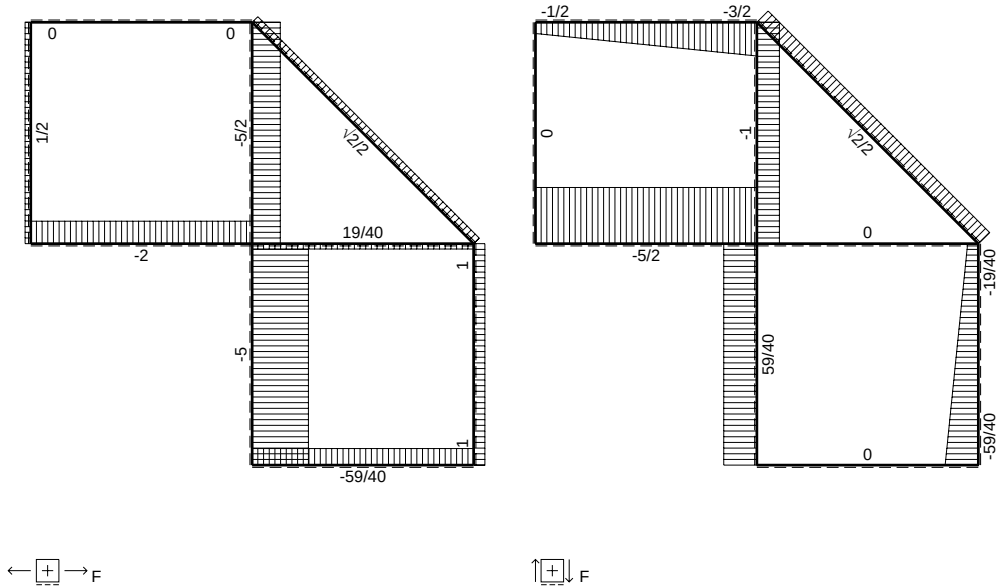
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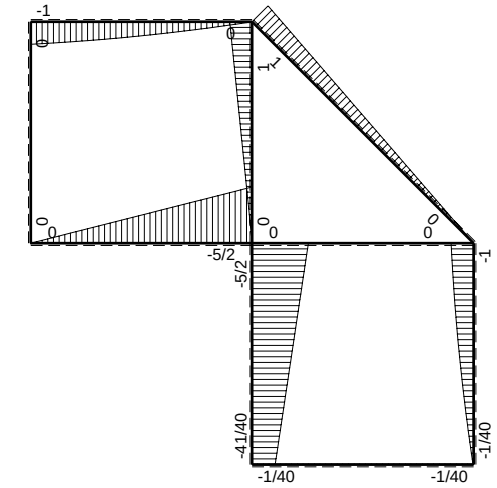


A = 154. mm^2
J_u = 63641. mm^4
J_v = 9072. mm^4
J_t = 132. mm^4
y_o = -9.26 mm
y_g = 19.77 mm
N = -1710. N
T_y = -1140. N
M_x = -535800. Nmm
x_m = 6. mm
y_m = 46. mm
u_m = -12. mm
v_m = 26.23 mm
$\sigma_m = N/A - Mv/J_u$ = 209.7 N/mm^2
x_c = 18. mm
y_c = 46. mm
v_c = 26.23 mm
$\sigma_c = N/A - Mv/J_u$ = 209.7 N/mm^2
$\tau_c = TS^*/tJ_u$ = 20.29 N/mm^2
$\tau_g = TS^*/tJ_u$ = 20.29 N/mm^2
t_c = 570. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 212.6 N/mm^2

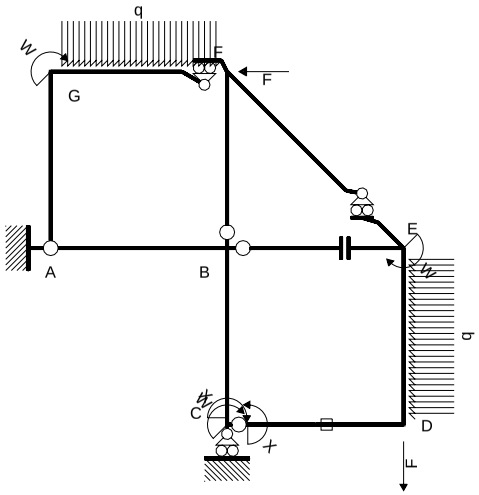
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G
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Fb
1/2F
3/2F
F
E
G
1/2F
F
F
Fb
5/2F
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A
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B
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2F
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59/40F
1/40Fb

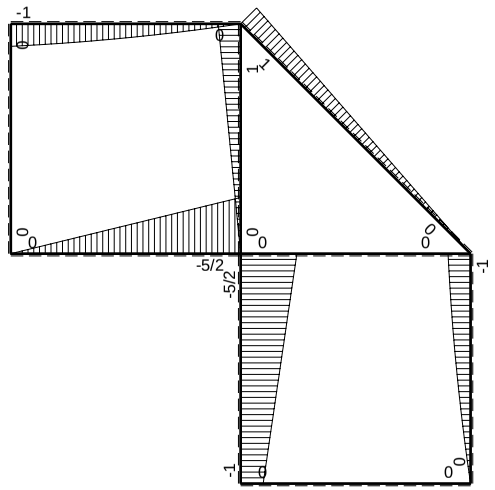

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-1
√2/2
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-19/40
59/40
-59/40
0
F
F


-1
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-41/40
-1/40
-1/40
-1/40

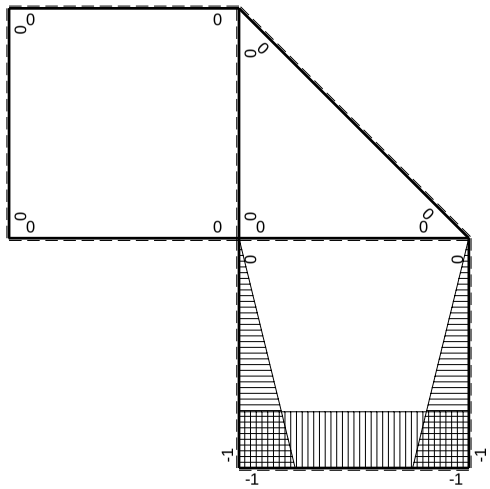
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0		
BC b	-x/b	-5/2Fb+3/2Fx	$5/2Fx-3/2Fx^2/b$	x^2/b^2	$3/4Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+3/2Fx	$Fb+1/2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	$-3/2Fx+1/2qx^2$	$3/2Fx-2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$5/24Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$Fb-1/2Fx-1/2qx^2$	$Fx-1/2Fx^2/b-1/2qx^3/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-3/2Fx+1/2qx^2$	0	0	0	0
GF b	0	$Fb-1/2Fx-1/2qx^2$	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/24Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				$1/40Fb$	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -3/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 +1/2\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x +1/4\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

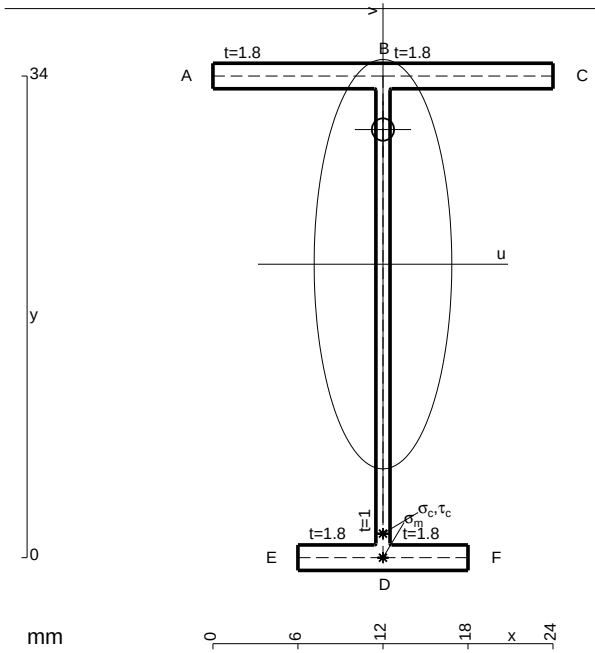
$= (\ b +1/4\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 3/4\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (3/2\ x/b -2\ x^2/b^2 +1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -2/3\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -2/3\ b +1/8\ b\ )\ Fb\ 1/EJ\ = 5/24\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (\ x/b -1/2\ x^2/b^2 -1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/6\ x^3/b^2 -1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

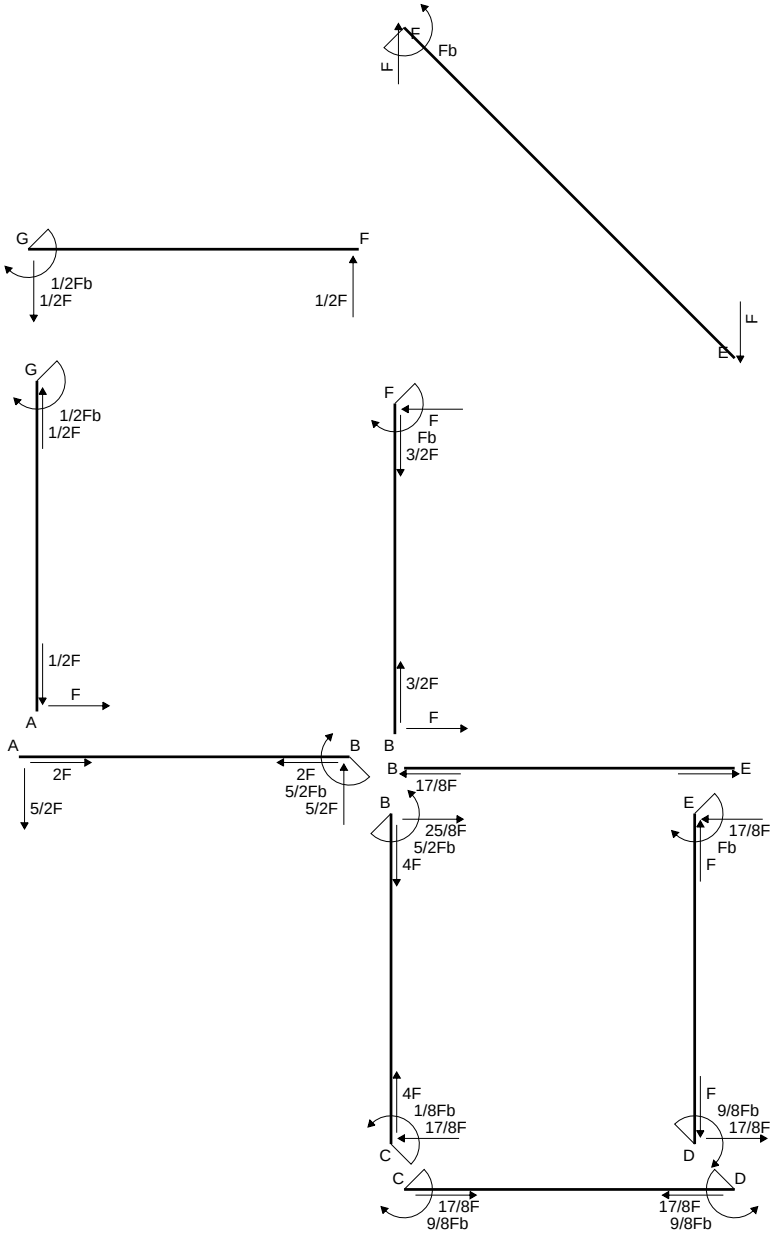
$= (1/2\ b -1/6\ b -1/8\ b\ )\ Fb\ 1/EJ\ = 5/24\ \ Fb^2/EJ$

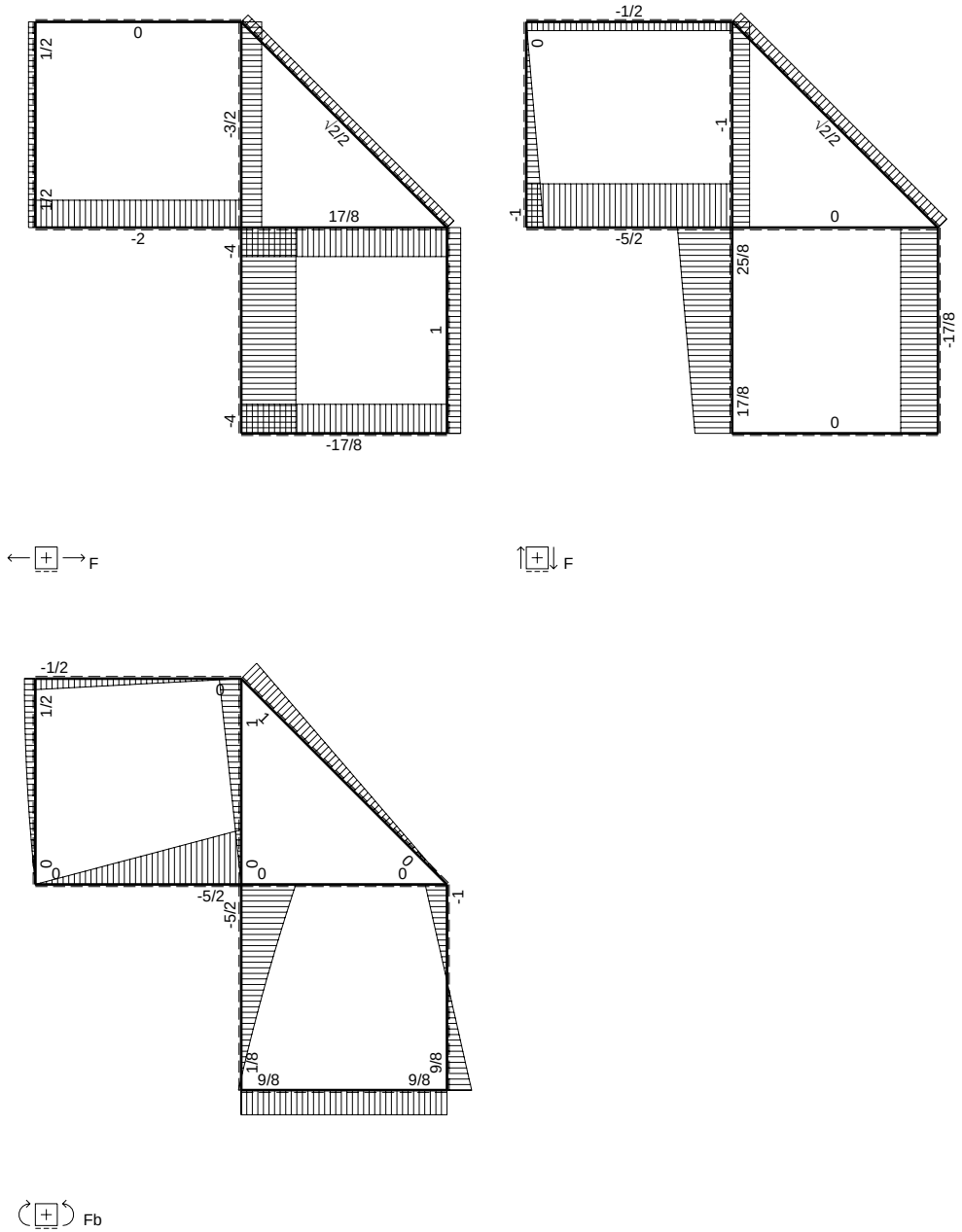


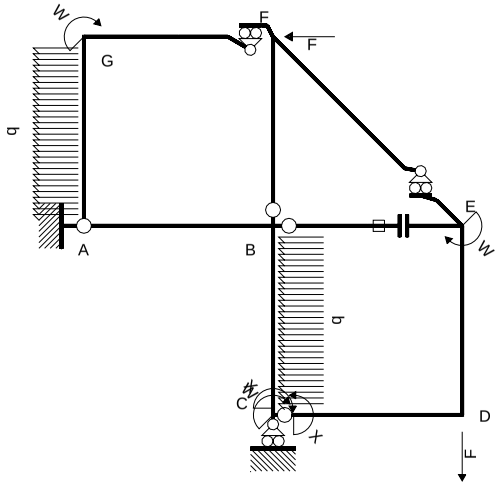
A = 98.8 mm^2
J_u = 20638. mm^4
J_v = 2333. mm^4
J_t = 81.32 mm^4
y_o = 9.506 mm
y_g = 20.72 mm
N = -440. N
T_y = -550. N
M_x = -209000. Nmm
x_m = 12. mm
v_m = -20.72 mm
$\sigma_m = N/A - Mv/J_u$ = -214.3 N/mm^2
y_c = 3. mm
u_c = -12. mm
v_c = -17.72 mm
$\sigma_c = N/A - Mv/J_u$ = -214.3 N/mm^2
$\tau_c = TS^*/tJ_u$ = 11.93 N/mm^2
$\tau_g = TS^*/tJ_u$ = 11.93 N/mm^2
t_c = 220. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 215.2 N/mm^2

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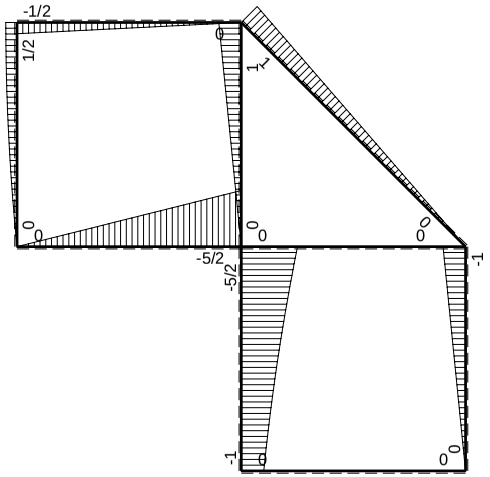
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2F
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4F
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9/8Fb

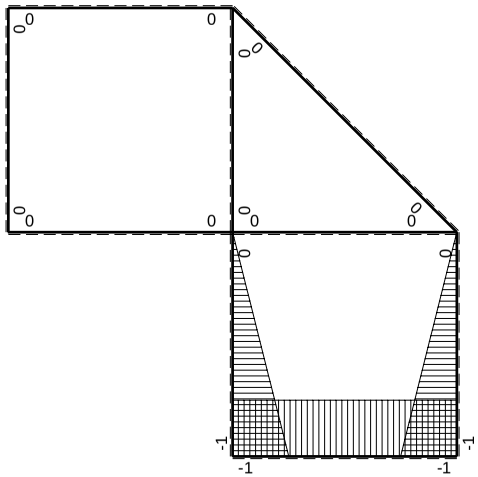

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-1
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25/8
-17/8
17/8
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F
-1/2
1/2
0
1
0
0
0
0
0
-5/2
-5/2
-1
1/8
9/8
9/8
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0		
BC b	-x/b	$-5/2Fb+2Fx-1/2qx^2$	$5/2Fx-2Fx^2/b+1/2qx^3/b$	x^2/b^2	$17/24Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	$Fb+Fx+1/2qx^2$	$Fb-1/2Fx^2/b-1/2qx^3/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	1/3Xb/EJ
ED b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-1/2Fx	0	0	0	0
GF b	0	1/2Fb-1/2Fx	0	0		
GA b	0	$1/2Fb-1/2qx^2$	0	0	0	0
AG b	0	$-Fx+1/2qx^2$	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$15/8Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-9/8Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -2\ x^2/b^2 +1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -2/3\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -2/3\ b +1/8\ b\ )\ Fb\ 1/EJ\ = 17/24\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x^2/b^2 -1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [\ x -1/6\ x^3/b^2 -1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/6\ b -1/8\ b\ )\ Fb\ 1/EJ\ = 17/24\ Fb^2/EJ$

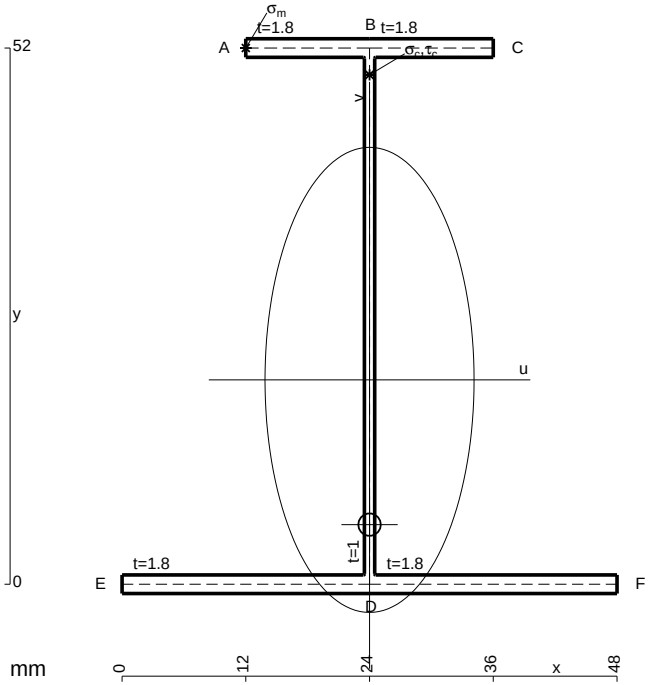
$L^{Xo}_{DE} = \int_o^b (\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

PROCEDIMENTO E RISULTATI 248282 CI02.xxxx.093

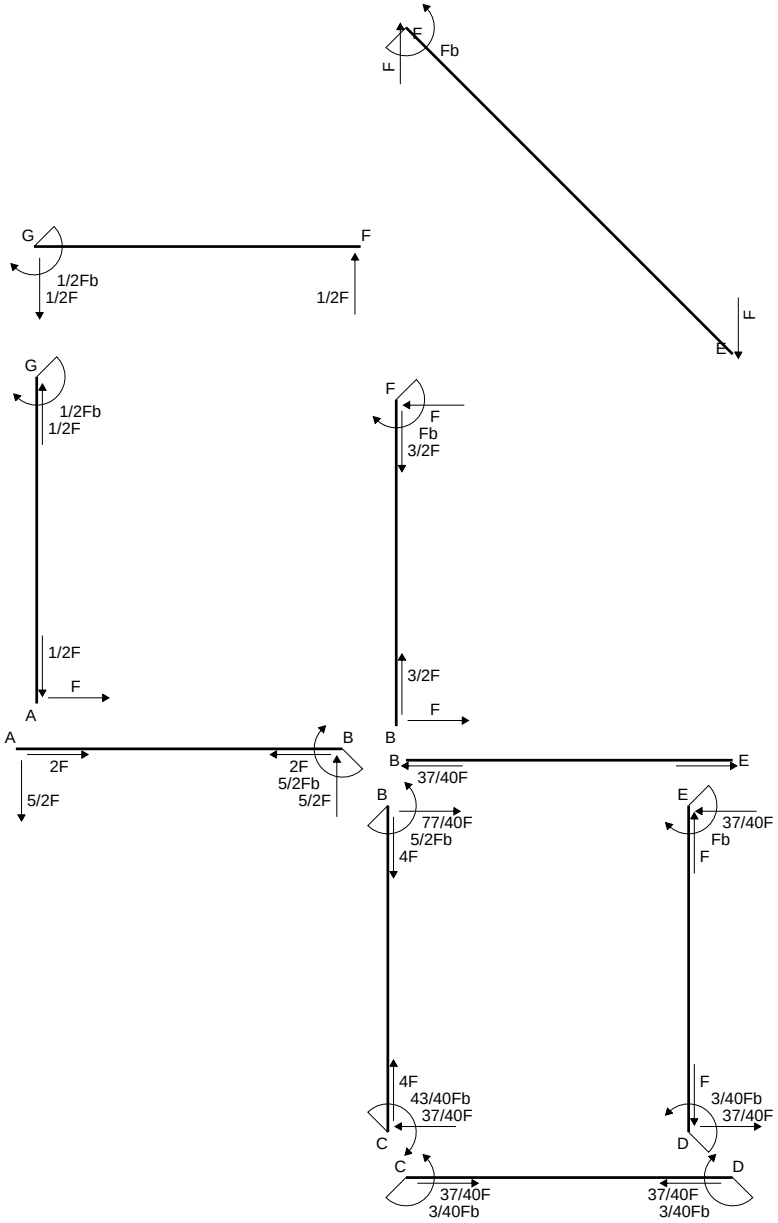


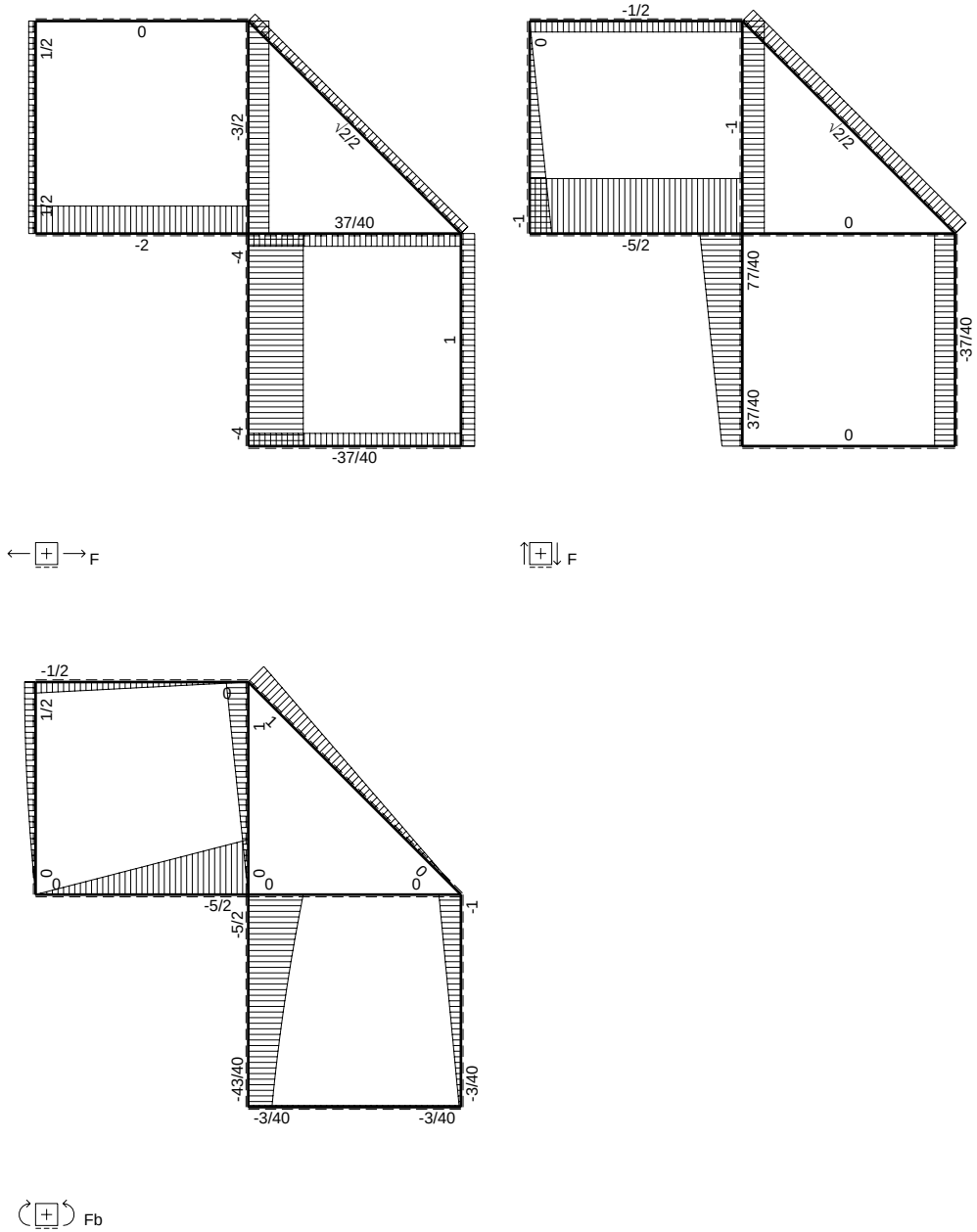
A = 181.6 mm^2
J_u = 92380. mm^4
J_v = 18662. mm^4
J_t = 157.3 mm^4
y_o = -14.04 mm
y_g = 19.82 mm
N = -840. N
T_y = -1050. N
M_x = -661500. Nmm
x_m = 12. mm
y_m = 52. mm
u_m = -12. mm
v_m = 32.19 mm
$\sigma_m = N/A - Mv/J_u$ = 225.8 N/mm^2
x_c = 24. mm
y_c = 52. mm
v_c = 32.19 mm
$\sigma_c = N/A - Mv/J_u$ = 225.8 N/mm^2
$\tau_c = TS^*/tJ_u$ = 15.8 N/mm^2
$\tau_g = TS^*/tJ_u$ = 15.8 N/mm^2
t_c = 420. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 227.5 N/mm^2

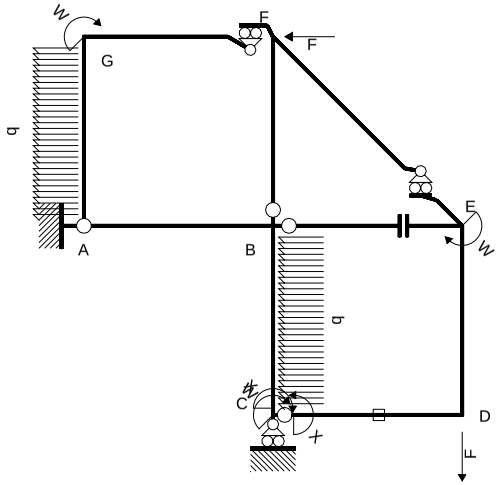
@ Adolfo Zavelani Rossi, Politecnico di Milano, vers.27.03.13 16.04.26

CI02.xxxx.093

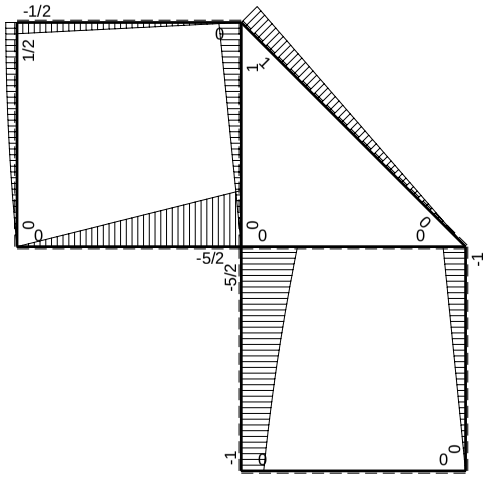
@ Adolfo Zavelani Rossi, Politecnico di Milano, vers.27.03.13 16.04.26


F
Fb
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1/2Fb
1/2F
1/2F
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G
1/2Fb
1/2F
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3/40Fb

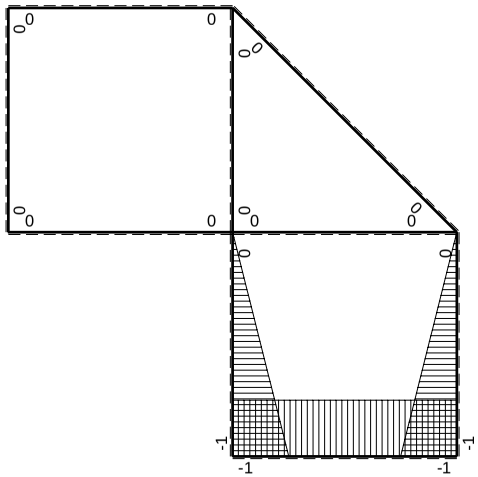

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√2/2
-1
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-5/2
77/40
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37/40
0
F
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0
1/2
1
1
0
0
0
0
0
-1
-5/2
-5/2
-43/40
-3/40
-3/40
-3/40
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0		
BC b	-x/b	$-5/2Fb+2Fx-1/2qx^2$	$5/2Fx-2Fx^2/b+1/2qx^3/b$	x^2/b^2	$17/24Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	$Fb+Fx+1/2qx^2$	$Fb-1/2Fx^2/b-1/2qx^3/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	1/3Xb/EJ
ED b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-1/2Fx	0	0	0	0
GF b	0	1/2Fb-1/2Fx	0	0		
GA b	0	$1/2Fb-1/2qx^2$	0	0	0	0
AG b	0	$-Fx+1/2qx^2$	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/8Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				3/40Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -2\ x^2/b^2 +1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -2/3\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -2/3\ b +1/8\ b\ )\ Fb\ 1/EJ\ = 17/24\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x^2/b^2 -1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [\ x -1/6\ x^3/b^2 -1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

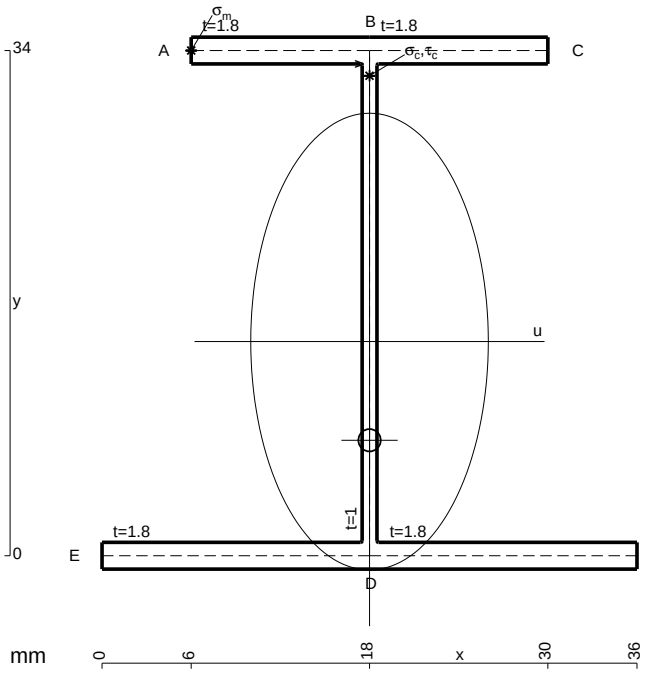
$= (\ b -1/6\ b -1/8\ b\ )\ Fb\ 1/EJ\ = 17/24\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

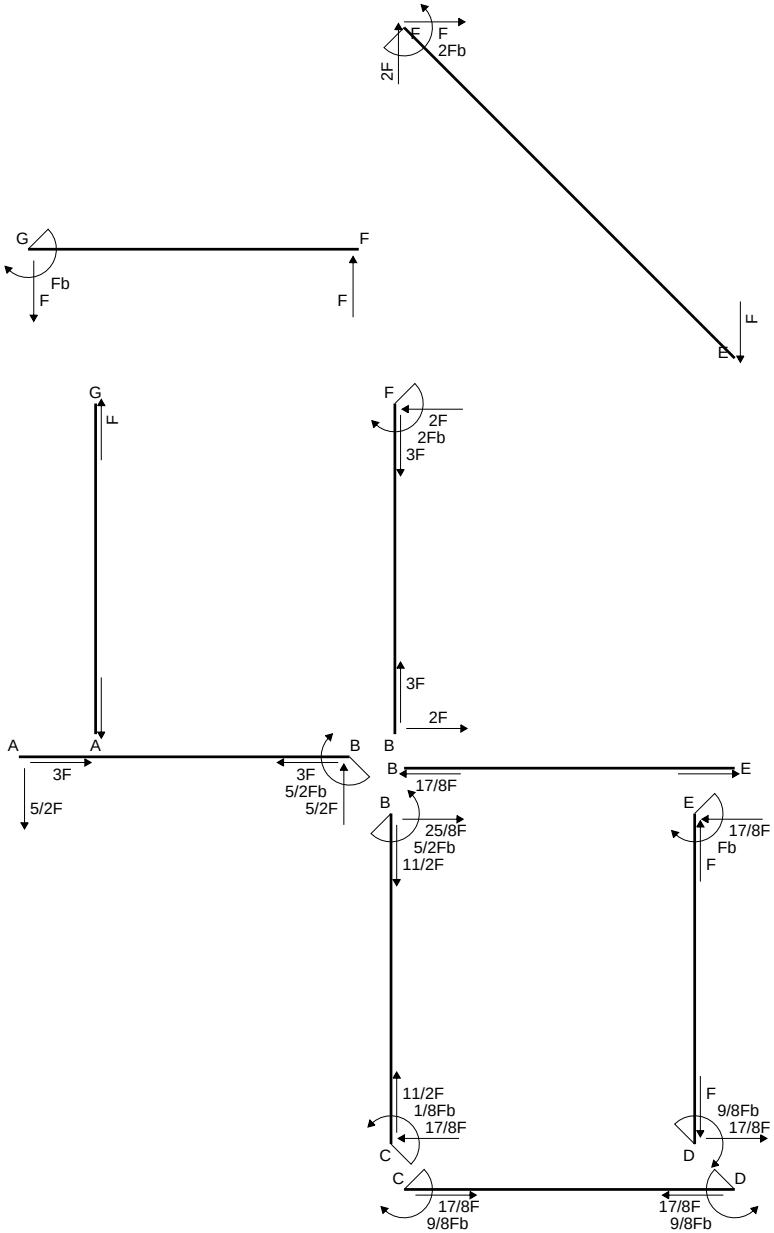
$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

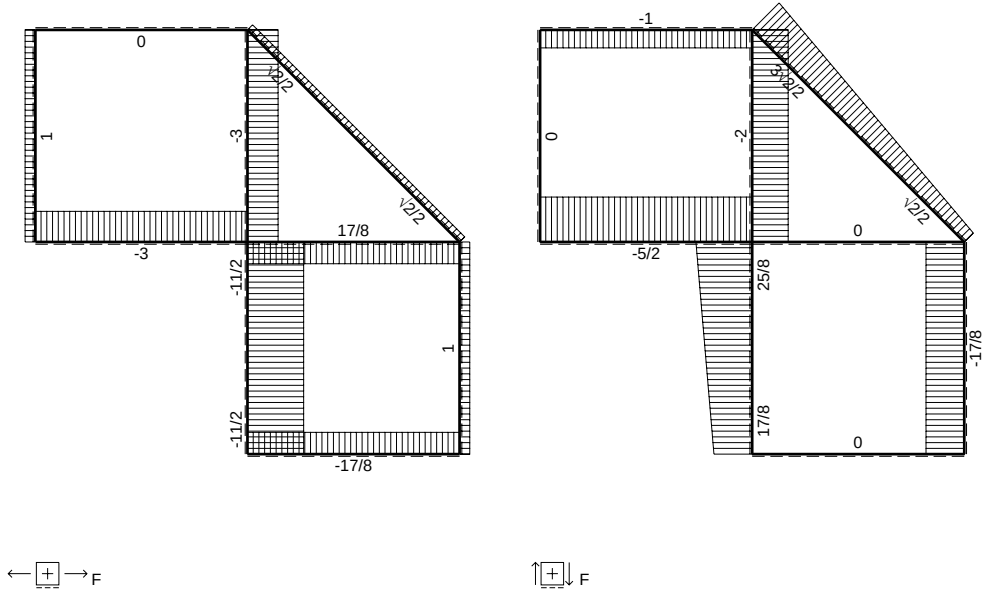


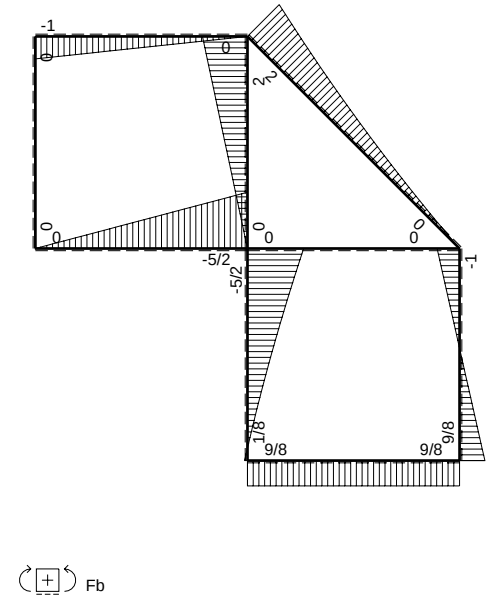
A = 142. mm^2
J_u = 33538. mm^4
J_v = 9072. mm^4
J_t = 128. mm^4
y_o = -6.643 mm
y_g = 14.41 mm
N = -760. N
T_y = -950. N
M_x = -418000. Nmm
x_m = 6. mm
y_m = 34. mm
u_m = -12. mm
v_m = 19.59 mm
$\sigma_m = N/A - Mv/J_u$ = 238.8 N/mm^2
x_c = 18. mm
y_c = 34. mm
v_c = 19.59 mm
$\sigma_c = N/A - Mv/J_u$ = 238.8 N/mm^2
$\tau_c = TS^*/tJ_u$ = 23.97 N/mm^2
$\tau_g = TS^*/tJ_u$ = 23.97 N/mm^2
t_c = 380. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 242.3 N/mm^2

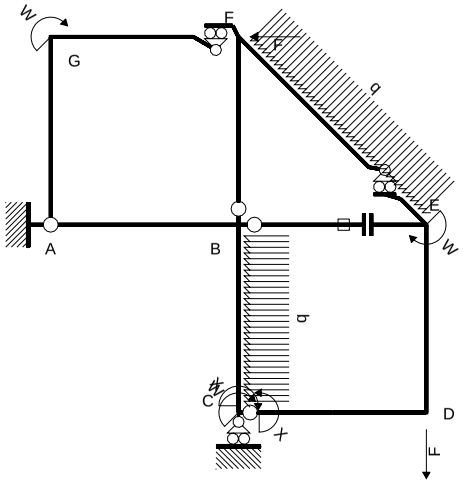
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@ Adolfo Zavelani Rossi, Politecnico di Milano, vers.27.03.13 16.04.26

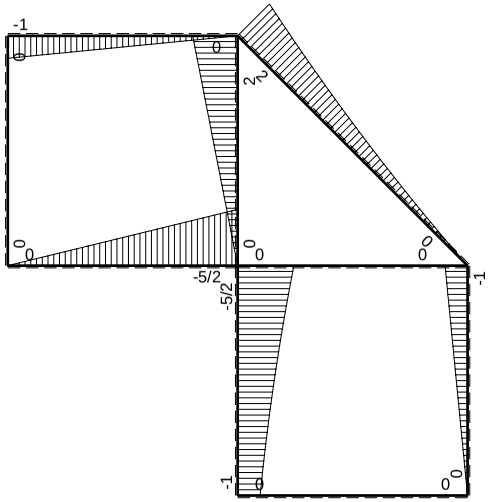

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C
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17/8F
9/8Fb


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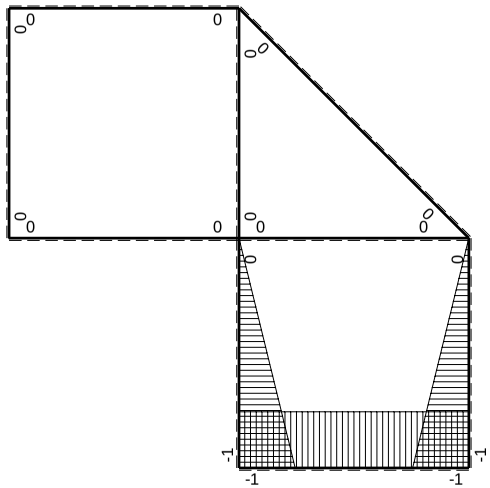

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1/2
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0
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-5/2
-5/2
-1
1/8
9/8
9/8
9/8
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0		
BC b	-x/b	$-5/2Fb+2Fx-1/2qx^2$	$5/2Fx-2Fx^2/b+1/2qx^3/b$	x^2/b^2	$17/24Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	$Fb+Fx+1/2qx^2$	$Fb-1/2Fx^2/b-1/2qx^3/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	1/3Xb/EJ
ED b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2		
EF √2b	0	$\sqrt{2}/2Fx+1/2qx^2$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$15/8Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-9/8Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -2\ x^2/b^2 +1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -2/3\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -2/3\ b +1/8\ b\ )\ Fb\ 1/EJ\ = 17/24\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x^2/b^2 -1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [\ x -1/6\ x^3/b^2 -1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/6\ b -1/8\ b\ )\ Fb\ 1/EJ\ = 17/24\ Fb^2/EJ$

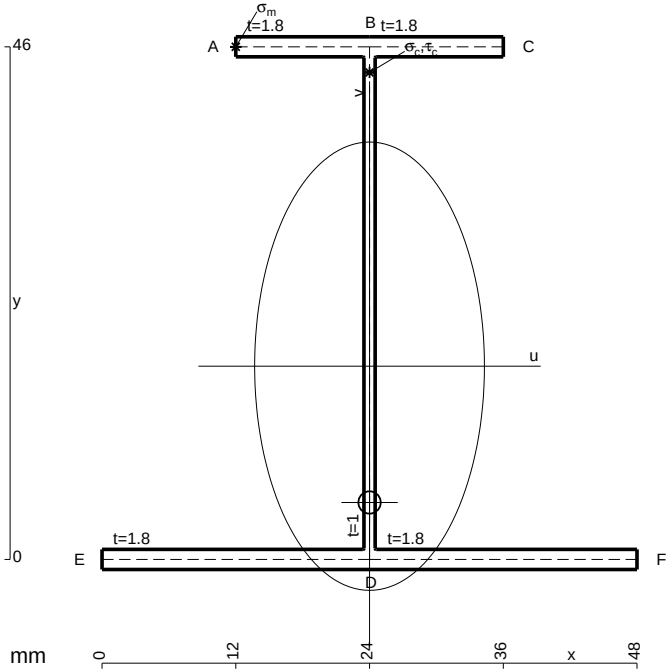
$L^{Xo}_{DE} = \int_o^b (\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

PROCEDIMENTO E RISULTATI 264038 CI02.xxxx.095

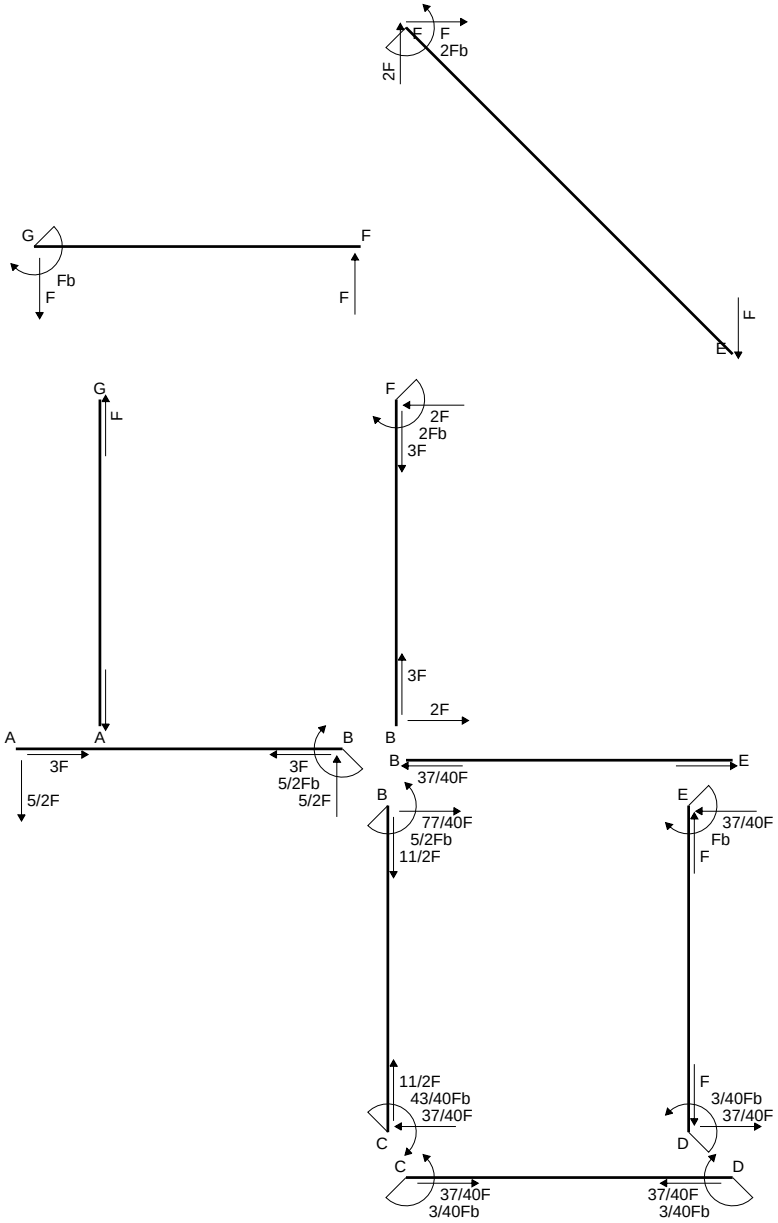


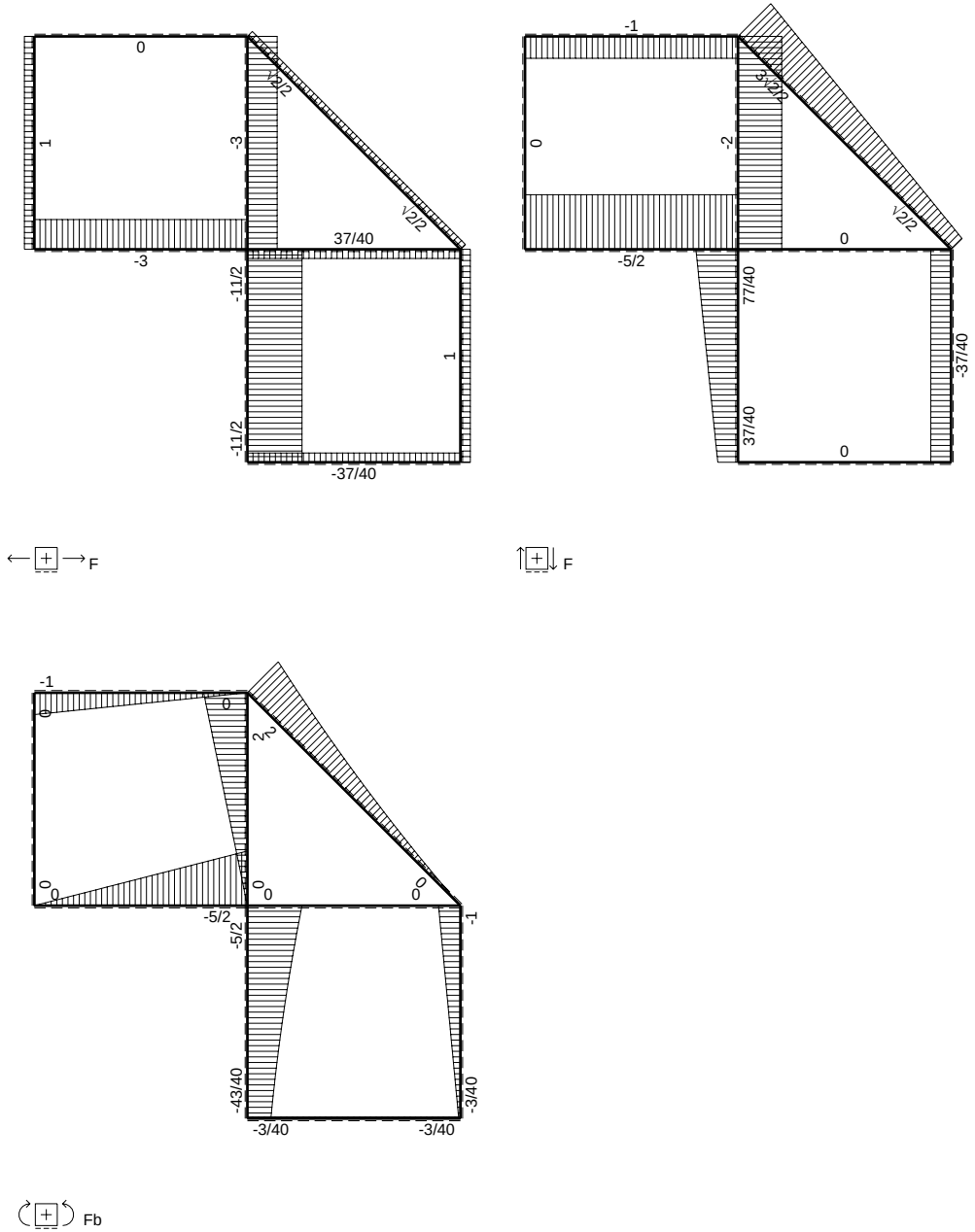
A = 175.6 mm^2
J_u = 71048. mm^4
J_v = 18662. mm^4
J_t = 155.3 mm^4
y_o = -12.23 mm
y_g = 17.34 mm
N = -930. N
T_y = -775. N
M_x = -496000. Nmm
x_m = 12. mm
y_m = 46. mm
u_m = -12. mm
v_m = 28.66 mm
$\sigma_m = N/A - Mv/J_u$ = 194.8 N/mm^2
x_c = 24. mm
y_c = 46. mm
v_c = 28.66 mm
$\sigma_c = N/A - Mv/J_u$ = 194.8 N/mm^2
$\tau_c = TS^*/tJ_u$ = 13.5 N/mm^2
$\tau_g = TS^*/tJ_u$ = 13.5 N/mm^2
t_c = 310. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 196.2 N/mm^2

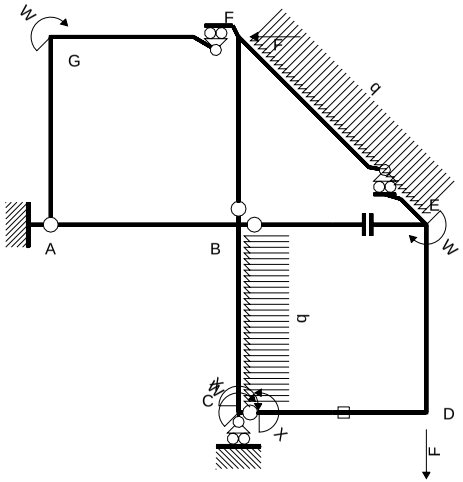
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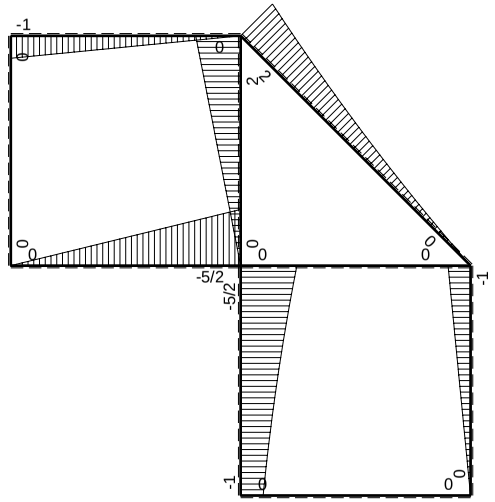
@ Adolfo Zavelani Rossi, Politecnico di Milano, vers.27.03.13 16.04.26


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3F
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A
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3F
5/2Fb
5/2F
5/2F
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B
77/40F
5/2Fb
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43/40Fb
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3/40Fb
37/40F
3/40Fb

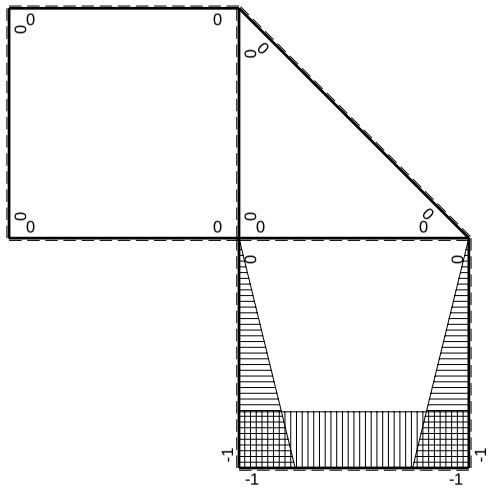

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-11/2
-37/40
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√2/2
-5/2
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77/40
37/40
-37/40
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√2/2
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0
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0
-5/2
-5/2
-1
-43/40
-3/40
-3/40
-3/40
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0		
BC b	-x/b	$-5/2Fb+2Fx-1/2qx^2$	$5/2Fx-2Fx^2/b+1/2qx^3/b$	x^2/b^2	$17/24Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	$Fb+Fx+1/2qx^2$	$Fb-1/2Fx^2/b-1/2qx^3/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	1/3Xb/EJ
ED b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx+1/2qx^2$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/8Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				3/40Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -2\ x^2/b^2 +1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -2/3\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -2/3\ b +1/8\ b\ )\ Fb\ 1/EJ\ = 17/24\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x^2/b^2 -1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [\ x -1/6\ x^3/b^2 -1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

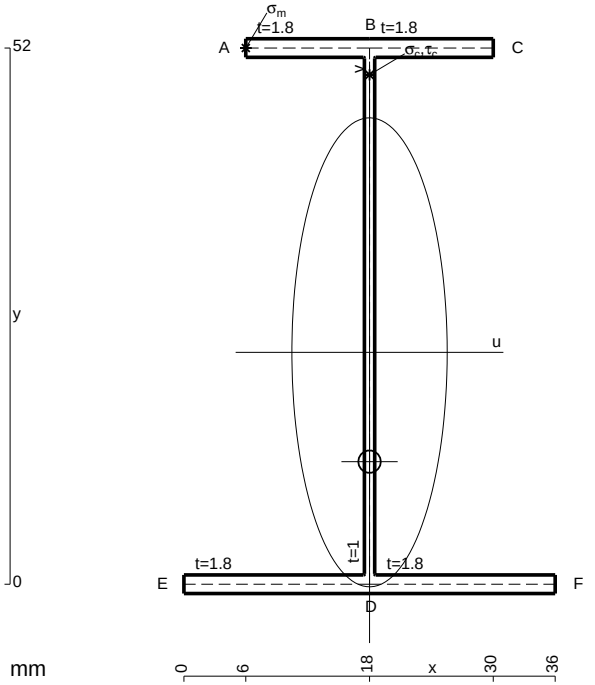
$= (\ b -1/6\ b -1/8\ b\ )\ Fb\ 1/EJ\ = 17/24\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

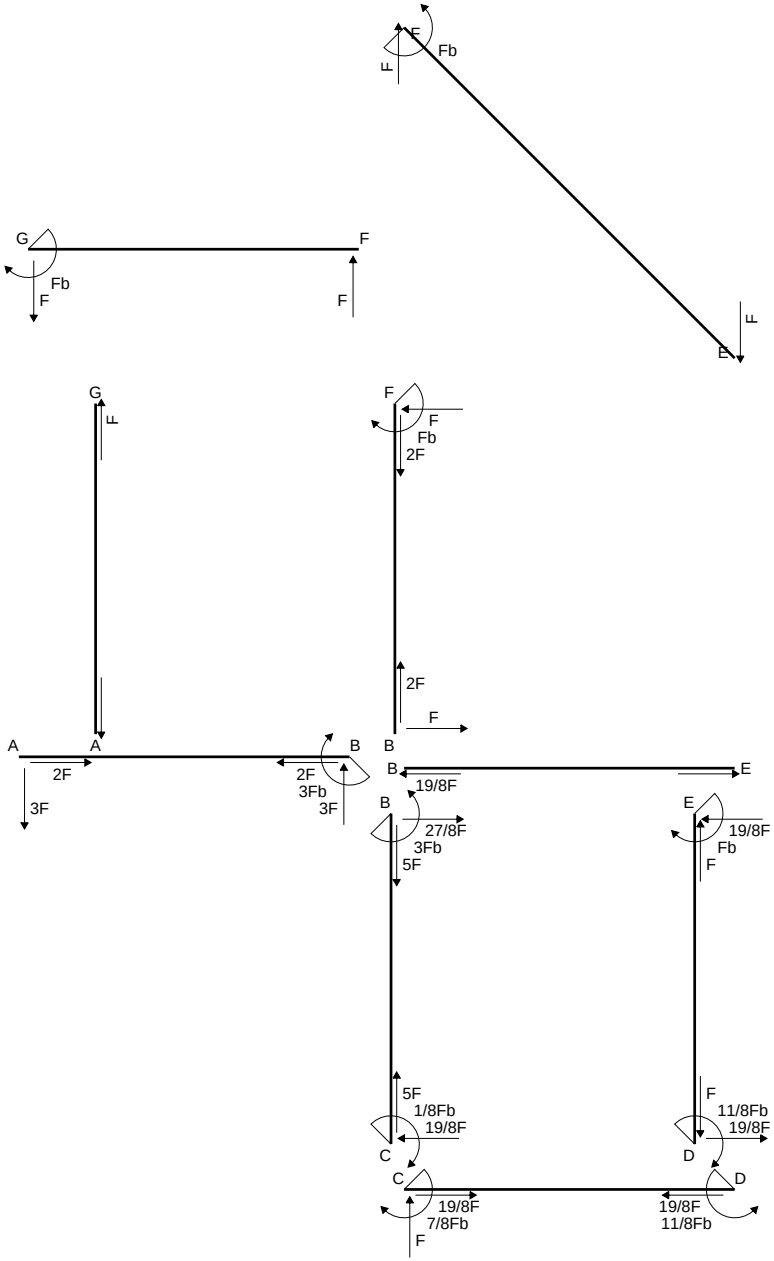
$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

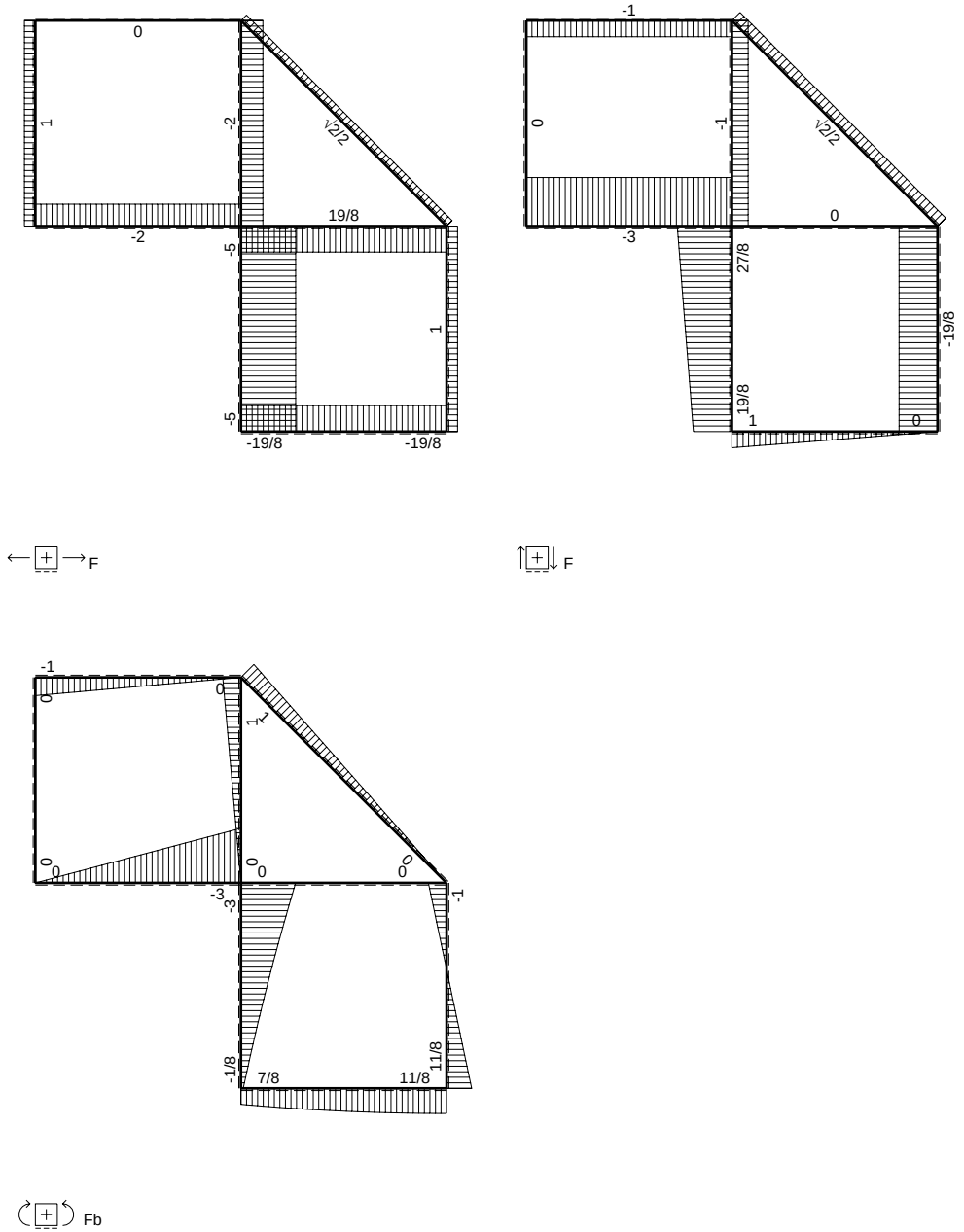


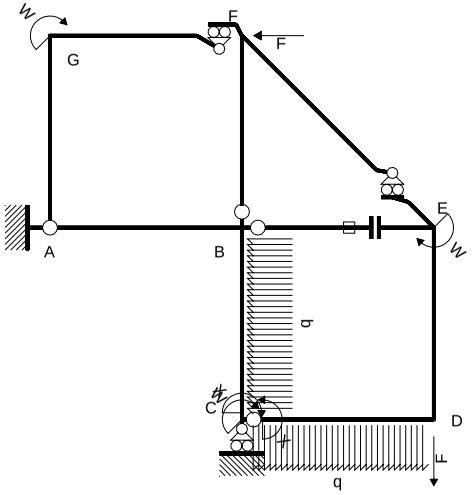
A = 160. mm^2
J_u = 82754. mm^4
J_v = 9072. mm^4
J_t = 134. mm^4
y_o = -10.6 mm
y_g = 22.49 mm
N = -930. N
T_y = -775. N
M_x = -604500. Nmm
x_m = 6. mm
y_m = 52. mm
u_m = -12. mm
v_m = 29.51 mm
$\sigma_m = N/A - Mv/J_u$ = 209.8 N/mm^2
x_c = 18. mm
y_c = 52. mm
v_c = 29.51 mm
$\sigma_c = N/A - Mv/J_u$ = 209.8 N/mm^2
$\tau_c = TS^*/tJ_u$ = 11.94 N/mm^2
$\tau_g = TS^*/tJ_u$ = 11.94 N/mm^2
t_c = 310. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 210.8 N/mm^2

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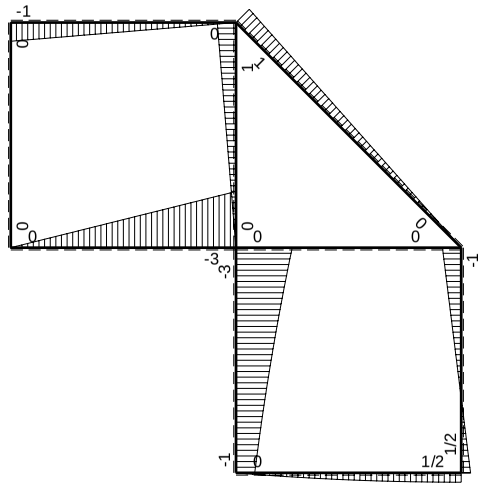
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F
Fb
2F
2F
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A
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3F
2F
3Fb
3F
B
E
19/8F
B
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3Fb
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E
19/8F
Fb
F
5F
1/8Fb
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7/8Fb
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11/8Fb

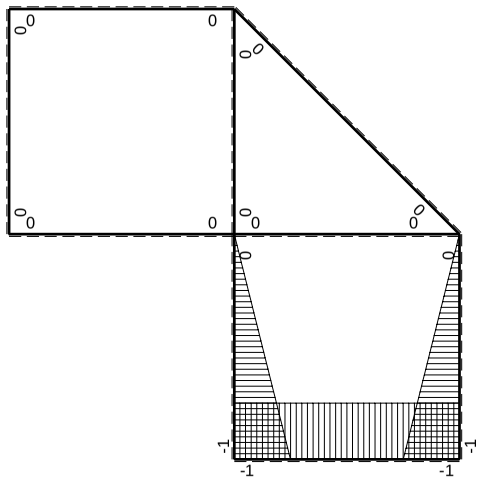

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-2
√2/2
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1
-5
-19/8
-19/8
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-1
0
-1
√2/2
0
-3
27/8
-19/8
19/8
1
0
F
-1
0
0
1
-1
0
0
0
0
0
-3
-3
-1
-1/8
7/8
11/8
11/8
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3Fx	0	0	0	0
BA b	0	3Fb-3Fx	0	0		
BC b	-x/b	$-3Fb+5/2Fx-1/2qx^2$	$3Fx-5/2Fx^2/b+1/2qx^3/b$	x^2/b^2	$19/24Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	$Fb+3/2Fx+1/2qx^2$	$Fb+1/2Fx-Fx^2/b-1/2qx^3/b$	$1-2x/b+x^2/b^2$		
CD b	-1	$Fx-1/2qx^2$	$-Fx+1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fb+1/2qx^2$	$-1/2Fb+1/2Fx^2/b$	1		
DE b	-1+x/b	1/2Fb-3/2Fx	$-1/2Fb+2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	0	1/3Xb/EJ
ED b	x/b	Fb-3/2Fx	$Fx-3/2Fx^2/b$	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$35/24Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-7/8Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3\ x/b -5/2\ x^2/b^2 +1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [3/2\ x^2/b -5/6\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (3/2\ b -5/6\ b +1/8\ b\ )\ Fb\ 1/EJ\ = 19/24\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 +1/2\ x/b - x^2/b^2 -1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [\ x +1/4\ x^2/b -1/3\ x^3/b^2 -1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (\ b +1/4\ b -1/3\ b -1/8\ b\ )\ Fb\ 1/EJ\ = 19/24\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/3\ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2 +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/2\ x +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

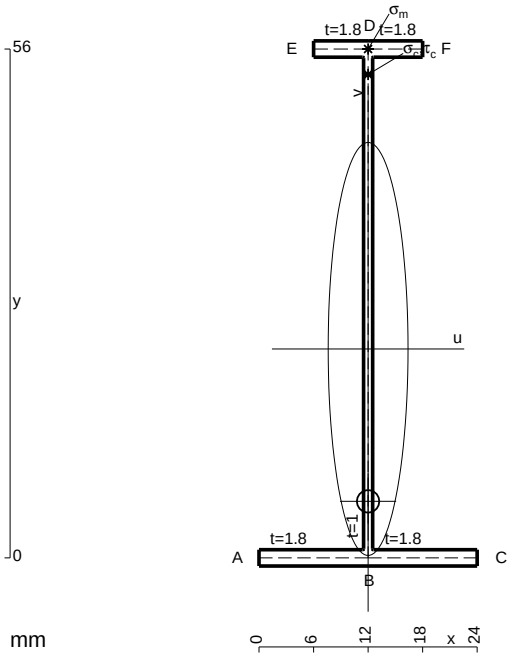
$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/3\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (-1/2 +2\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/2\ x + x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b + b -1/2\ b\ )\ Fb\ 1/EJ\ = 0$

$L^{Xo}_{ED} = \int_o^b (\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

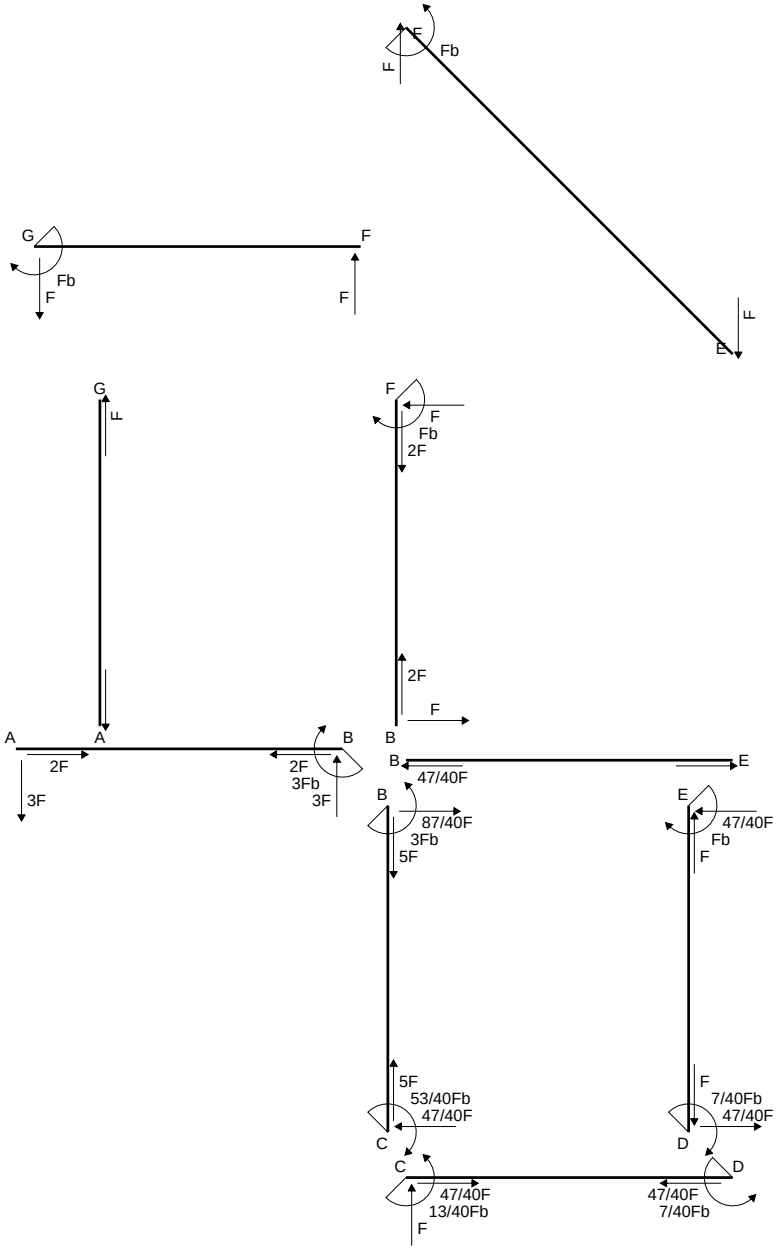
$= (1/2\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 0$

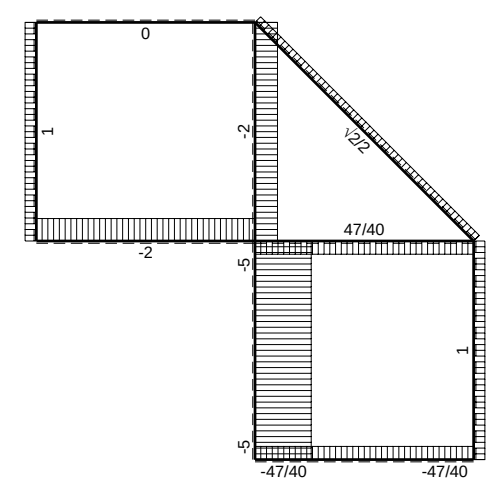


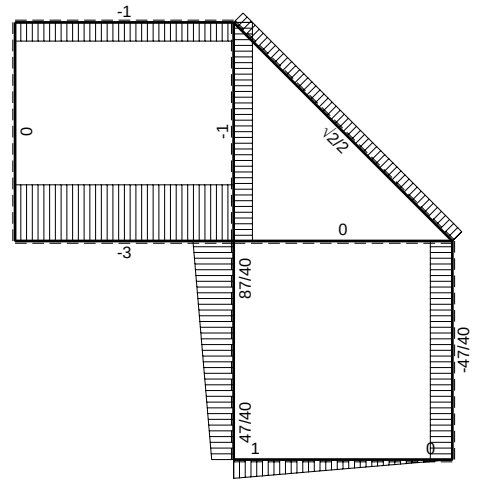
A = 120.8 mm^2
J_u = 62410. mm^4
J_v = 2333. mm^4
J_t = 88.65 mm^4
y_o = -16.77 mm
y_g = 22.99 mm
N = -300. N
T_y = -450. N
M_x = -405000. Nmm
x_m = 12. mm
y_m = 56. mm
v_m = 33.01 mm
$\sigma_m = N/A - Mv/J_u$ = 211.7 N/mm^2
y_c = 2. mm
u_c = -12. mm
v_c = -20.99 mm
$\sigma_c = N/A - Mv/J_u$ = 211.7 N/mm^2
$\tau_c = TS^*/tJ_u$ = 5.141 N/mm^2
$\tau_g = TS^*/tJ_u$ = 5.141 N/mm^2
t_c = 150. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 211.9 N/mm^2

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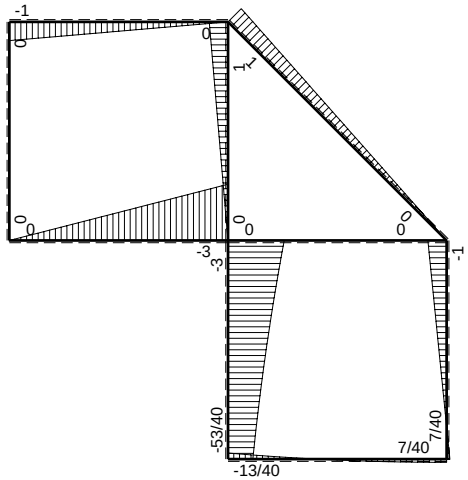

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F
7/40Fb
47/40F
D
D
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-47/40
-47/40

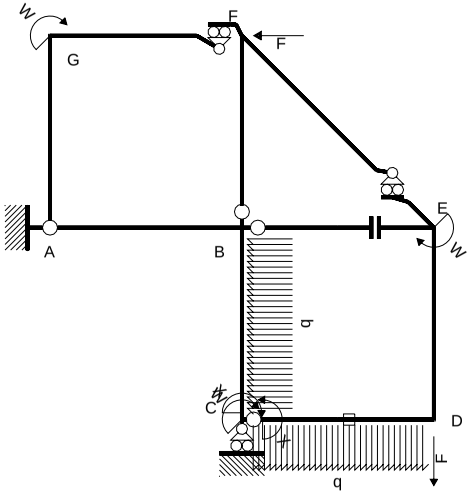

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87/40
-47/40
47/40
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←⊞→ F

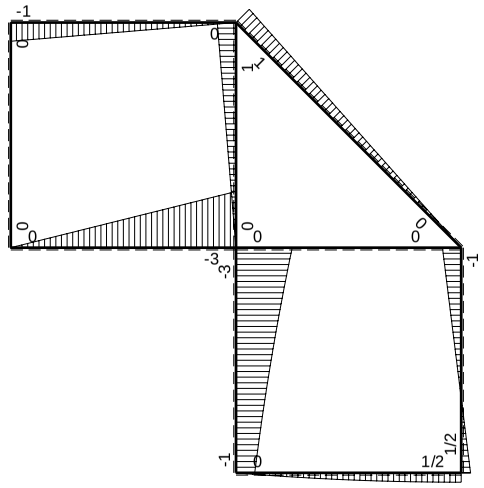
↑⊞↓ F


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7/40
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-13/40

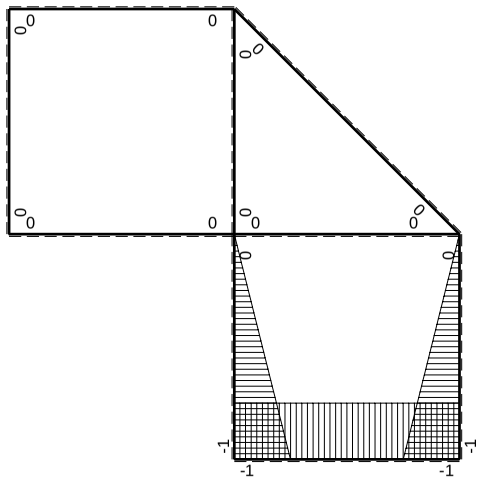
↻⊞↺ Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3Fx	0	0	0	0
BA b	0	3Fb-3Fx	0	0		
BC b	-x/b	$-3Fb+5/2Fx-1/2qx^2$	$3Fx-5/2Fx^2/b+1/2qx^3/b$	x^2/b^2	$19/24Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	$Fb+3/2Fx+1/2qx^2$	$Fb+1/2Fx-Fx^2/b-1/2qx^3/b$	$1-2x/b+x^2/b^2$		
CD b	-1	$Fx-1/2qx^2$	$-Fx+1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fb+1/2qx^2$	$-1/2Fb+1/2Fx^2/b$	1		
DE b	-1+x/b	1/2Fb-3/2Fx	$-1/2Fb+2Fx-3/2Fx^2/b$	$1-2x/b+x^2/b^2$	0	1/3Xb/EJ
ED b	x/b	Fb-3/2Fx	$Fx-3/2Fx^2/b$	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-13/24Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				13/40Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2\ )\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3\ x/b -5/2\ x^2/b^2 +1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [3/2\ x^2/b -5/6\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (3/2\ b -5/6\ b +1/8\ b\ )\ Fb\ 1/EJ\ = 19/24\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 +1/2\ x/b - x^2/b^2 -1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [\ x +1/4\ x^2/b -1/3\ x^3/b^2 -1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (\ b +1/4\ b -1/3\ b -1/8\ b\ )\ Fb\ 1/EJ\ = 19/24\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -4/3\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2 +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/2\ x +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

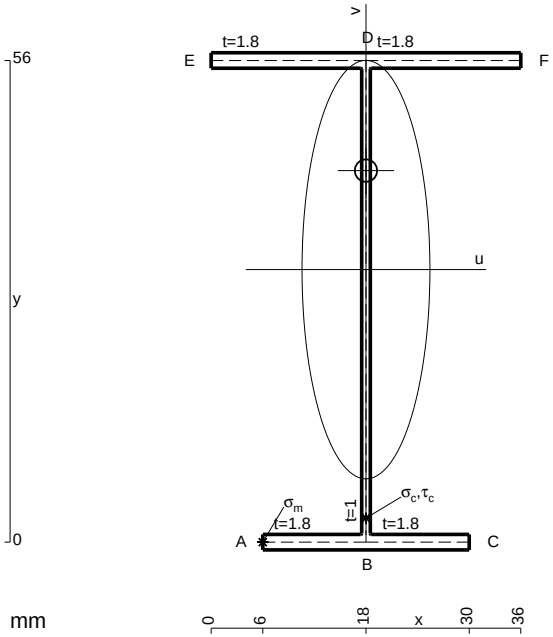
$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -4/3\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (-1/2 +2\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/2\ x + x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b + b -1/2\ b\ )\ Fb\ 1/EJ\ = 0$

$L^{Xo}_{ED} = \int_o^b (\ x/b -3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

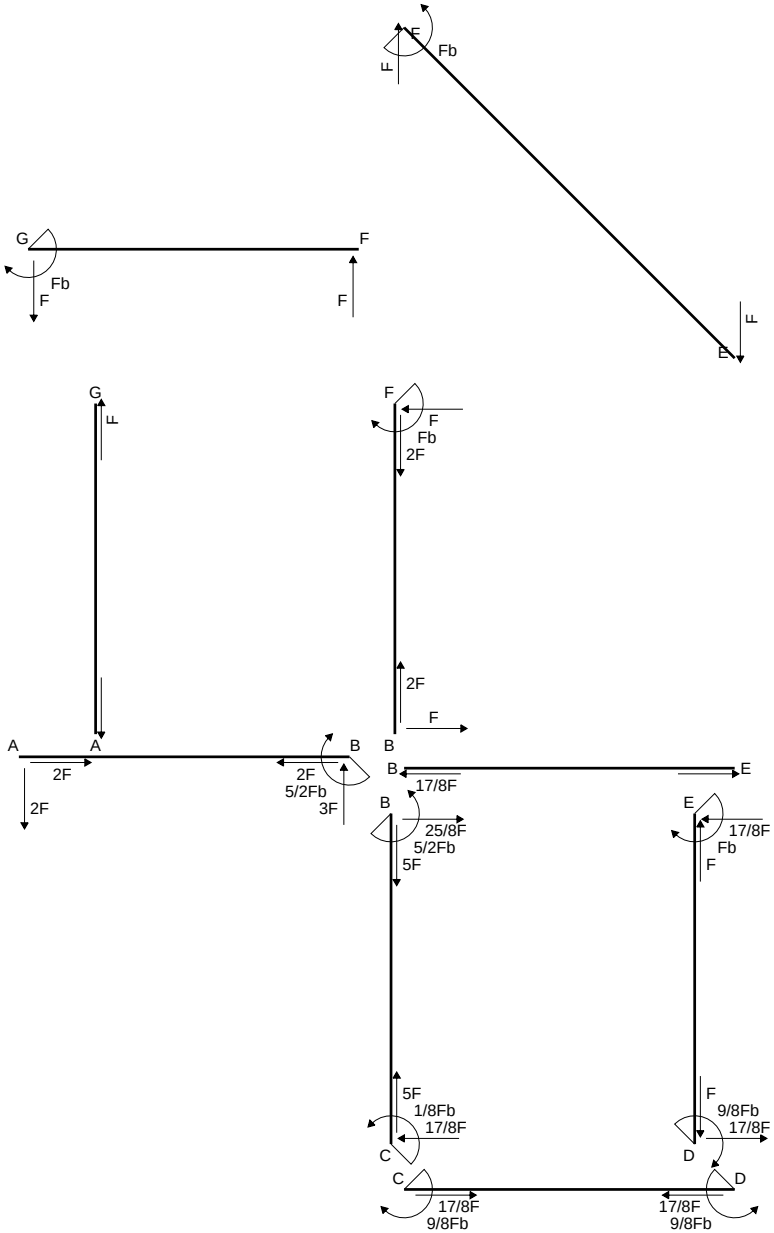
$= (1/2\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 0$

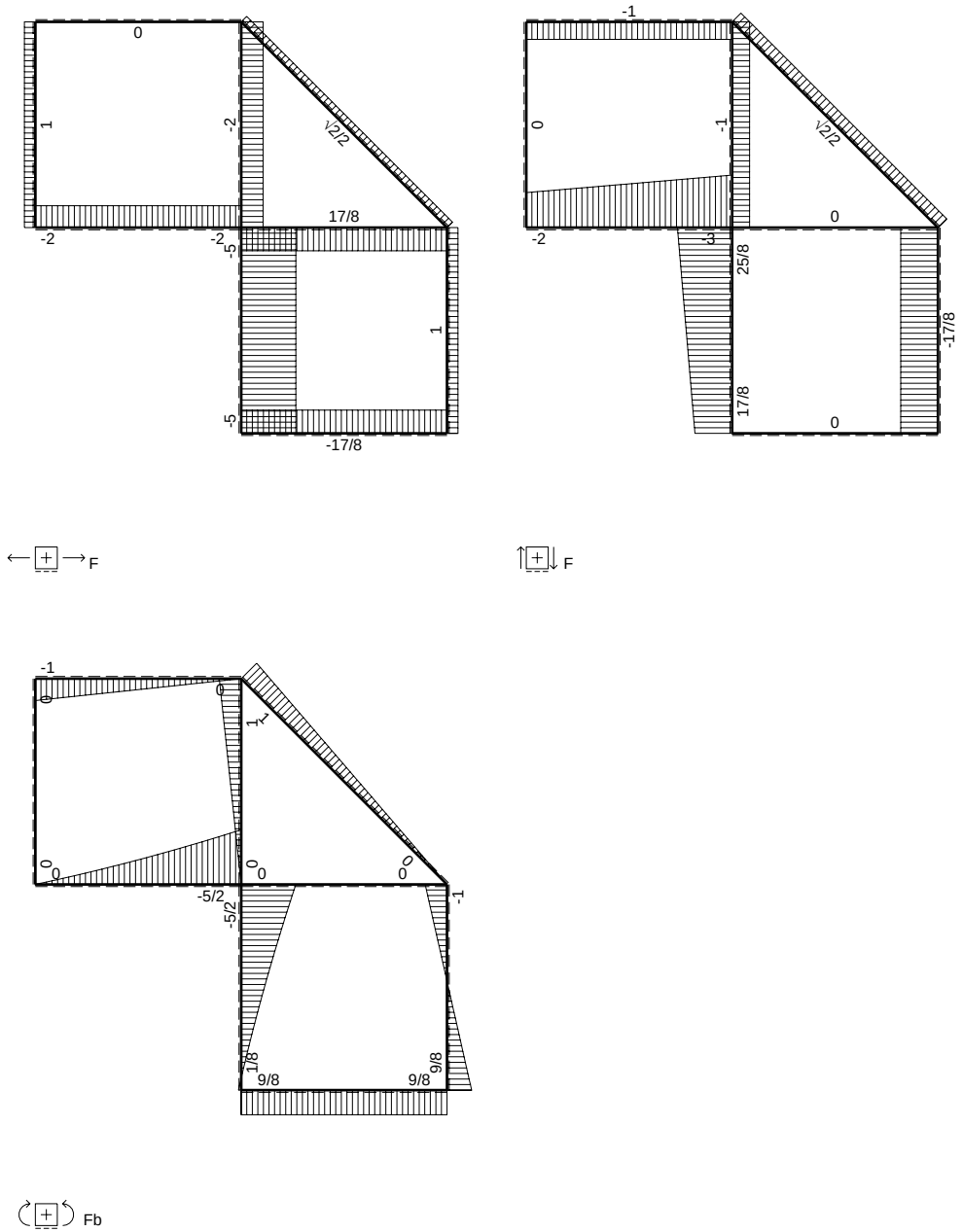


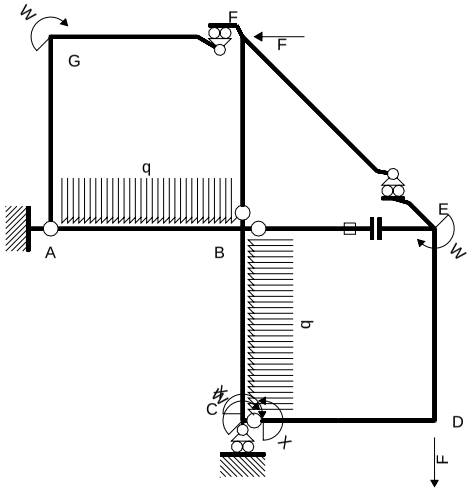
A = 164. mm^2
J_u = 97076. mm^4
J_v = 9072. mm^4
J_t = 135.3 mm^4
y_o = 11.51 mm
y_g = 31.69 mm
N = -480. N
T_y = -720. N
M_x = -684000. Nmm
x_m = 6. mm
u_m = -12. mm
v_m = -31.69 mm
$\sigma_m = N/A - Mv/J_u$ = -226.2 N/mm^2
x_c = 18. mm
v_c = -31.69 mm
$\sigma_c = N/A - Mv/J_u$ = -226.2 N/mm^2
$\tau_c = TS^*/tJ_u$ = 10.15 N/mm^2
$\tau_g = TS^*/tJ_u$ = 10.15 N/mm^2
t_c = 240. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 226.9 N/mm^2

CI02.xxxx.098

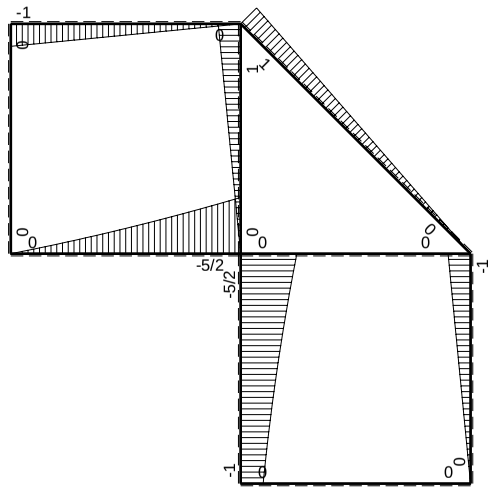
@ Adolfo Zavelani Rossi, Politecnico di Milano, vers.27.03.13 16.04.26


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F
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2F
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5/2Fb
3F
B
E
17/8F
B
25/8F
5/2Fb
5F
E
17/8F
Fb
F
5F
1/8Fb
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9/8Fb
17/8F
9/8Fb

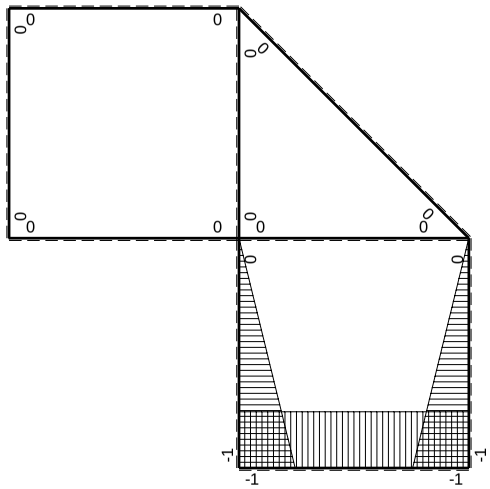

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√2/2
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-17/8
F
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3
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25/8
-17/8
17/8
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F
-1
0
1
0
0
0
0
0
-5/2
-5/2
-1
1/8
9/8
9/8
9/8
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-2Fx-1/2qx^2$	0	0	0	0
BA b	0	$5/2Fb-3Fx+1/2qx^2$	0	0		
BC b	-x/b	$-5/2Fb+2Fx-1/2qx^2$	$5/2Fx-2Fx^2/b+1/2qx^3/b$	x^2/b^2	$17/24Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	$Fb+Fx+1/2qx^2$	$Fb-1/2Fx^2/b-1/2qx^3/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	1/3Xb/EJ
ED b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$15/8Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-9/8Fb	

Sviluppi di calcolo iperstatica

PROCEDIMENTO E RISULTATI 264047 CI02.xxxx.099

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$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -2\ x^2/b^2 +1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -2/3\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -2/3\ b +1/8\ b\ )\ Fb\ 1/EJ\ = 17/24\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x^2/b^2 -1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [\ x -1/6\ x^3/b^2 -1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

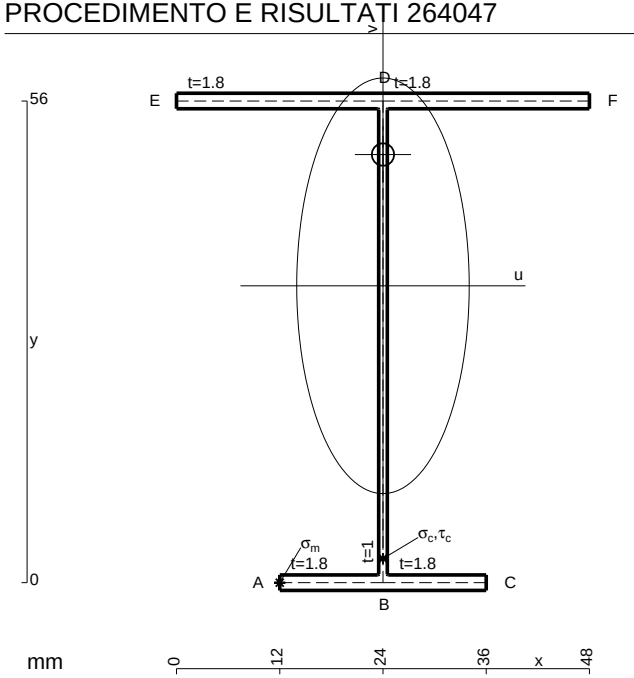
$= (\ b -1/6\ b -1/8\ b\ )\ Fb\ 1/EJ\ = 17/24\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

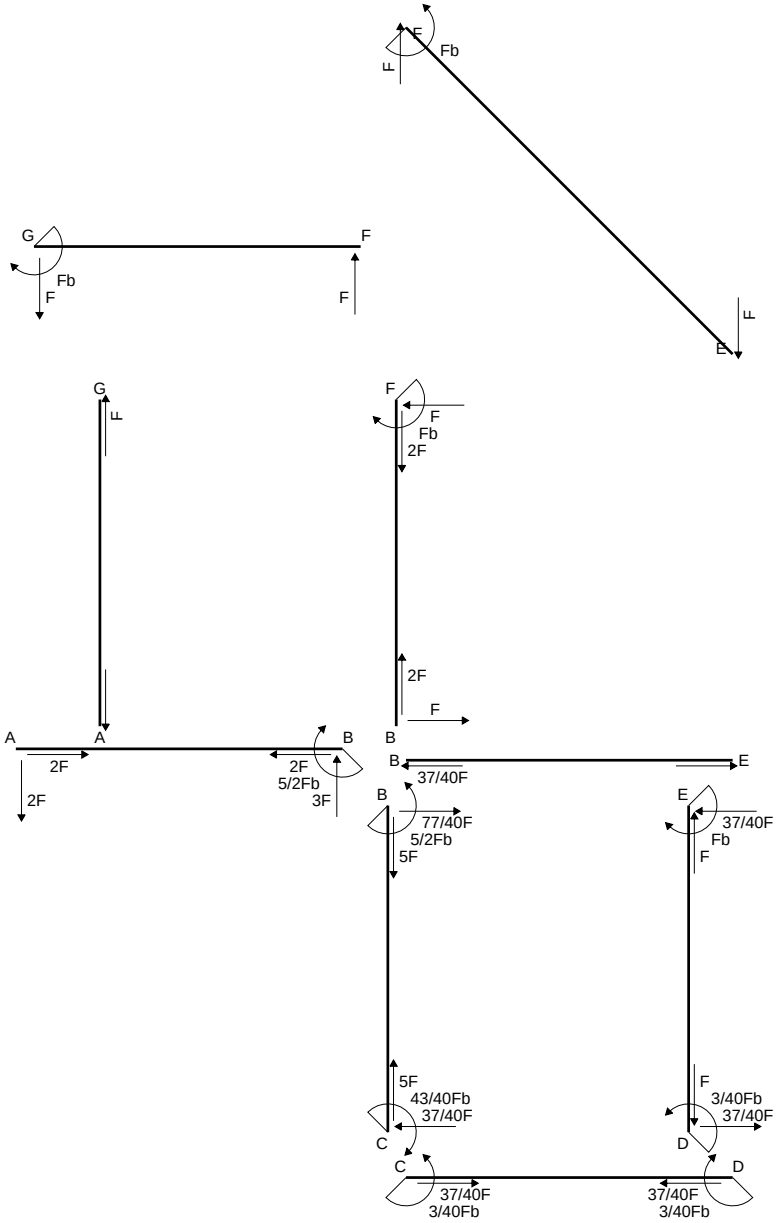
$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

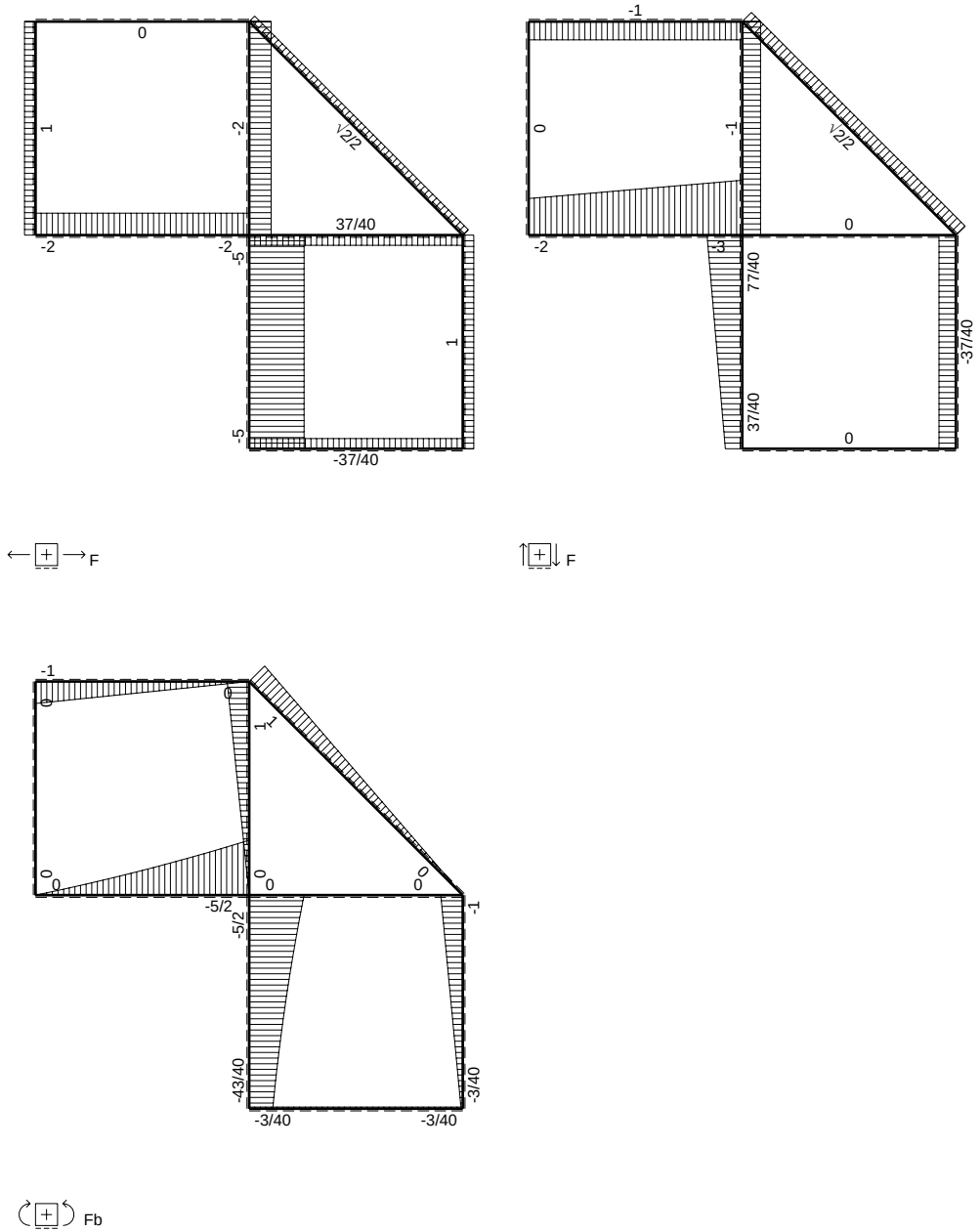


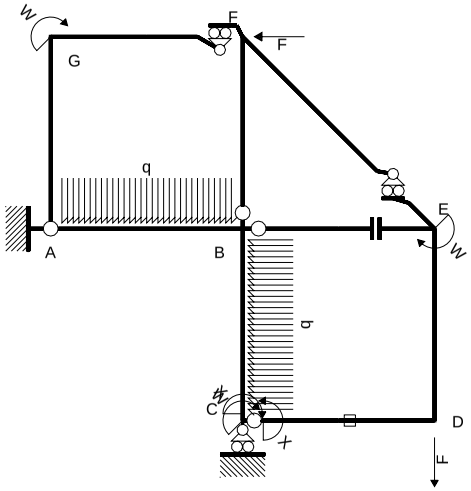
A = 185.6 mm^2
J_u = 108358. mm^4
J_v = 18662. mm^4
J_t = 158.6 mm^4
y_o = 15.26 mm
y_g = 34.52 mm
N = -580. N
T_y = -870. N
M_x = -725000. Nmm
x_m = 12. mm
u_m = -12. mm
v_m = -34.52 mm
$\sigma_m = N/A - Mv/J_u$ = -234.1 N/mm^2
x_c = 24. mm
v_c = -34.52 mm
$\sigma_c = N/A - Mv/J_u$ = -234.1 N/mm^2
$\tau_c = TS^*/tJ_u$ = 11.97 N/mm^2
$\tau_g = TS^*/tJ_u$ = 11.97 N/mm^2
t_c = 290. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 235. N/mm^2

CI02.xxxx.099

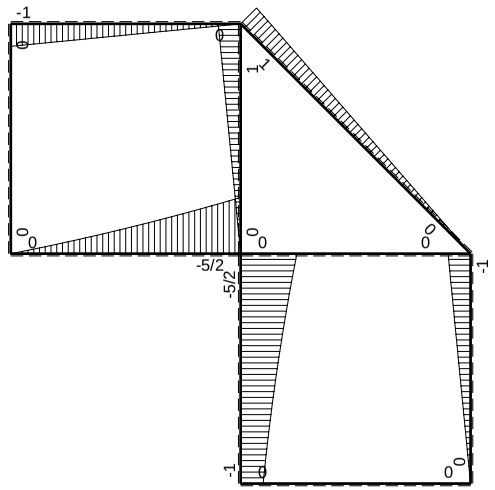
@ Adolfo Zavelani Rossi, Politecnico di Milano, vers.27.03.13 16.04.26


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3/40Fb

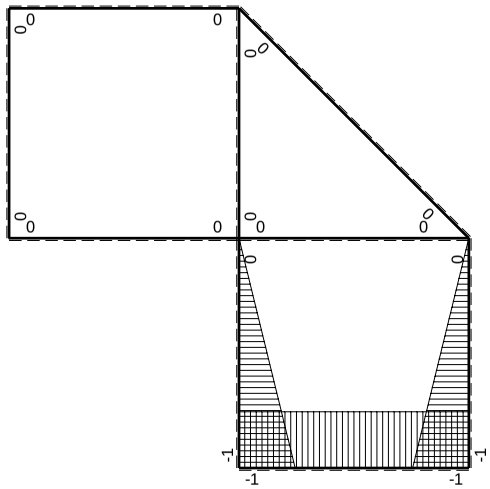

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√2/2
-2
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77/40
37/40
-37/40
0
F
-1
0
0
1
1
0
0
0
0
0
-5/2
-5/2
-1
-43/40
-3/40
-3/40
-3/40
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-2Fx-1/2qx^2$	0	0	0	0
BA b	0	$5/2Fb-3Fx+1/2qx^2$	0	0		
BC b	-x/b	$-5/2Fb+2Fx-1/2qx^2$	$5/2Fx-2Fx^2/b+1/2qx^3/b$	x^2/b^2	$17/24Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	$Fb+Fx+1/2qx^2$	$Fb-1/2Fx^2/b-1/2qx^3/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	1/3Xb/EJ
ED b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/8Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				3/40Fb	

Sviluppi di calcolo iperstatica

PROCEDIMENTO E RISULTATI 248062 CI02.xxxx.100

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$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -2\ x^2/b^2 +1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -2/3\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -2/3\ b +1/8\ b\ )\ Fb\ 1/EJ\ = 17/24\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x^2/b^2 -1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [\ x -1/6\ x^3/b^2 -1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

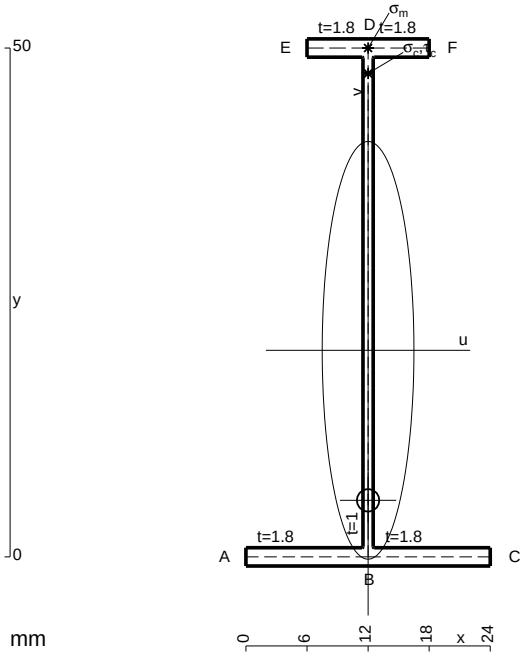
$= (\ b -1/6\ b -1/8\ b\ )\ Fb\ 1/EJ\ = 17/24\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

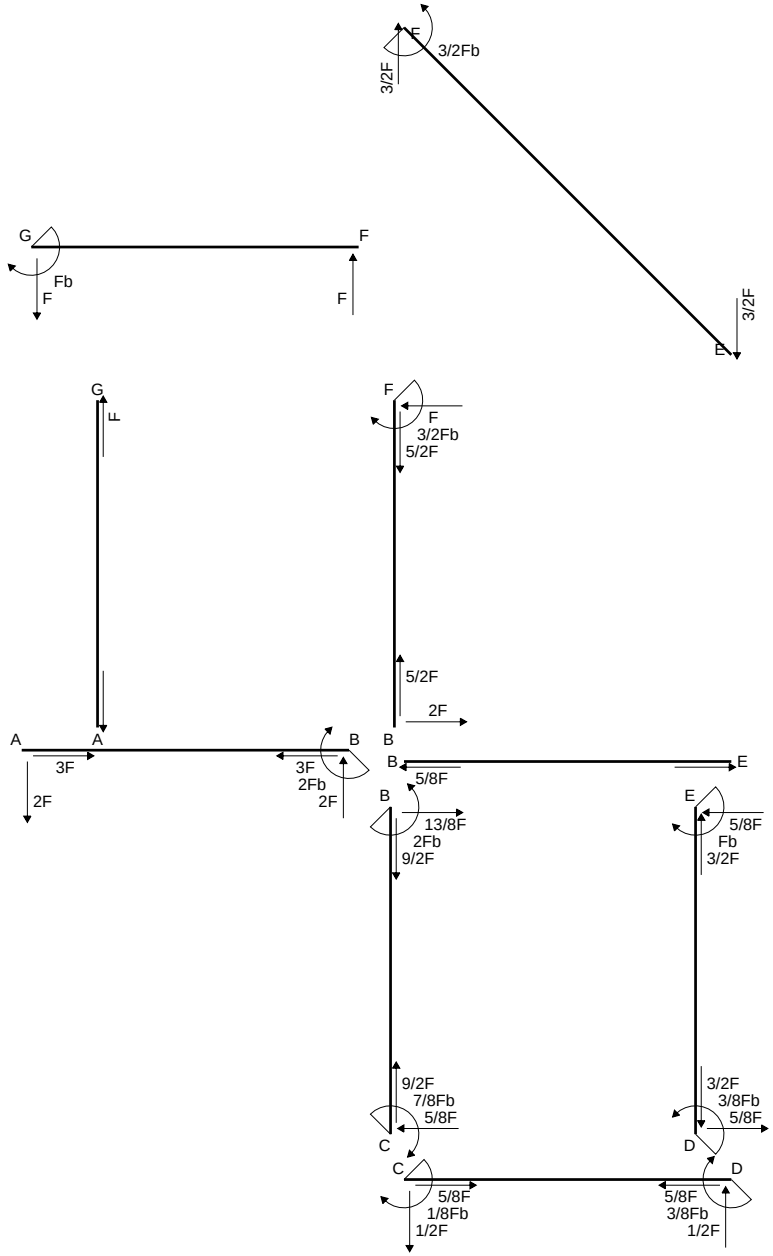
$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

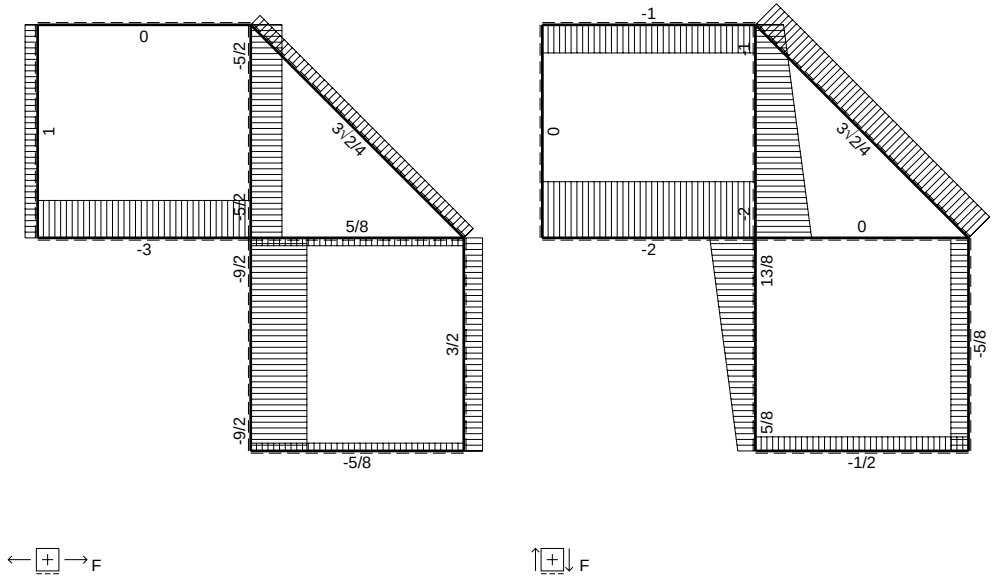


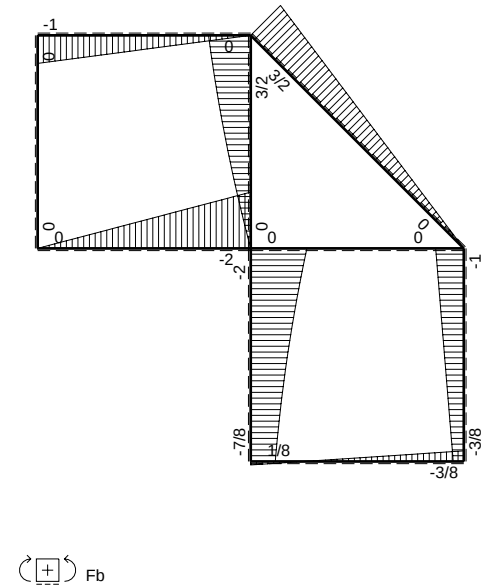
A = 114.8 mm^2
J_u = 48377. mm^4
J_v = 2333. mm^4
J_t = 86.65 mm^4
y_o = -14.74 mm
y_g = 20.3 mm
N = -560. N
T_y = -840. N
M_x = -329000. Nmm
x_m = 12. mm
y_m = 50. mm
v_m = 29.7 mm
$\sigma_m = N/A - Mv/J_u$ = 197.1 N/mm^2
y_c = 2. mm
u_c = -12. mm
v_c = -18.3 mm
$\sigma_c = N/A - Mv/J_u$ = 197.1 N/mm^2
$\tau_c = TS^*/tJ_u$ = 11.14 N/mm^2
$\tau_g = TS^*/tJ_u$ = 11.14 N/mm^2
t_c = 280. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 198.1 N/mm^2

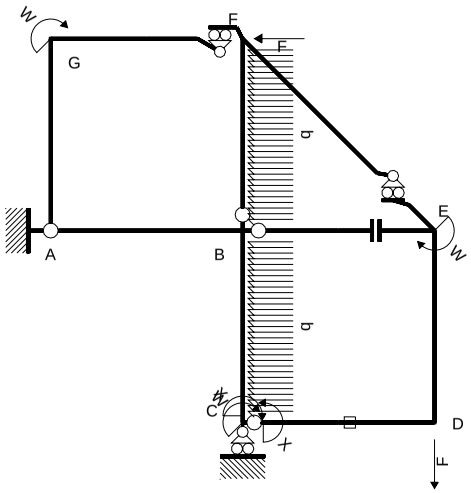
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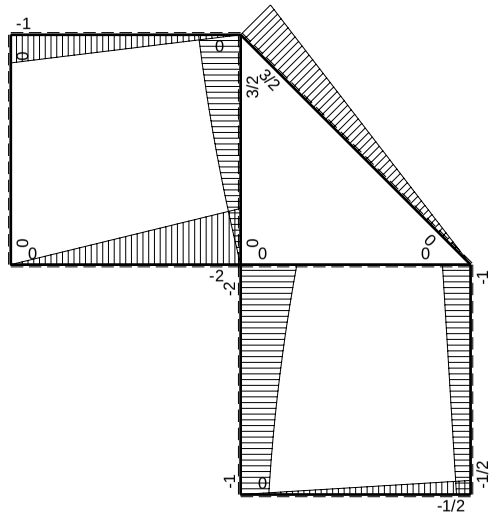

G
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3/2Fb
3/2F
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2F
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2F
3F
2Fb
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5/8F
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13/8F
2Fb
9/2F
E
5/8F
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3/2F
9/2F
7/8Fb
5/8F
C
3/2F
3/8Fb
5/8F
D
C
D
5/8F
1/8Fb
1/2F
5/8F
3/8Fb
1/2F


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3√2/4
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-5/8
3√2/4
F

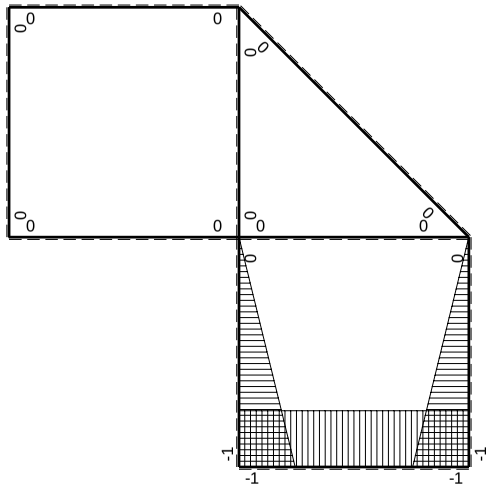

-1
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0
0
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-2
-2
-1
-7/8
1/8
-3/8
-3/8
3√2/2
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0		
BC b	-x/b	$-2Fb+3/2Fx-1/2qx^2$	$2Fx-3/2Fx^2/b+1/2qx^3/b$	x^2/b^2	$5/8Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	$Fb+1/2Fx+1/2qx^2$	$Fb-1/2Fx-1/2qx^3/b$	$1-2x/b+x^2/b^2$		
CD b	-1	-1/2Fx	1/2Fx	1	$1/4Fb^2/EJ$	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE b	-1+x/b	-1/2Fb-1/2Fx	$1/2Fb-1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/3Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	Fb-1/2Fx	$Fx-1/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	$3/2Fb-Fx-1/2qx^2$	0	0	0	0
BF b	0	$-2Fx+1/2qx^2$	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$5/24Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				-1/8Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2\ )\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (2\ x/b -3/2\ x^2/b^2 +1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [\ x^2/b -1/2\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/2\ b +1/8\ b\ )\ Fb\ 1/EJ\ = 5/8\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/4\ b -1/8\ b\ )\ Fb\ 1/EJ\ = 5/8\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (1/2\ x/b\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = [1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (1/4\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -3/4\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (1/2 -1/2\ x/b\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = [1/2\ x -1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/E$

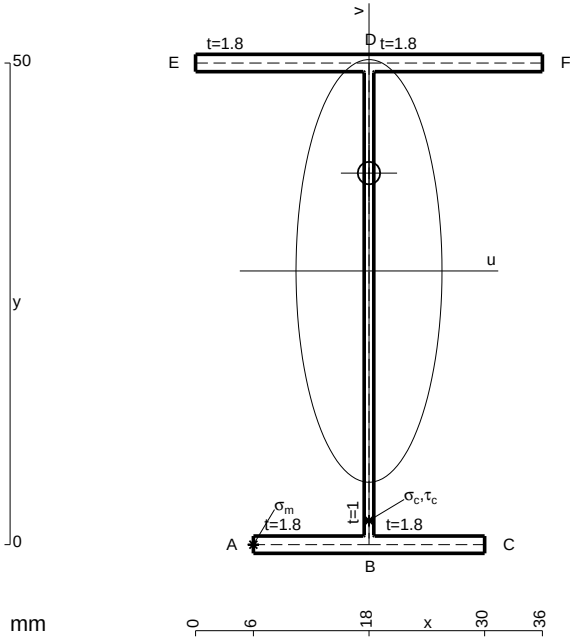
$= (1/2\ b -1/4\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -3/4\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2 -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/3\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (\ x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

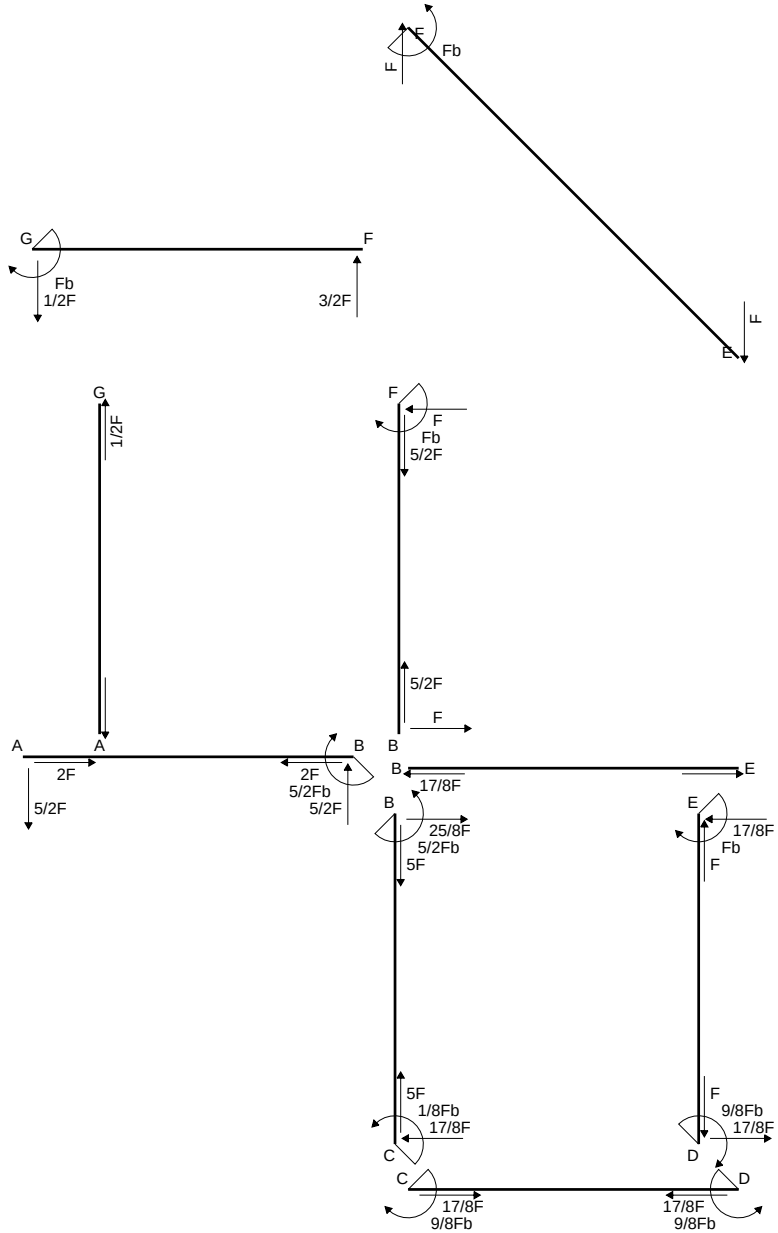
$= (1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/3\ \ Fb^2/EJ$

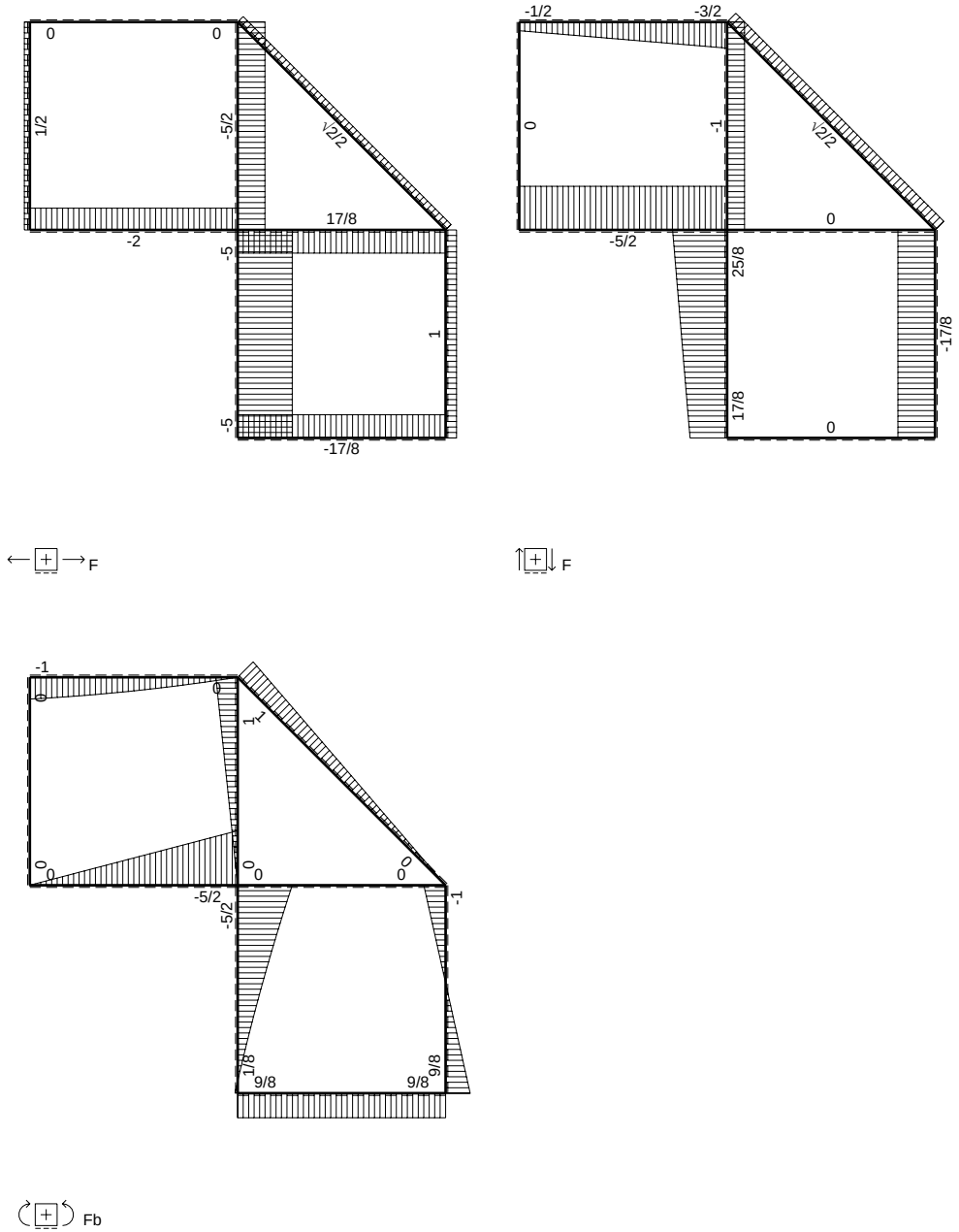


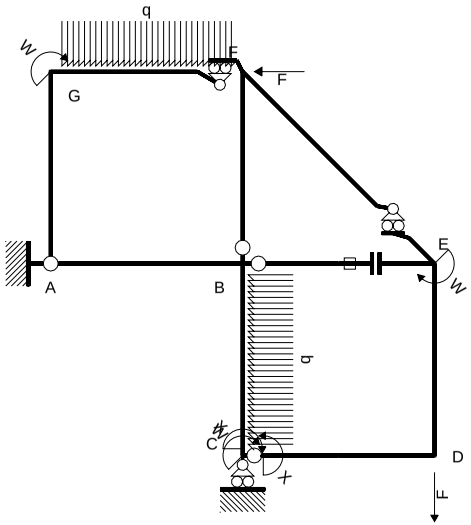
A = 158. mm^2
J_u = 76071. mm^4
J_v = 9072. mm^4
J_t = 133.3 mm^4
y_o = 10.15 mm
y_g = 28.42 mm
N = -1560. N
T_y = -1040. N
M_x = -530400. Nmm
x_m = 6. mm
u_m = -12. mm
v_m = -28.42 mm
$\sigma_m = N/A - Mv/J_u$ = -208. N/mm^2
x_c = 18. mm
v_c = -28.42 mm
$\sigma_c = N/A - Mv/J_u$ = -208. N/mm^2
$\tau_c = TS^*/tJ_u$ = 16.78 N/mm^2
$\tau_g = TS^*/tJ_u$ = 16.78 N/mm^2
t_c = 520. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 210. N/mm^2

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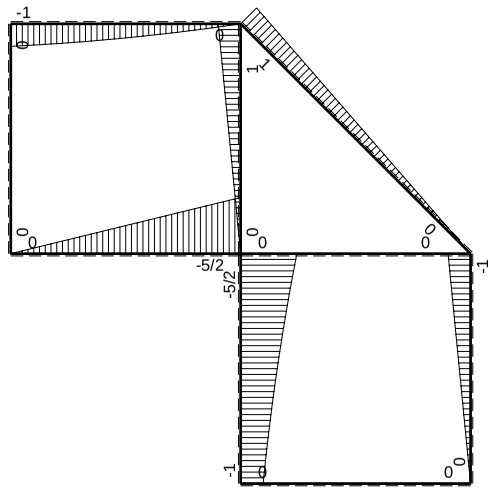
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Fb
1/2F
3/2F
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E
G
1/2F
F
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Fb
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5/2F
F
A
A
B
B
2F
2F
5/2Fb
5/2F
5/2F
B
E
17/8F
B
25/8F
5/2Fb
5F
E
17/8F
Fb
F
5F
1/8Fb
17/8F
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9/8Fb
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D
17/8F
9/8Fb
17/8F
9/8Fb

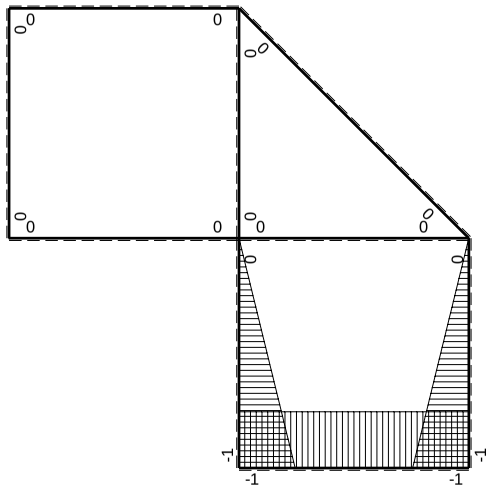

0
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1/2
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√2/2
17/8
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1
-5
-17/8
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-3/2
0
-1
√2/2
0
-5/2
25/8
-17/8
17/8
0
F
-1
0
1
0
0
0
0
0
-5/2
-5/2
-1
1/8
9/8
9/8
9/8
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0		
BC b	-x/b	$-5/2Fb+2Fx-1/2qx^2$	$5/2Fx-2Fx^2/b+1/2qx^3/b$	x^2/b^2	$17/24Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	$Fb+Fx+1/2qx^2$	$Fb-1/2Fx^2/b-1/2qx^3/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	1/3Xb/EJ
ED b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-3/2Fx+1/2qx^2$	0	0	0	0
GF b	0	$Fb-1/2Fx-1/2qx^2$	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$15/8Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-9/8Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -2\ x^2/b^2 +1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -2/3\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -2/3\ b +1/8\ b\ )\ Fb\ 1/EJ\ = 17/24\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x^2/b^2 -1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [\ x -1/6\ x^3/b^2 -1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

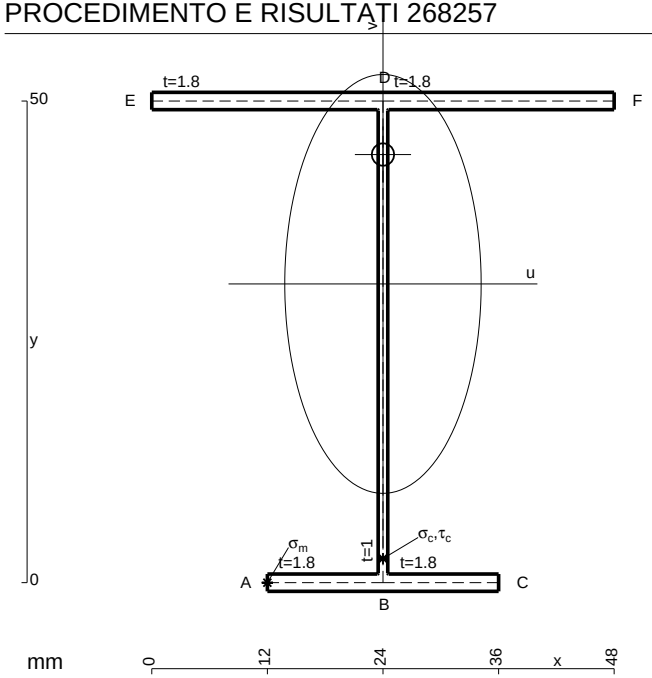
$= (\ b -1/6\ b -1/8\ b\ )\ Fb\ 1/EJ\ = 17/24\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

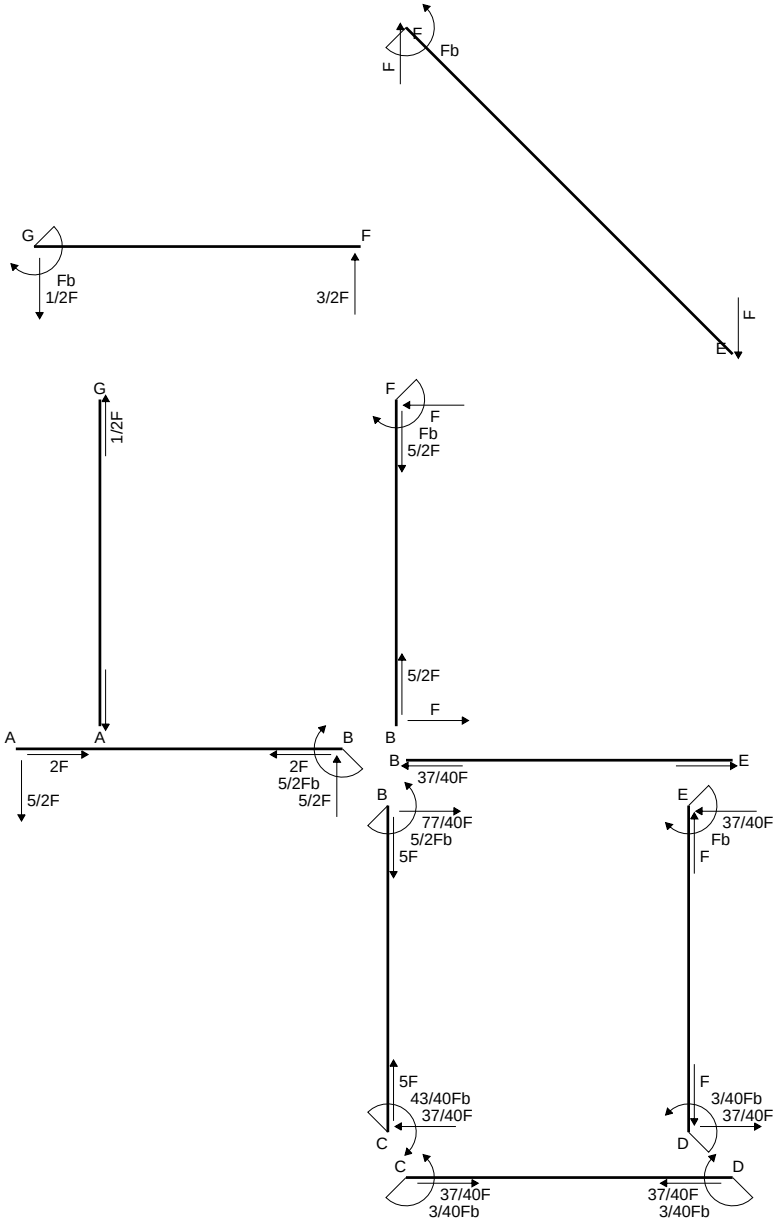
$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

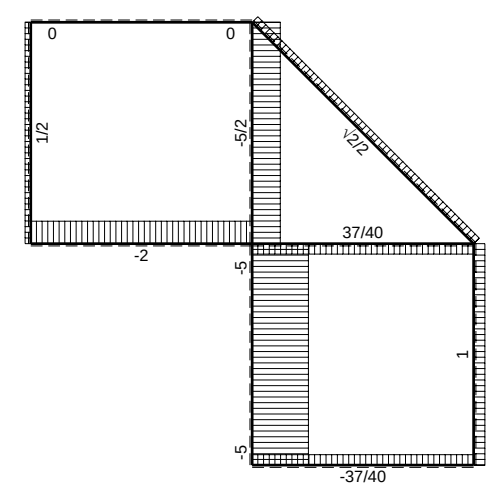


A = 179.6 mm^2
J_u = 84922. mm^4
J_v = 18662. mm^4
J_t = 156.6 mm^4
y_o = 13.43 mm
y_g = 31.01 mm
N = -840. N
T_y = -1050. N
M_x = -588000. Nmm
x_m = 12. mm
u_m = -12. mm
v_m = -31.01 mm
$\sigma_m = N/A - Mv/J_u$ = -219.4 N/mm^2
x_c = 24. mm
v_c = -31.01 mm
$\sigma_c = N/A - Mv/J_u$ = -219.4 N/mm^2
$\tau_c = TS^*/tJ_u$ = 16.57 N/mm^2
$\tau_g = TS^*/tJ_u$ = 16.57 N/mm^2
t_c = 420. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 221.3 N/mm^2

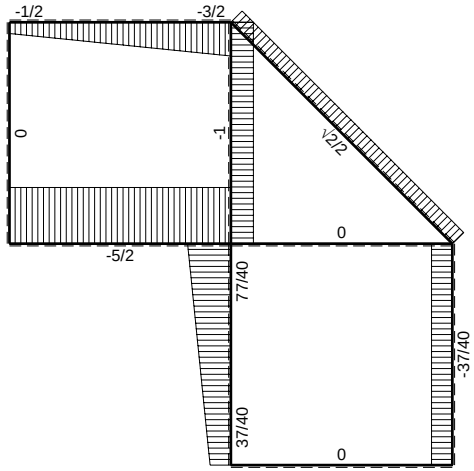
CI02.xxxx.102

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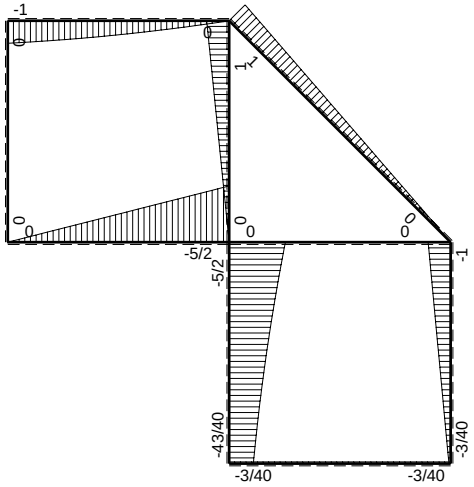

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1/2F
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5/2F
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2F
2F
37/40F
5/2Fb
5/2F
5/2F
B
77/40F
5/2Fb
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37/40F
D
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D
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-5
-37/40

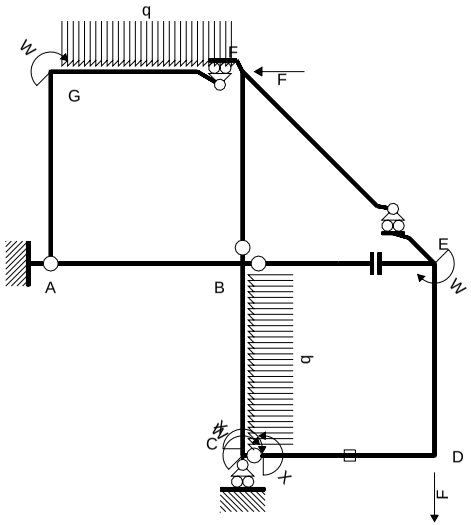
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-5/2
77/40
-37/40
37/40
0

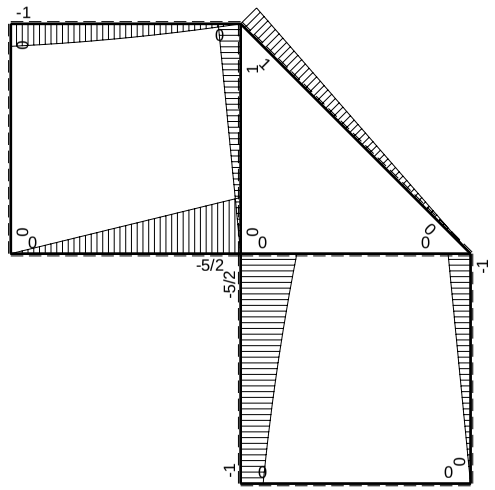
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-43/40
-3/40
-3/40
-3/40

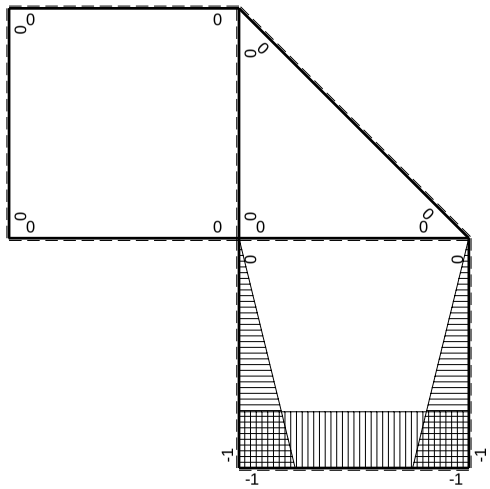
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-5/2Fx	0	0	0	0
BA b	0	5/2Fb-5/2Fx	0	0		
BC b	-x/b	$-5/2Fb+2Fx-1/2qx^2$	$5/2Fx-2Fx^2/b+1/2qx^3/b$	x^2/b^2	$17/24Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	$Fb+Fx+1/2qx^2$	$Fb-1/2Fx^2/b-1/2qx^3/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	-Fx	$Fx-Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	1/3Xb/EJ
ED b	x/b	Fb-Fx	$Fx-Fx^2/b$	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	$-3/2Fx+1/2qx^2$	0	0	0	0
GF b	0	$Fb-1/2Fx-1/2qx^2$	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/8Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				3/40Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (5/2\ x/b -2\ x^2/b^2 +1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [5/4\ x^2/b -2/3\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (5/4\ b -2/3\ b +1/8\ b\ )\ Fb\ 1/EJ\ = 17/24\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x^2/b^2 -1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [\ x -1/6\ x^3/b^2 -1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

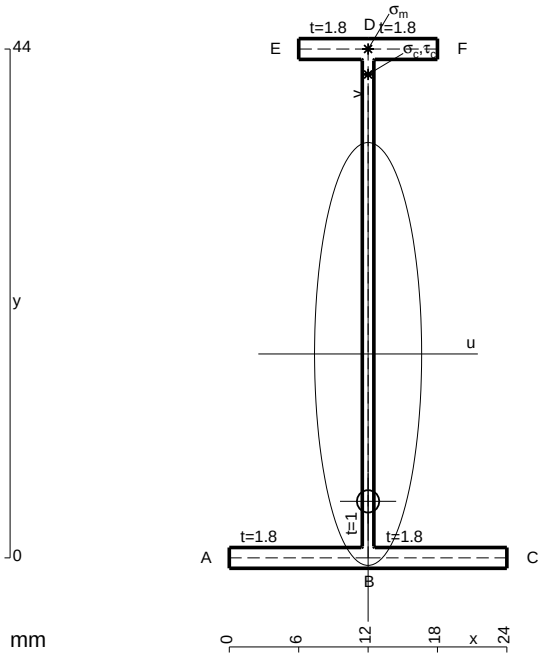
$= (\ b -1/6\ b -1/8\ b\ )\ Fb\ 1/EJ\ = 17/24\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

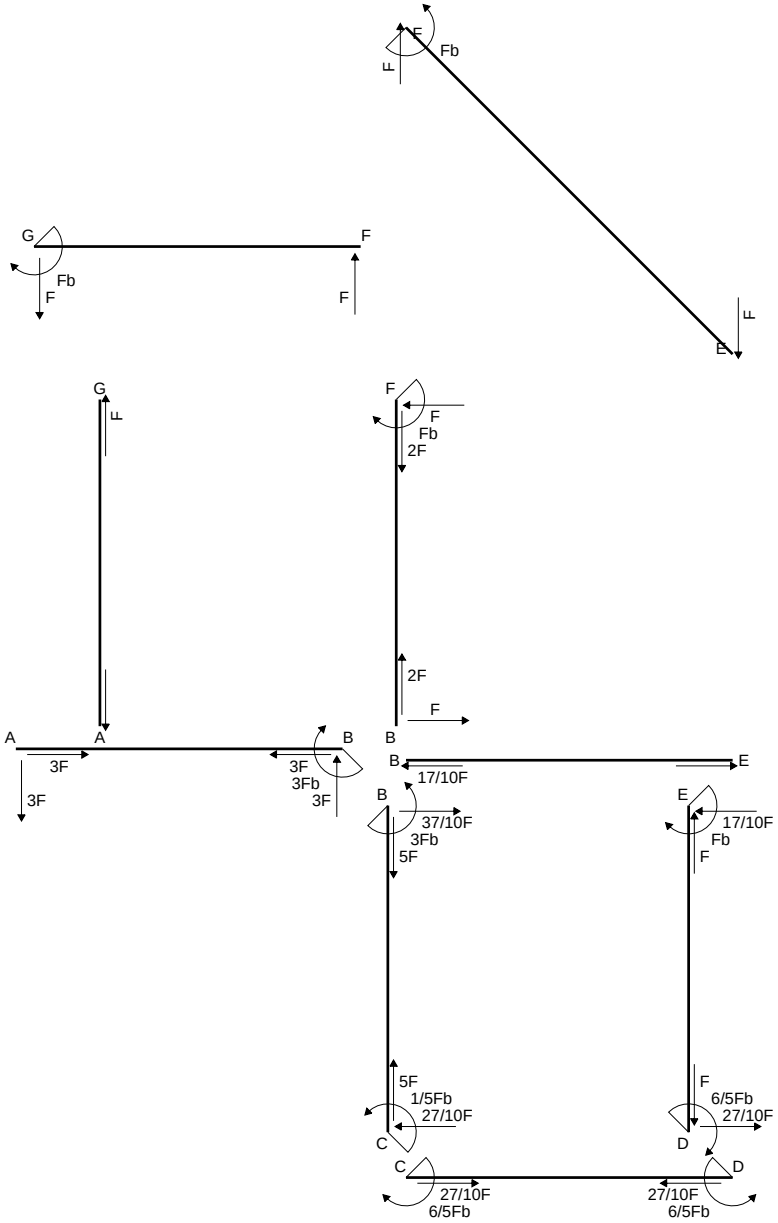
$= (1/2\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

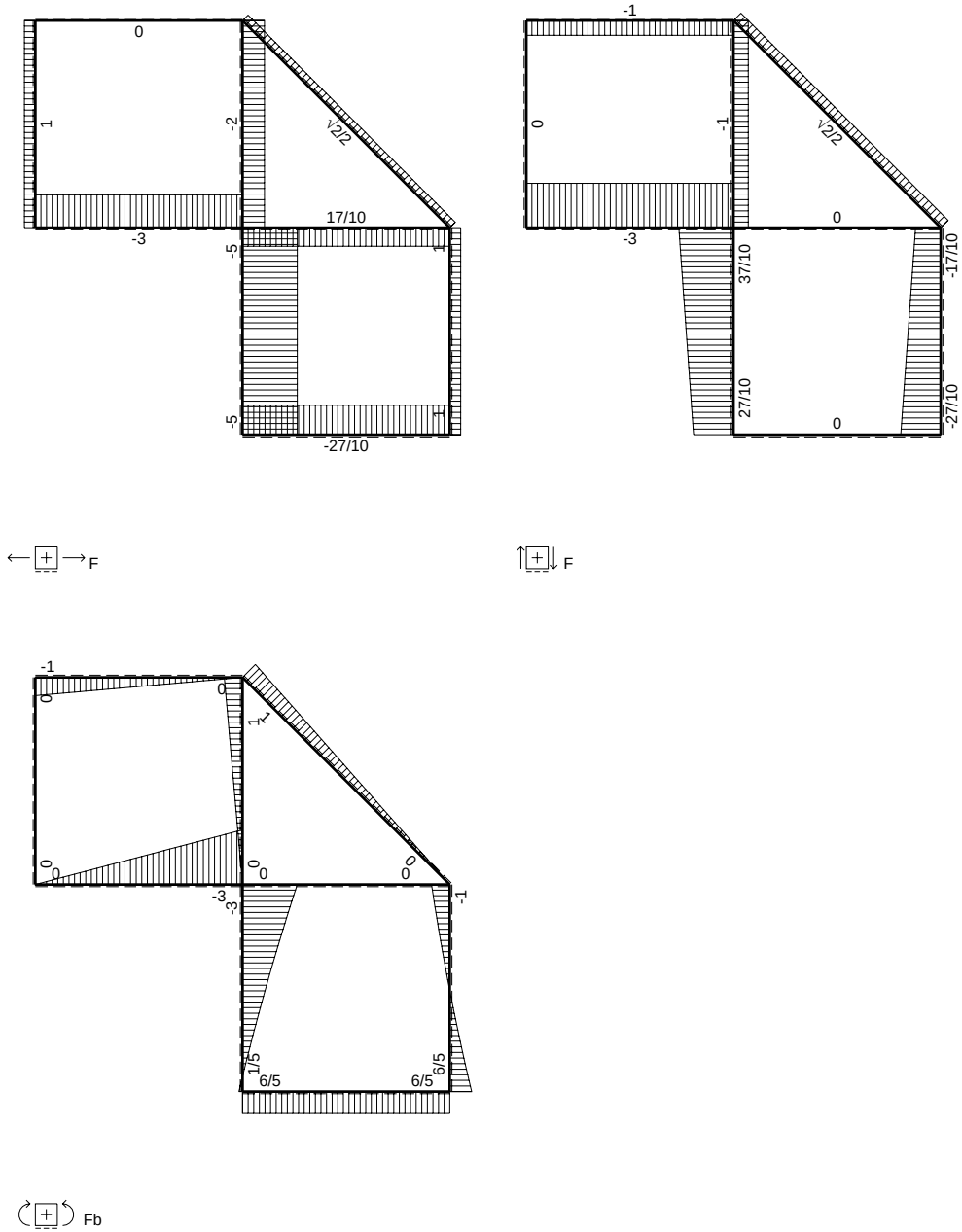


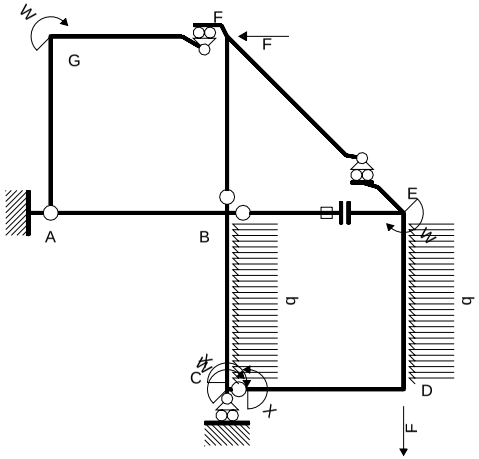
A = 108.8 mm^2
J_u = 36386. mm^4
J_v = 2333. mm^4
J_t = 84.65 mm^4
y_o = -12.74 mm
y_g = 17.63 mm
N = -460. N
T_y = -575. N
M_x = -310500. Nmm
x_m = 12. mm
y_m = 44. mm
v_m = 26.37 mm
$\sigma_m = N/A - Mv/J_u$ = 220.8 N/mm^2
y_c = 2. mm
u_c = -12. mm
v_c = -15.63 mm
$\sigma_c = N/A - Mv/J_u$ = 220.8 N/mm^2
$\tau_c = TS^*/tJ_u$ = 9. N/mm^2
$\tau_g = TS^*/tJ_u$ = 9. N/mm^2
t_c = 230. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 221.3 N/mm^2

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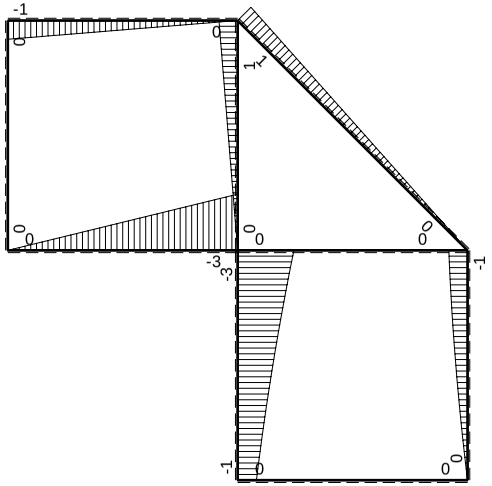
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2F
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B
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3F
3F
3Fb
3F
3F
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3Fb
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5F
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27/10F
6/5Fb

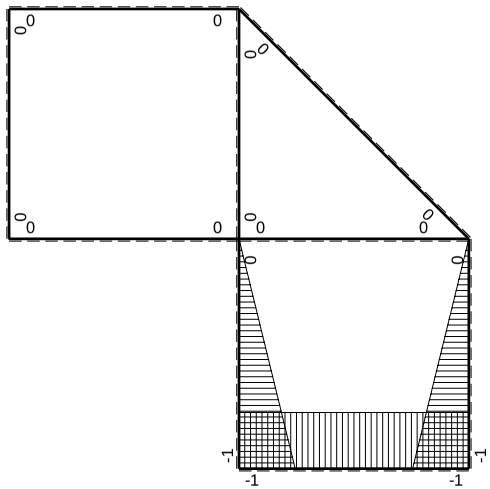

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1
-2
√2/2
17/10
-3
-5
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-5
1
-27/10
-1
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-1
√2/2
0
-3
37/10
-17/10
27/10
0
-27/10
F
F
-1
0
1
0
0
0
0
0
-3
-2
-1
-1/5
6/5
6/5
6/5
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3Fx	0	0	0	0
BA b	0	3Fb-3Fx	0	0		
BC b	-x/b	$-3Fb+5/2Fx-1/2qx^2$	$3Fx-5/2Fx^2/b+1/2qx^3/b$	x^2/b^2	$19/24Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	$Fb+3/2Fx+1/2qx^2$	$Fb+1/2Fx-Fx^2/b-1/2qx^3/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	$-3/2Fx+1/2qx^2$	$3/2Fx-2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$5/24Fb^2/EJ$	1/3Xb/EJ
ED b	x/b	$Fb-1/2Fx-1/2qx^2$	$Fx-1/2Fx^2/b-1/2qx^3/b$	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-Fx	0	0	0	0
GF b	0	Fb-Fx	0	0		
GA b	0	0	0	0	0	0
AG b	0	0	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$2Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-6/5Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3\ x/b -5/2\ x^2/b^2 +1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [3/2\ x^2/b -5/6\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (3/2\ b -5/6\ b +1/8\ b\ )\ Fb\ 1/EJ\ = 19/24\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 +1/2\ x/b - x^2/b^2 -1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [\ x +1/4\ x^2/b -1/3\ x^3/b^2 -1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

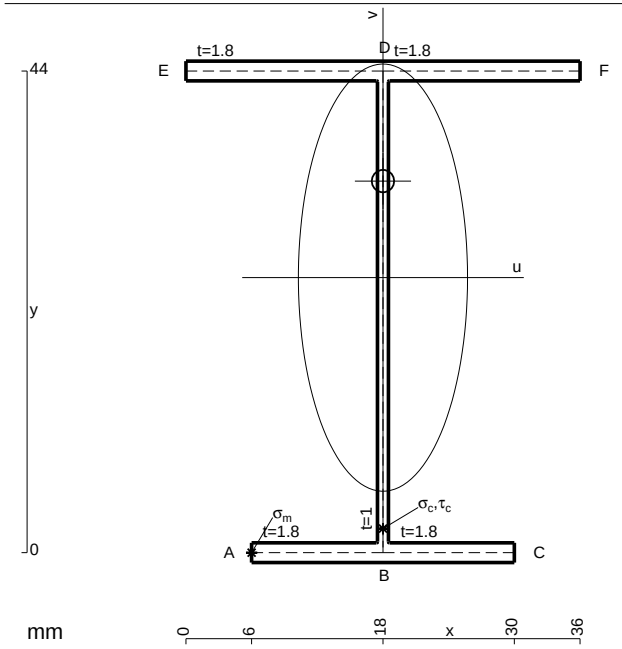
$= (\ b +1/4\ b -1/3\ b -1/8\ b\ )\ Fb\ 1/EJ\ = 19/24\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (3/2\ x/b -2\ x^2/b^2 +1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -2/3\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -2/3\ b +1/8\ b\ )\ Fb\ 1/EJ\ = 5/24\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (\ x/b -1/2\ x^2/b^2 -1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/6\ x^3/b^2 -1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

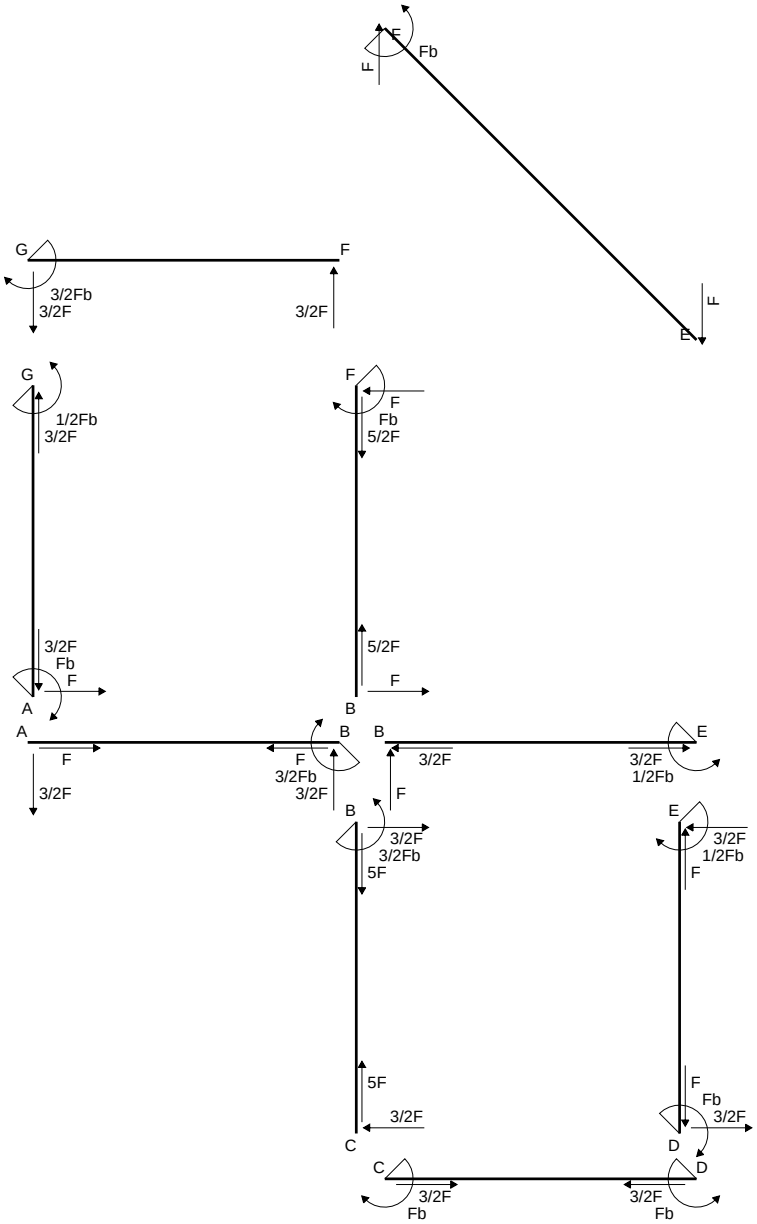
$= (1/2\ b -1/6\ b -1/8\ b\ )\ Fb\ 1/EJ\ = 5/24\ Fb^2/EJ$

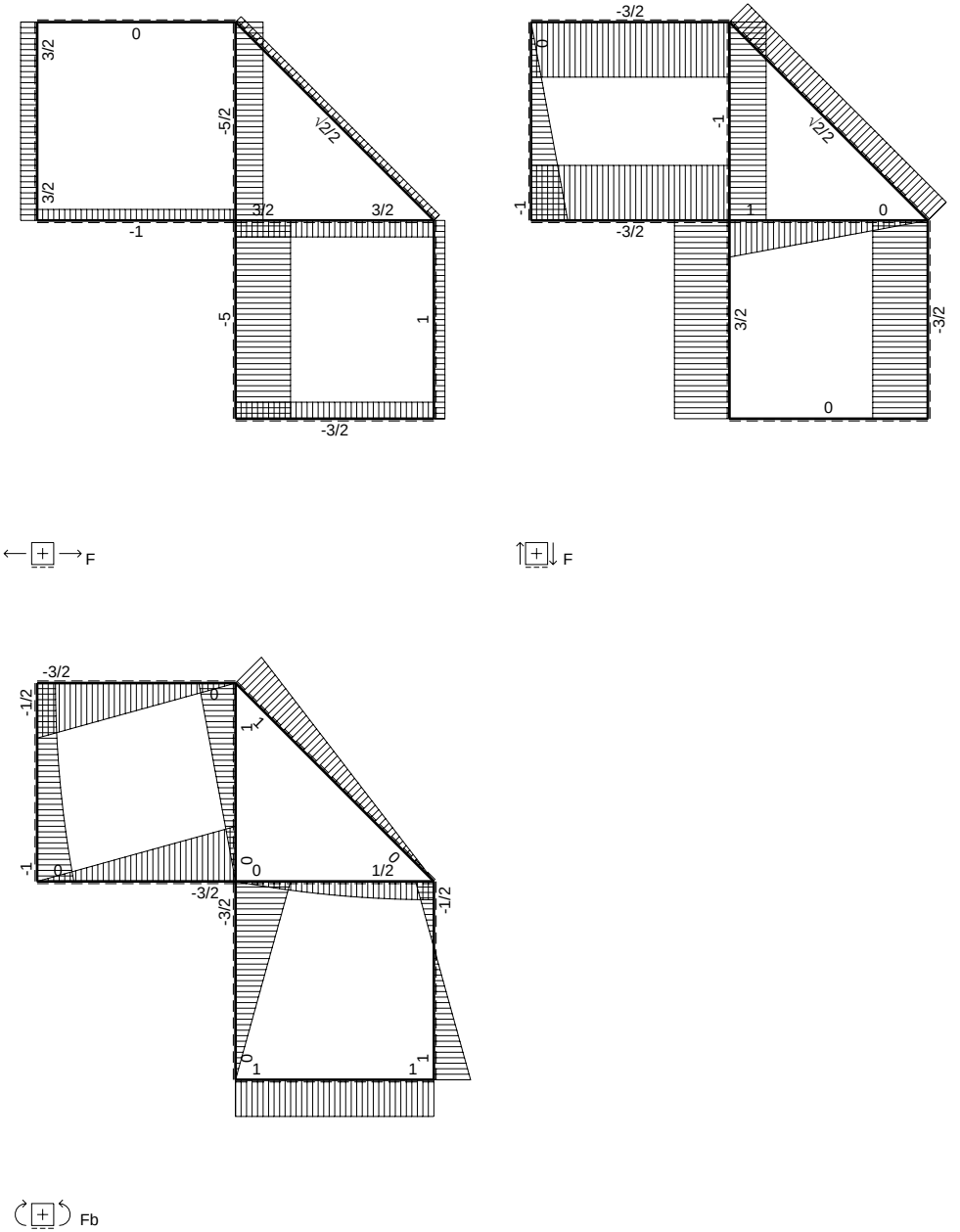


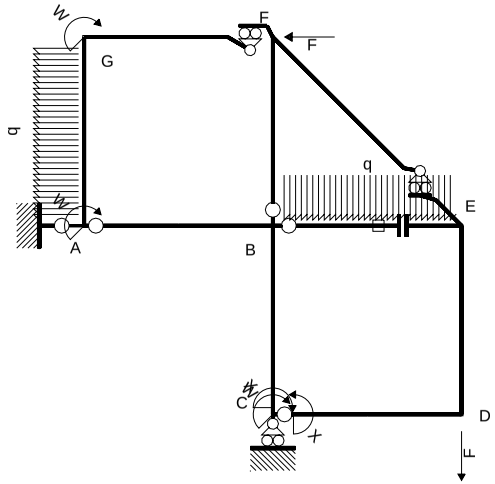
A = 152. mm^2
J_u = 57885. mm^4
J_v = 9072. mm^4
J_t = 131.3 mm^4
y_o = 8.817 mm
y_g = 25.13 mm
N = -900. N
T_y = -900. N
M_x = -522000. Nmm
x_m = 6. mm
u_m = -12. mm
v_m = -25.13 mm
$\sigma_m = N/A - Mv/J_u$ = -232.5 N/mm^2
x_c = 18. mm
v_c = -25.13 mm
$\sigma_c = N/A - Mv/J_u$ = -232.5 N/mm^2
$\tau_c = TS^*/tJ_u$ = 16.88 N/mm^2
$\tau_g = TS^*/tJ_u$ = 16.88 N/mm^2
t_c = 300. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 234.3 N/mm^2

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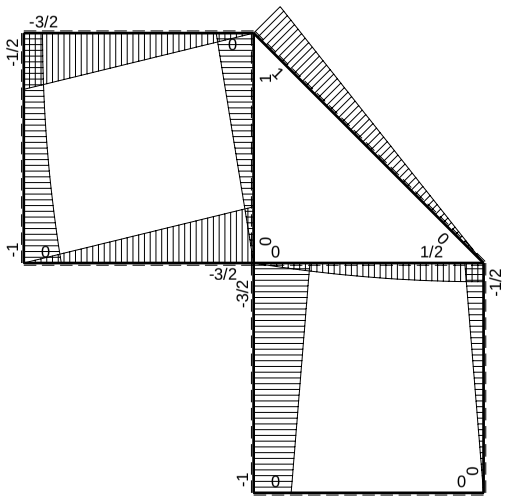
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F
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3/2Fb
3/2F
3/2F
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1/2Fb
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5/2F
3/2F
Fb
F
5/2F
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A
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3/2F
1/2Fb
3/2Fb
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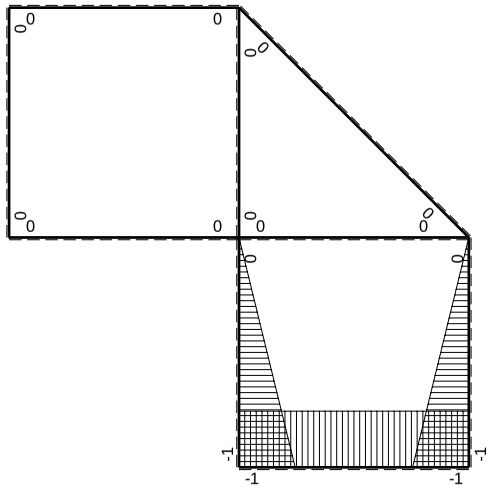

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-3/2
-3/2
-1/2
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1
1
1
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0		
BC b	-x/b	-3/2Fb+1/2Fx	$3/2Fx-1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	$Fb-1/2Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE 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
ED b	x/b	1/2Fb-1/2Fx	$1/2Fx-1/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}$/2Fx	0	0	0	0
FG b	0	-3/2Fx	0	0	0	0
GF b	0	3/2Fb-3/2Fx	0	0		
GA b	0	$-1/2Fb-1/2qx^2$	0	0	0	0
AG b	0	$Fb-Fx+1/2qx^2$	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	$Fx-1/2qx^2$	0	0	0	0
EB b	0	$-1/2Fb+1/2qx^2$	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$5/3Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b)\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

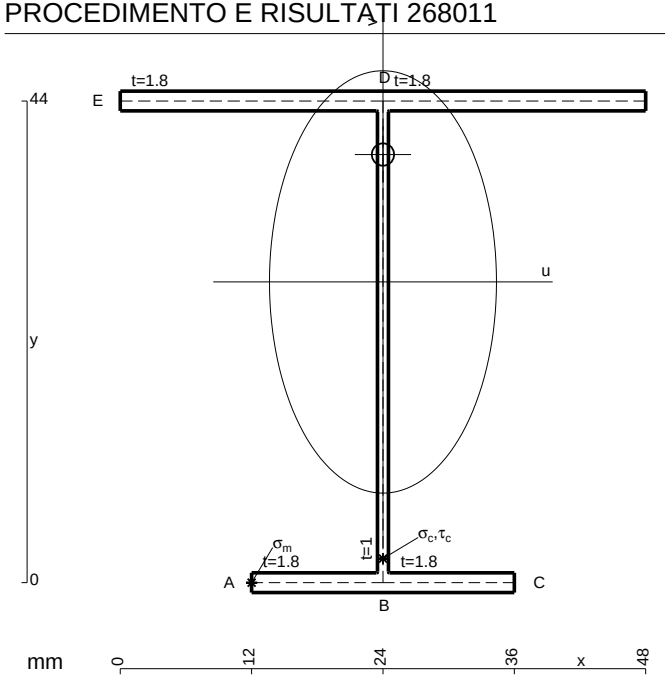
$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b -1/6\ b)\ Fb\ 1/EJ\ = 1/12\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

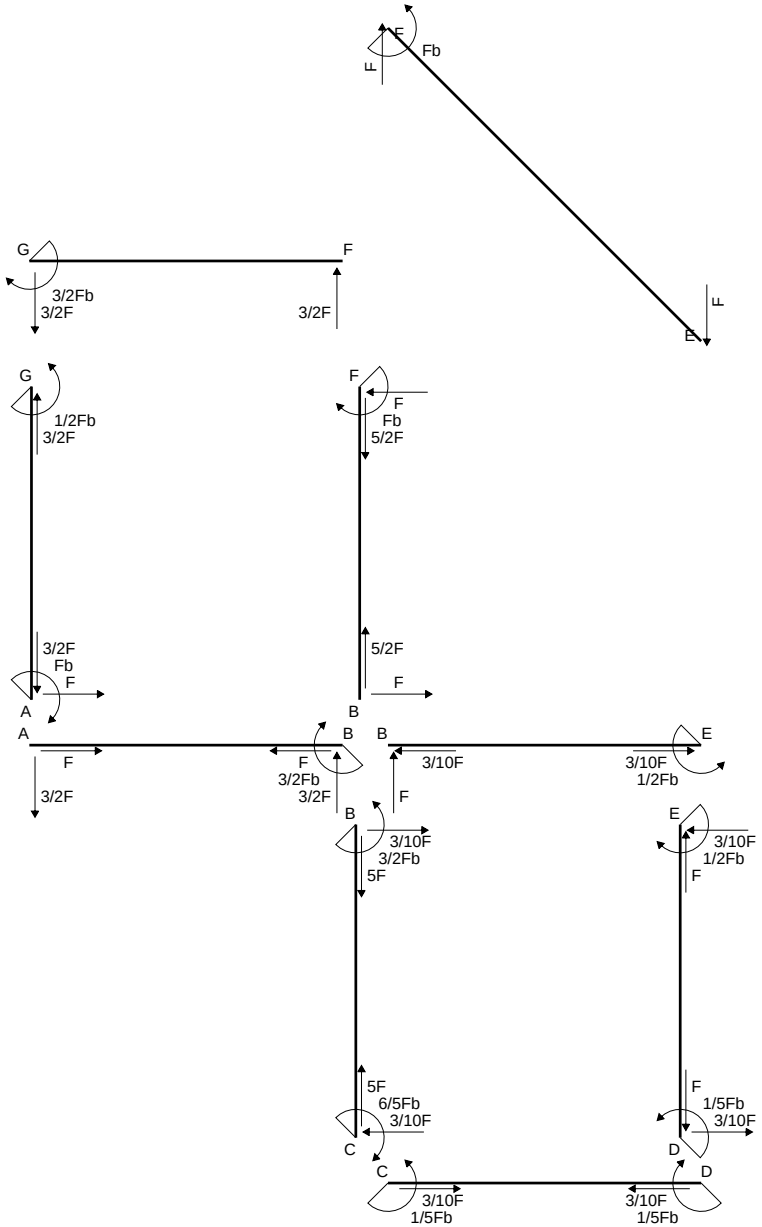
$= (1/4\ b -1/6\ b)\ Fb\ 1/EJ\ = 1/12\ Fb^2/EJ$

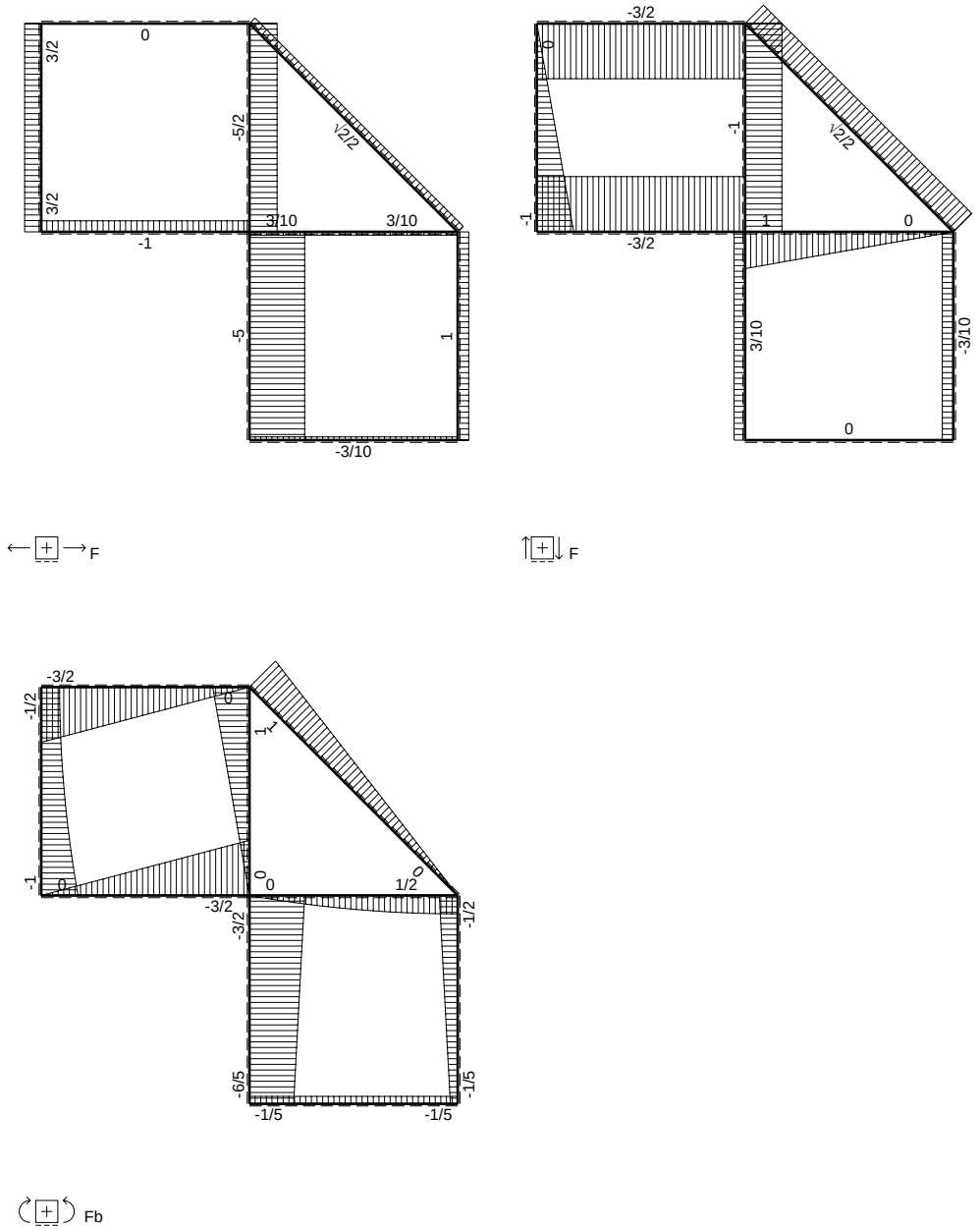


A = 173.6 mm^2
J_u = 64622. mm^4
J_v = 18662. mm^4
J_t = 154.6 mm^4
y_o = 11.64 mm
y_g = 27.47 mm
N = -490. N
T_y = -735. N
M_x = -463050. Nmm
x_m = 12. mm
u_m = -12. mm
v_m = -27.47 mm
$\sigma_m = N/A - Mv/J_u$ = -199.7 N/mm^2
x_c = 24. mm
v_c = -27.47 mm
$\sigma_c = N/A - Mv/J_u$ = -199.7 N/mm^2
$\tau_c = TS^*/tJ_u$ = 13.5 N/mm^2
$\tau_g = TS^*/tJ_u$ = 13.5 N/mm^2
t_c = 490. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 201.1 N/mm^2

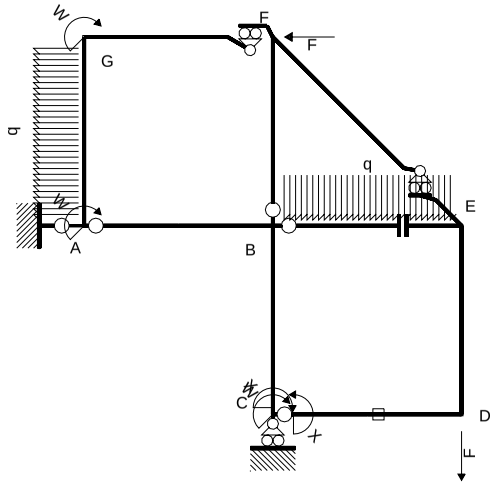
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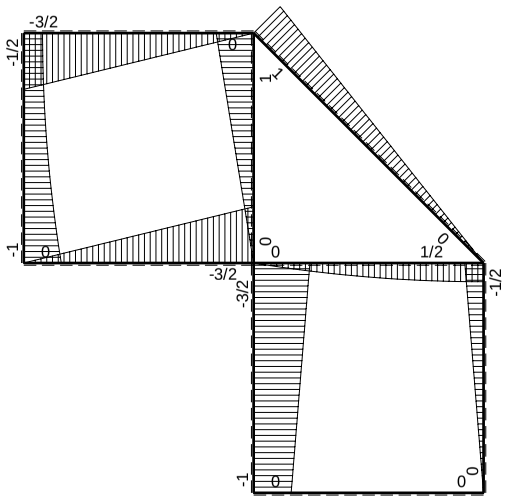




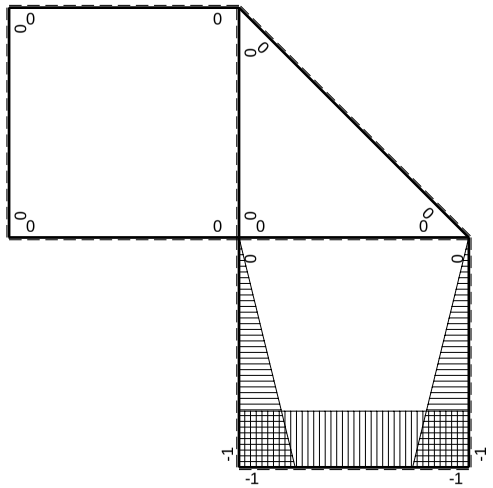
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Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0		
BC b	-x/b	-3/2Fb+1/2Fx	$3/2Fx-1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	$Fb-1/2Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE 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
ED b	x/b	1/2Fb-1/2Fx	$1/2Fx-1/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}$/2Fx	0	0	0	0
FG b	0	-3/2Fx	0	0	0	0
GF b	0	3/2Fb-3/2Fx	0	0		
GA b	0	$-1/2Fb-1/2qx^2$	0	0	0	0
AG b	0	$Fb-Fx+1/2qx^2$	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	$Fx-1/2qx^2$	0	0	0	0
EB b	0	$-1/2Fb+1/2qx^2$	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/3Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				1/5Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b)\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

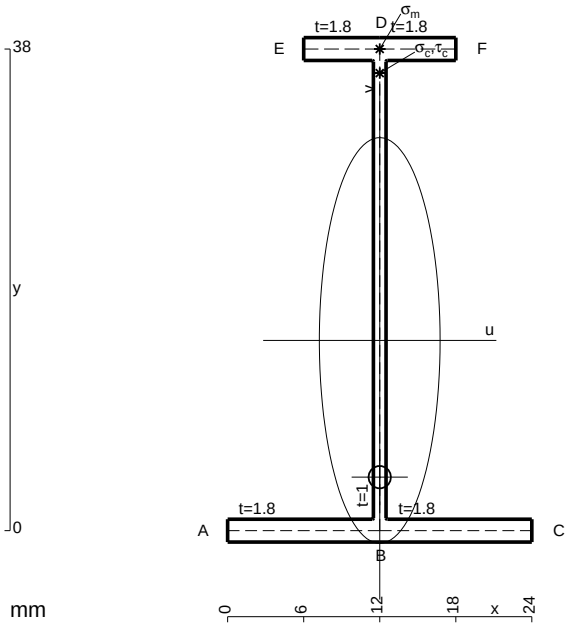
$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b -1/6\ b)\ Fb\ 1/EJ\ = 1/12\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

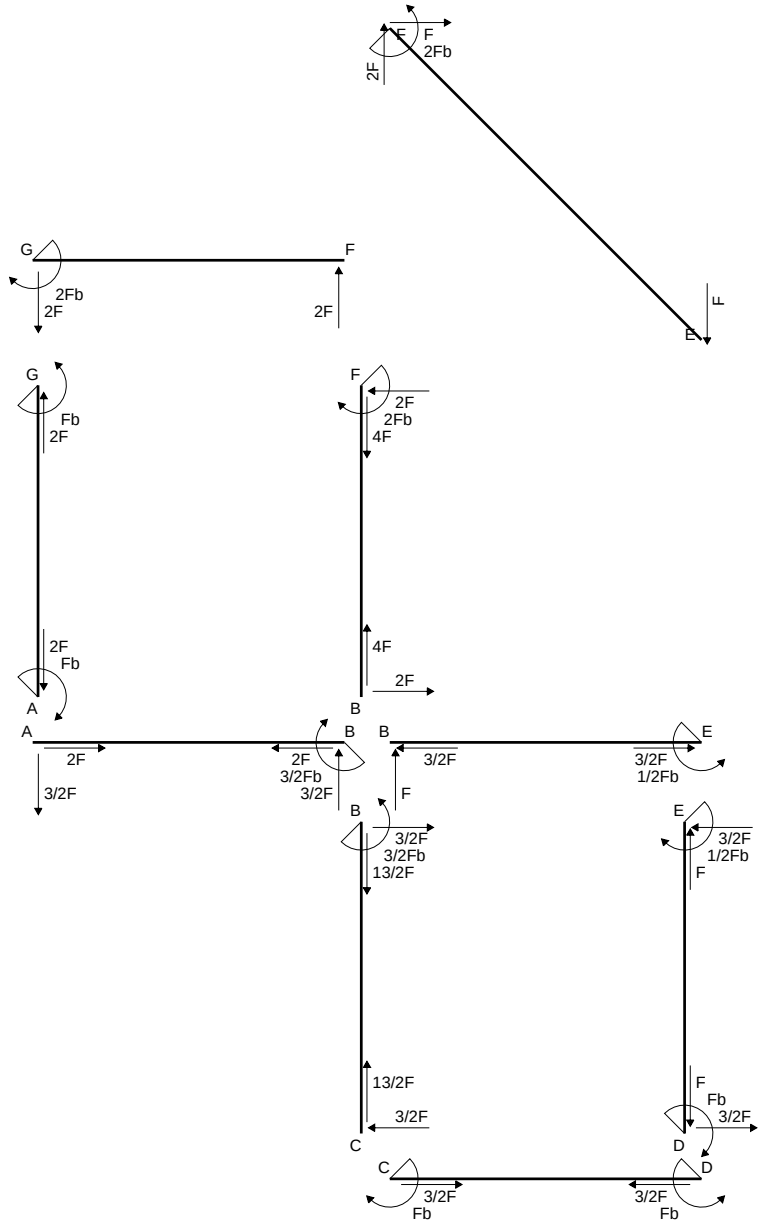
$= (1/4\ b -1/6\ b)\ Fb\ 1/EJ\ = 1/12\ Fb^2/EJ$

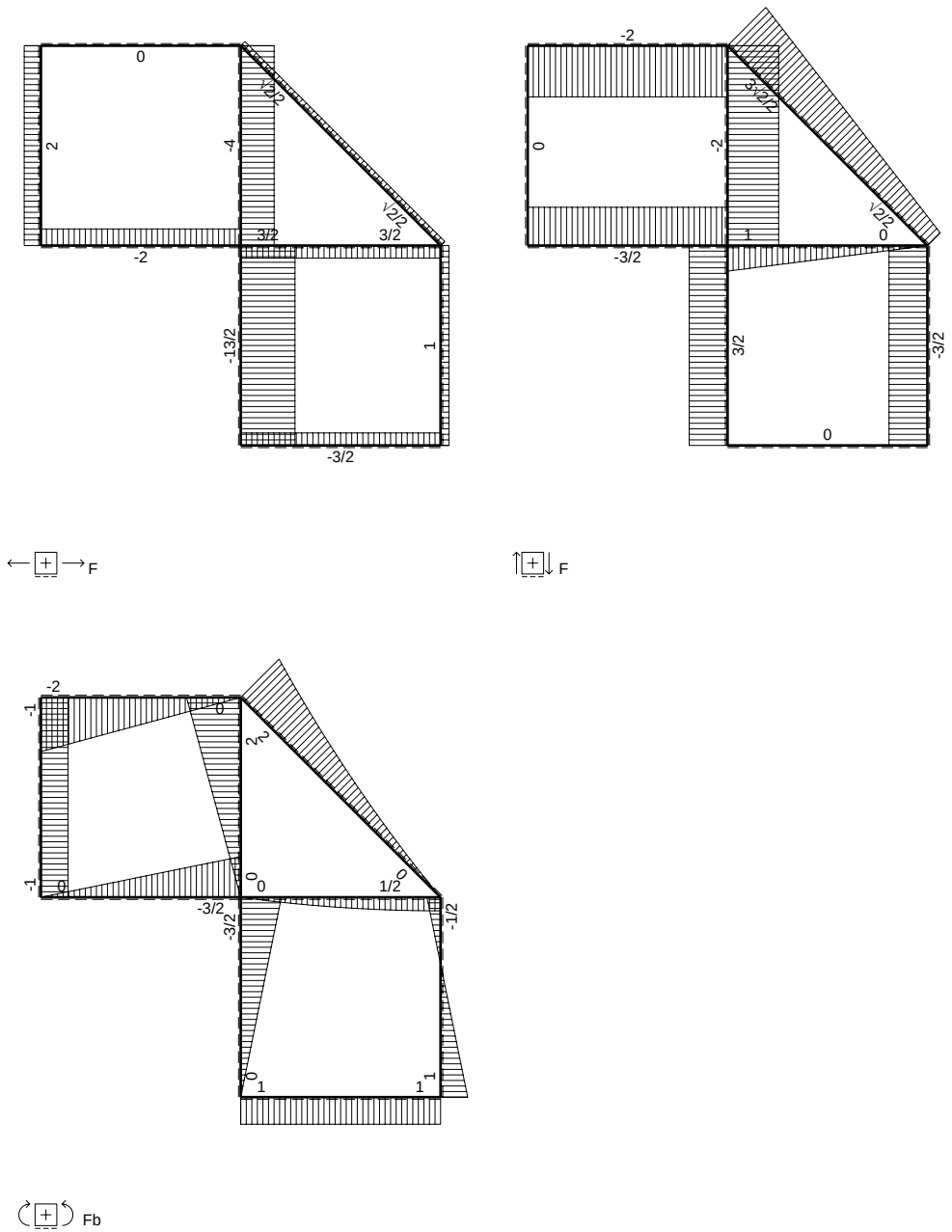


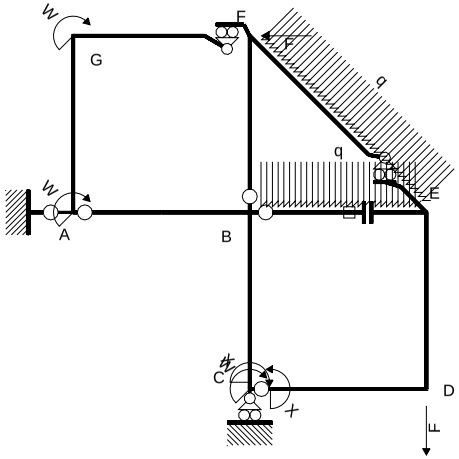
A = 102.8 mm^2
J_u = 26327. mm^4
J_v = 2333. mm^4
J_t = 82.65 mm^4
y_o = -10.79 mm
y_g = 15.01 mm
T_y = -420. N
M_x = -239400. Nmm
x_m = 12. mm
y_m = 38. mm
v_m = 22.99 mm
$\sigma_m = -Mv/J_u$ = 209.1 N/mm^2
y_c = 2. mm
u_c = -12. mm
v_c = -13.01 mm
$\sigma_c = -Mv/J_u$ = 209.1 N/mm^2
$\tau_c = TS^*/tJ_u$ = 7.923 N/mm^2
$\tau_g = TS^*/tJ_u$ = 7.923 N/mm^2
t_c = 280. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 209.5 N/mm^2

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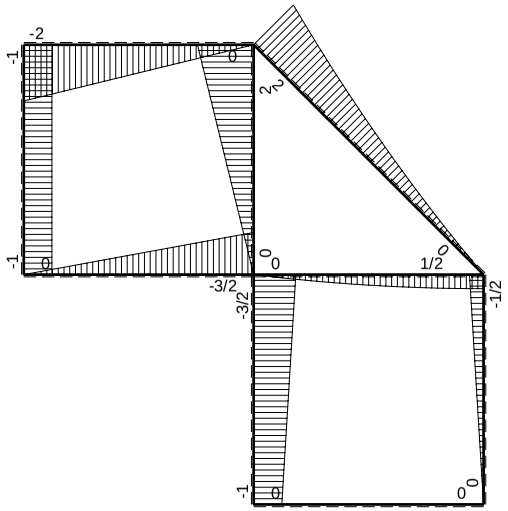
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F
F
2Fb
2F
G
F
2Fb
2F
2F
F
G
Fb
2F
F
2F
2Fb
4F
2F
Fb
4F
2F
A
B
A
B
B
E
2F
2F
3/2Fb
3/2F
3/2F
3/2F
1/2Fb
3/2F
F
B
E
3/2F
3/2Fb
13/2F
3/2F
1/2Fb
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3/2F
Fb
3/2F
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D
C
D
3/2F
Fb
3/2F
Fb

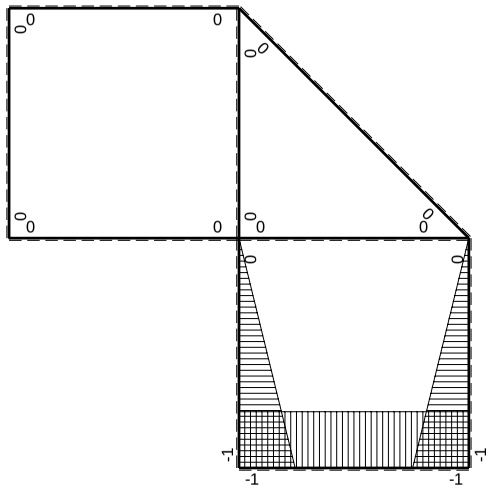

0
2
-4
1/2
0
1/2
3/2
-2
3/2
-13/2
1
-3/2
F
-2
0
-2
3/2
1/2
1
0
-3/2
3/2
-3/2
0
F
-2
-1
0
2
-1
0
0
0
1/2
-3/2
-3/2
-1/2
0
1
1
Fb



Schema di calcolo iperstatico



M_o flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0		
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx^2/b	x^2/b^2	7/12Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE 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
ED b	x/b	1/2Fb-1/2Fx	1/2Fx-1/2Fx^2/b	x^2/b^2		
EF √2b	0	√2/2Fx+1/2qx^2	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	Fx-1/2qx^2	0	0	0	0
EB b	0	-1/2Fb+1/2qx^2	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				5/3Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2\ )\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

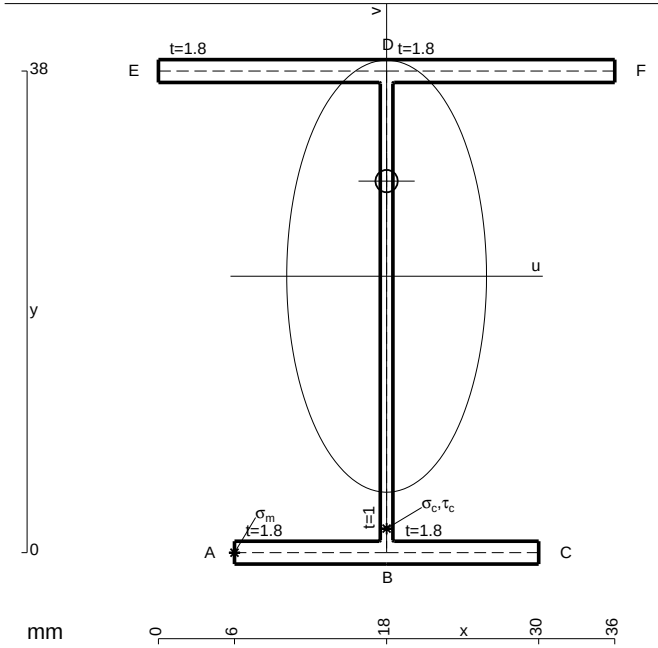
$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2\ x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/12\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

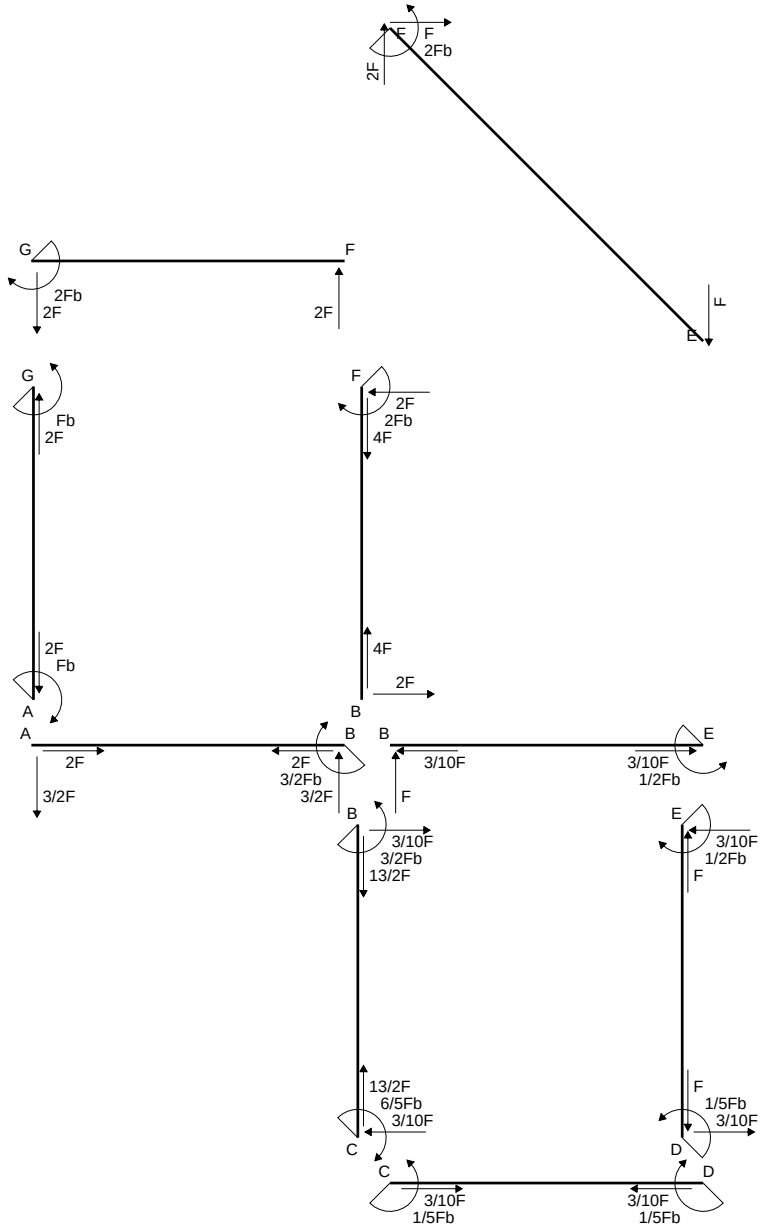
$= (1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/12\ Fb^2/EJ$

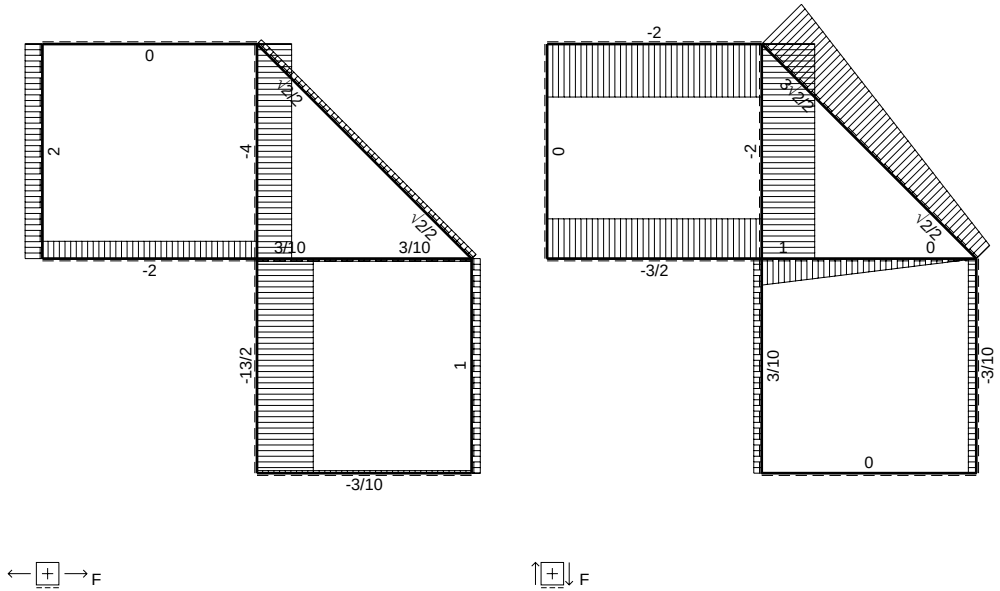


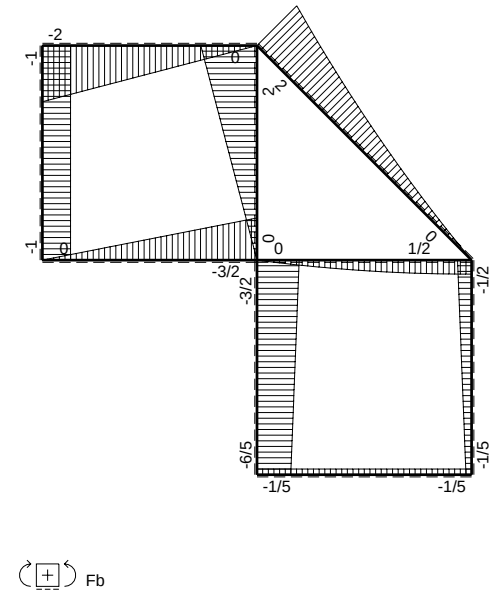
A = 146. mm^2
J_u = 42407. mm^4
J_v = 9072. mm^4
J_t = 129.3 mm^4
y_o = 7.503 mm
y_g = 21.81 mm
N = 240.4 N
T_y = 721.2 N
M_x = 414800. Nmm
x_m = 6. mm
u_m = -12. mm
v_m = -21.81 mm
$\sigma_m = N/A - Mv/J_u$ = 215. N/mm^2
x_c = 18. mm
v_c = -21.81 mm
$\sigma_c = N/A - Mv/J_u$ = 215. N/mm^2
$\tau_c = TS^*/tJ_u$ = 16.03 N/mm^2
$\tau_g = TS^*/tJ_u$ = 16.03 N/mm^2
t_c = 340. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 216.8 N/mm^2

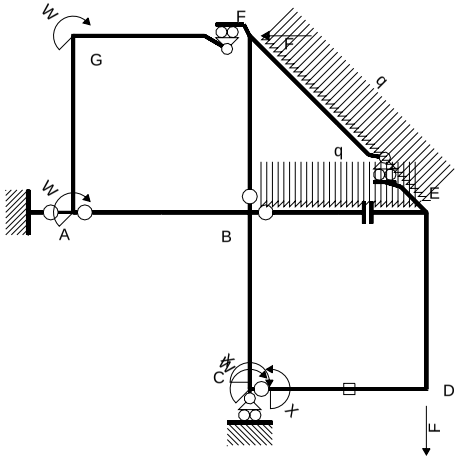
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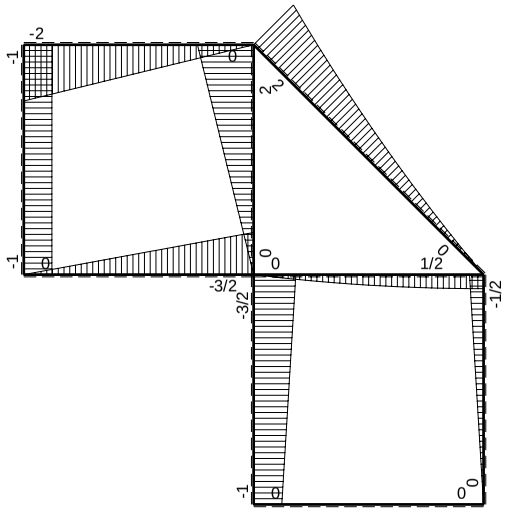

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C
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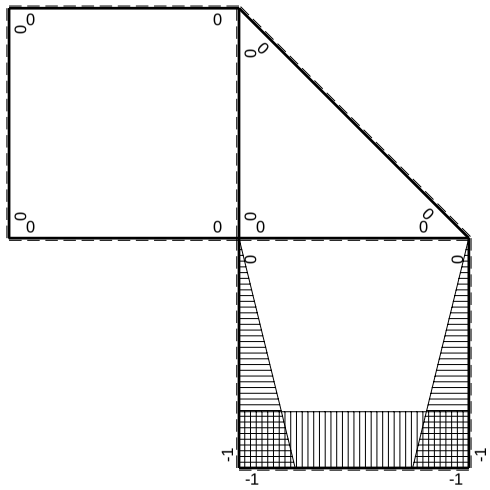

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-1/5
-1/5
-1/5
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0		
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx^2/b	x^2/b^2	7/12Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE 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
ED b	x/b	1/2Fb-1/2Fx	1/2Fx-1/2Fx^2/b	x^2/b^2		
EF √2b	0	√2/2Fx+1/2qx^2	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	Fx-1/2qx^2	0	0	0	0
EB b	0	-1/2Fb+1/2qx^2	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				-Fb^2/EJ	
	totali				-1/3Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				1/5Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b)\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

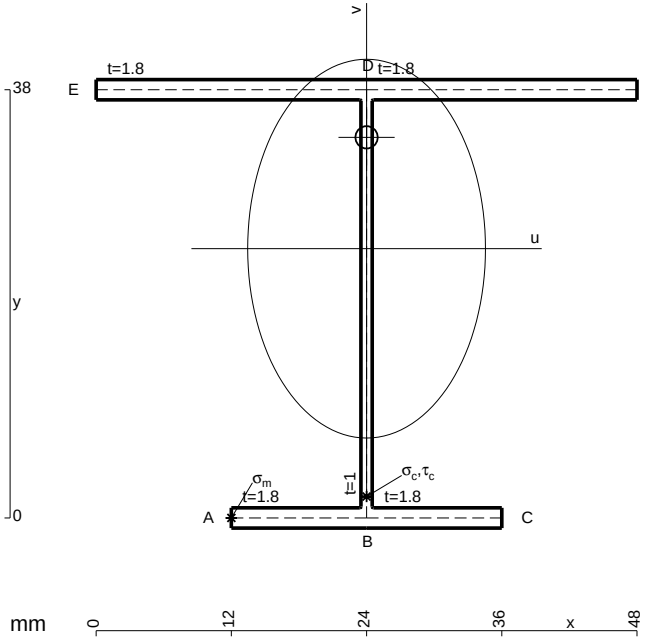
$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b -1/6\ b)\ Fb\ 1/EJ\ = 1/12\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

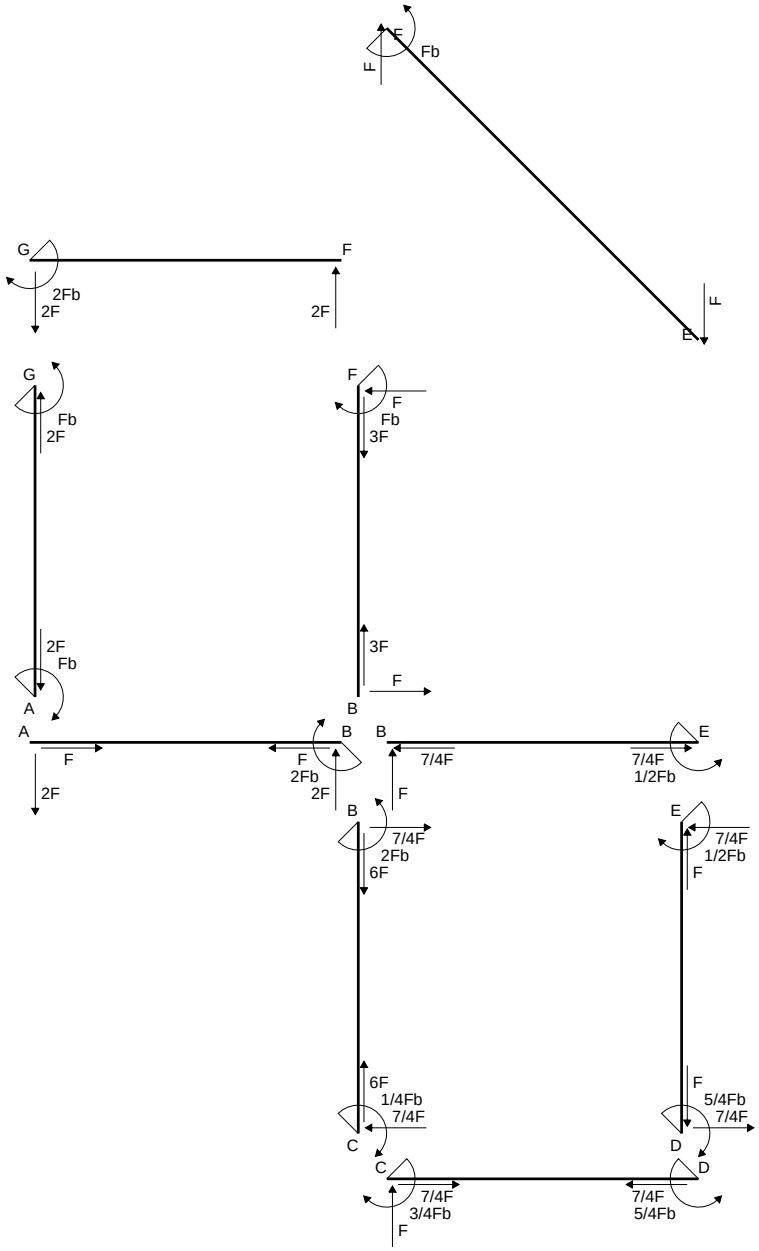
$= (1/4\ b -1/6\ b)\ Fb\ 1/EJ\ = 1/12\ Fb^2/EJ$

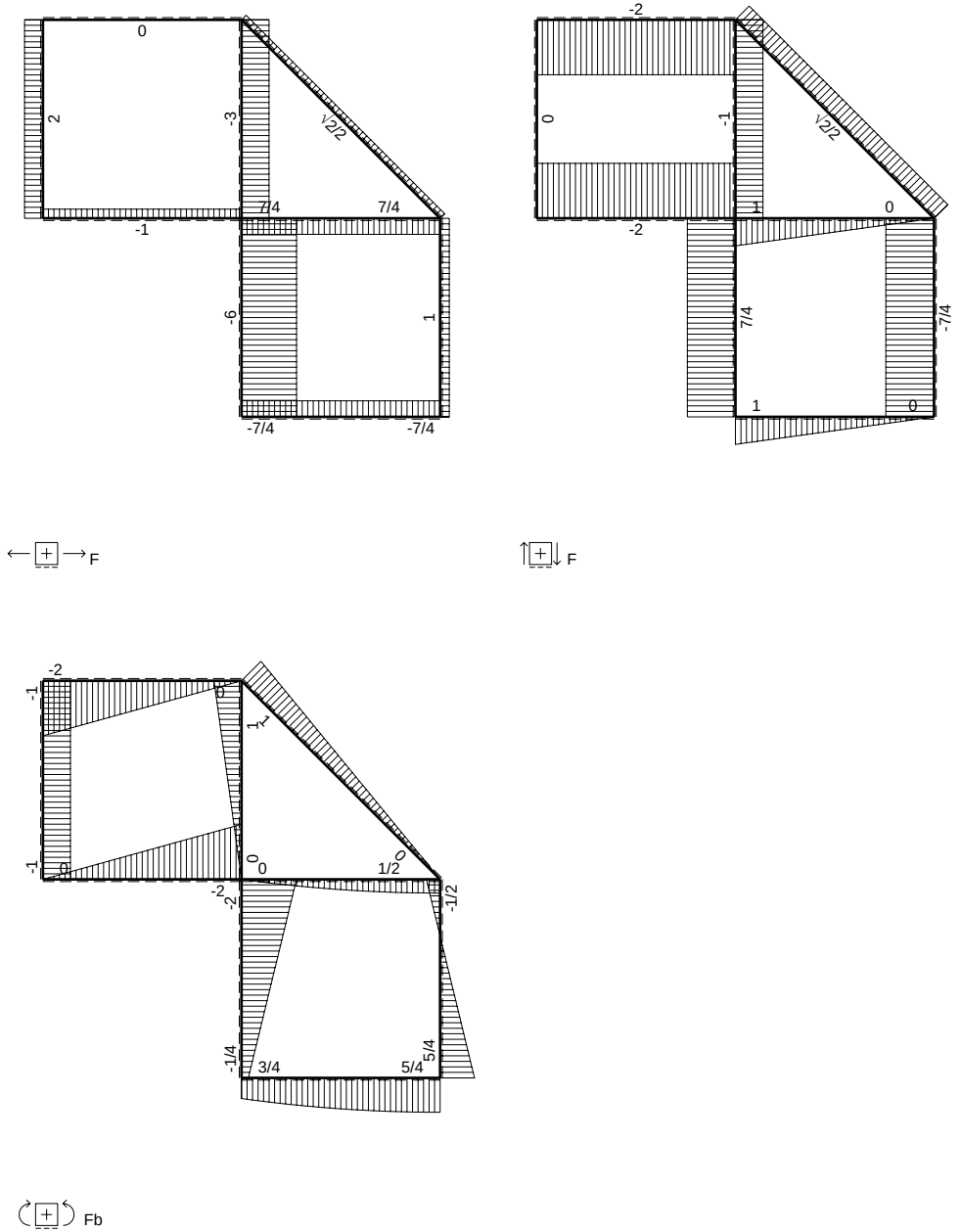


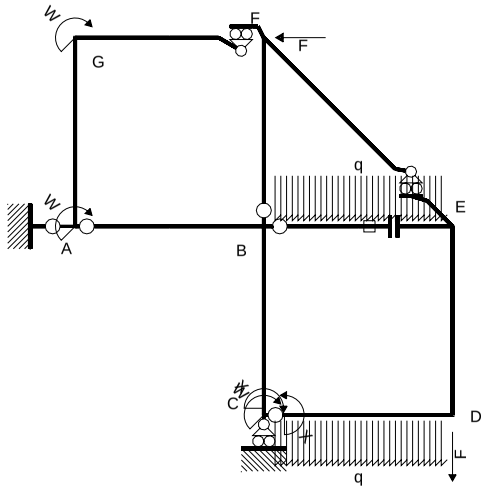
A = 167.6 mm^2
J_u = 47339. mm^4
J_v = 18662. mm^4
J_t = 152.6 mm^4
y_o = 9.88 mm
y_g = 23.9 mm
N = 247.5 N
T_y = 742.5 N
M_x = 448000. Nmm
x_m = 12. mm
u_m = -12. mm
v_m = -23.9 mm
$\sigma_m = N/A - Mv/J_u$ = 227.6 N/mm^2
x_c = 24. mm
v_c = -23.9 mm
$\sigma_c = N/A - Mv/J_u$ = 227.6 N/mm^2
$\tau_c = TS^*/tJ_u$ = 16.19 N/mm^2
$\tau_g = TS^*/tJ_u$ = 16.19 N/mm^2
t_c = 350. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 229.4 N/mm^2

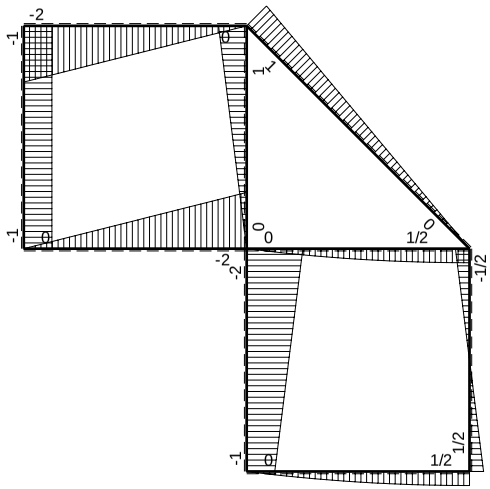
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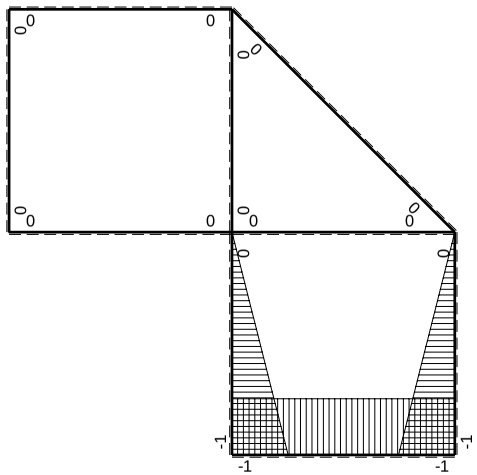

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1/2
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-1/2
-1/4
3/4
5/4
5/4
Fb





M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0		
BC b	-x/b	-2Fb+Fx	2Fx-Fx^2/b	x^2/b^2	2/3Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	Fx-1/2qx^2	-Fx+1/2Fx^2/b	1	-1/3Fb^2/EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx^2	-1/2Fb+1/2Fx^2/b	1		
DE b	-1+x/b	1/2Fb-Fx	-1/2Fb+3/2Fx-Fx^2/b	1-2x/b+x^2/b^2	-1/12Fb^2/EJ	1/3Xb/EJ
ED b	x/b	1/2Fb-Fx	1/2Fx-Fx^2/b	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	Fx-1/2qx^2	0	0	0	0
EB b	0	-1/2Fb+1/2qx^2	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				5/4Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-3/4Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (2\ x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-\ x/b +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/3\ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2 +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

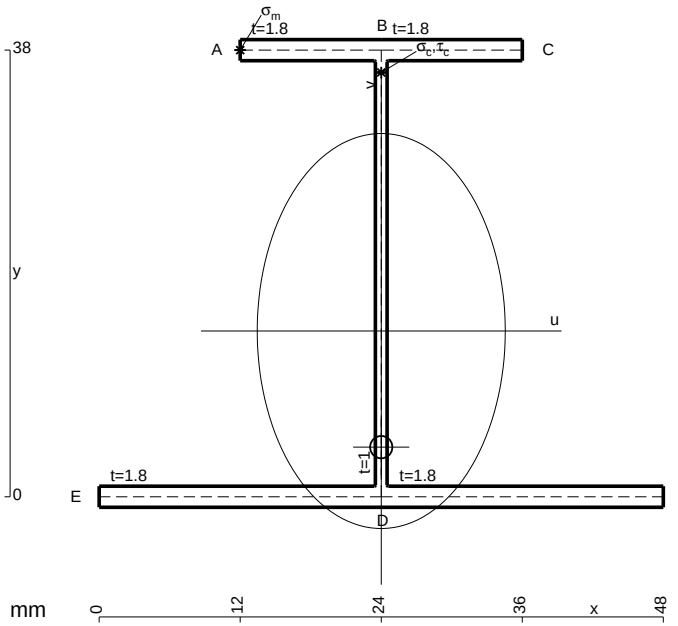
$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/3\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (-1/2 +3/2\ x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x +3/4\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +3/4\ b -1/3\ b\ )\ Fb\ 1/EJ\ = -1/12\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

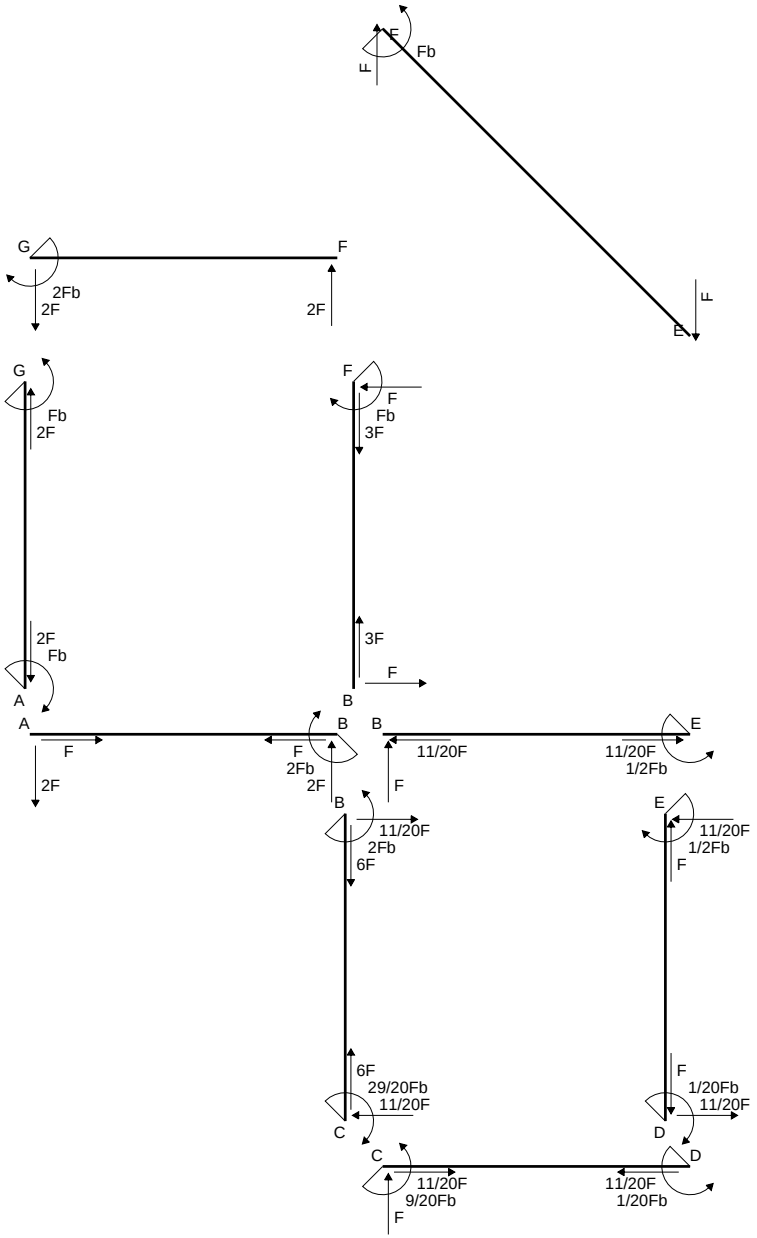
$= (1/4\ b -1/3\ b\ )\ Fb\ 1/EJ\ = -1/12\ Fb^2/EJ$

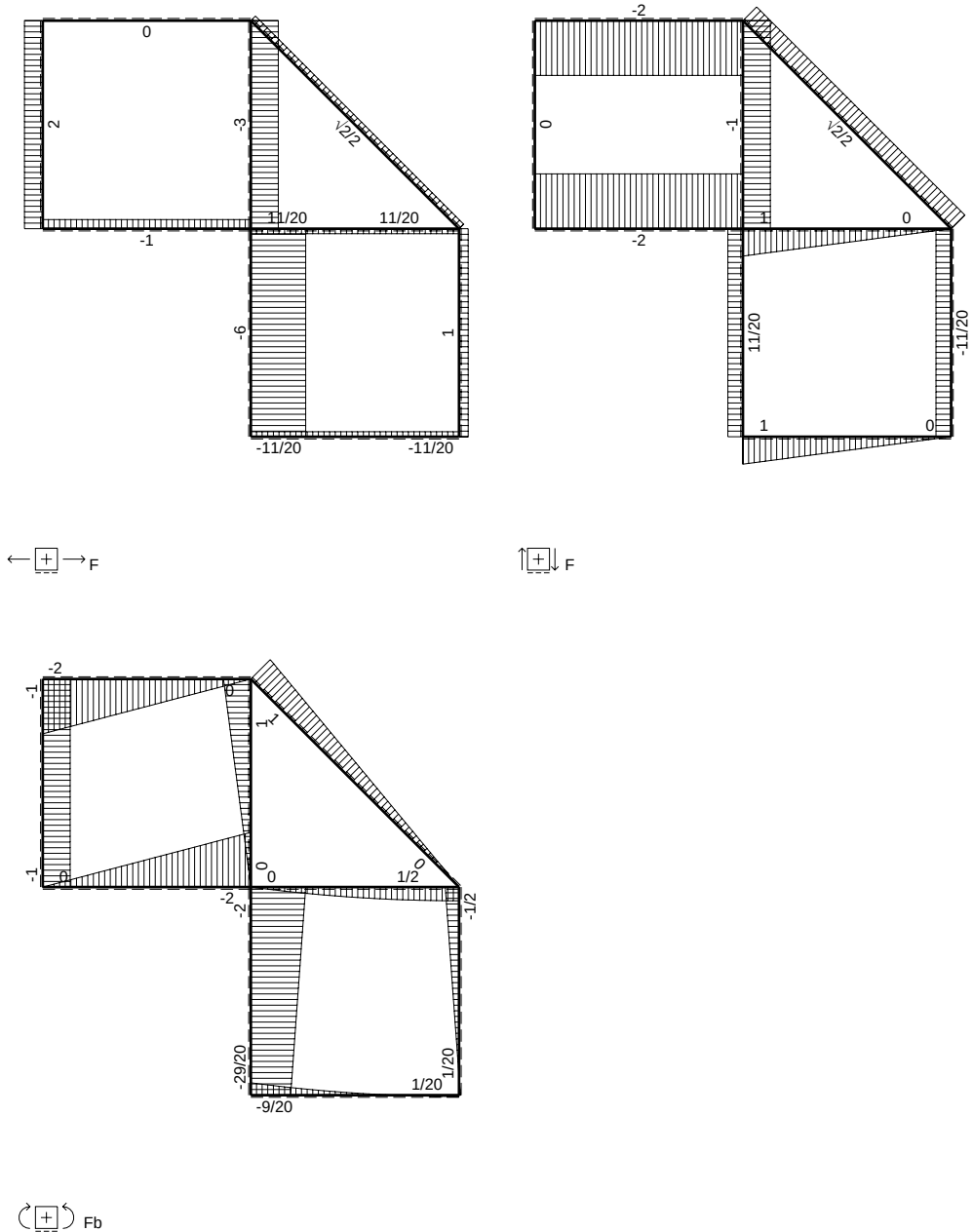


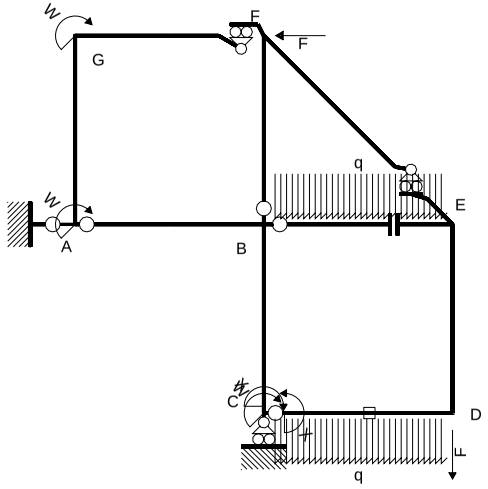
A = 167.6 mm^2
J_u = 47339. mm^4
J_v = 18662. mm^4
J_t = 152.6 mm^4
y_o = -9.88 mm
y_g = 14.1 mm
T_y = -680. N
M_x = -462400. Nmm
x_m = 12. mm
y_m = 38. mm
u_m = -12. mm
v_m = 23.9 mm
$\sigma_m = -Mv/J_u$ = 233.4 N/mm^2
x_c = 24. mm
y_c = 38. mm
v_c = 23.9 mm
$\sigma_c = -Mv/J_u$ = 233.4 N/mm^2
$\tau_c = TS^*/tJ_u$ = 14.83 N/mm^2
$\tau_g = TS^*/tJ_u$ = 14.83 N/mm^2
t_c = 340. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 234.8 N/mm^2

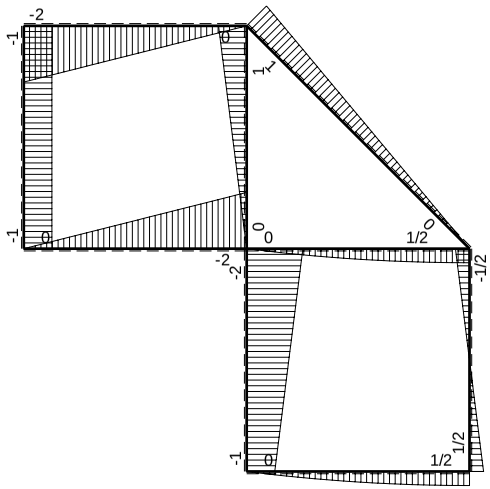
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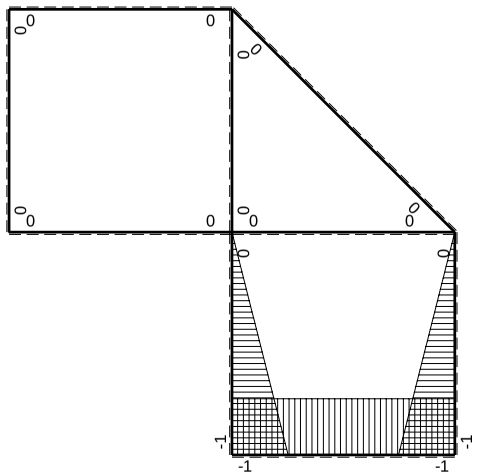

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1/20
1/20
-9/20
Fb





M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0		
BC b	-x/b	-2Fb+Fx	2Fx-Fx^2/b	x^2/b^2	2/3Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	Fx-1/2qx^2	-Fx+1/2Fx^2/b	1	-1/3Fb^2/EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx^2	-1/2Fb+1/2Fx^2/b	1		
DE b	-1+x/b	1/2Fb-Fx	-1/2Fb+3/2Fx-Fx^2/b	1-2x/b+x^2/b^2	-1/12Fb^2/EJ	1/3Xb/EJ
ED b	x/b	1/2Fb-Fx	1/2Fx-Fx^2/b	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	Fx-1/2qx^2	0	0	0	0
EB b	0	-1/2Fb+1/2qx^2	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				-Fb^2/EJ	
	totali				-3/4Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				9/20Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (2\ x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ \ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -4/3\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2 +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/2\ x +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

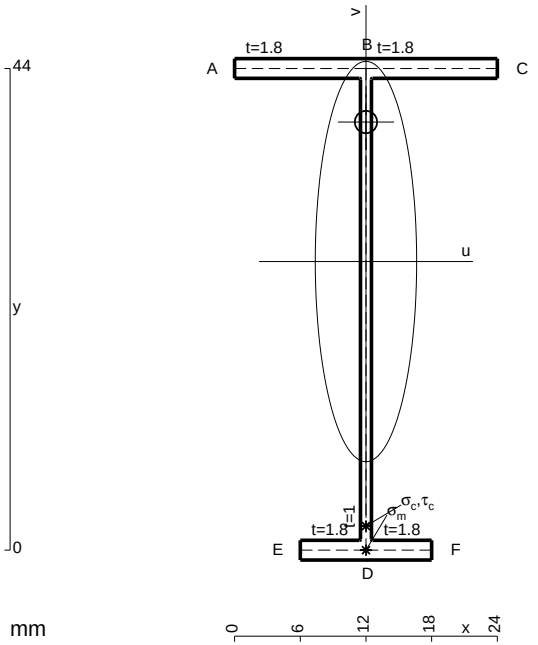
$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -4/3\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (-1/2 +3/2\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/2\ x +3/4\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +3/4\ b -1/3\ b\ )\ Fb\ 1/EJ\ = -1/12\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

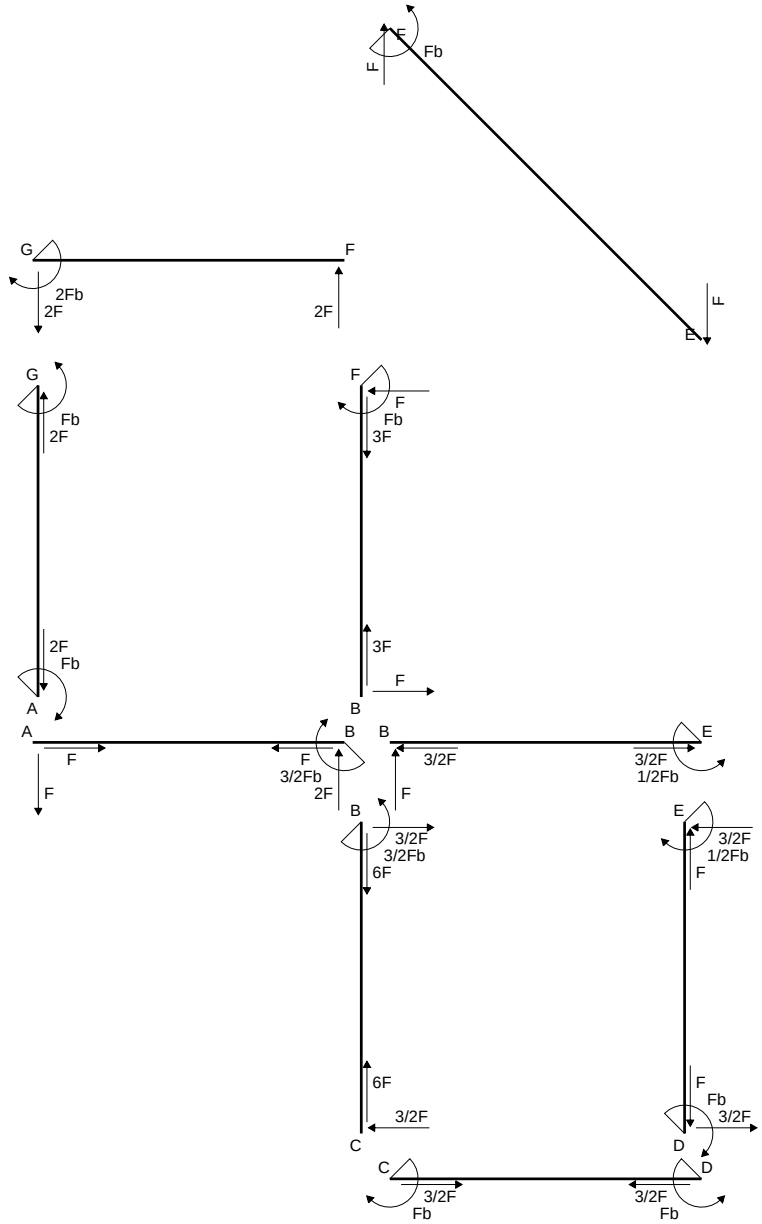
$= (1/4\ b -1/3\ b\ )\ Fb\ 1/EJ\ = -1/12\ \ Fb^2/EJ$

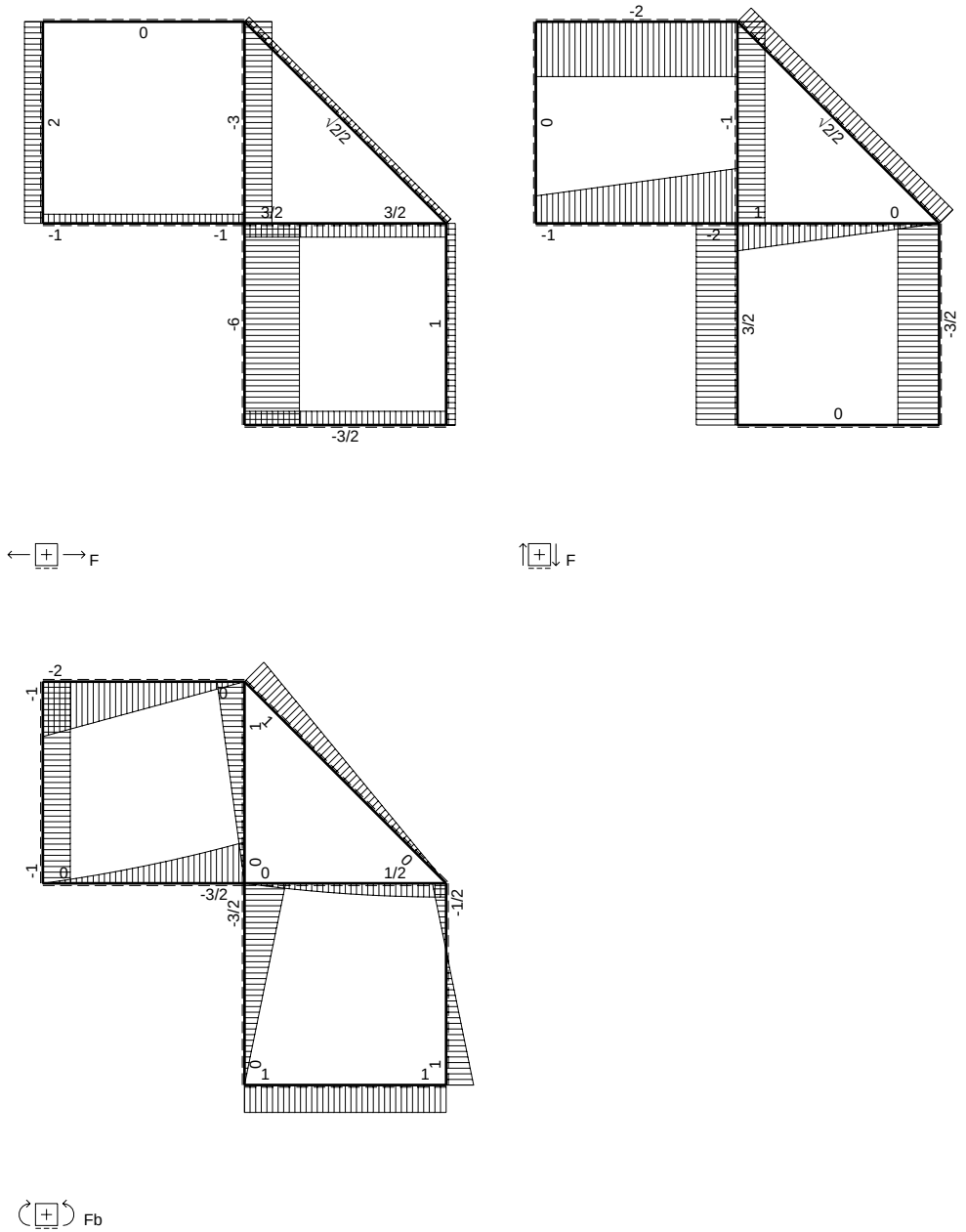


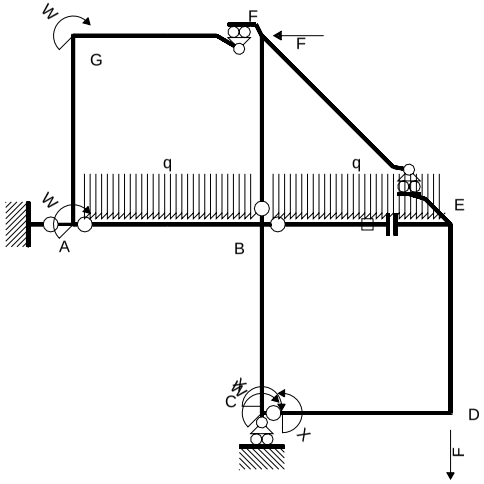
A = 108.8 mm^2
J_u = 36386. mm^4
J_v = 2333. mm^4
J_t = 84.65 mm^4
y_o = 12.74 mm
y_g = 26.37 mm
N = -320. N
T_y = -640. N
M_x = -268800. Nmm
x_m = 12. mm
v_m = -26.37 mm
$\sigma_m = N/A - Mv/J_u$ = -197.7 N/mm^2
y_c = 3. mm
u_c = -12. mm
v_c = -23.37 mm
$\sigma_c = N/A - Mv/J_u$ = -197.7 N/mm^2
$\tau_c = TS^*/tJ_u$ = 10.02 N/mm^2
$\tau_g = TS^*/tJ_u$ = 10.02 N/mm^2
t_c = 320. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 198.5 N/mm^2

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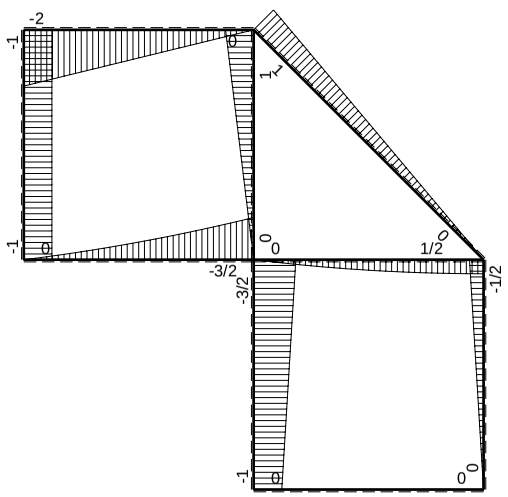
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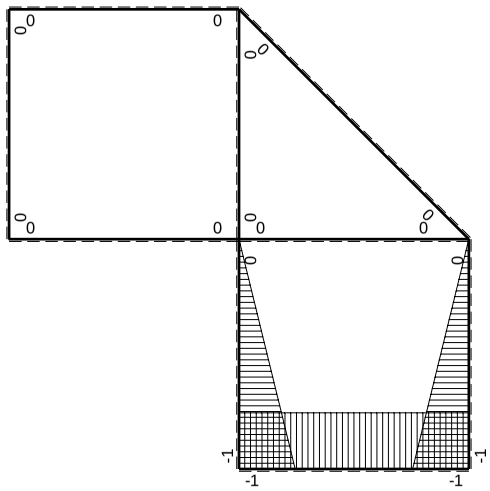

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Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-Fx-1/2qx^2$	0	0	0	0
BA b	0	$3/2Fb-2Fx+1/2qx^2$	0	0		
BC b	-x/b	$-3/2Fb+1/2Fx$	$3/2Fx-1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	$Fb+1/2Fx$	$Fb-1/2Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE 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
ED b	x/b	1/2Fb-1/2Fx	$1/2Fx-1/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	$Fx-1/2qx^2$	0	0	0	0
EB b	0	$-1/2Fb+1/2qx^2$	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$5/3Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b)\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

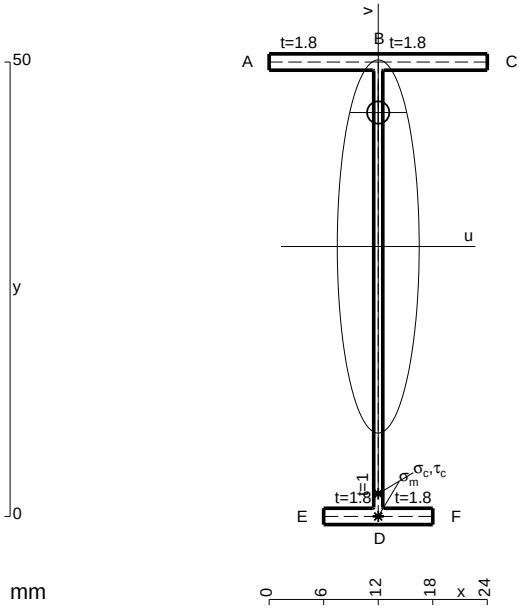
$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b -1/6\ b)\ Fb\ 1/EJ\ = 1/12\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

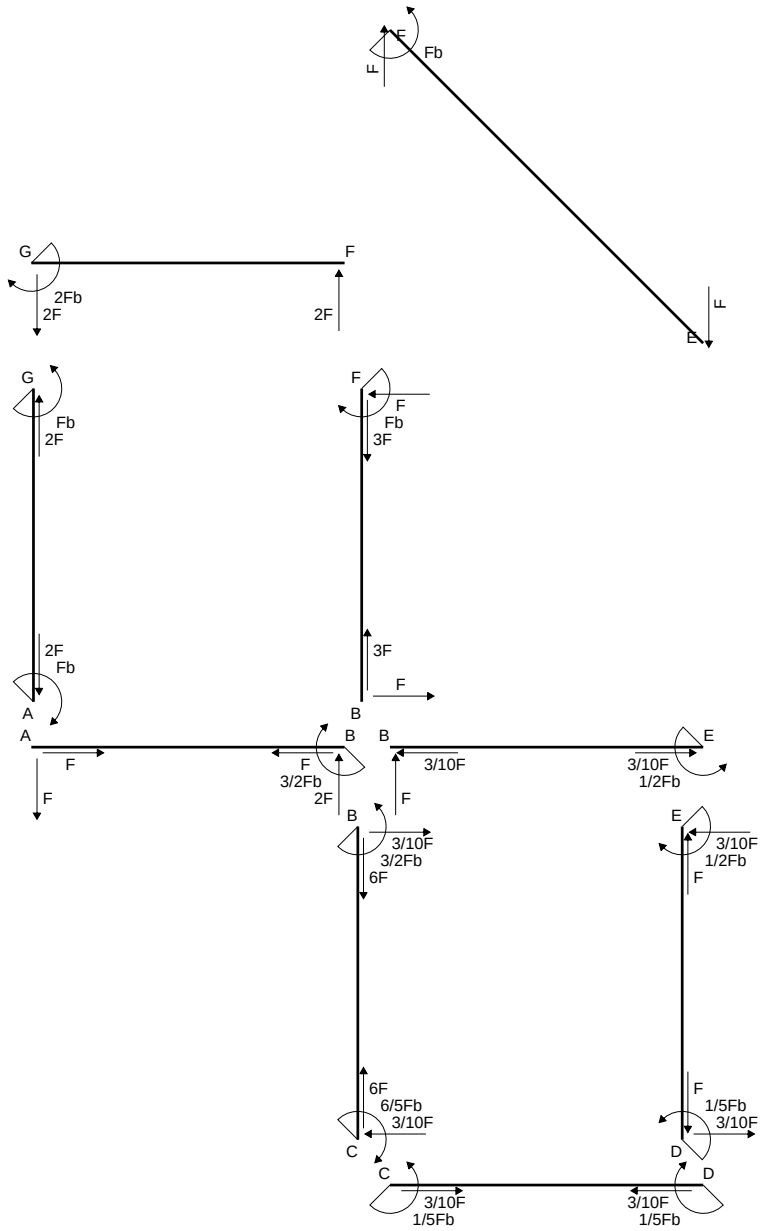
$= (1/4\ b -1/6\ b)\ Fb\ 1/EJ\ = 1/12\ Fb^2/EJ$

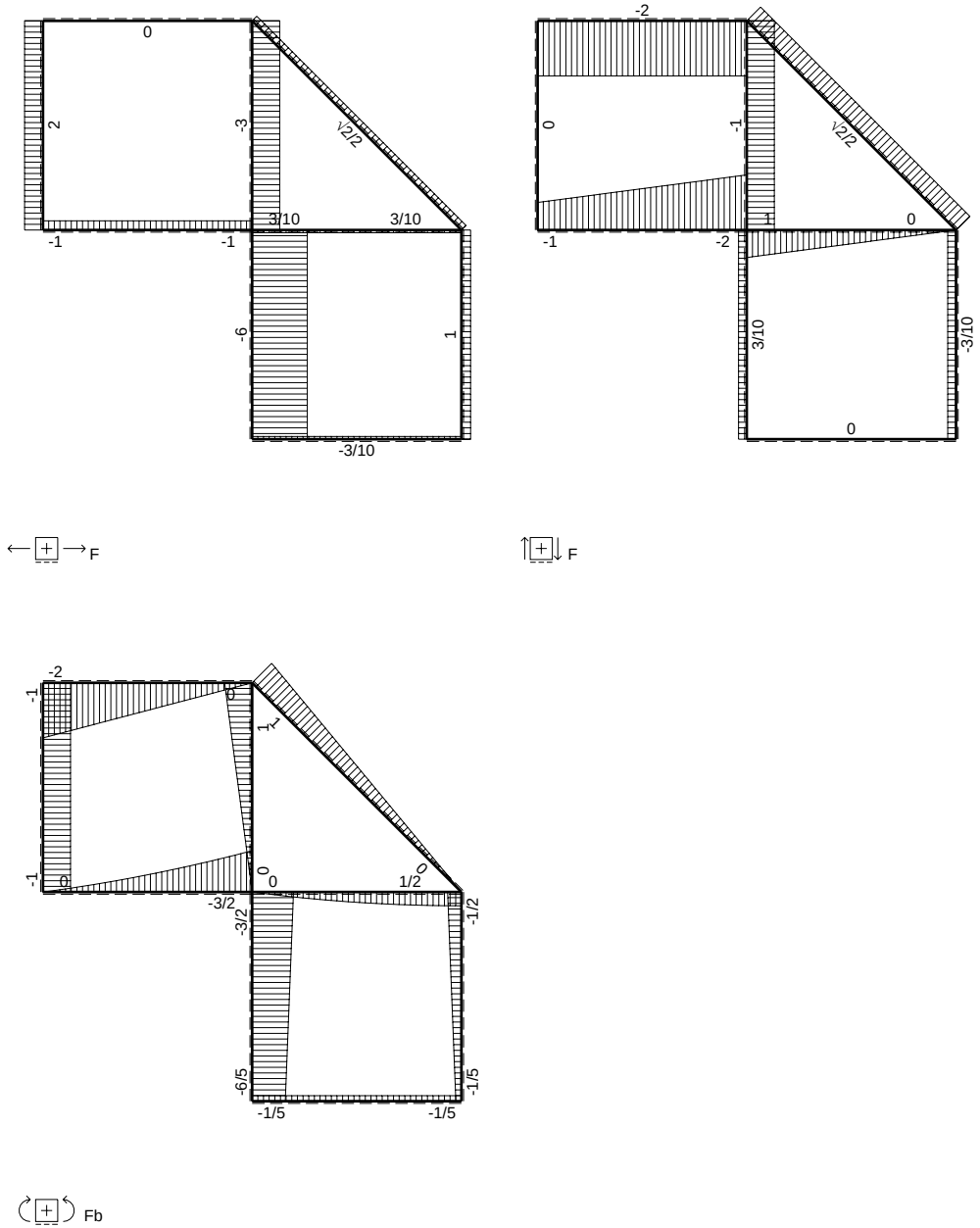


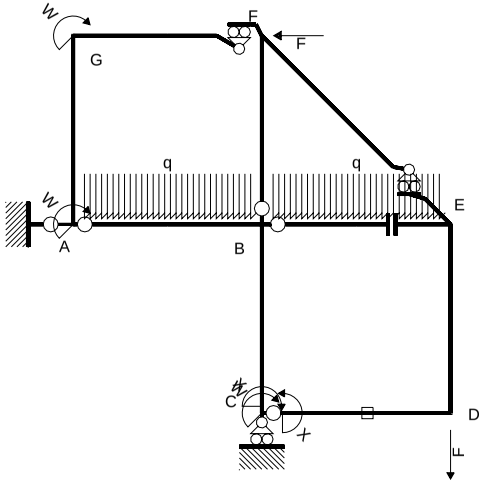
A = 114.8 mm^2
J_u = 48377. mm^4
J_v = 2333. mm^4
J_t = 86.65 mm^4
y_o = 14.74 mm
y_g = 29.7 mm
T_y = -660. N
M_x = -336600. Nmm
x_m = 12. mm
v_m = -29.7 mm
$\sigma_m = -Mv/J_u$ = -206.7 N/mm^2
y_c = 3. mm
u_c = -12. mm
v_c = -26.7 mm
$\sigma_c = -Mv/J_u$ = -206.7 N/mm^2
$\tau_c = TS^*/tJ_u$ = 8.753 N/mm^2
$\tau_g = TS^*/tJ_u$ = 8.753 N/mm^2
t_c = 330. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 207.2 N/mm^2

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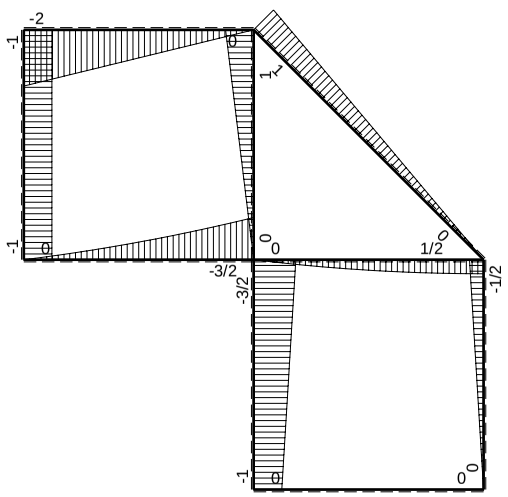
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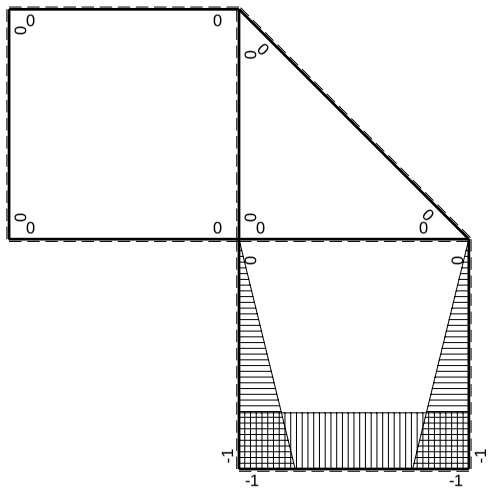

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Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-Fx-1/2qx^2$	0	0	0	0
BA b	0	$3/2Fb-2Fx+1/2qx^2$	0	0		
BC b	-x/b	$-3/2Fb+1/2Fx$	$3/2Fx-1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	$Fb+1/2Fx$	$Fb-1/2Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE 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
ED b	x/b	1/2Fb-1/2Fx	$1/2Fx-1/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	$Fx-1/2qx^2$	0	0	0	0
EB b	0	$-1/2Fb+1/2qx^2$	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/3Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				1/5Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ \ Fb^2/EJ$

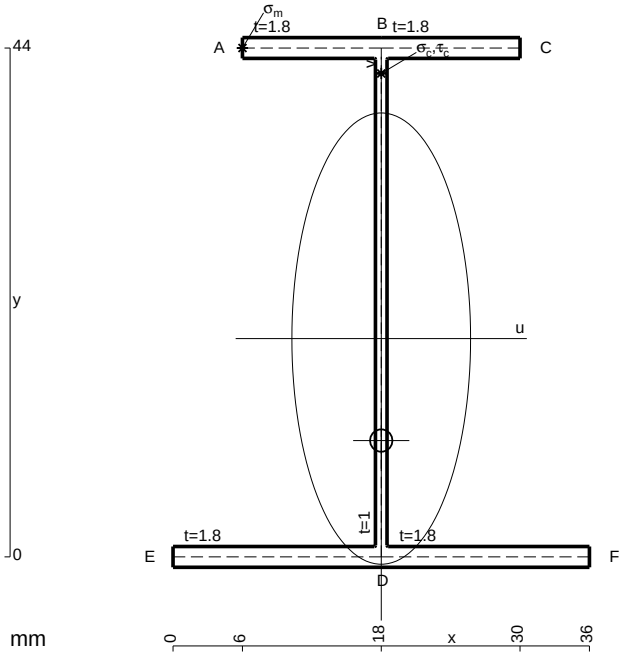
$L^{Xo}_{DE} = \int_o^b (1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/12\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/12\ \ Fb^2/EJ$

PROCEDIMENTO E RISULTATI 270433 CI02.xxxx.112

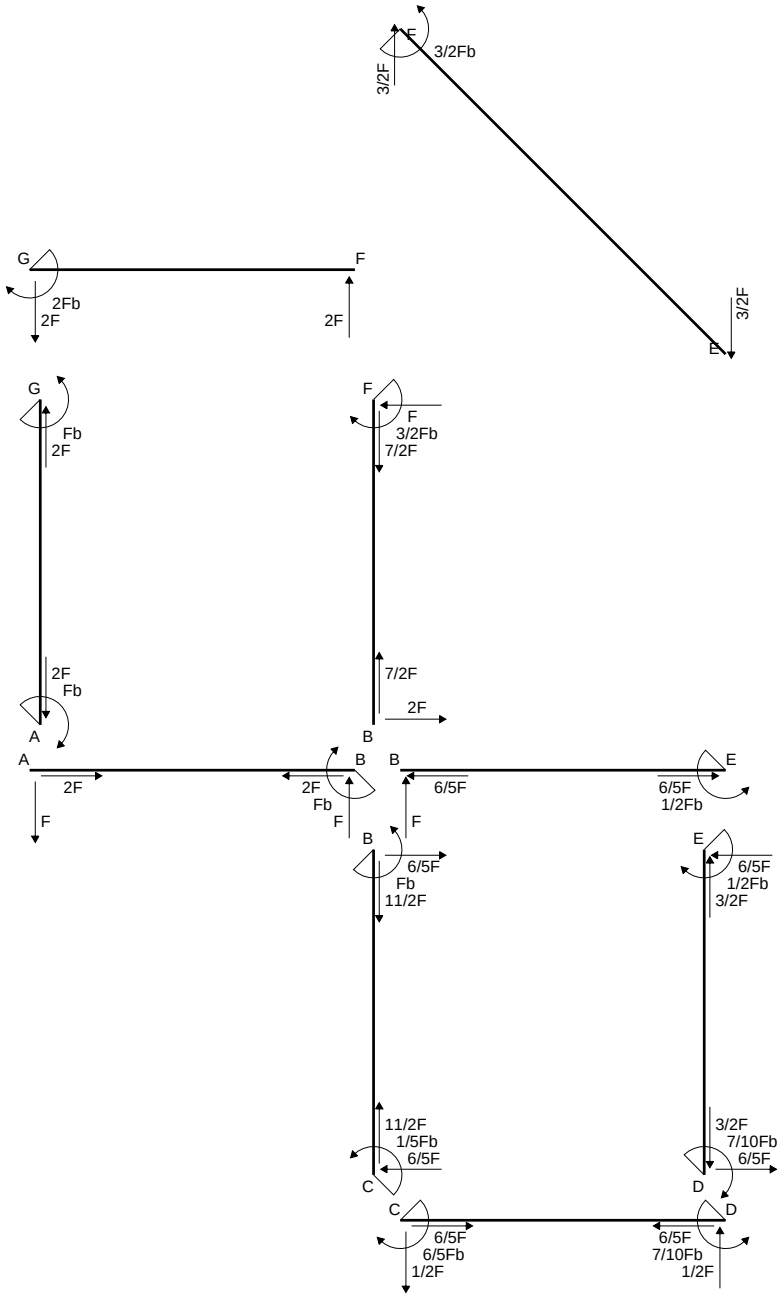


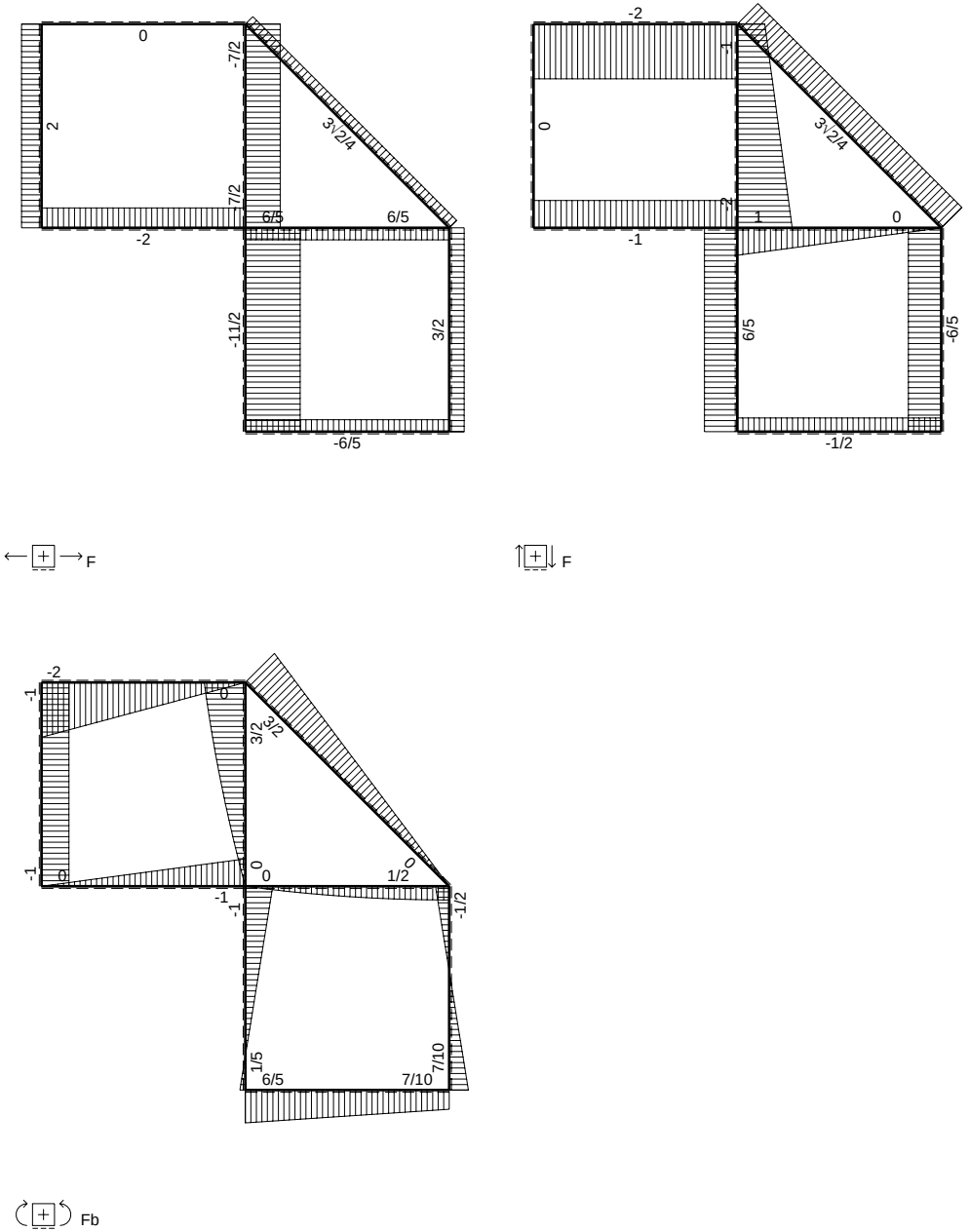
A = 152. mm^2
J_u = 57885. mm^4
J_v = 9072. mm^4
J_t = 131.3 mm^4
y_o = -8.817 mm
y_g = 18.87 mm
T_y = -1000. N
M_x = -500000. Nmm
x_m = 6. mm
y_m = 44. mm
u_m = -12. mm
v_m = 25.13 mm
$\sigma_m = -Mv/J_u$ = 217. N/mm^2
x_c = 18. mm
y_c = 44. mm
v_c = 25.13 mm
$\sigma_c = -Mv/J_u$ = 217. N/mm^2
$\tau_c = TS^*/tJ_u$ = 18.75 N/mm^2
$\tau_g = TS^*/tJ_u$ = 18.75 N/mm^2
t_c = 500. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 219.5 N/mm^2

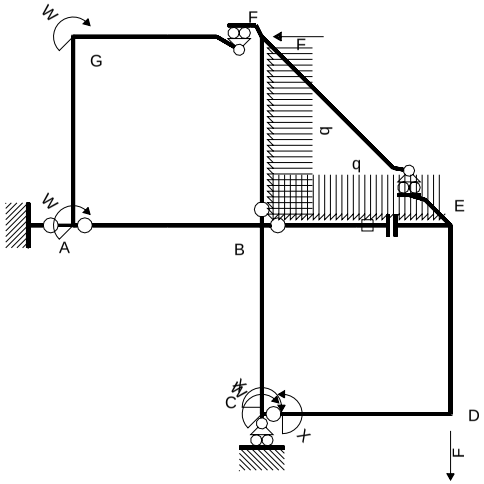
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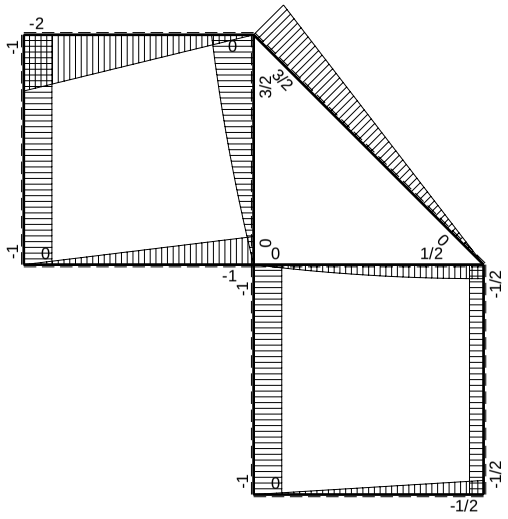
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E
3/2Fb
3/2F
G
F
2Fb
2F
2F
3/2F
E
G
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Fb
2F
F
3/2Fb
7/2F
2F
Fb
7/2F
2F
A
B
A
B
B
E
2F
2F
Fb
6/5F
6/5F
1/2Fb
F
F
B
E
6/5F
Fb
11/2F
6/5F
1/2Fb
3/2F
11/2F
1/5Fb
6/5F
3/2F
7/10Fb
6/5F
C
D
C
D
6/5F
6/5Fb
1/2F
6/5F
7/10Fb
1/2F

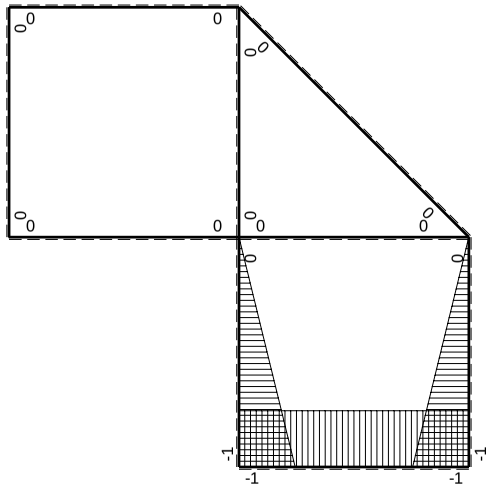

0
-7/2
2
3√2/4
7/2
6/5
6/5
-2
-11/2
3/2
-6/5
-2
-1
0
3√2/4
2
1
0
-1
6/5
-6/5
-1/2
F
F
-2
-1
0
3/2
3/2
-1
0
0
1/2
-1
-1
-1/2
1/5
6/5
7/10
7/10
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-Fx	0	0	0	0
BA b	0	Fb-Fx	0	0		
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb	Fb-Fx	$1-2x/b+x^2/b^2$		
CD b	-1	-1/2Fx	1/2Fx	1	$1/4Fb^2/EJ$	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE b	-1+x/b	-1/2Fb	1/2Fb-1/2Fx	$1-2x/b+x^2/b^2$	$1/4Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	1/2Fb	1/2Fx	x^2/b^2		
EF $\sqrt{2}$b	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	$3/2Fb-Fx-1/2qx^2$	0	0	0	0
BF b	0	$-2Fx+1/2qx^2$	0	0		
BE b	0	$Fx-1/2qx^2$	0	0	0	0
EB b	0	$-1/2Fb+1/2qx^2$	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$2Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				-6/5Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (x/b)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b)\ Fb\ 1/EJ\ = 1/2\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x/b)\ Fb\ 1/EJ\ dx = [\ x -1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 1/2\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (1/2\ x/b)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b)\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (1/2 -1/2\ x/b)\ Fb\ 1/EJ\ dx = [1/2\ x -1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

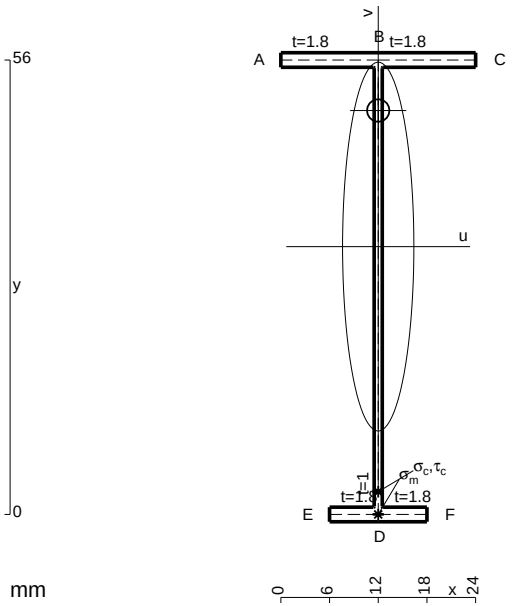
$= (1/2\ b -1/4\ b)\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2 -1/2\ x/b)\ Fb\ 1/EJ\ dx = [1/2\ x -1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/4\ b)\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x/b)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

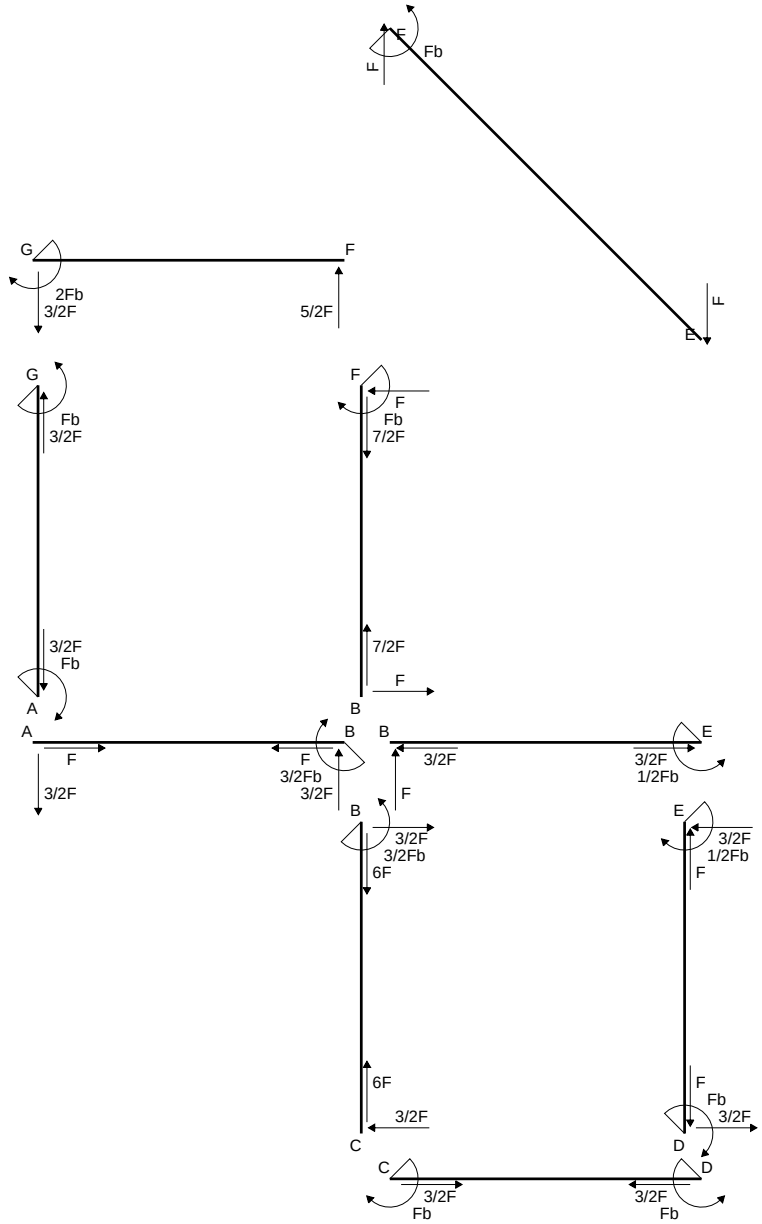
$= (1/4\ b)\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

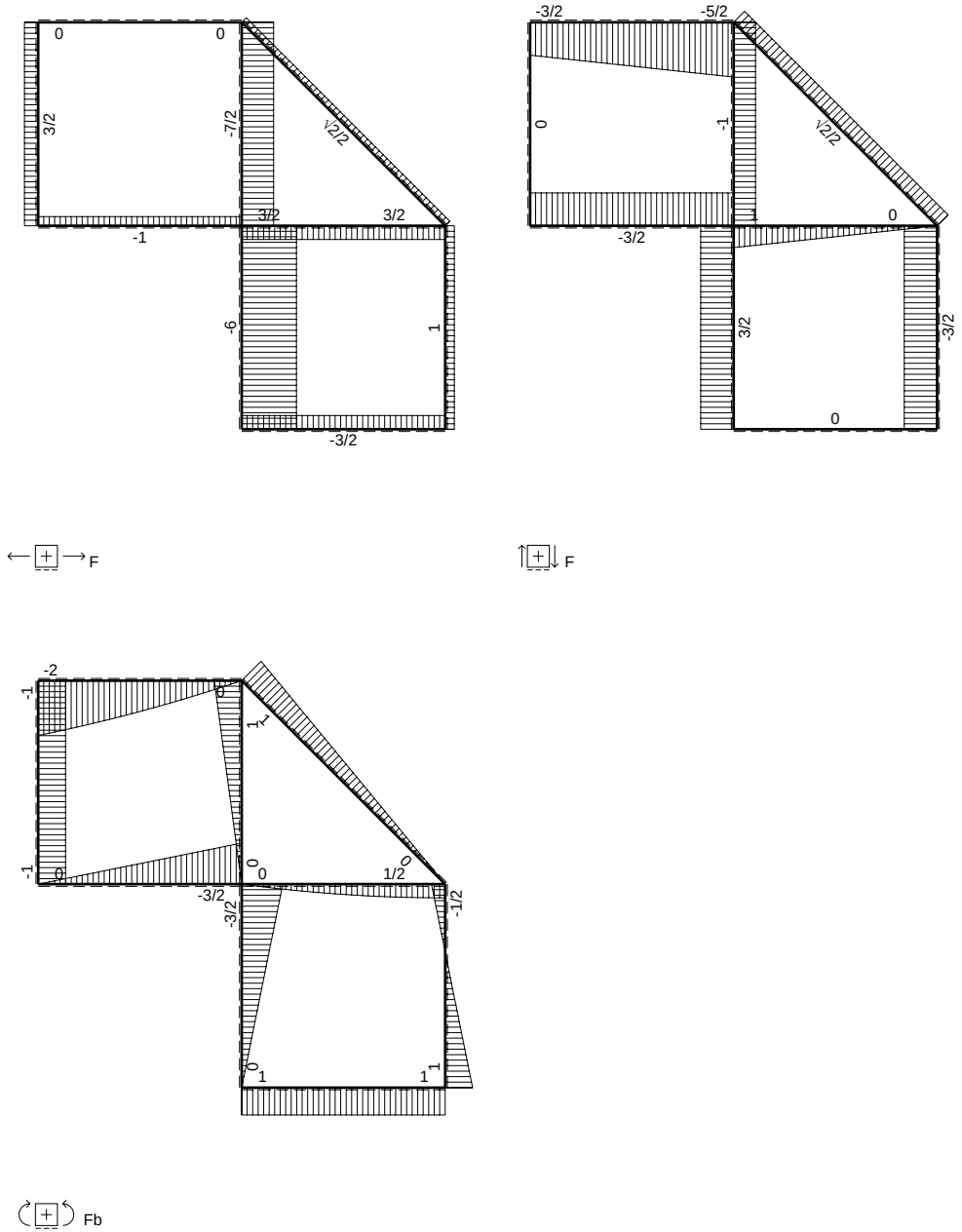


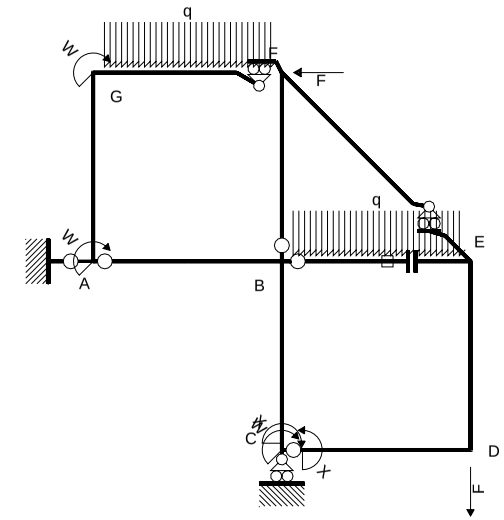
A = 120.8 mm^2
J_u = 62410. mm^4
J_v = 2333. mm^4
J_t = 88.65 mm^4
y_o = 16.77 mm
y_g = 33.01 mm
T_y = -620. N
M_x = -421600. Nmm
x_m = 12. mm
v_m = -33.01 mm
$\sigma_m = -Mv/J_u$ = -223. N/mm^2
y_c = 3. mm
u_c = -12. mm
v_c = -30.01 mm
$\sigma_c = -Mv/J_u$ = -223. N/mm^2
$\tau_c = TS^*/tJ_u$ = 7.083 N/mm^2
$\tau_g = TS^*/tJ_u$ = 7.083 N/mm^2
t_c = 310. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 223.3 N/mm^2

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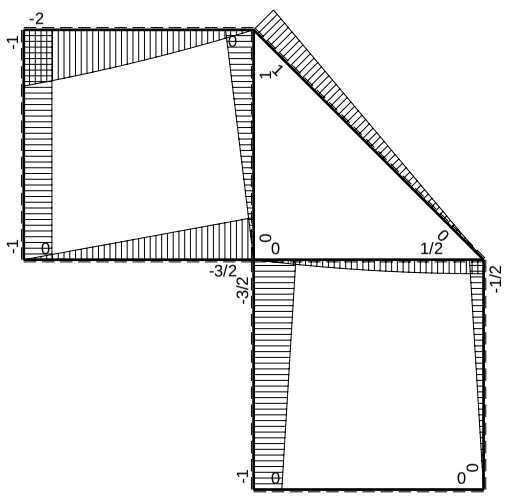
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F
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2Fb
3/2F
5/2F
F
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Fb
3/2F
F
Fb
7/2F
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Fb
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A
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B
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3/2F
3/2Fb
1/2Fb
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D
C
D
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3/2F
Fb
Fb

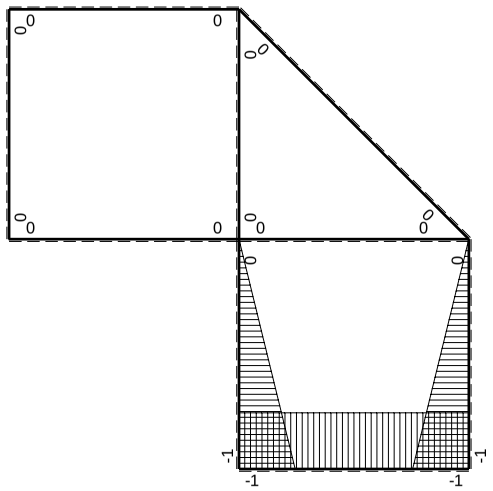

0
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3/2
-7/2
√2/2
3/2
3/2
-1
-6
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-3/2
F
-3/2
-5/2
0
-1
√2/2
1
0
-3/2
3/2
-3/2
0
F
-2
-1
0
1
1
-1
0
0
0
1/2
0
-3/2
-3/2
-1/2
0
1
1
1
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0		
BC b	-x/b	-3/2Fb+1/2Fx	$3/2Fx-1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	$Fb-1/2Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE 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
ED b	x/b	1/2Fb-1/2Fx	$1/2Fx-1/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-5/2Fx+1/2qx^2$	0	0	0	0
GF b	0	$2Fb-3/2Fx-1/2qx^2$	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	$Fx-1/2qx^2$	0	0	0	0
EB b	0	$-1/2Fb+1/2qx^2$	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$5/3Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b)\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

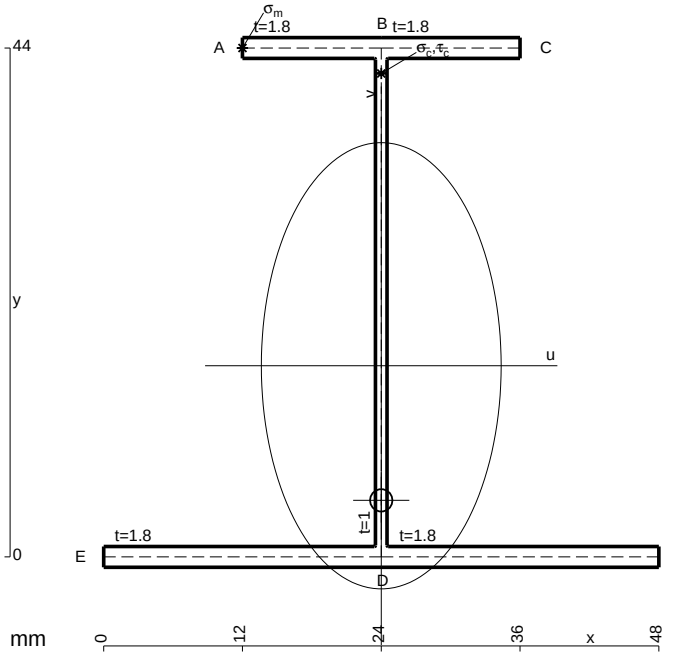
$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b -1/6\ b)\ Fb\ 1/EJ\ = 1/12\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

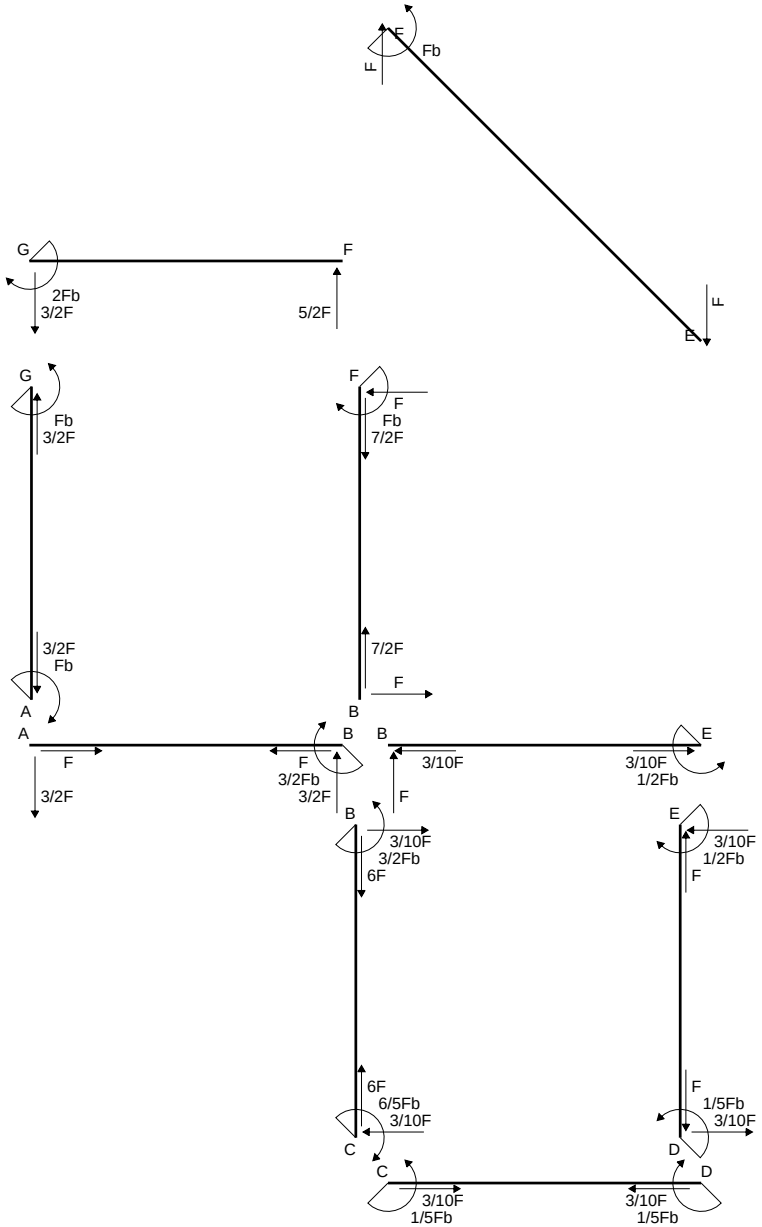
$= (1/4\ b -1/6\ b)\ Fb\ 1/EJ\ = 1/12\ Fb^2/EJ$

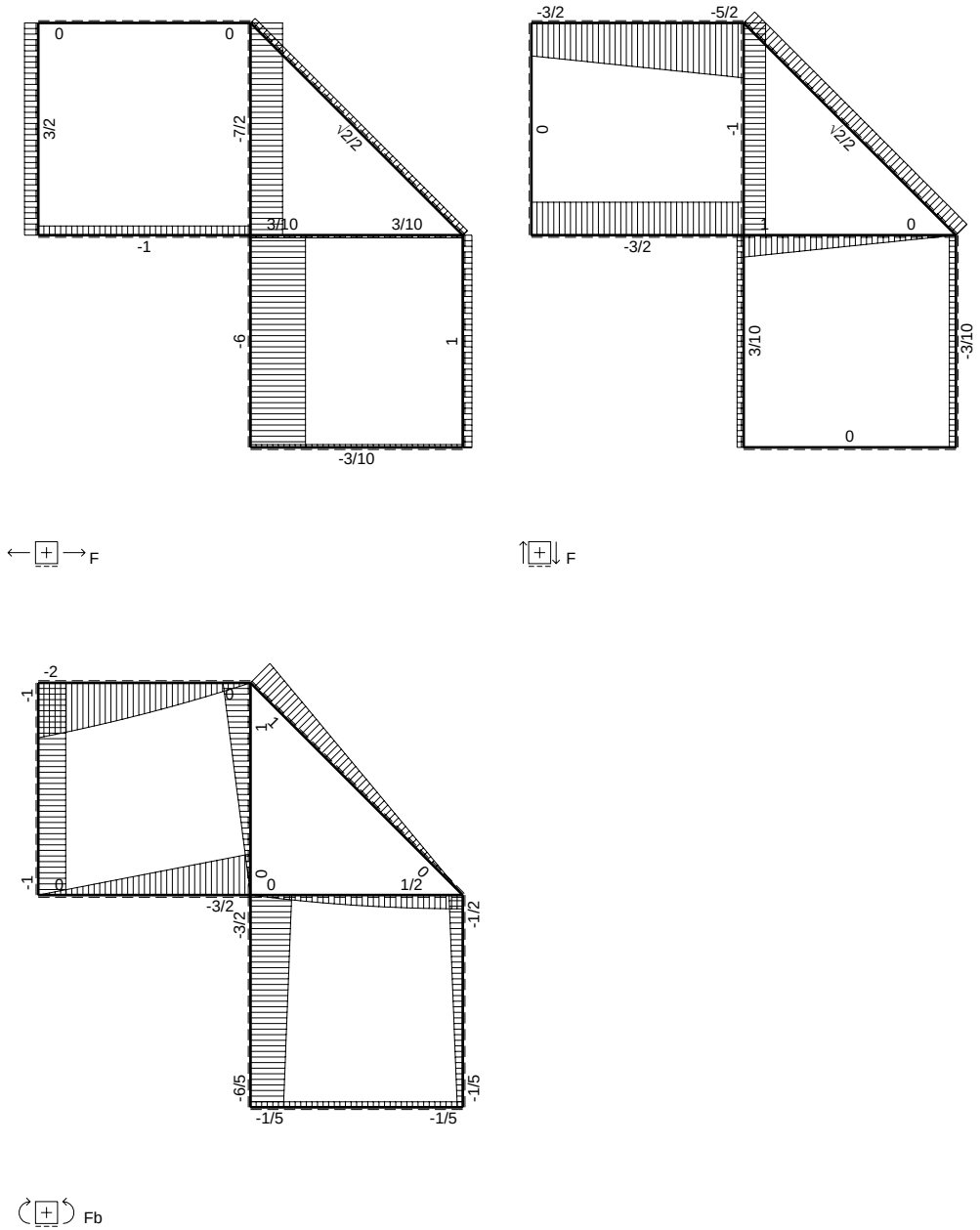


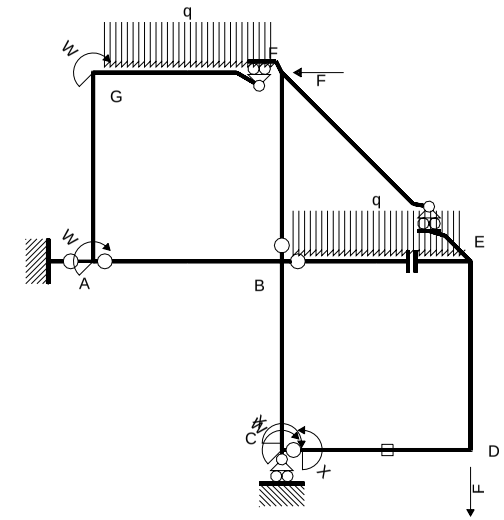
A = 173.6 mm^2
J_u = 64622. mm^4
J_v = 18662. mm^4
J_t = 154.6 mm^4
y_o = -11.64 mm
y_g = 16.53 mm
T_y = -720. N
M_x = -556800. Nmm
x_m = 12. mm
y_m = 44. mm
u_m = -12. mm
v_m = 27.47 mm
$\sigma_m = -Mv/J_u$ = 236.7 N/mm^2
x_c = 24. mm
y_c = 44. mm
v_c = 27.47 mm
$\sigma_c = -Mv/J_u$ = 236.7 N/mm^2
$\tau_c = TS^*/tJ_u$ = 13.22 N/mm^2
$\tau_g = TS^*/tJ_u$ = 13.22 N/mm^2
t_c = 480. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 237.8 N/mm^2

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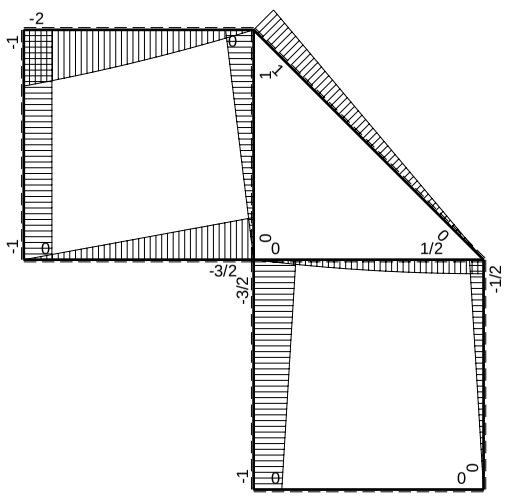
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F
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2Fb
3/2F
5/2F
G
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Fb
3/2F
F
Fb
7/2F
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Fb
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B
A
B
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F
1/5Fb
3/10F
C
D
C
D
3/10F
1/5Fb
3/10F
1/5Fb

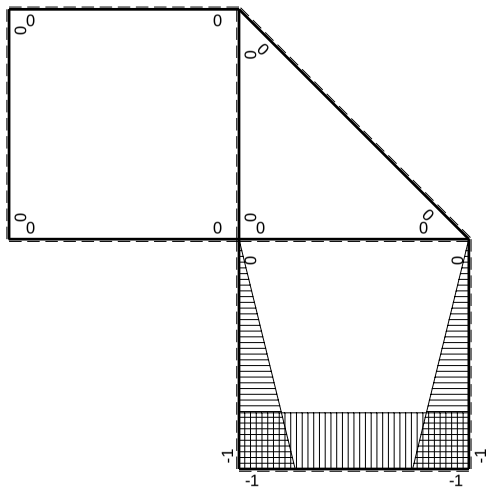

0
0
3/2
-7/2
√2/2
3/10
3/10
-1
-6
1
-3/10
F
-3/2
-5/2
0
-1
√2/2
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0
3/10
-3/10
0
F
-2
-1
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1/2
-3/2
-3/2
-1/2
-6/5
-1/5
-1/5
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0		
BC b	-x/b	-3/2Fb+1/2Fx	$3/2Fx-1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	$Fb-1/2Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE 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
ED b	x/b	1/2Fb-1/2Fx	$1/2Fx-1/2Fx^2/b$	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	$-5/2Fx+1/2qx^2$	0	0	0	0
GF b	0	$2Fb-3/2Fx-1/2qx^2$	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	$Fx-1/2qx^2$	0	0	0	0
EB b	0	$-1/2Fb+1/2qx^2$	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/3Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				1/5Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x]_o^b\ 1/EJ$

$= (\ b)\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x]_o^b\ 1/EJ$

$= (\ b)\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b)\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2]_o^b\ Fb\ 1/EJ$

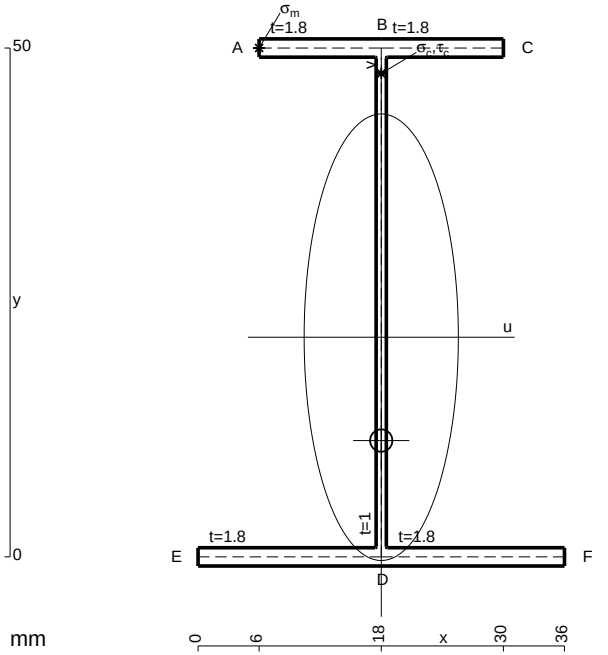
$= (\ b -1/4\ b -1/6\ b)\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/6\ x^3/b^2]_o^b\ Fb\ 1/EJ$

$= (1/4\ b -1/6\ b)\ Fb\ 1/EJ\ = 1/12\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/6\ x^3/b^2]_o^b\ Fb\ 1/EJ$

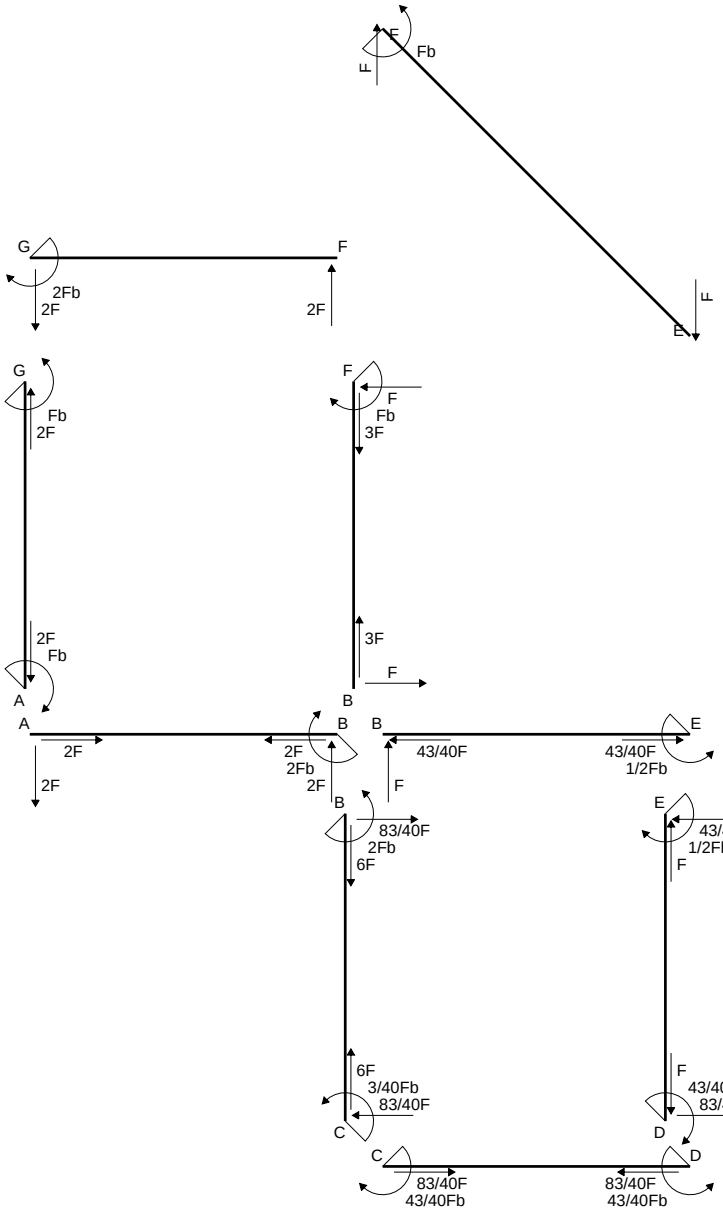
$= (1/4\ b -1/6\ b)\ Fb\ 1/EJ\ = 1/12\ Fb^2/EJ$

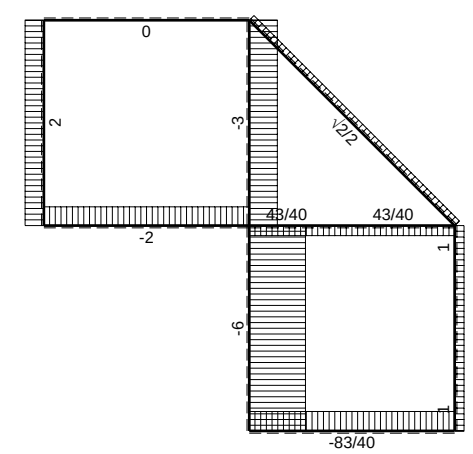


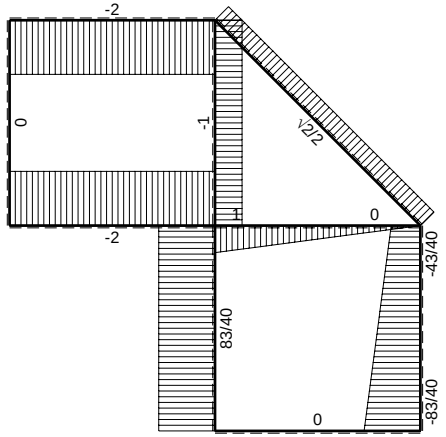
A = 158. mm^2
J_u = 76071. mm^4
J_v = 9072. mm^4
J_t = 133.3 mm^4
y_o = -10.15 mm
y_g = 21.58 mm
T_y = -570. N
M_x = -532000. Nmm
x_m = 6. mm
y_m = 50. mm
u_m = -12. mm
v_m = 28.42 mm
$\sigma_m = -Mv/J_u$ = 198.7 N/mm^2
x_c = 18. mm
y_c = 50. mm
v_c = 28.42 mm
$\sigma_c = -Mv/J_u$ = 198.7 N/mm^2
$\tau_c = TS^*/tJ_u$ = 9.199 N/mm^2
$\tau_g = TS^*/tJ_u$ = 9.199 N/mm^2
t_c = 380. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 199.4 N/mm^2

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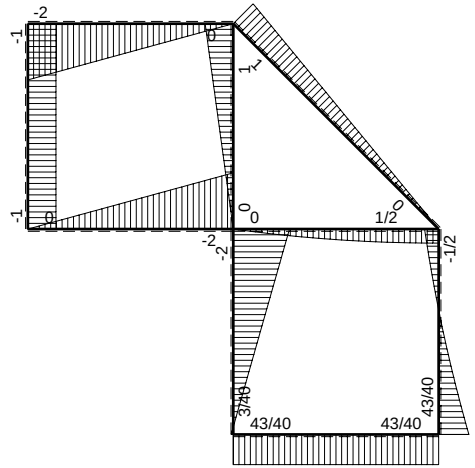

F
Fb
F
E
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2Fb
2F
2F
G
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Fb
2F
Fb
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3F
Fb
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A
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B
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2F
2F
43/40F
43/40F
2F
2Fb
1/2Fb
2F
F
B
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83/40F
43/40F
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1/2Fb
6F
F
6F
F
3/40Fb
43/40Fb
83/40F
83/40F
C
D
C
D
83/40F
83/40F
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-2
1
-6
1
-83/40

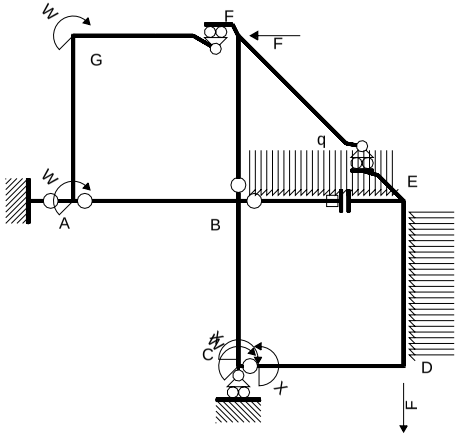

-2
0
-1
√2/2
1
0
-2
-43/40
83/40
-83/40
0

F

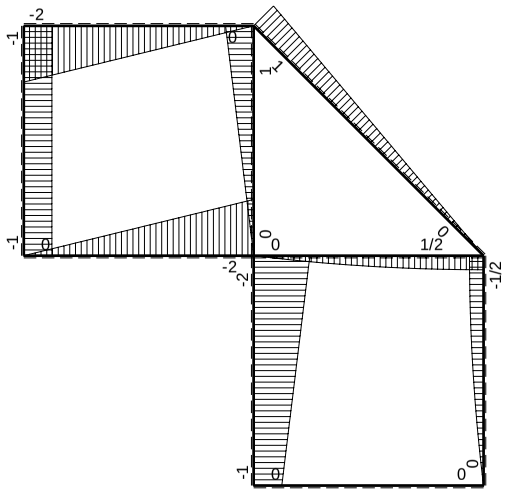
F


-2
-1
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-1
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0
1/2
-2
-2
-1/2
3/40
43/40
43/40
43/40

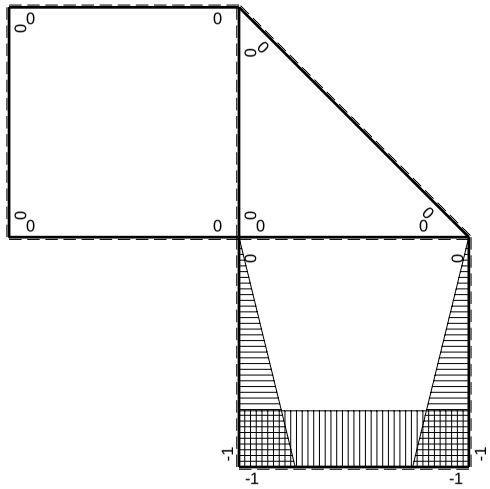
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0		
BC b	-x/b	-2Fb+Fx	$2Fx-Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+Fx	$Fb-Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	$-Fx+1/2qx^2$	$Fx-3/2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$1/8Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$1/2Fb-1/2qx^2$	$1/2Fx-1/2qx^3/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	$Fx-1/2qx^2$	0	0	0	0
EB b	0	$-1/2Fb+1/2qx^2$	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$43/24Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				-43/40Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (2\ x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

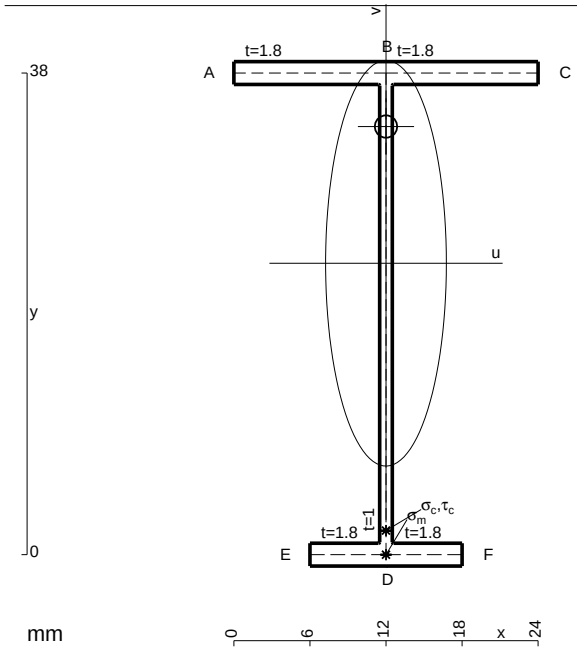
$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (\ x/b -3/2\ x^2/b^2 +1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/2\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/2\ b +1/8\ b\ )\ Fb\ 1/EJ\ = 1/8\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x/b -1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

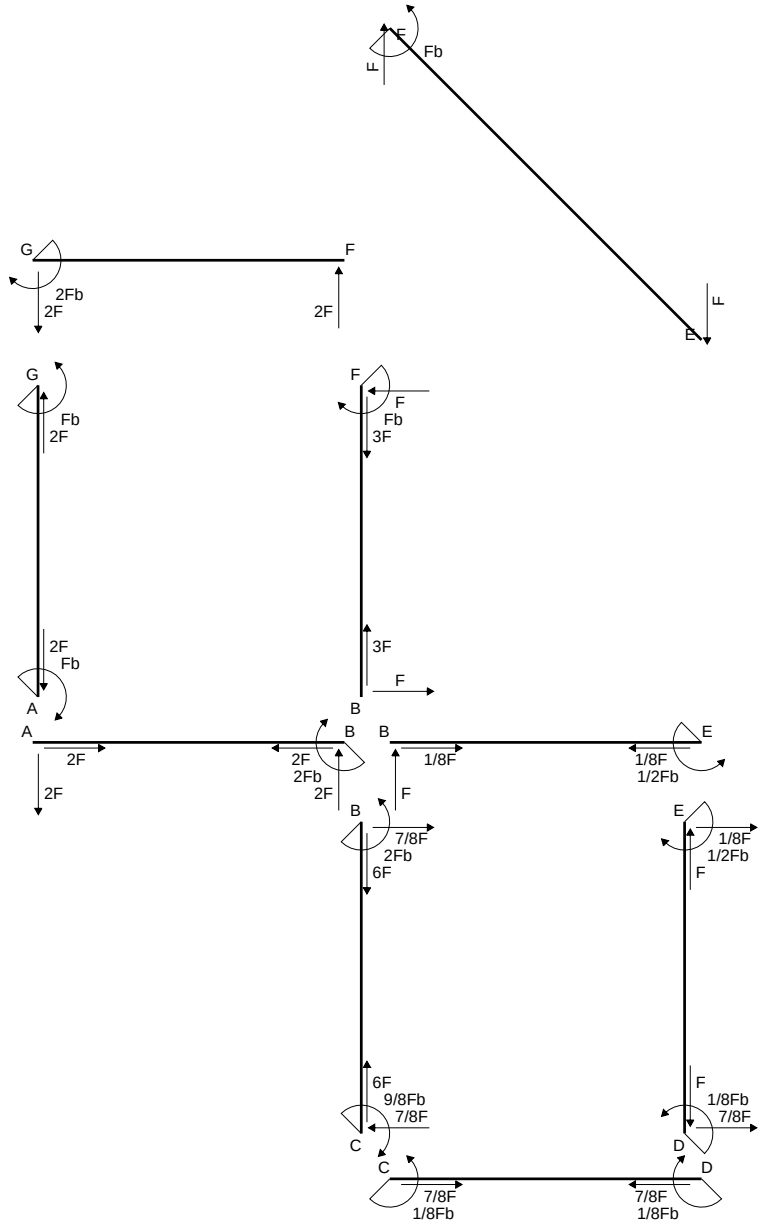
$= (1/4\ b -1/8\ b\ )\ Fb\ 1/EJ\ = 1/8\ Fb^2/EJ$

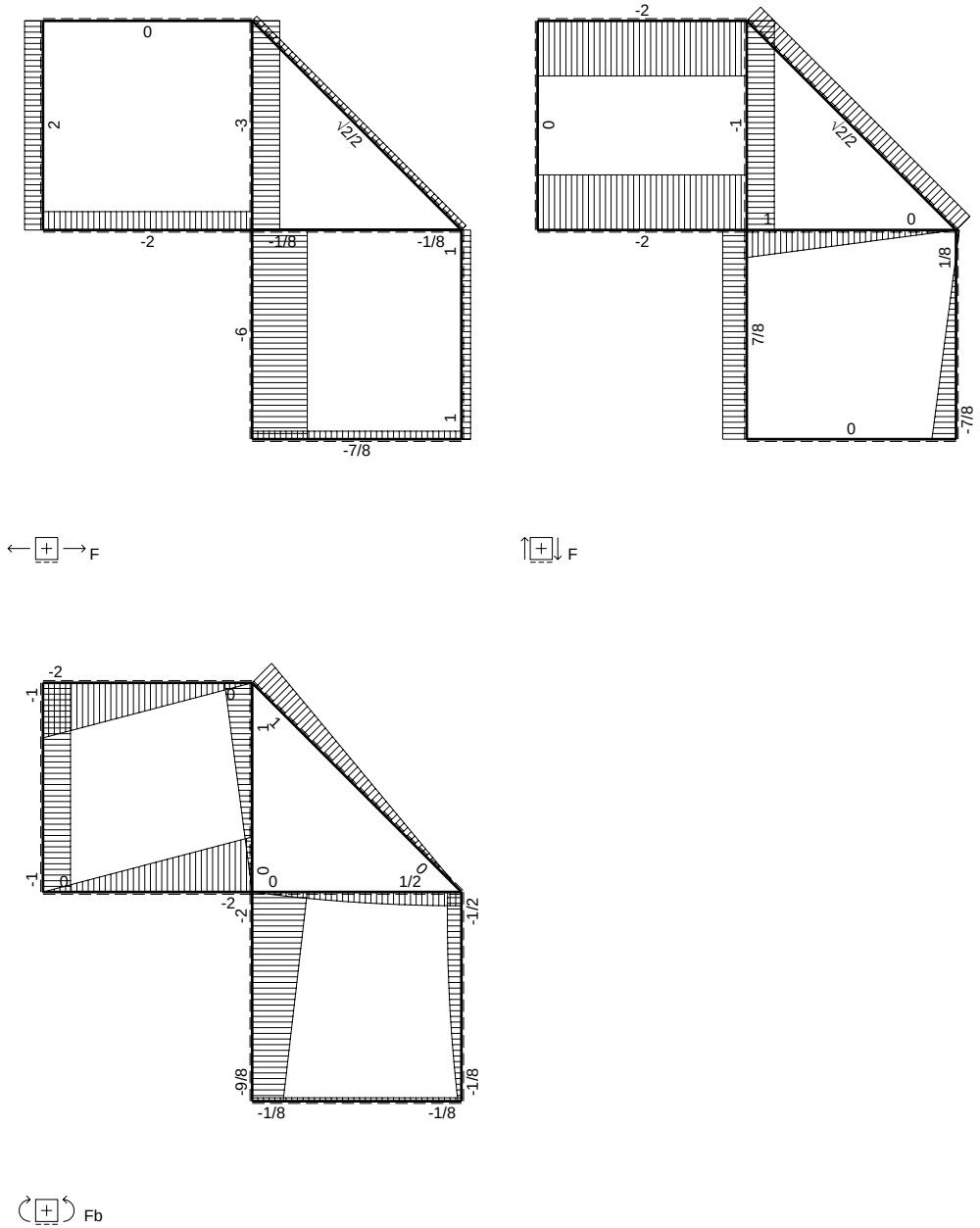


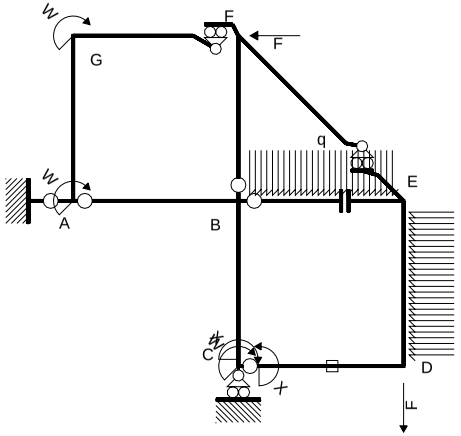
A = 102.8 mm^2
J_u = 26327. mm^4
J_v = 2333. mm^4
J_t = 82.65 mm^4
y_o = 10.79 mm
y_g = 22.99 mm
N = -400. N
T_y = -400. N
M_x = -228000. Nmm
x_m = 12. mm
v_m = -22.99 mm
$\sigma_m = N/A - Mv/J_u$ = -203. N/mm^2
y_c = 3. mm
u_c = -12. mm
v_c = -19.99 mm
$\sigma_c = N/A - Mv/J_u$ = -203. N/mm^2
$\tau_c = TS^*/tJ_u$ = 7.546 N/mm^2
$\tau_g = TS^*/tJ_u$ = 7.546 N/mm^2
t_c = 200. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 203.4 N/mm^2

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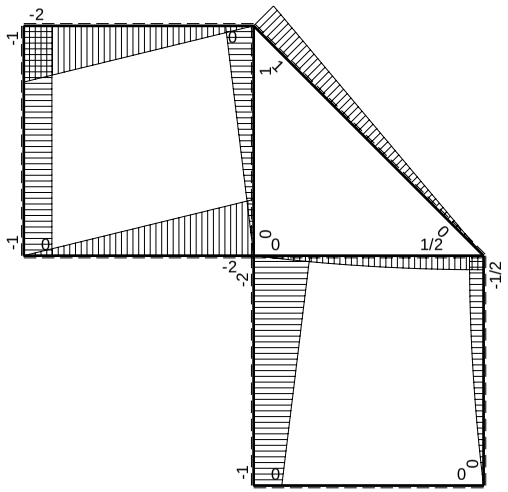
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2Fb
2F
2F
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3F
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6F
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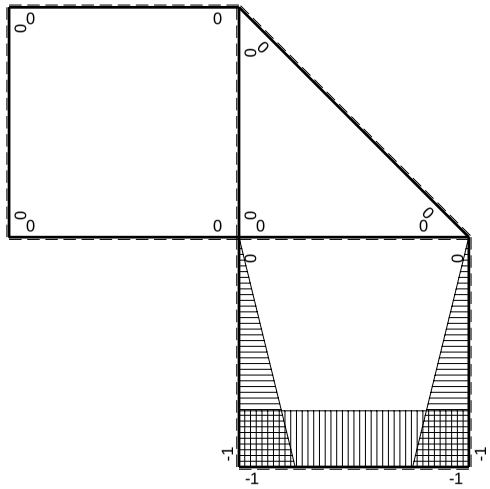

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√2/2
-2
1
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1/8
7/8
0
-7/8
F
-2
-1
0
1
-1
0
0
0
1/2
-2
-2
-1/2
-9/8
-1/8
-1/8
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0		
BC b	-x/b	-2Fb+Fx	$2Fx-Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	$Fb-Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	$-Fx+1/2qx^2$	$Fx-3/2Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$1/8Fb^2/EJ$	1/3Xb/EJ
ED b	x/b	$1/2Fb-1/2qx^2$	$1/2Fx-1/2qx^3/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	$Fx-1/2qx^2$	0	0	0	0
EB b	0	$-1/2Fb+1/2qx^2$	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-5/24Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				1/8Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (2\ x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ \ Fb^2/EJ$

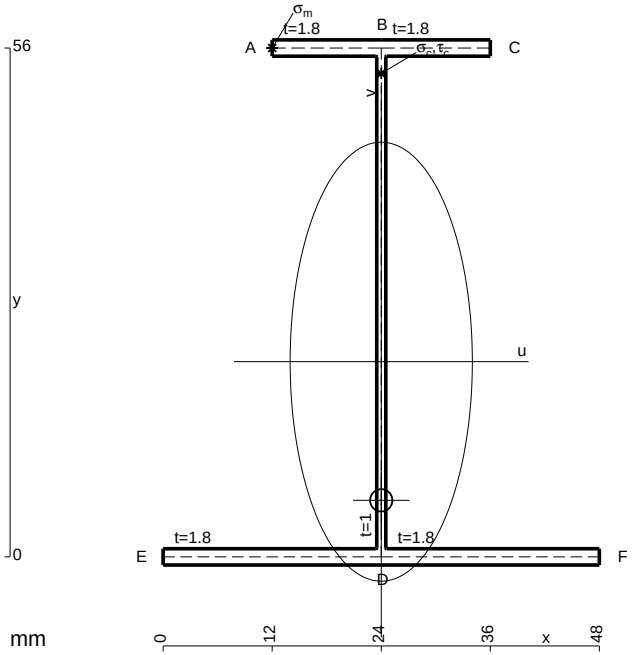
$L^{Xo}_{DE} = \int_o^b (\ x/b -3/2\ x^2/b^2 +1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b -1/2\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/2\ b +1/8\ b\ )\ Fb\ 1/EJ\ = 1/8\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x/b -1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b -1/8\ b\ )\ Fb\ 1/EJ\ = 1/8\ \ Fb^2/EJ$

PROCEDIMENTO E RISULTATI 247897 CI02.xxxx.117

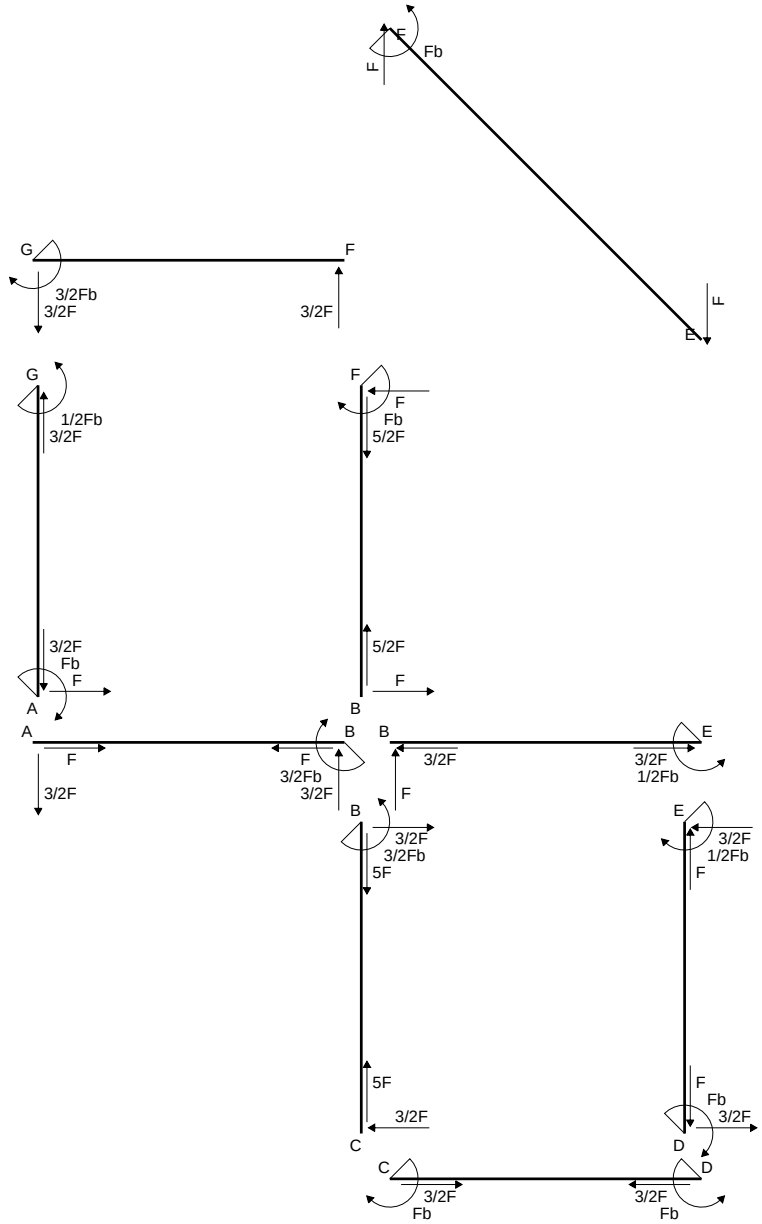


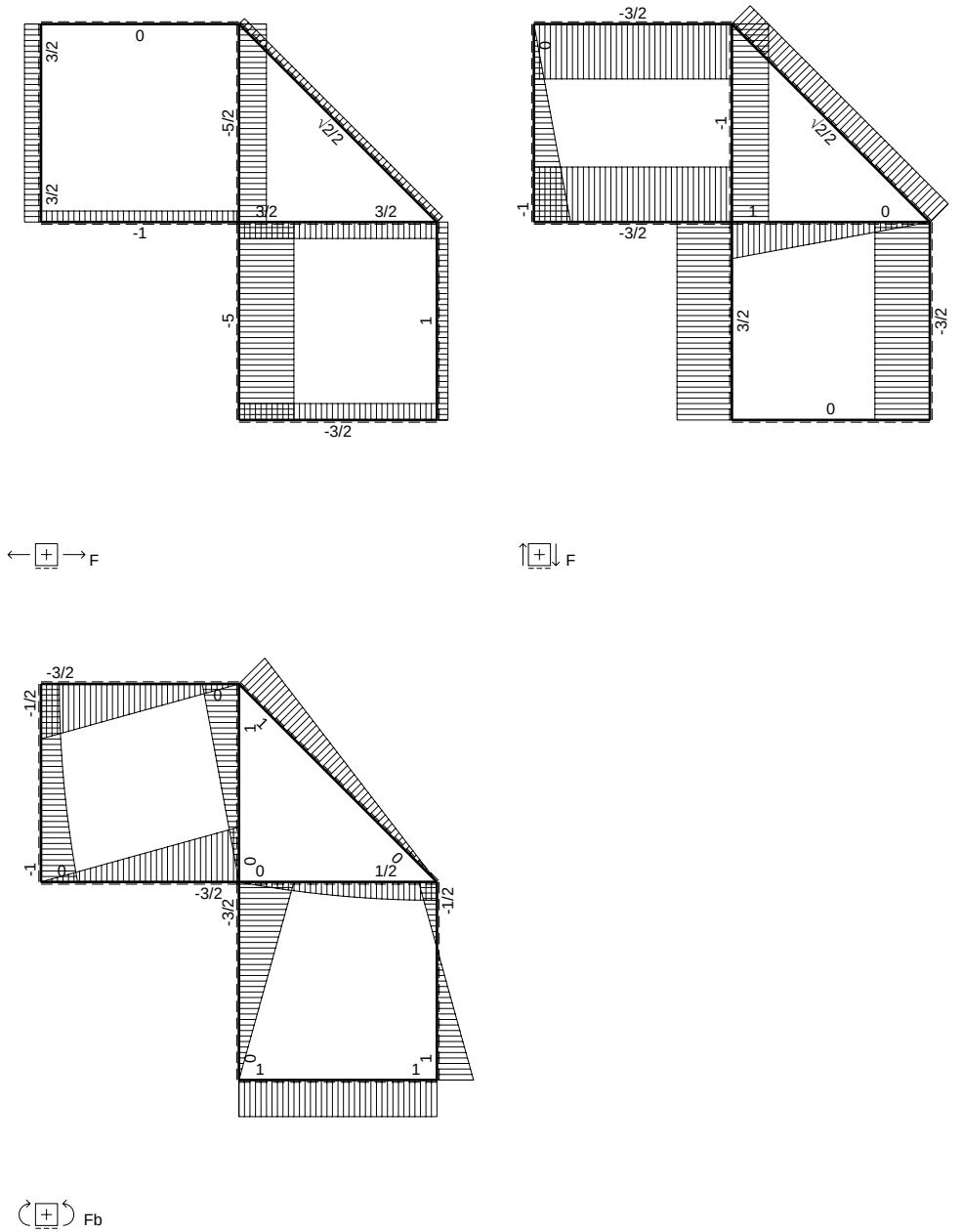
A = 185.6 mm^2
J_u = 108358. mm^4
J_v = 18662. mm^4
J_t = 158.6 mm^4
y_o = -15.26 mm
y_g = 21.48 mm
T_y = -760. N
M_x = -684000. Nmm
x_m = 12. mm
y_m = 56. mm
u_m = -12. mm
v_m = 34.52 mm
$\sigma_m = -Mv/J_u$ = 217.9 N/mm^2
x_c = 24. mm
y_c = 56. mm
v_c = 34.52 mm
$\sigma_c = -Mv/J_u$ = 217.9 N/mm^2
$\tau_c = TS^*/tJ_u$ = 10.46 N/mm^2
$\tau_g = TS^*/tJ_u$ = 10.46 N/mm^2
t_c = 380. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 218.6 N/mm^2

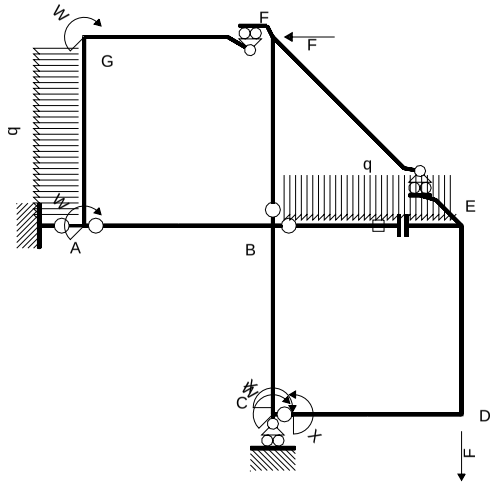
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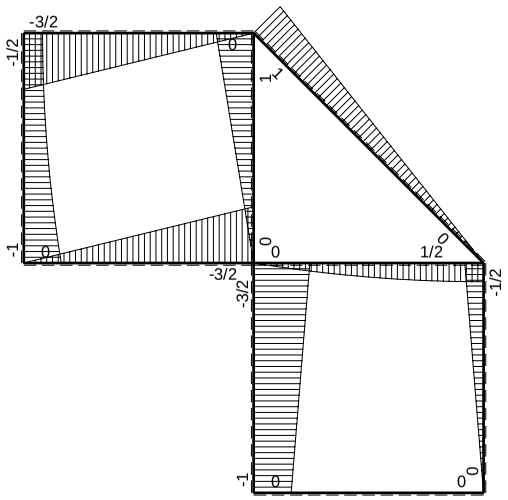
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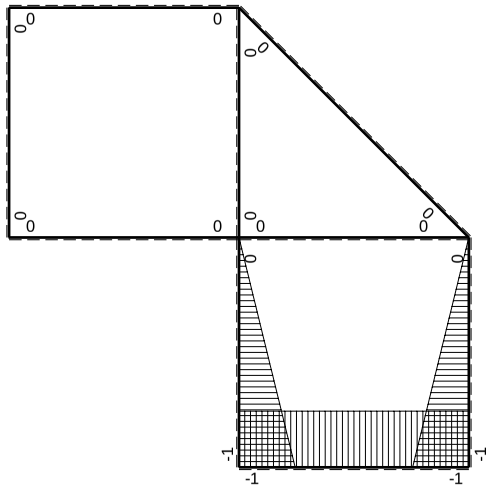

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Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0		
BC b	-x/b	-3/2Fb+1/2Fx	$3/2Fx-1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	$Fb-1/2Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE 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
ED b	x/b	1/2Fb-1/2Fx	$1/2Fx-1/2Fx^2/b$	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-3/2Fx	0	0	0	0
GF b	0	3/2Fb-3/2Fx	0	0		
GA b	0	$-1/2Fb-1/2qx^2$	0	0	0	0
AG b	0	$Fb-Fx+1/2qx^2$	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	$Fx-1/2qx^2$	0	0	0	0
EB b	0	$-1/2Fb+1/2qx^2$	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$5/3Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

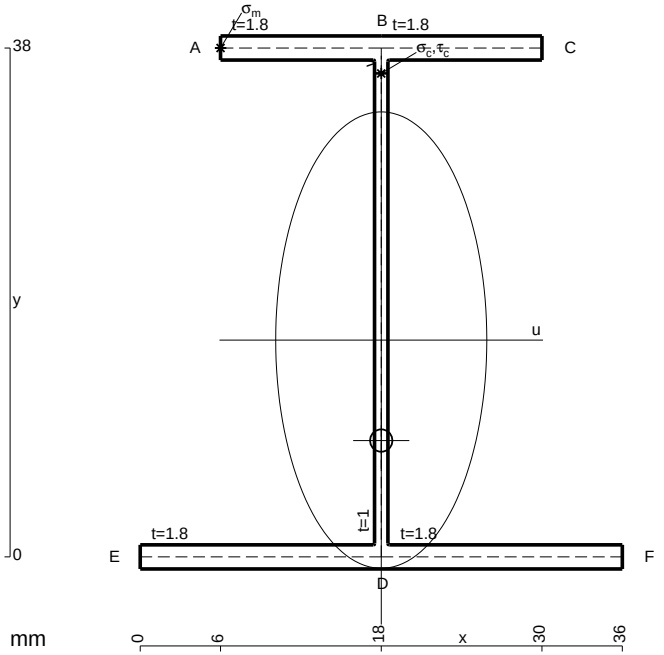
$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/12\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

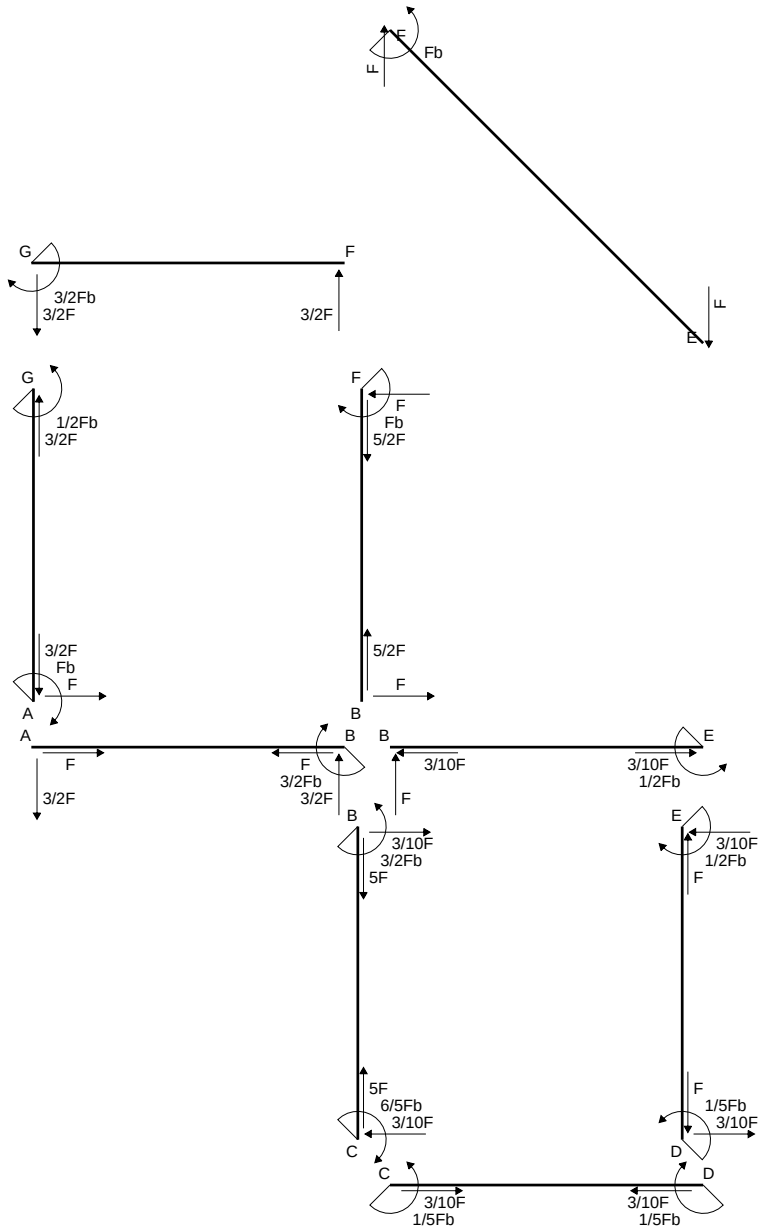
$= (1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/12\ \ Fb^2/EJ$

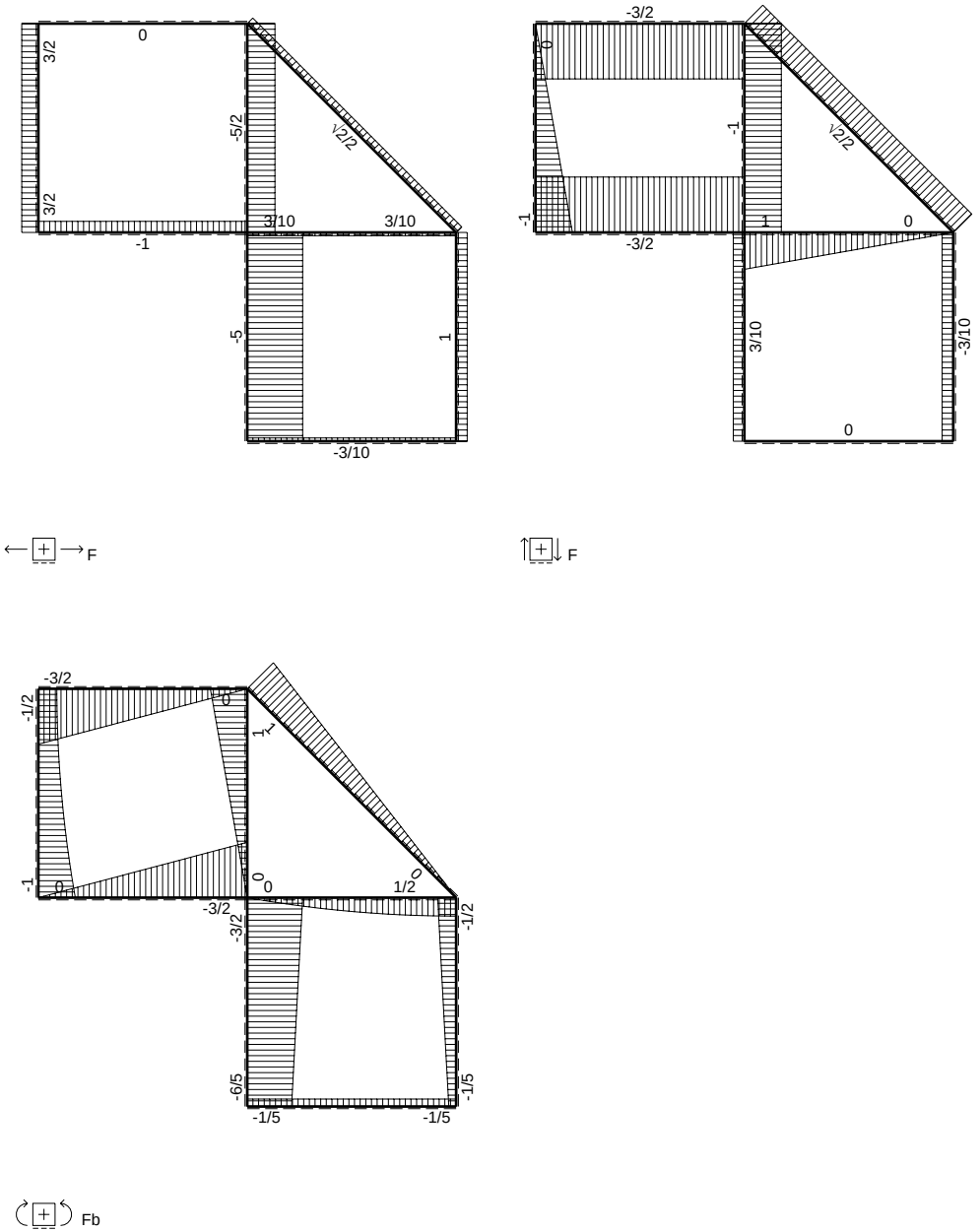


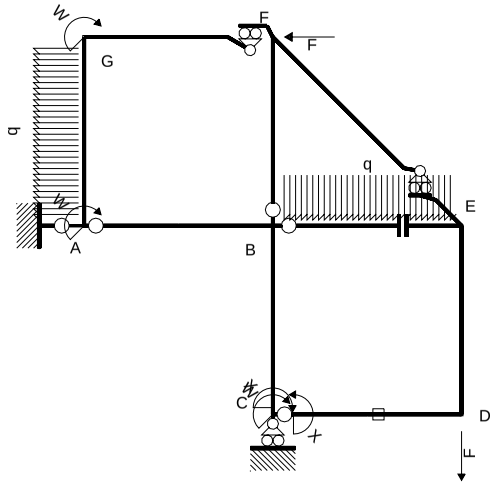
A = 146. mm^2
J_u = 42407. mm^4
J_v = 9072. mm^4
J_t = 129.3 mm^4
y_o = -7.503 mm
y_g = 16.19 mm
T_y = -690. N
M_x = -441600. Nmm
x_m = 6. mm
y_m = 38. mm
u_m = -12. mm
v_m = 21.81 mm
$\sigma_m = -Mv/J_u$ = 227.1 N/mm^2
x_c = 18. mm
y_c = 38. mm
v_c = 21.81 mm
$\sigma_c = -Mv/J_u$ = 227.1 N/mm^2
$\tau_c = TS^*/tJ_u$ = 15.33 N/mm^2
$\tau_g = TS^*/tJ_u$ = 15.33 N/mm^2
t_c = 460. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 228.7 N/mm^2

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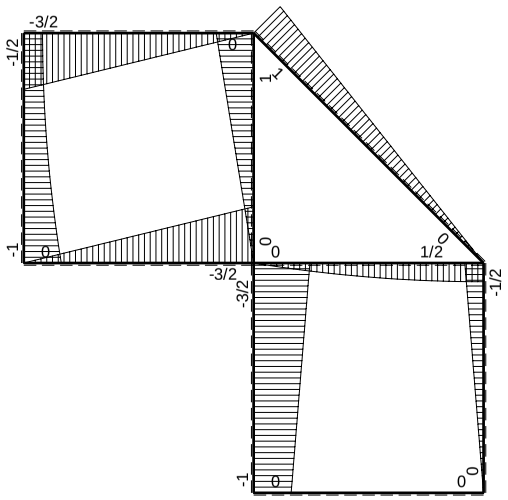
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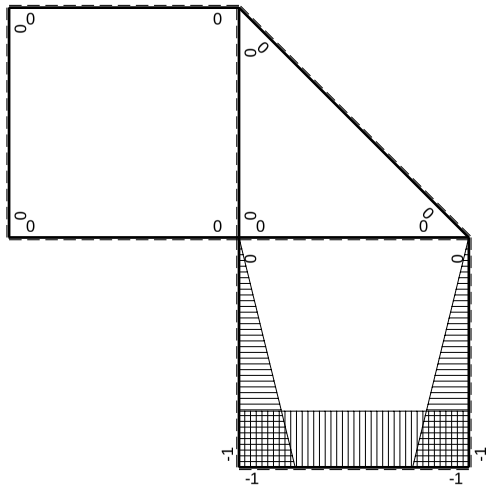

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-1/5
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0		
BC b	-x/b	-3/2Fb+1/2Fx	$3/2Fx-1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	$Fb-1/2Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE 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
ED b	x/b	1/2Fb-1/2Fx	$1/2Fx-1/2Fx^2/b$	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-3/2Fx	0	0	0	0
GF b	0	3/2Fb-3/2Fx	0	0		
GA b	0	$-1/2Fb-1/2qx^2$	0	0	0	0
AG b	0	$Fb-Fx+1/2qx^2$	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	$Fx-1/2qx^2$	0	0	0	0
EB b	0	$-1/2Fb+1/2qx^2$	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/3Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				1/5Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

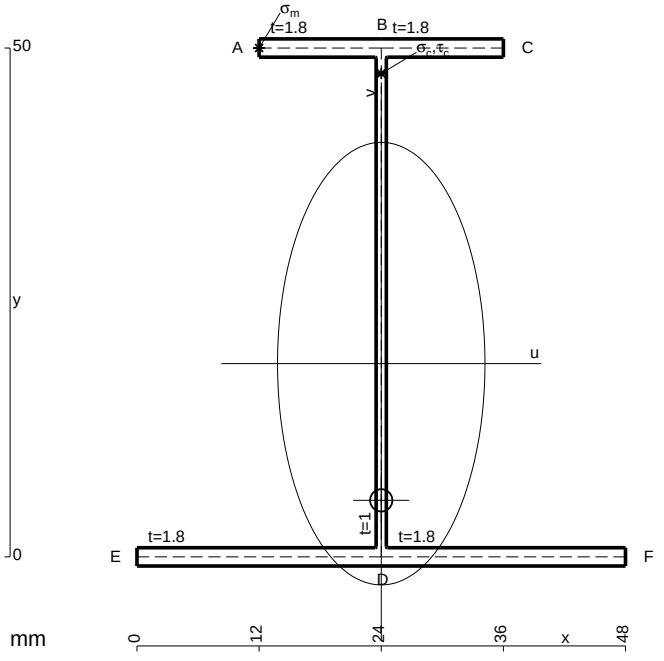
$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/12\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

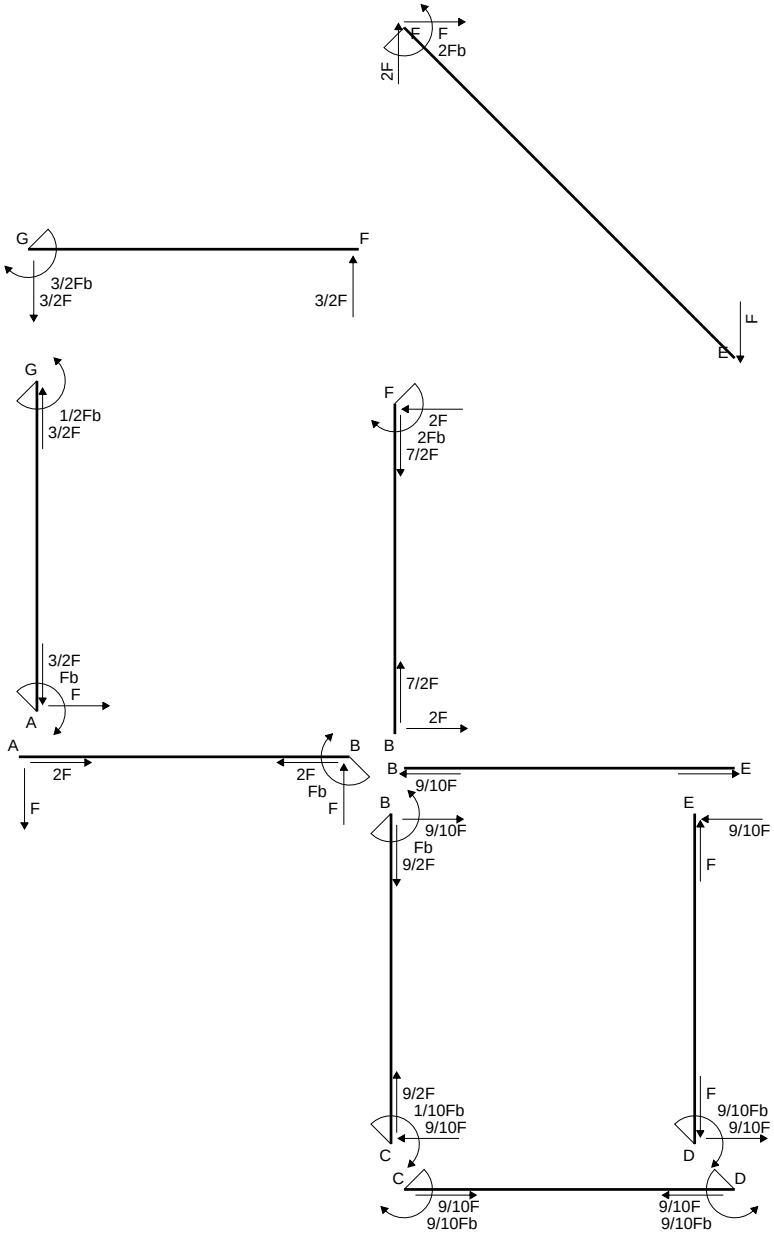
$= (1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/12\ \ Fb^2/EJ$

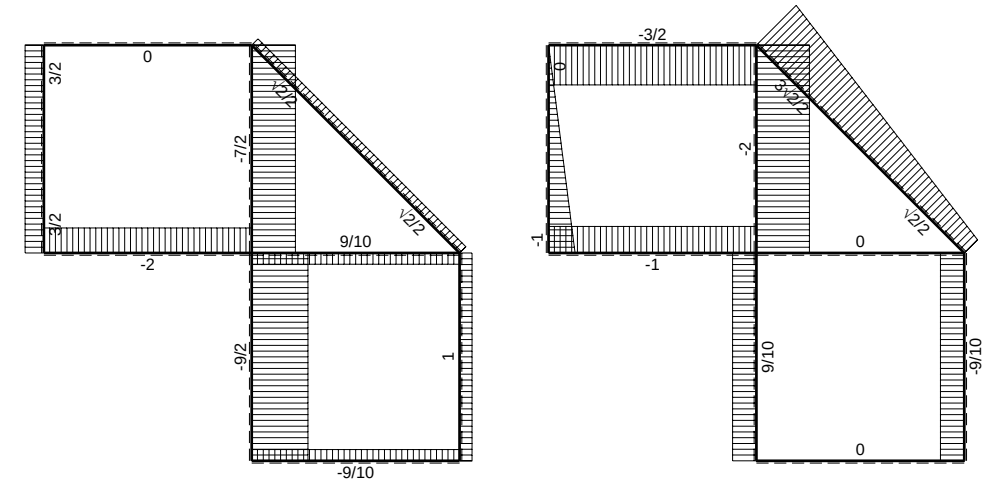


A = 179.6 mm^2
J_u = 84922. mm^4
J_v = 18662. mm^4
J_t = 156.6 mm^4
y_o = -13.43 mm
y_g = 18.99 mm
T_y = -735. N
M_x = -654150. Nmm
x_m = 12. mm
y_m = 50. mm
u_m = -12. mm
v_m = 31.01 mm
$\sigma_m = -Mv/J_u$ = 238.9 N/mm^2
x_c = 24. mm
y_c = 50. mm
v_c = 31.01 mm
$\sigma_c = -Mv/J_u$ = 238.9 N/mm^2
$\tau_c = TS^*/tJ_u$ = 11.6 N/mm^2
$\tau_g = TS^*/tJ_u$ = 11.6 N/mm^2
t_c = 490. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 239.7 N/mm^2

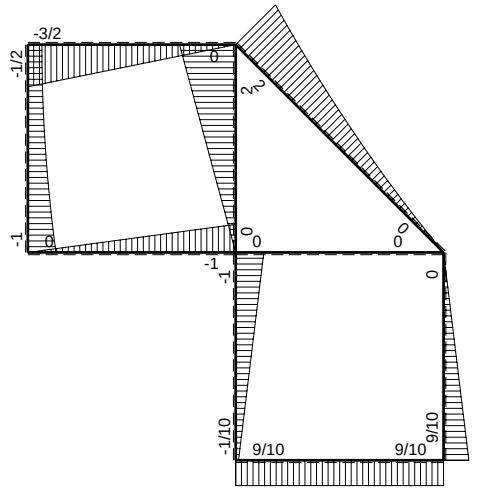
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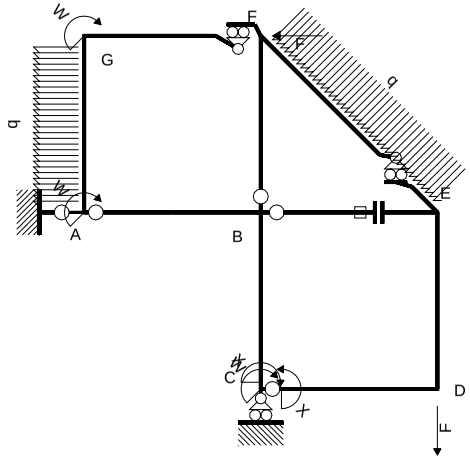

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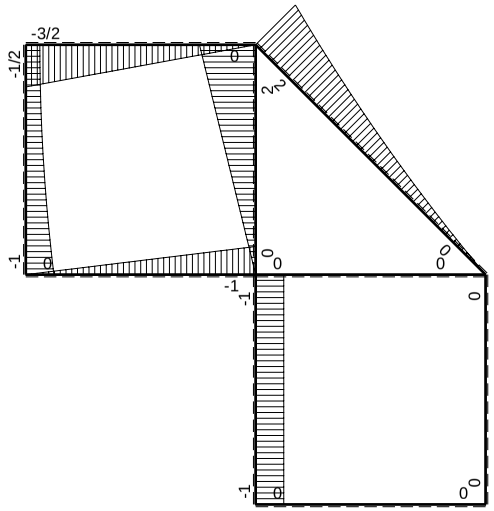
F F


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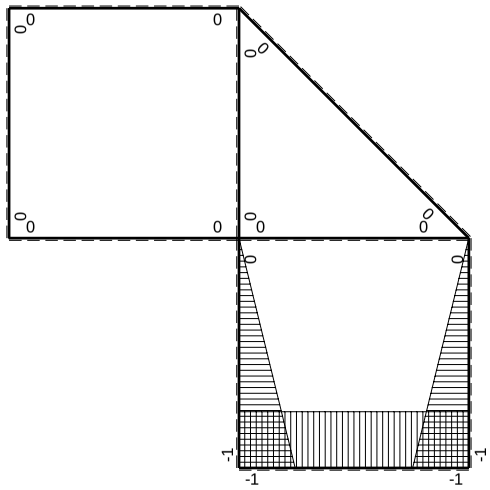
Fb



Schema di calcolo iperstatico



M_o flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-Fx	0	0	0	0
BA b	0	Fb-Fx	0	0		
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb	Fb-Fx	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	0	0	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx+1/2qx^2$	0	0	0	0
FG b	0	-3/2Fx	0	0	0	0
GF b	0	3/2Fb-3/2Fx	0	0		
GA b	0	$-1/2Fb-1/2qx^2$	0	0	0	0
AG b	0	$Fb-Fx+1/2qx^2$	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$3/2Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				-9/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

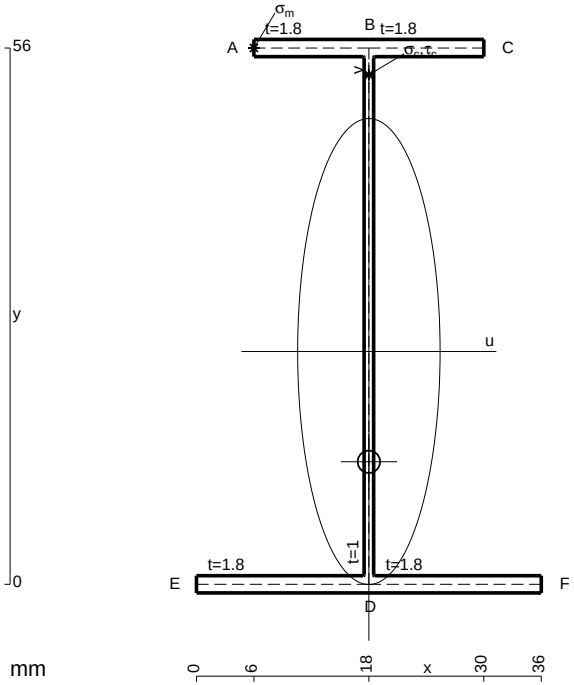
$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (\ x/b\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b\ )\ Fb\ 1/EJ\ = 1/2\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x/b\ )\ Fb\ 1/EJ\ dx = [\ x -1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

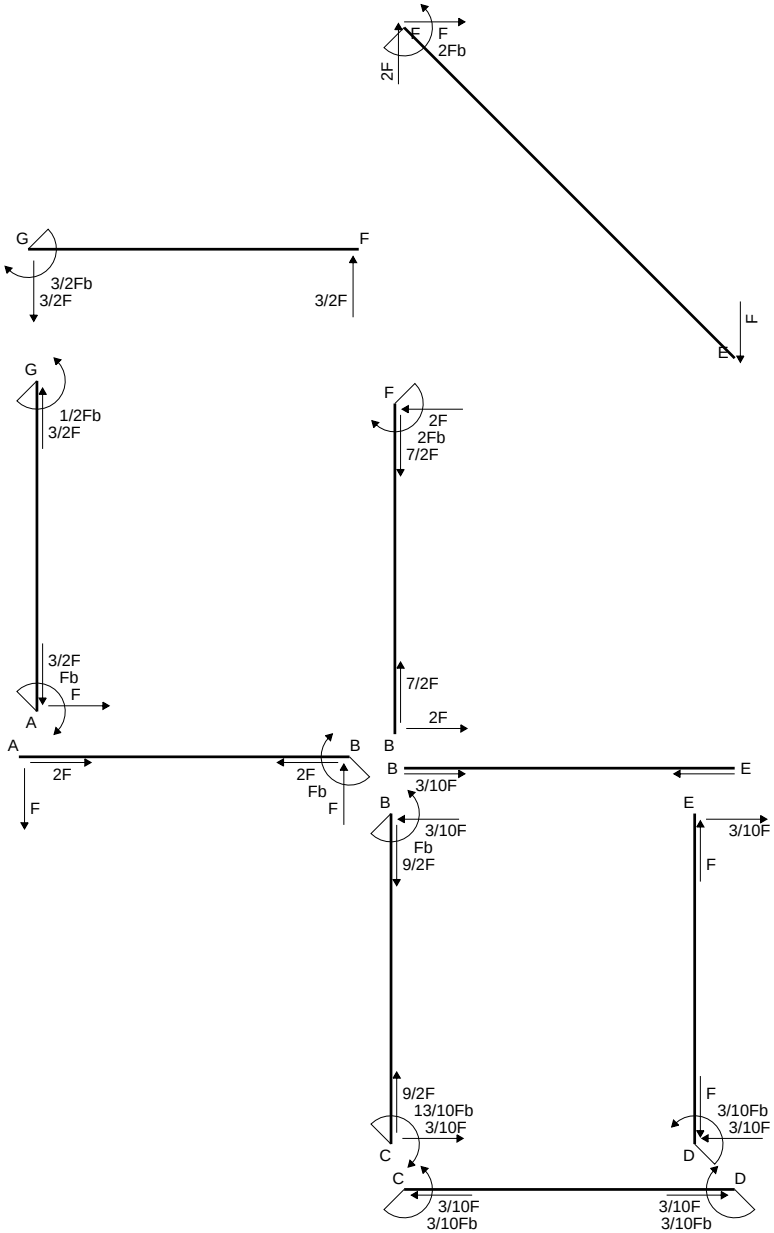
$= (\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 1/2\ \ Fb^2/EJ$

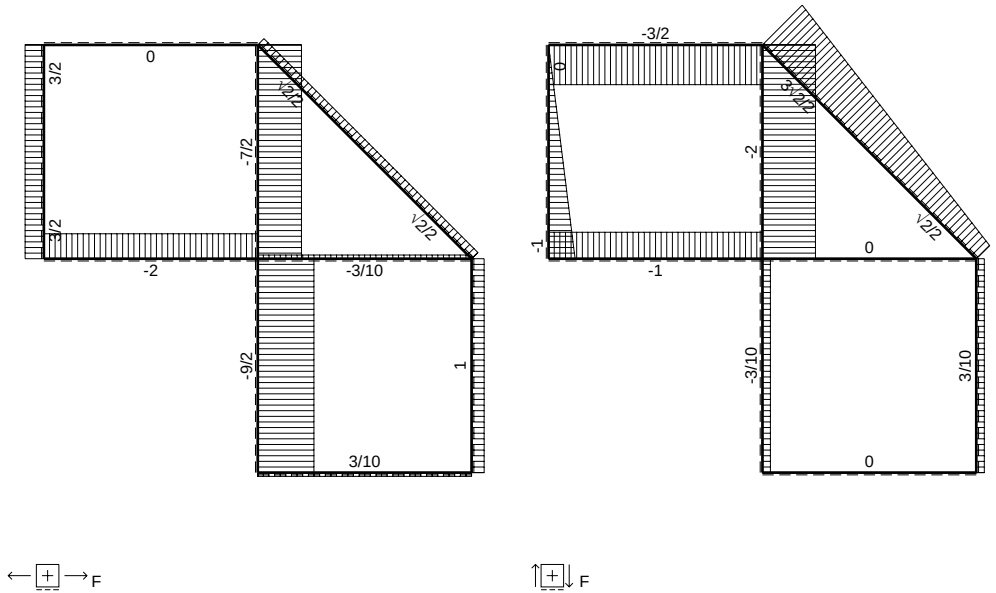


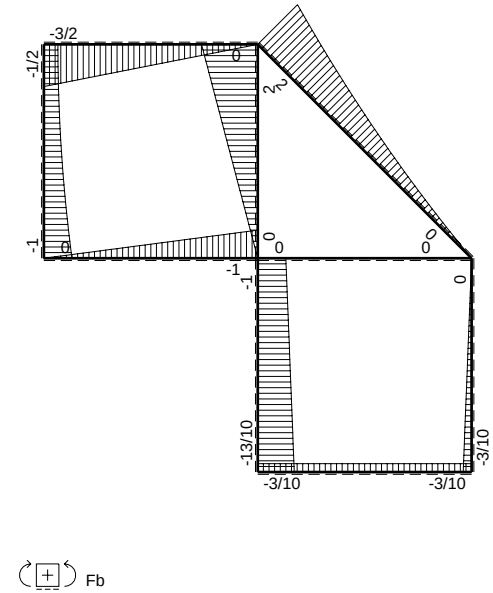
A = 164. mm^2
J_u = 97076. mm^4
J_v = 9072. mm^4
J_t = 135.3 mm^4
y_o = -11.51 mm
y_g = 24.31 mm
N = -1890. N
T_y = -1080. N
M_x = 572400. Nmm
x_m = 6. mm
y_m = 56. mm
u_m = -12. mm
v_m = 31.69 mm
$\sigma_m = N/A - Mv/J_u$ = -198.4 N/mm^2
x_c = 18. mm
y_c = 56. mm
v_c = 31.69 mm
$\sigma_c = N/A - Mv/J_u$ = -198.4 N/mm^2
$\tau_c = TS^*/tJ_u$ = 15.23 N/mm^2
$\tau_g = TS^*/tJ_u$ = 15.23 N/mm^2
t_c = 540. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 200.1 N/mm^2

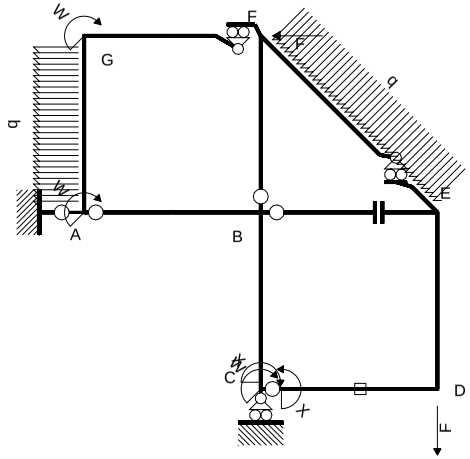
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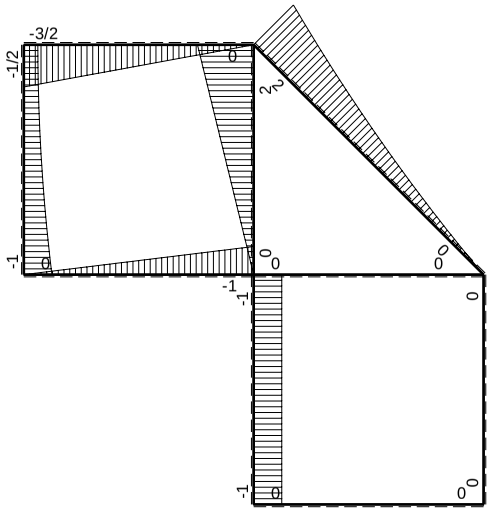

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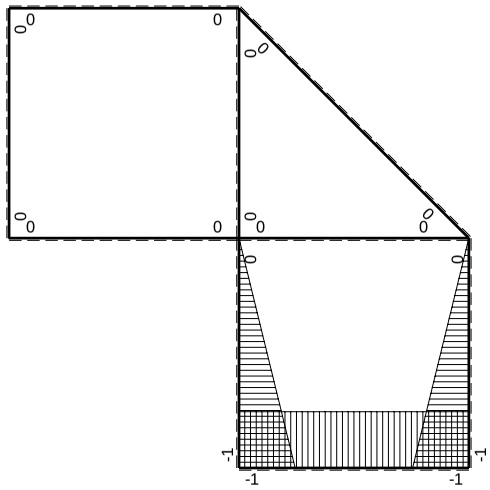

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Fb



Schema di calcolo iperstatico



M_o flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-Fx	0	0	0	0
BA b	0	Fb-Fx	0	0		
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb	Fb-Fx	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	0	0	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx+1/2qx^2$	0	0	0	0
FG b	0	-3/2Fx	0	0	0	0
GF b	0	3/2Fb-3/2Fx	0	0		
GA b	0	$-1/2Fb-1/2qx^2$	0	0	0	0
AG b	0	$Fb-Fx+1/2qx^2$	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/2Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				3/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 - 2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b + 1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b + 1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 - 2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b + 1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b + 1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

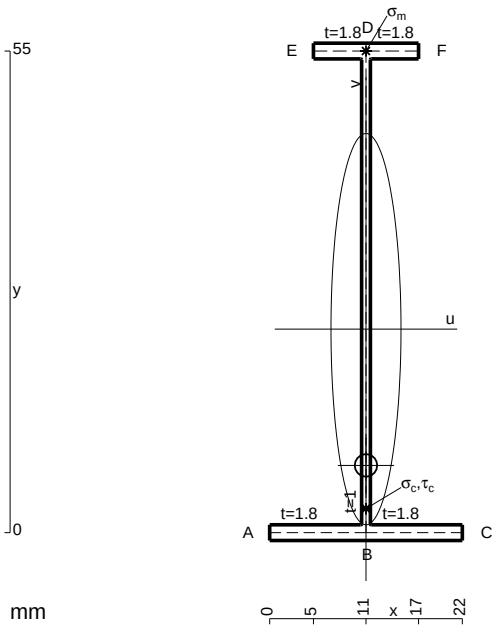
$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (x/b)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b)\ Fb\ 1/EJ\ = 1/2\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x/b)\ Fb\ 1/EJ\ dx = [\ x - 1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

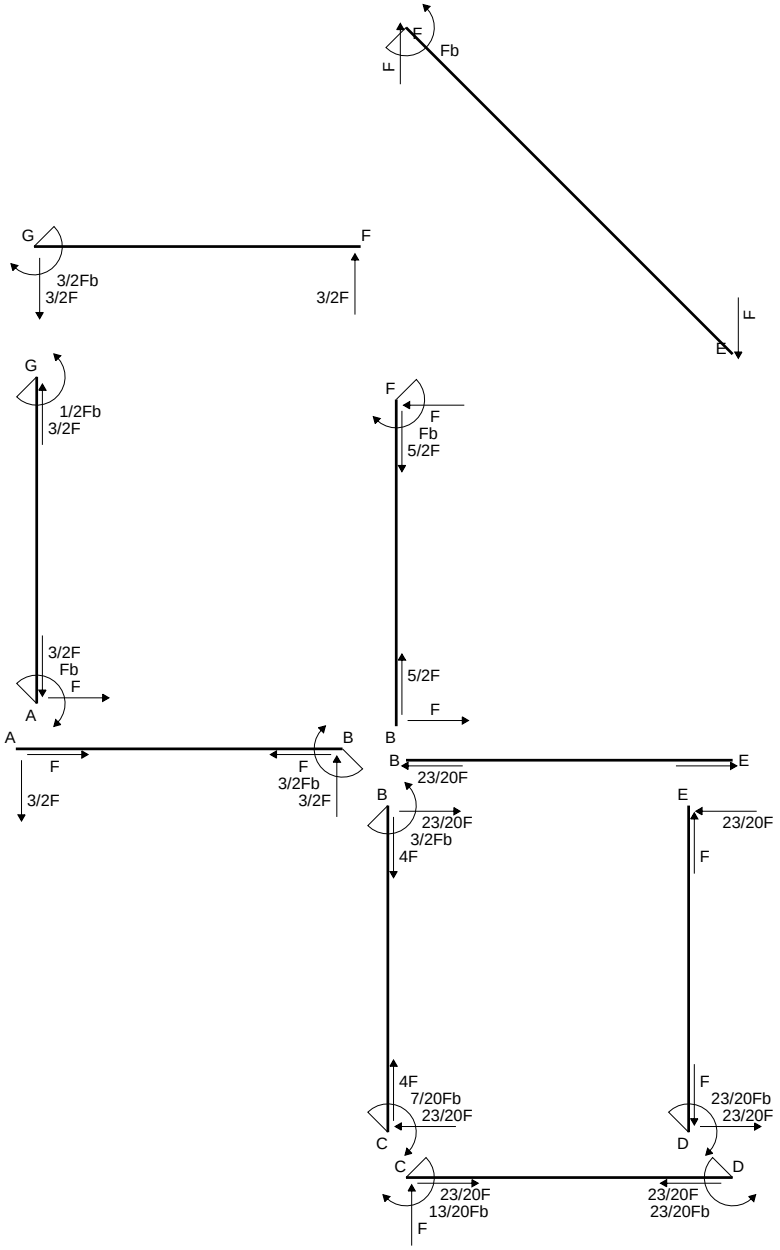
$= (\ b - 1/2\ b\ )\ Fb\ 1/EJ\ = 1/2\ Fb^2/EJ$

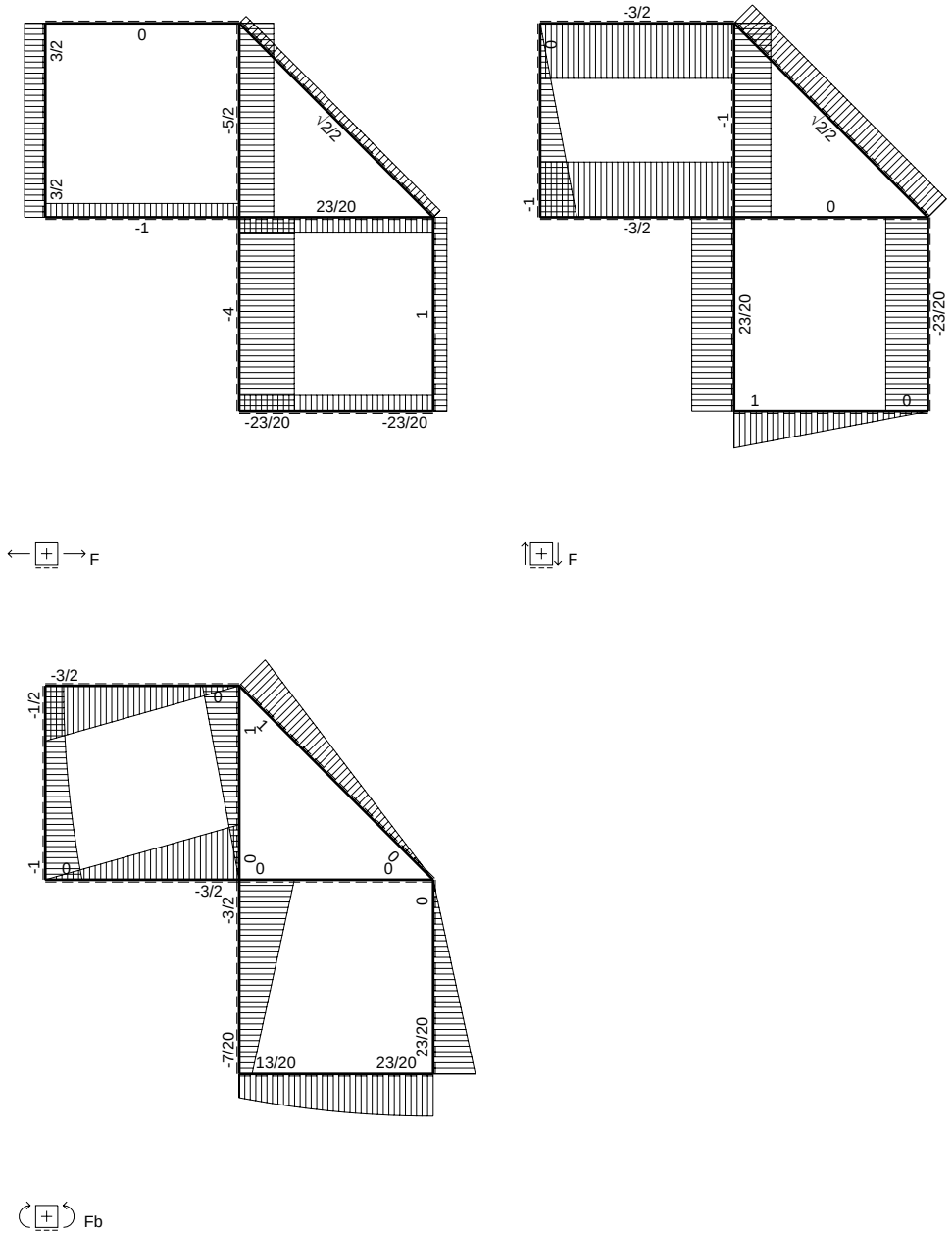


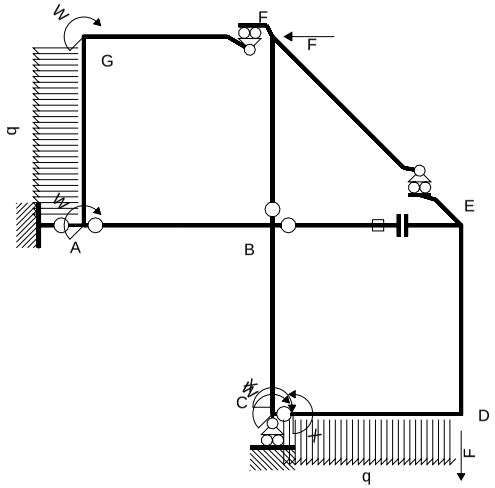
A = 116.2 mm^2
J_u = 58038. mm^4
J_v = 1856. mm^4
J_t = 84.43 mm^4
y_o = -15.56 mm
y_g = 23.24 mm
N = 233.3 N
T_y = 700. N
M_x = 376200. Nmm
x_m = 11. mm
y_m = 55. mm
v_m = 31.76 mm
$\sigma_m = N/A - Mv/J_u$ = -203.9 N/mm^2
x_c = 11. mm
v_c = -23.24 mm
$\sigma_c = N/A - Mv/J_u$ = 152.6 N/mm^2
$\tau_c = TS^*/tJ_u$ = 11.1 N/mm^2
$\tau_g = TS^*/tJ_u$ = 11.1 N/mm^2
t_c = 330. mm
$\sigma_o = \sqrt{\sigma^2 + 3\tau^2}$ = 153.9 N/mm^2

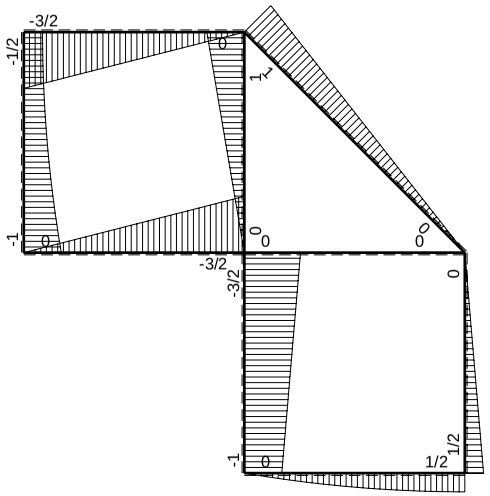
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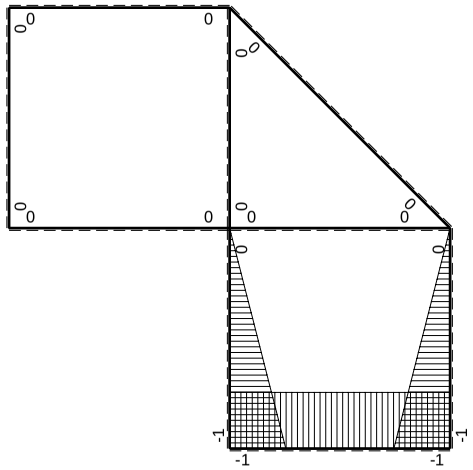

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√2/2
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√2
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0
-7/20
13/20
23/20
23/20
Fb





M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0		
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx^2/b	x^2/b^2	7/12Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	Fx-1/2qx^2	-Fx+1/2Fx^2/b	1	-1/3Fb^2/EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx^2	-1/2Fb+1/2Fx^2/b	1		
DE 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
ED b	x/b	-1/2Fx	-1/2Fx^2/b	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-3/2Fx	0	0	0	0
GF b	0	3/2Fb-3/2Fx	0	0		
GA b	0	-1/2Fb-1/2qx^2	0	0	0	0
AG b	0	Fb-Fx+1/2qx^2	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				13/12Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-13/20Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-\ x/b +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/3\ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2 +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

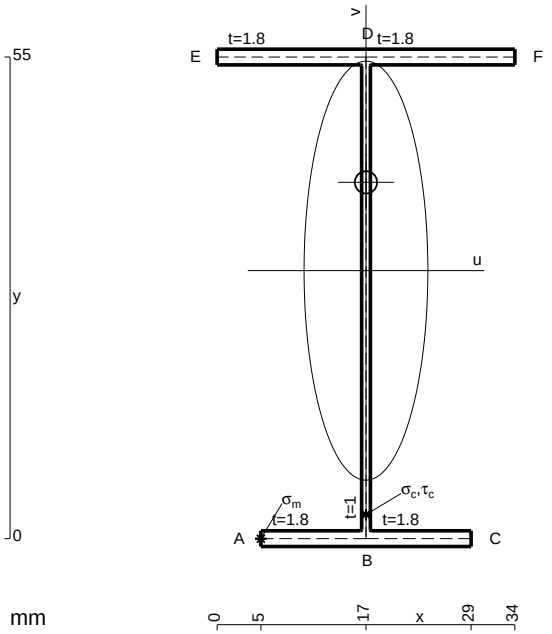
$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/3\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (-1/2 + x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x +1/2\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = -1/6\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (-1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

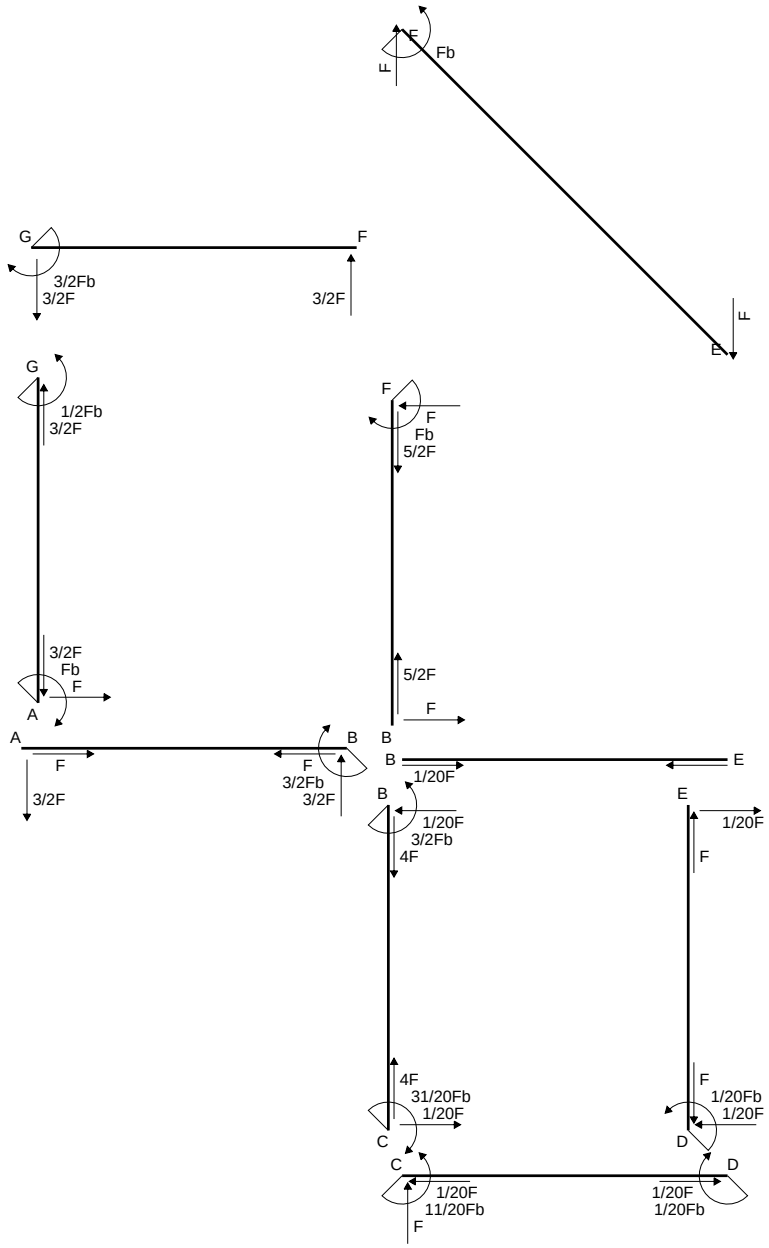
$= (-1/6\ b\ )\ Fb\ 1/EJ\ = -1/6\ Fb^2/EJ$

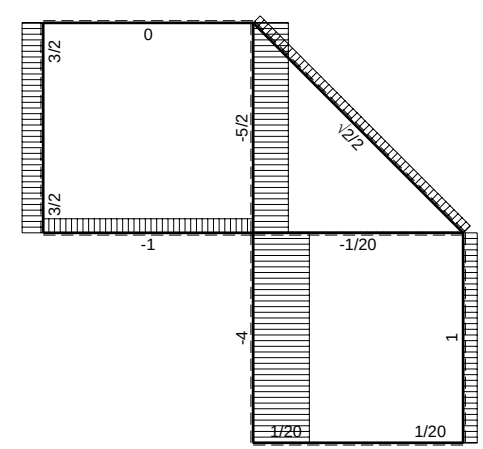


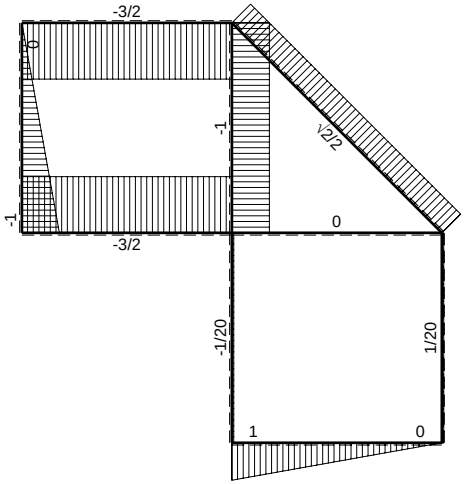
A = 159.4 mm^2
J_u = 91280. mm^4
J_v = 7969. mm^4
J_t = 131.1 mm^4
y_o = 10.08 mm
y_g = 30.61 mm
N = -690. N
T_y = -1035. N
M_x = -641700. Nmm
x_m = 5. mm
u_m = -12. mm
v_m = -30.61 mm
$\sigma_m = N/A - Mv/J_u$ = -219.5 N/mm^2
x_c = 17. mm
v_c = -30.61 mm
$\sigma_c = N/A - Mv/J_u$ = -219.5 N/mm^2
$\tau_c = TS^*/tJ_u$ = 14.99 N/mm^2
$\tau_g = TS^*/tJ_u$ = 14.99 N/mm^2
t_c = 690. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 221. N/mm^2

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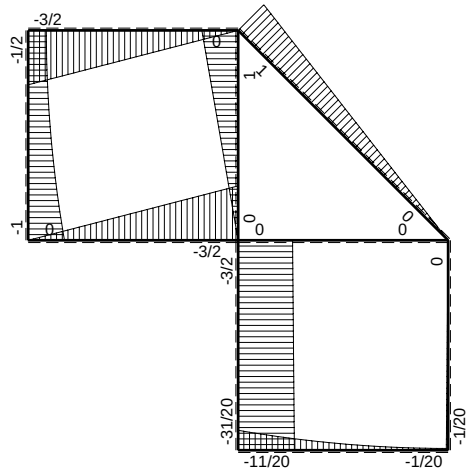

G
F
3/2Fb
3/2F
3/2F
E
Fb
F
F
G
1/2Fb
3/2F
F
Fb
5/2F
3/2F
Fb
F
A
5/2F
F
A
B
B
F
3/2Fb
3/2F
3/2F
B
1/20F
E
B
1/20F
3/2Fb
4F
E
1/20F
F
4F
31/20Fb
1/20F
F
1/20Fb
1/20F
C
D
C
D
1/20F
11/20Fb
1/20F
1/20Fb
F


0
3/2
3/2
-5/2
√2/2
-1
-1/20
-4
1
1/20
1/20

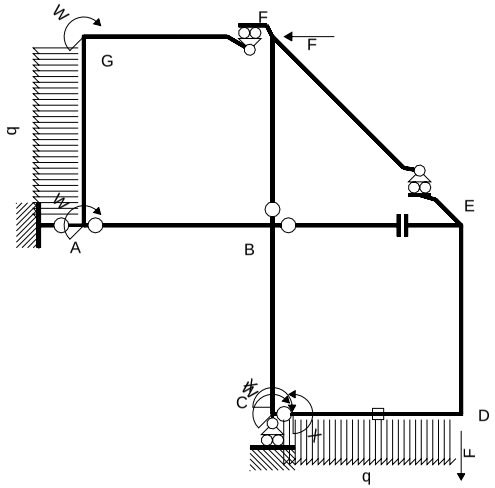

-3/2
0
-1
√2/2
-1
0
-3/2
-1/20
1/20
1
0

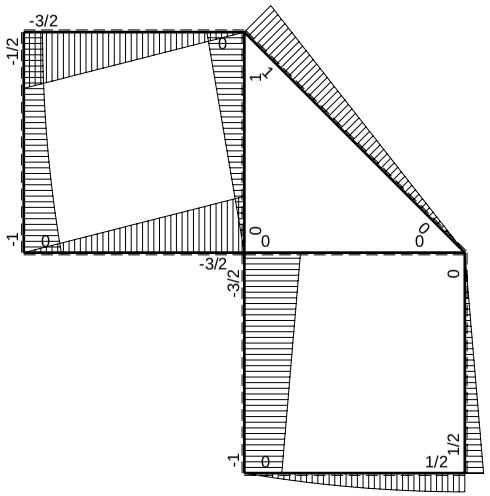
←□→ F

↑□↓ F

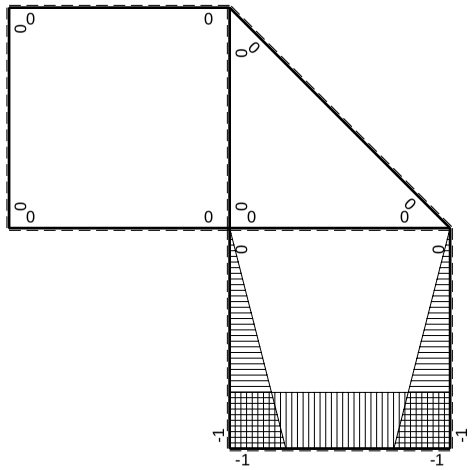

-3/2
-1/2
0
1
-1
0
0
0
0
-3/2
-3/2
0
-31/20
-1/20
-11/20
-1/20

↻□↺ Fb





M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0		
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx^2/b	x^2/b^2	7/12Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	Fx-1/2qx^2	-Fx+1/2Fx^2/b	1	-1/3Fb^2/EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx^2	-1/2Fb+1/2Fx^2/b	1		
DE 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
ED b	x/b	-1/2Fx	-1/2Fx^2/b	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-3/2Fx	0	0	0	0
GF b	0	3/2Fb-3/2Fx	0	0		
GA b	0	-1/2Fb-1/2qx^2	0	0	0	0
AG b	0	Fb-Fx+1/2qx^2	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				-Fb^2/EJ	
	totali				-11/12Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				11/20Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-\ x/b +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -4/3\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2 +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/2\ x +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

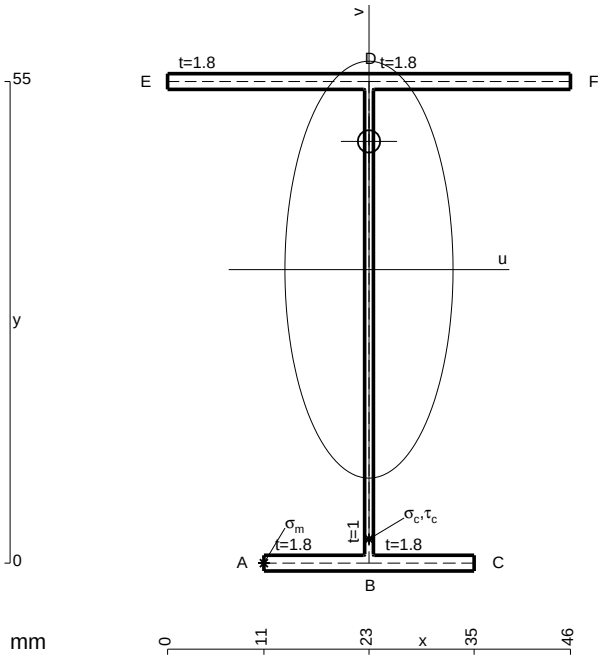
$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -4/3\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (-1/2 + x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x +1/2\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = -1/6\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (-1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

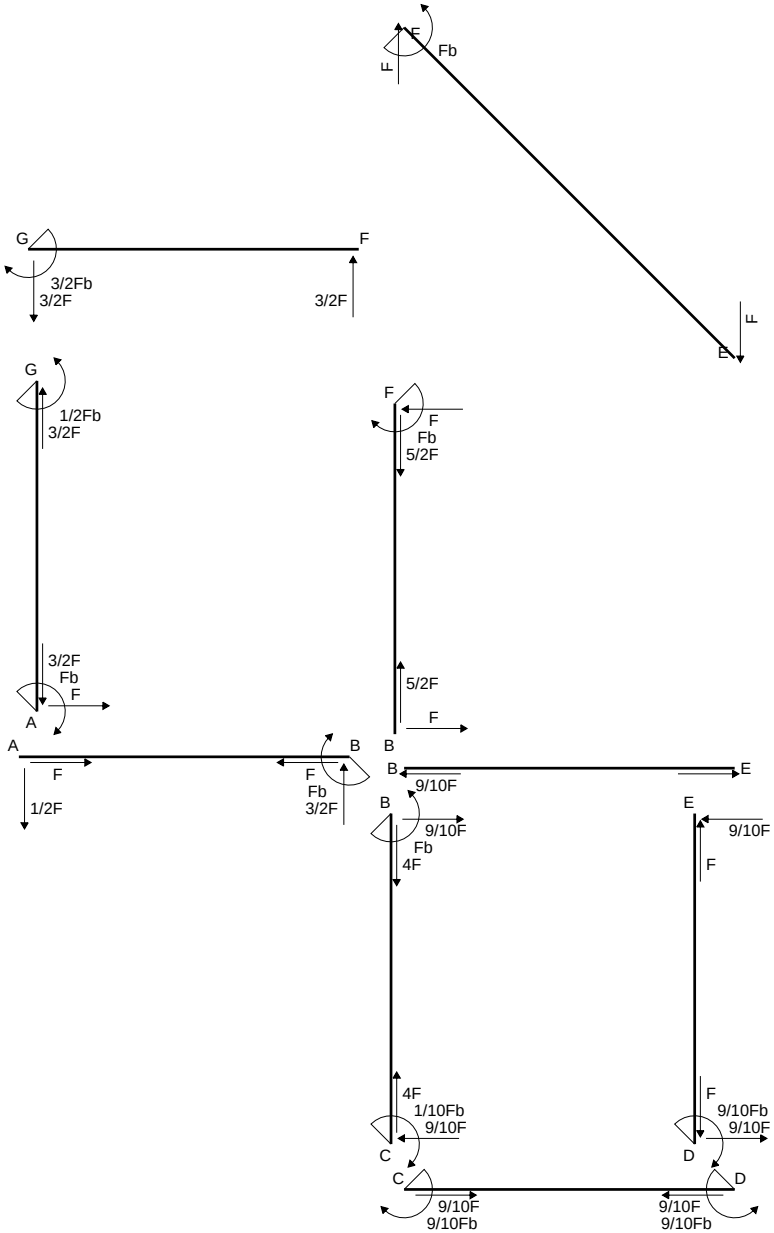
$= (-1/6\ b\ )\ Fb\ 1/EJ\ = -1/6\ \ Fb^2/EJ$

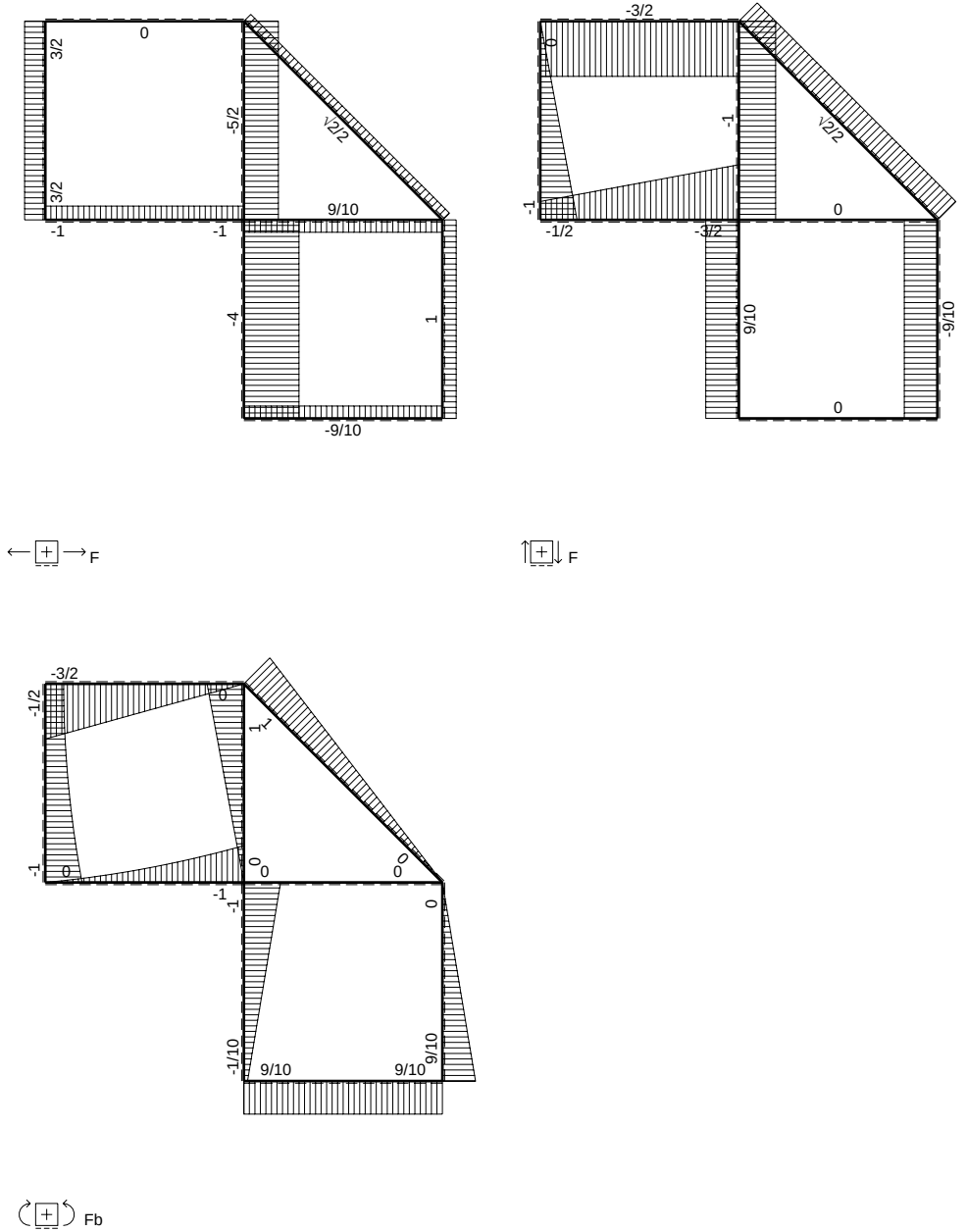


A = 181. mm^2
J_u = 102600. mm^4
J_v = 16674. mm^4
J_t = 154.4 mm^4
y_o = 14.64 mm
y_g = 33.52 mm
N = -680. N
T_y = -1020. N
M_x = -683400. Nmm
x_m = 11. mm
u_m = -12. mm
v_m = -33.52 mm
$\sigma_m = N/A - Mv/J_u$ = -227. N/mm^2
x_c = 23. mm
v_c = -33.52 mm
$\sigma_c = N/A - Mv/J_u$ = -227. N/mm^2
$\tau_c = TS^*/tJ_u$ = 14.39 N/mm^2
$\tau_g = TS^*/tJ_u$ = 14.39 N/mm^2
t_c = 680. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 228.4 N/mm^2

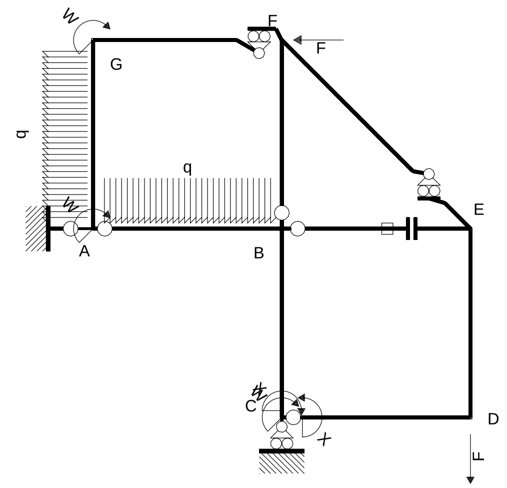
CI02.xxxx.123

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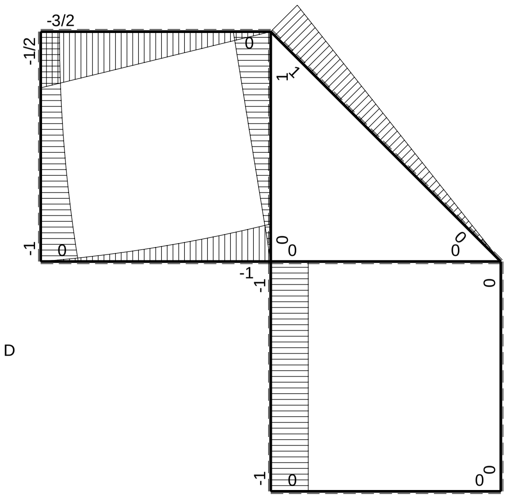




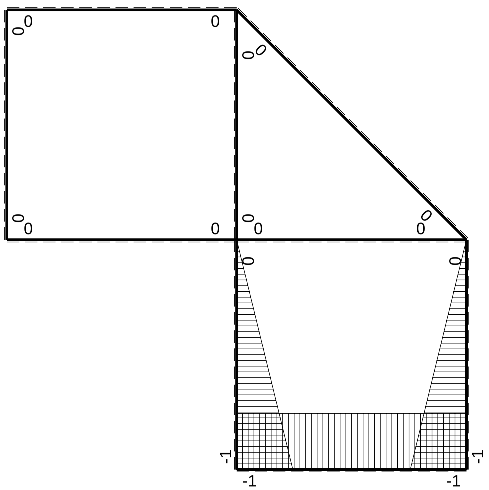
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Schema di calcolo iperstatico



M_o flessione da carichi assegnati



M_x flessione da iperstatica X=1

PROCEDIMENTO E RISULTATI 264142 CI02.xxxx.124

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-1/2Fx-1/2qx^2$	0	0	0	0
BA b	0	$Fb-3/2Fx+1/2qx^2$	0	0		
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb	Fb-Fx	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	0	0	$1-2x/b+x^2/b^2$	0	1/3Xb/EJ
ED b	x/b	0	0	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-3/2Fx	0	0	0	0
GF b	0	3/2Fb-3/2Fx	0	0		
GA b	0	$-1/2Fb-1/2qx^2$	0	0	0	0
AG b	0	$Fb-Fx+1/2qx^2$	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$3/2Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-9/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

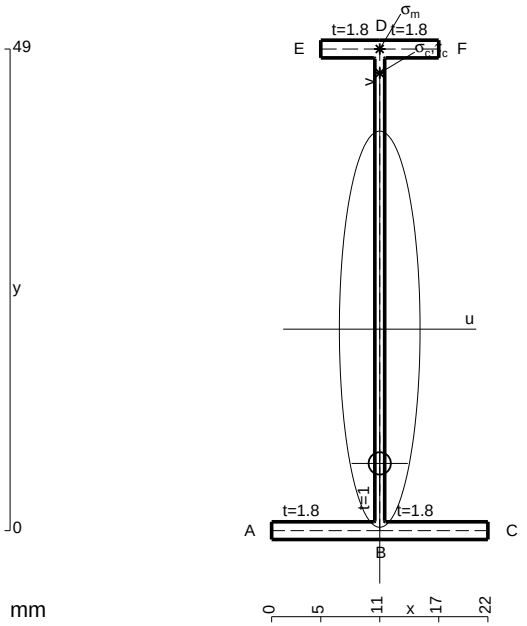
$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (x/b)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b)\ Fb\ 1/EJ\ = 1/2\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x/b)\ Fb\ 1/EJ\ dx = [\ x -1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

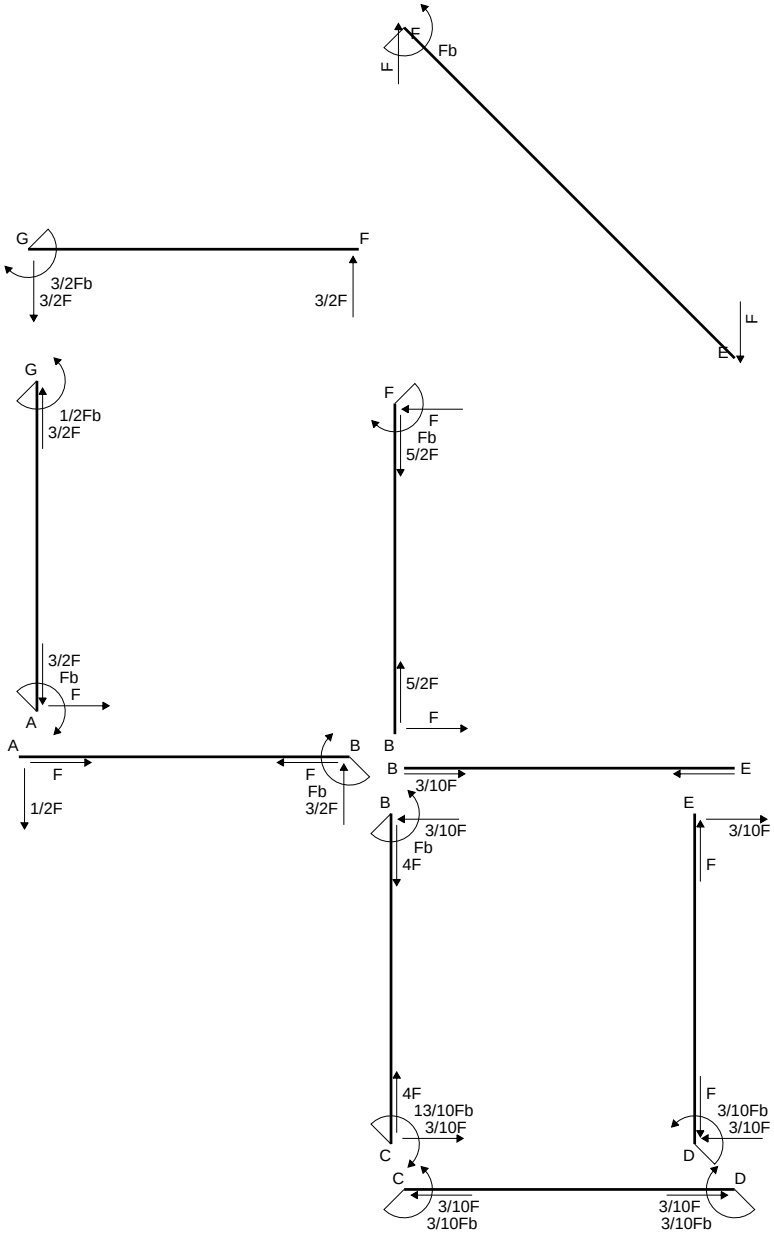
$= (\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 1/2\ Fb^2/EJ$

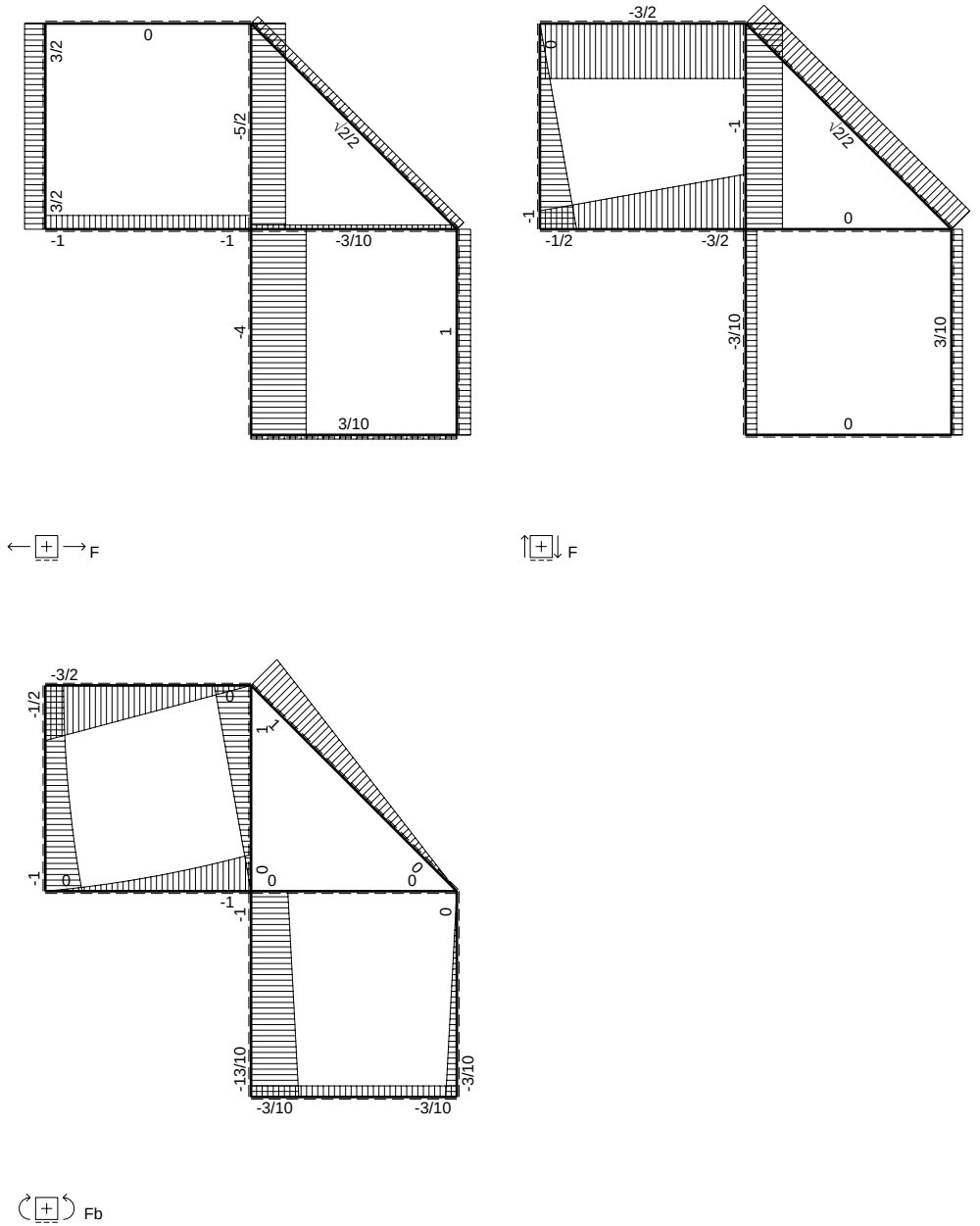


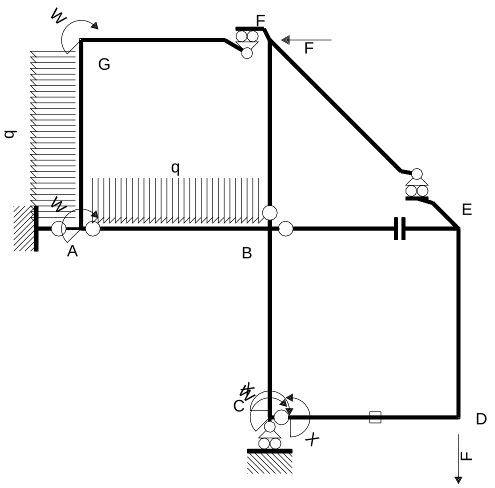
A = 110.2 mm^2
J_u = 44775. mm^4
J_v = 1856. mm^4
J_t = 82.43 mm^4
y_o = -13.66 mm
y_g = 20.5 mm
T_y = -585. N
M_x = -374400. Nmm
x_m = 11. mm
y_m = 49. mm
v_m = 28.5 mm
$\sigma_m = -Mv/J_u$ = 238.3 N/mm^2
y_c = 2. mm
u_c = -11. mm
v_c = -18.5 mm
$\sigma_c = -Mv/J_u$ = 238.3 N/mm^2
$\tau_c = TS^*/tJ_u$ = 8.044 N/mm^2
$\tau_g = TS^*/tJ_u$ = 8.044 N/mm^2
t_c = 390. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 238.7 N/mm^2

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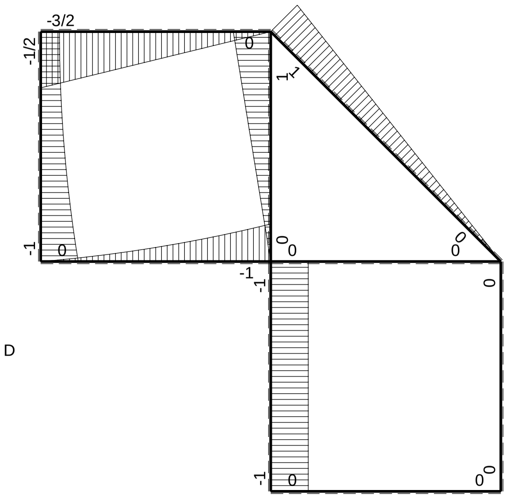
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E
Fb
F
F
G
F
3/2Fb
3/2F
3/2F
E
F
G
1/2Fb
3/2F
F
Fb
5/2F
3/2F
Fb
F
5/2F
A
B
B
F
F
E
1/2F
Fb
3/2F
3/10F
B
E
3/10F
Fb
4F
3/10F
F
4F
13/10Fb
3/10F
F
3/10Fb
3/10F
C
D
C
D
3/10F
3/10Fb
3/10F
3/10Fb

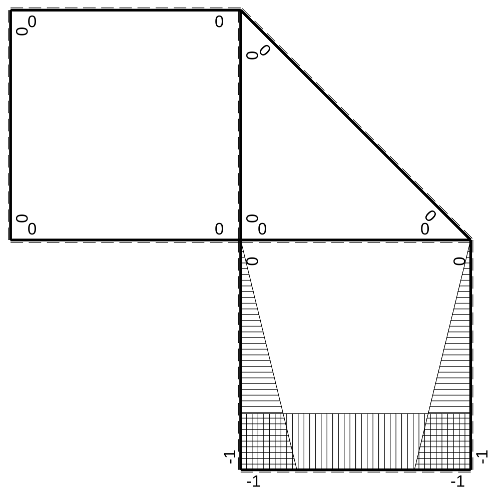

0
3/2
-5/2
√2/2
3/2
-1
-1
-3/10
-4
1
3/10
-3/2
0
-1
√2/2
-1
-1/2
-3/2
0
-3/10
3/10
0
F
F
-3/2
-1/2
1
√2
0
0
0
0
-1
-1
0
-13/10
-3/10
-3/10
-3/10
Fb



Schema di calcolo iperstatico



M_o flessione da carichi assegnati



M_x flessione da iperstatica X=1

PROCEDIMENTO E RISULTATI 267320 CI02.xxxx.125

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-1/2Fx-1/2qx^2$	0	0	0	0
BA b	0	$Fb-3/2Fx+1/2qx^2$	0	0		
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb	Fb-Fx	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	0	0	$1-2x/b+x^2/b^2$	0	1/3Xb/EJ
ED b	x/b	0	0	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-3/2Fx	0	0	0	0
GF b	0	3/2Fb-3/2Fx	0	0		
GA b	0	$-1/2Fb-1/2qx^2$	0	0	0	0
AG b	0	$Fb-Fx+1/2qx^2$	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/2Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				3/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

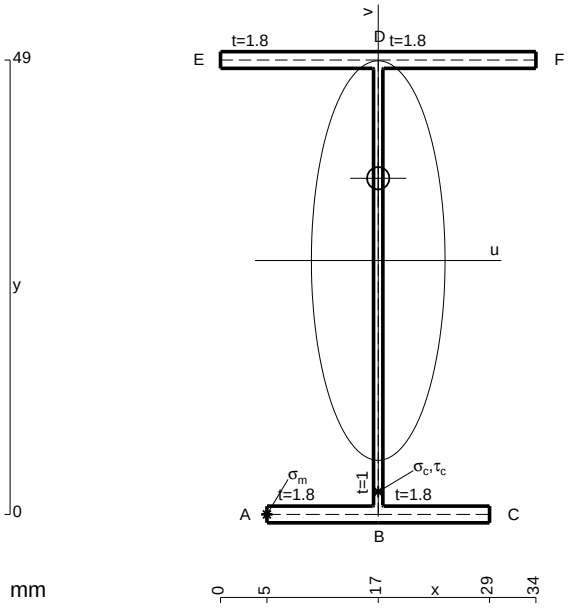
$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (x/b)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b)\ Fb\ 1/EJ\ = 1/2\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x/b)\ Fb\ 1/EJ\ dx = [\ x -1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

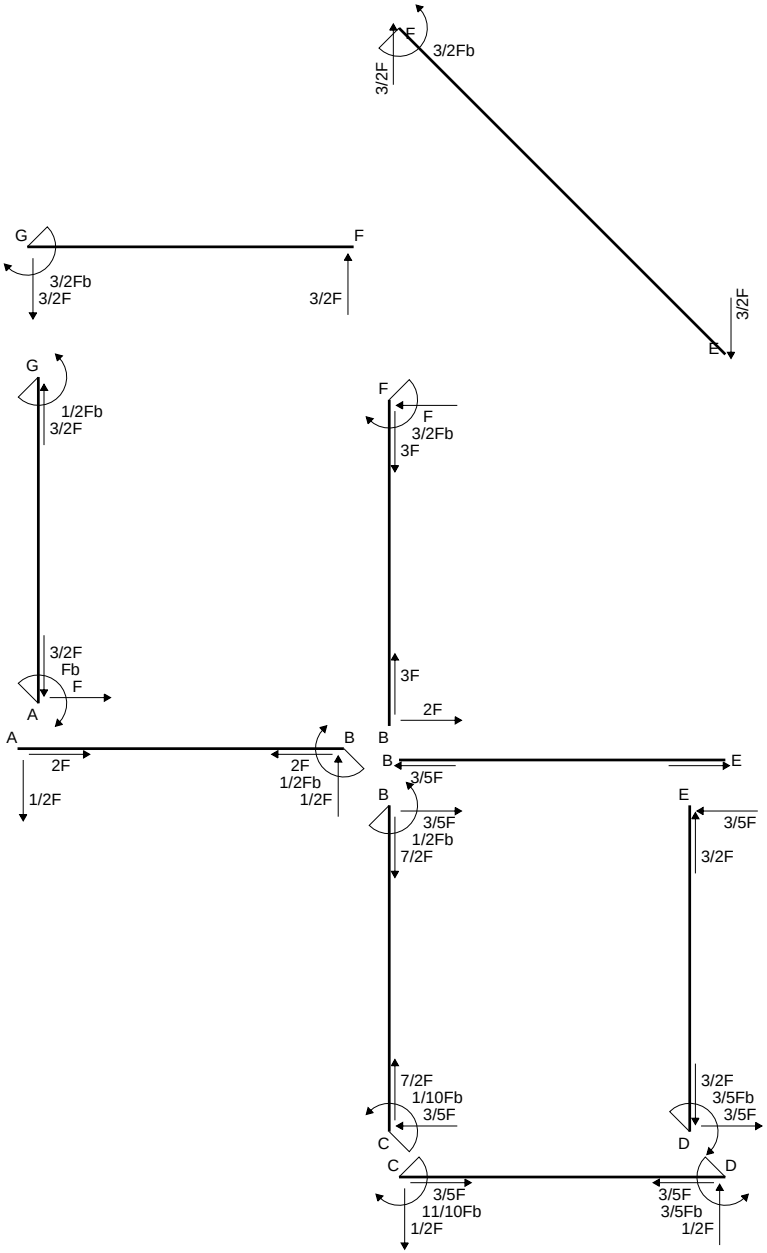
$= (\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 1/2\ \ Fb^2/EJ$

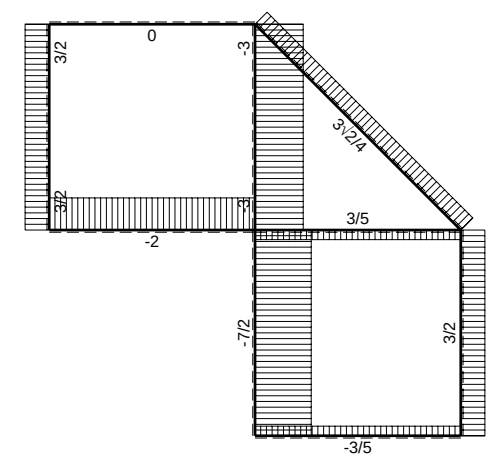


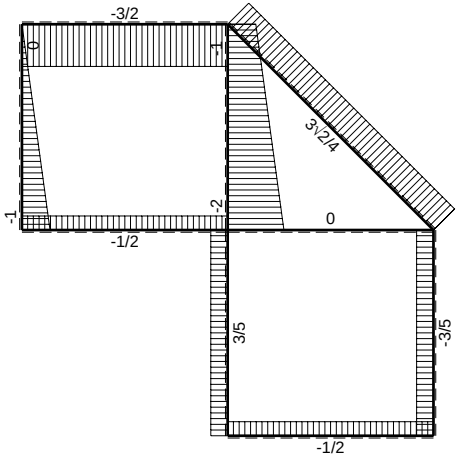
A = 153.4 mm^2
J_u = 71202. mm^4
J_v = 7969. mm^4
J_t = 129.1 mm^4
y_o = 8.875 mm
y_g = 27.37 mm
T_y = -750. N
M_x = -517500. Nmm
x_m = 5. mm
u_m = -12. mm
v_m = -27.37 mm
$\sigma_m = -Mv/J_u$ = -199. N/mm^2
x_c = 17. mm
v_c = -27.37 mm
$\sigma_c = -Mv/J_u$ = -199. N/mm^2
$\tau_c = TS^*/tJ_u$ = 12.46 N/mm^2
$\tau_g = TS^*/tJ_u$ = 12.46 N/mm^2
t_c = 500. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 200.1 N/mm^2

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E
3/2Fb
3/2F
G
F
3/2Fb
3/2F
3/2F
E
G
1/2Fb
3/2F
F
F
3/2Fb
3F
3/2F
Fb
F
A
3F
2F
A
B
B
E
2F
2F
1/2Fb
1/2F
1/2F
3/5F
B
E
3/5F
1/2Fb
7/2F
3/5F
3/2F
7/2F
1/10Fb
3/5F
3/2F
3/5Fb
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D
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3/5F
3/5Fb
1/2F

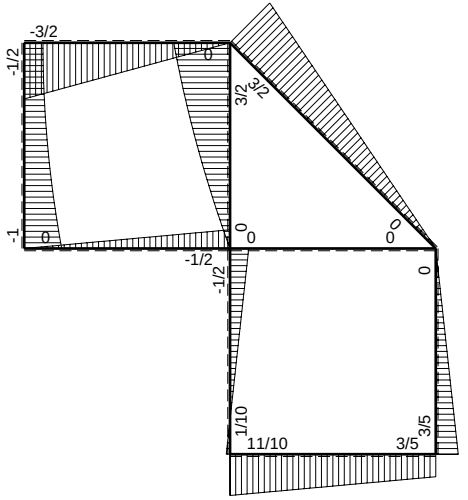

3/2
0
-3
3√2/4
3/2
-3
3/5
-2
-7/2
3/2
-3/5


-3/2
-1
-1
3√2/4
-1
-2
0
-1/2
3/5
-3/5
-1/2

F

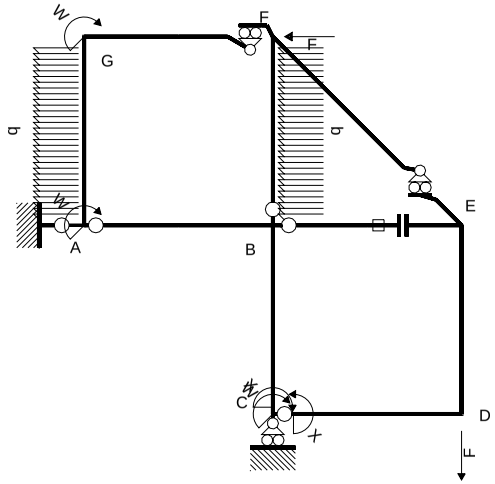


F

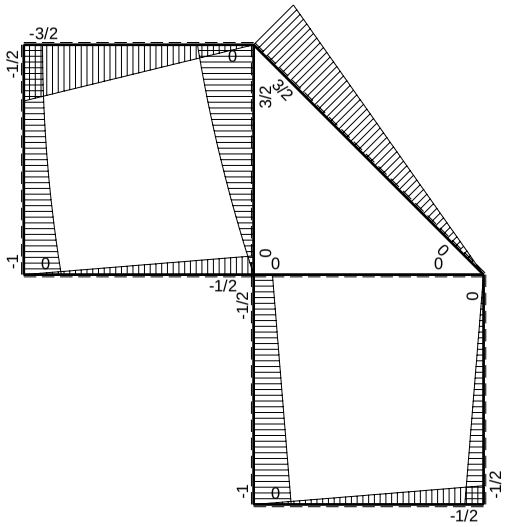

-3/2
-1/2
0
3/2
3√2/4
-1
0
0
0
-1/2
-1/2
0
1/10
11/10
3/5
3/5



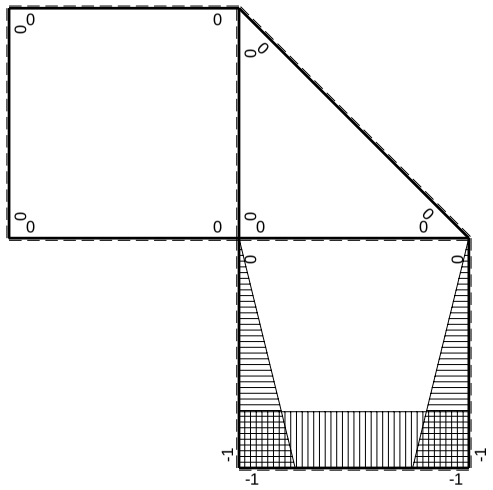
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-1/2Fx	0	0	0	0
BA b	0	1/2Fb-1/2Fx	0	0		
BC b	-x/b	-1/2Fb-1/2Fx	1/2Fx+1/2Fx^2/b	x^2/b^2	5/12Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb-1/2Fx	Fb-3/2Fx+1/2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb^2/EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE 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
ED b	x/b	1/2Fx	1/2Fx^2/b	x^2/b^2		
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-3/2Fx	0	0	0	0
GF b	0	3/2Fb-3/2Fx	0	0		
GA b	0	-1/2Fb-1/2qx^2	0	0	0	0
AG b	0	Fb-Fx+1/2qx^2	0	0		
FB b	0	3/2Fb-Fx-1/2qx^2	0	0	0	0
BF b	0	-2Fx+1/2qx^2	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				11/6Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-11/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2\ )\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (1/2\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b +1/6\ b\ )\ Fb\ 1/EJ\ = 5/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -3/2\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x -3/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -3/4\ b +1/6\ b\ )\ Fb\ 1/EJ\ = 5/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (1/2\ x/b\ )\ Fb\ 1/EJ\ dx = [1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b\ )\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (1/2 -1/2\ x/b\ )\ Fb\ 1/EJ\ dx = [1/2\ x -1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/4\ b\ )\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

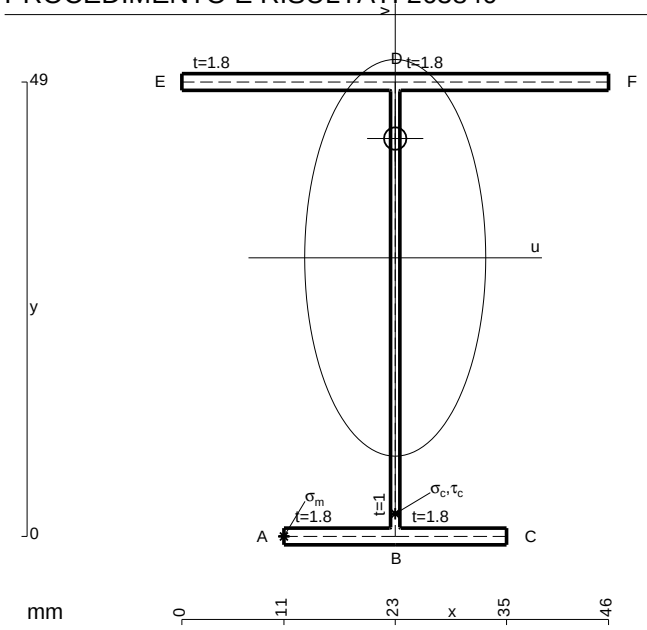
$L^{Xo}_{DE} = \int_o^b (1/2 -\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x -1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/6\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

PROCEDIMENTO E RISULTATI 263840 CI02.xxxx.126

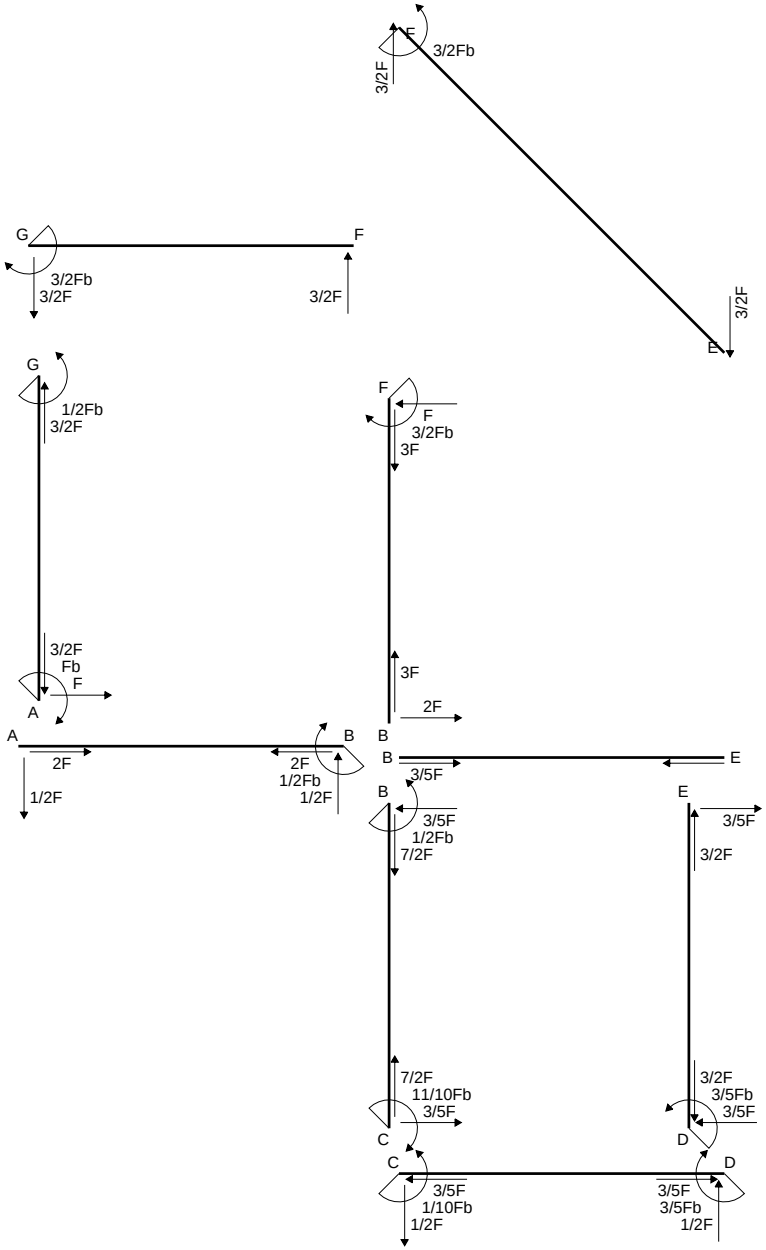


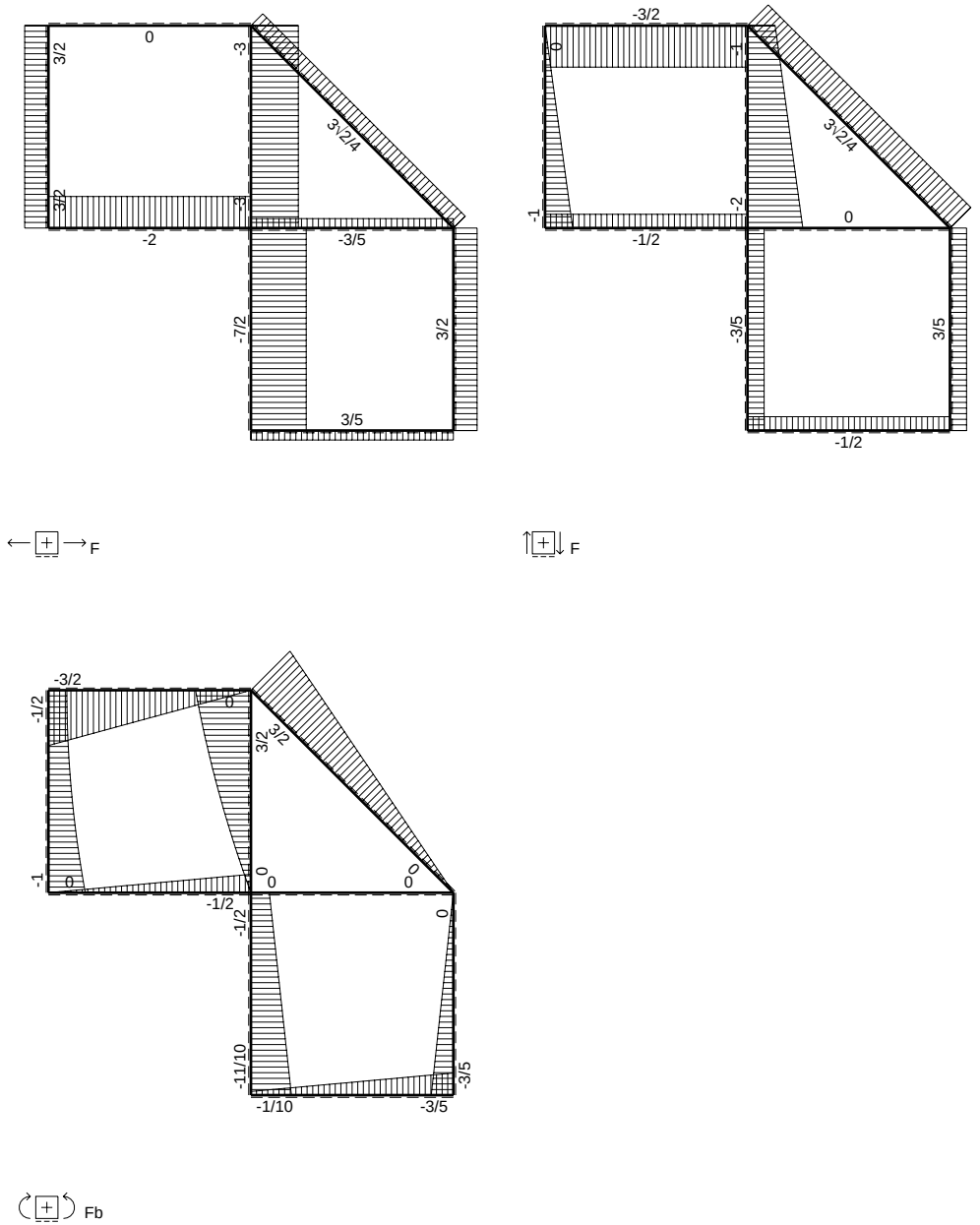
A = 175. mm^2
J_u = 80057. mm^4
J_v = 16674. mm^4
J_t = 152.4 mm^4
y_o = 12.86 mm
y_g = 30.04 mm
T_y = -765. N
M_x = -558450. Nmm
x_m = 11. mm
u_m = -12. mm
v_m = -30.04 mm
$\sigma_m = -Mv/J_u$ = -209.6 N/mm^2
x_c = 23. mm
v_c = -30.04 mm
$\sigma_c = -Mv/J_u$ = -209.6 N/mm^2
$\tau_c = TS^*/tJ_u$ = 12.4 N/mm^2
$\tau_g = TS^*/tJ_u$ = 12.4 N/mm^2
t_c = 510. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 210.7 N/mm^2

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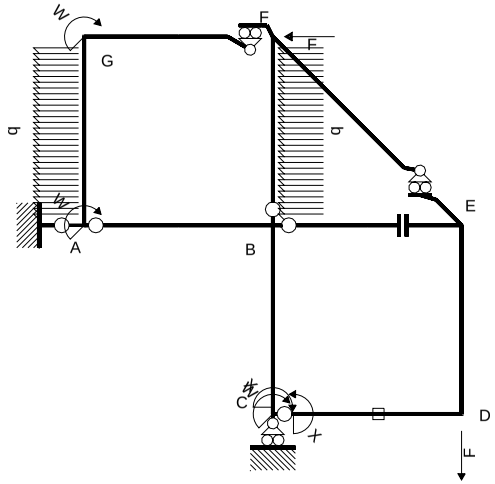
CI02.xxxx.126

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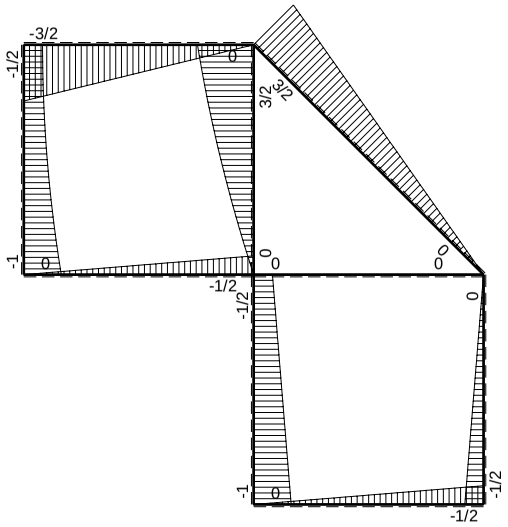




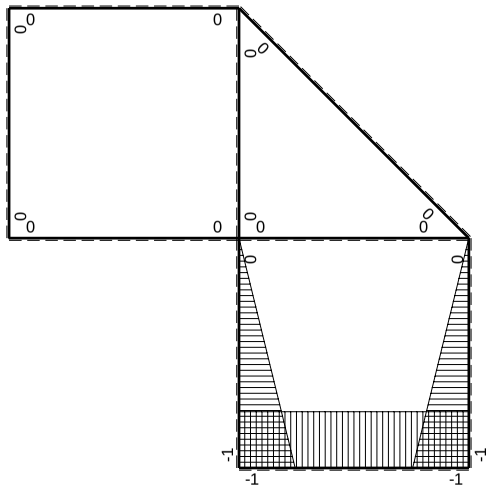
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Schema di calcolo iperstatico



M_o flessione da carichi assegnati



M_x flessione da iperstatica X=1

PROCEDIMENTO E RISULTATI 240551 CI02.xxxx.127

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-1/2Fx	0	0	0	0
BA b	0	1/2Fb-1/2Fx	0	0		
BC b	-x/b	-1/2Fb-1/2Fx	1/2Fx+1/2Fx^2/b	x^2/b^2	5/12Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb-1/2Fx	Fb-3/2Fx+1/2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb^2/EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE 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
ED b	x/b	1/2Fx	1/2Fx^2/b	x^2/b^2		
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-3/2Fx	0	0	0	0
GF b	0	3/2Fb-3/2Fx	0	0		
GA b	0	-1/2Fb-1/2qx^2	0	0	0	0
AG b	0	Fb-Fx+1/2qx^2	0	0		
FB b	0	3/2Fb-Fx-1/2qx^2	0	0	0	0
BF b	0	-2Fx+1/2qx^2	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				-Fb^2/EJ	
	totali				-1/6Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				1/10Fb	

Sviluppi di calcolo iperstatica

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$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (1/2\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b +1/6\ b\ )\ Fb\ 1/EJ\ = 5/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -3/2\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x -3/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -3/4\ b +1/6\ b\ )\ Fb\ 1/EJ\ = 5/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (1/2\ x/b\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = [1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (1/4\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -3/4\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (1/2 -1/2\ x/b\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = [1/2\ x -1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/E$

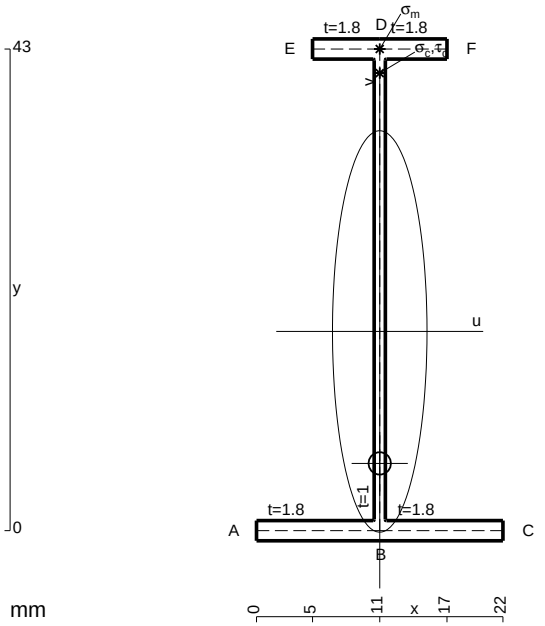
$= (1/2\ b -1/4\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -3/4\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2 - x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x -1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = 1/6\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

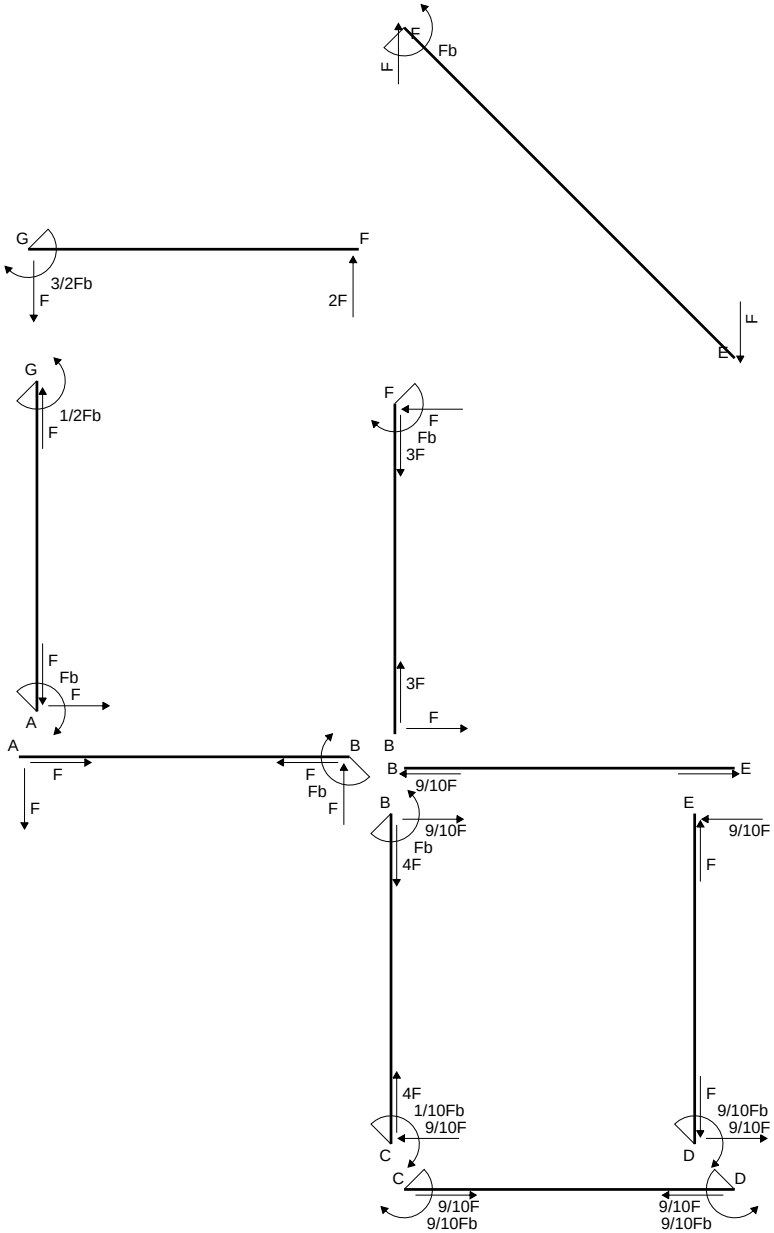
$= (1/6\ b\ )\ Fb\ 1/EJ\ = 1/6\ \ Fb^2/EJ$

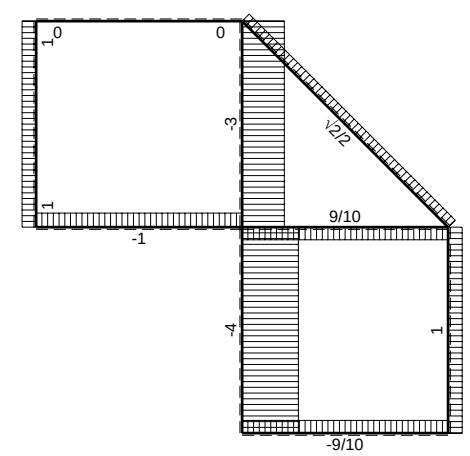


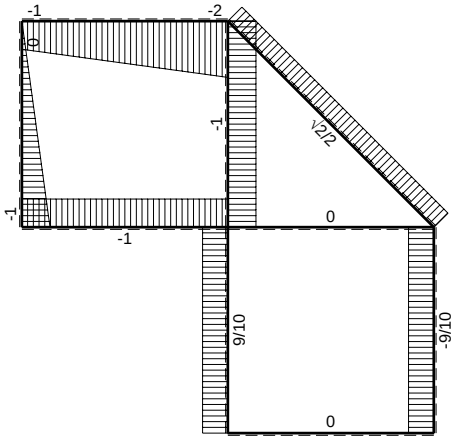
A = 104.2 mm^2
J_u = 33478. mm^4
J_v = 1856. mm^4
J_t = 80.43 mm^4
y_o = -11.78 mm
y_g = 17.79 mm
T_y = -420. N
M_x = -289800. Nmm
x_m = 11. mm
y_m = 43. mm
v_m = 25.21 mm
$\sigma_m = -Mv/J_u$ = 218.3 N/mm^2
y_c = 2. mm
u_c = -11. mm
v_c = -15.79 mm
$\sigma_c = -Mv/J_u$ = 218.3 N/mm^2
$\tau_c = TS^*/tJ_u$ = 6.833 N/mm^2
$\tau_g = TS^*/tJ_u$ = 6.833 N/mm^2
t_c = 280. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 218.6 N/mm^2

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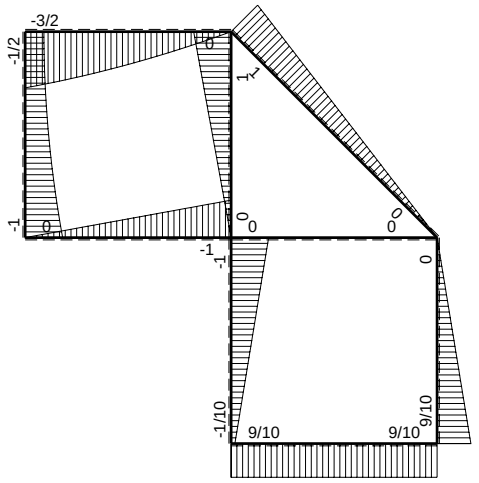

G
F
3/2Fb
F
2F
F
Fb
F
E
F
G
1/2Fb
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Fb
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9/10F
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4F
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9/10Fb
9/10F
D
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D
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9/10Fb
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-4
1
-9/10

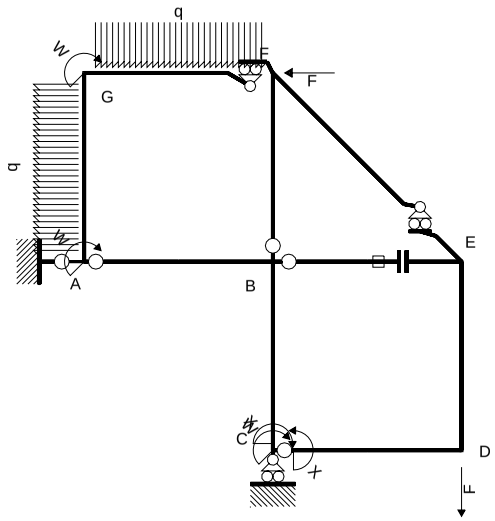

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-2
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-1
1/2/2
-1
0
-1
9/10
-9/10
0

F

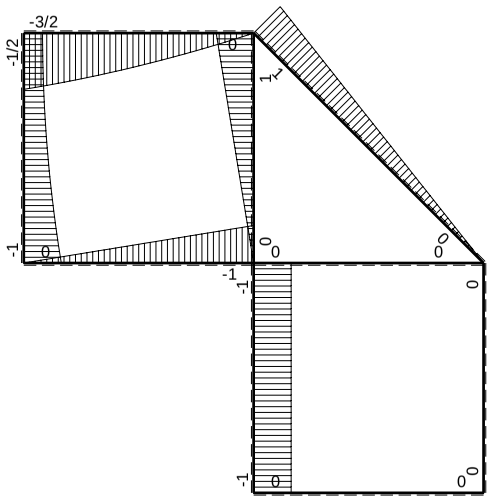
F


-3/2
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9/10
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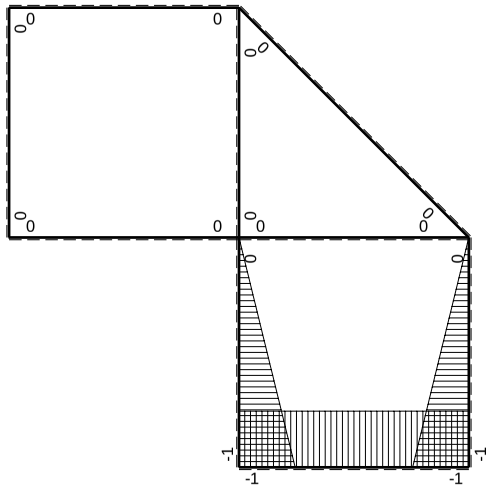
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-Fx	0	0	0	0
BA b	0	Fb-Fx	0	0		
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb	Fb-Fx	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	0	0	x^2/b^2		
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-2Fx+1/2qx^2$	0	0	0	0
GF b	0	$3/2Fb-Fx-1/2qx^2$	0	0		
GA b	0	$-1/2Fb-1/2qx^2$	0	0	0	0
AG b	0	$Fb-Fx+1/2qx^2$	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$3/2Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				$-9/10Fb$	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b)\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b)\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

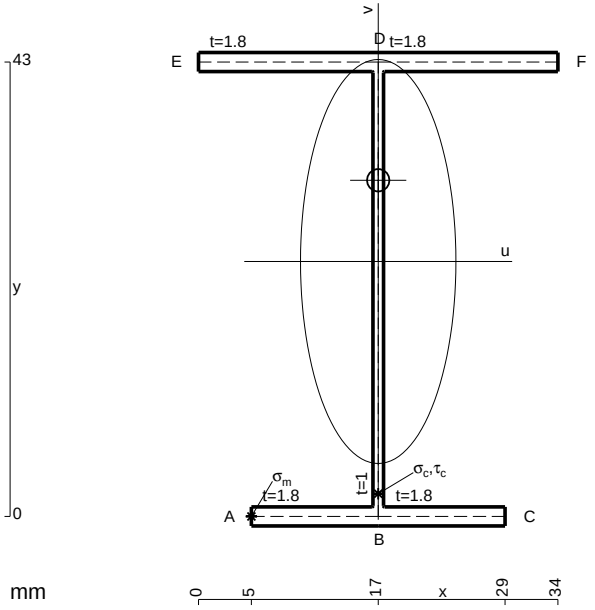
$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (x/b)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b)\ Fb\ 1/EJ\ = 1/2\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x/b)\ Fb\ 1/EJ\ dx = [\ x -1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

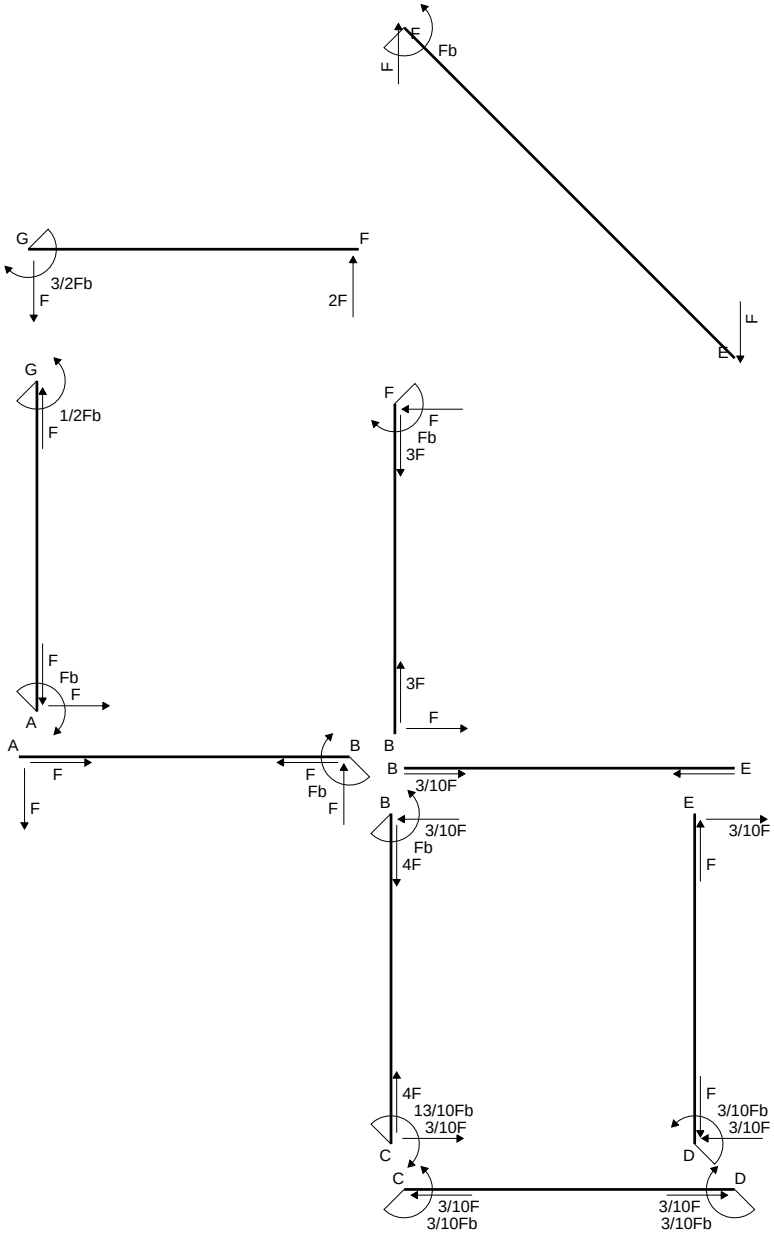
$= (\ b -1/2\ b)\ Fb\ 1/EJ\ = 1/2\ Fb^2/EJ$

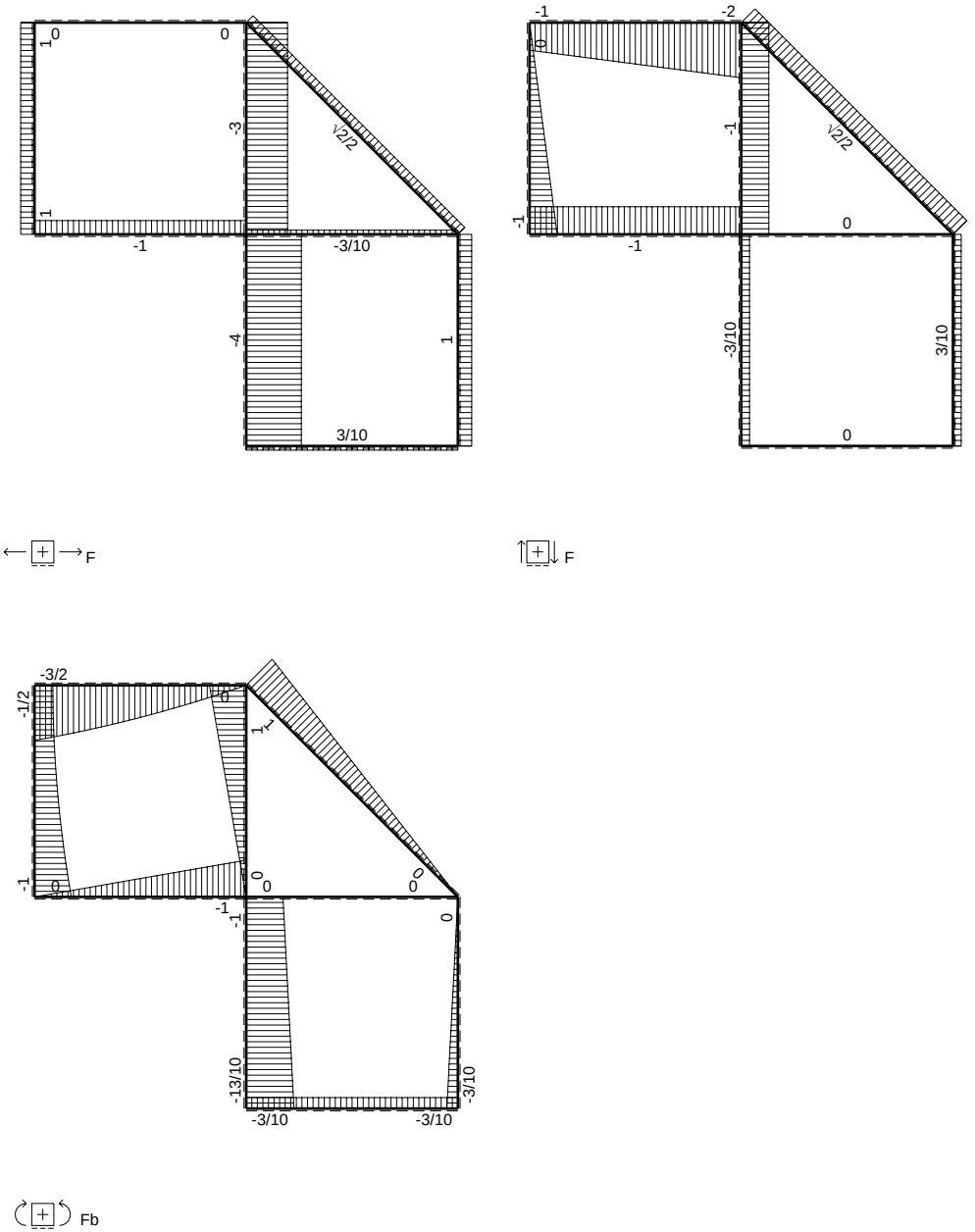


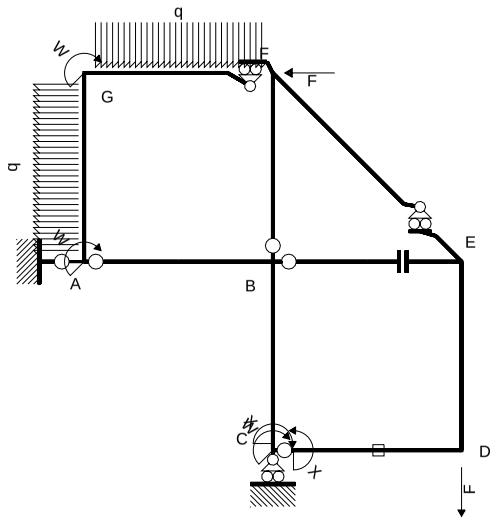
A = 147.4 mm^2
J_u = 53868. mm^4
J_v = 7969. mm^4
J_t = 127.1 mm^4
y_o = 7.686 mm
y_g = 24.13 mm
T_y = -460. N
M_x = -503700. Nmm
x_m = 5. mm
u_m = -12. mm
v_m = -24.13 mm
$\sigma_m = -Mv/J_u$ = -225.6 N/mm^2
x_c = 17. mm
v_c = -24.13 mm
$\sigma_c = -Mv/J_u$ = -225.6 N/mm^2
$\tau_c = TS^*/tJ_u$ = 8.9 N/mm^2
$\tau_g = TS^*/tJ_u$ = 8.9 N/mm^2
t_c = 460. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 226.1 N/mm^2

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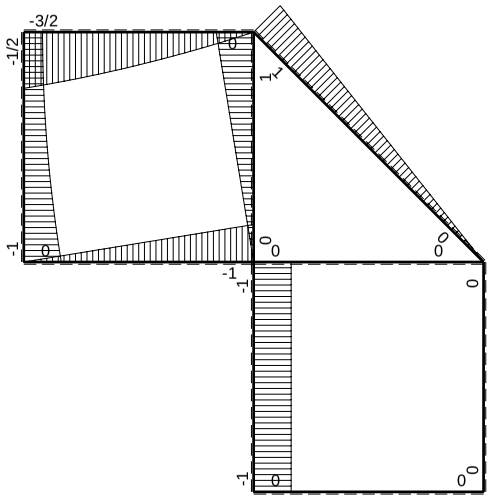
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G
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E
3/10F
B
3/10F
Fb
4F
E
3/10F
F
4F
13/10Fb
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3/10F
3/10Fb
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3/10Fb

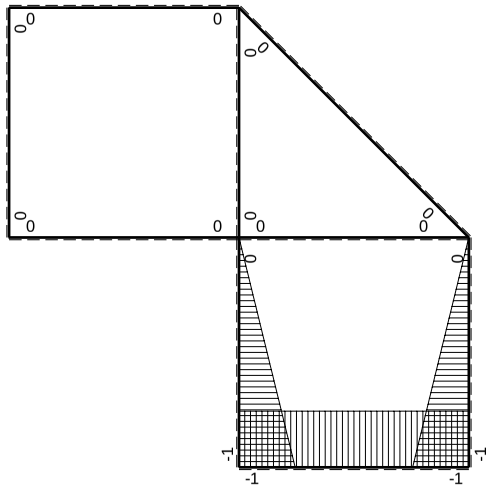

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3/10
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F
-3/2
-1/2
0
1
1
-1
0
0
0
0
-1
-1
0
-13/10
-3/10
-3/10
-3/10
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-Fx	0	0	0	0
BA b	0	Fb-Fx	0	0		
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb	Fb-Fx	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	0	0	$1-2x/b+x^2/b^2$	0	1/3Xb/EJ
ED b	x/b	0	0	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	$-2Fx+1/2qx^2$	0	0	0	0
GF b	0	$3/2Fb-Fx-1/2qx^2$	0	0		
GA b	0	$-1/2Fb-1/2qx^2$	0	0	0	0
AG b	0	$Fb-Fx+1/2qx^2$	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/2Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				3/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 - 2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b + 1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b + 1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 - 2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b + 1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b + 1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

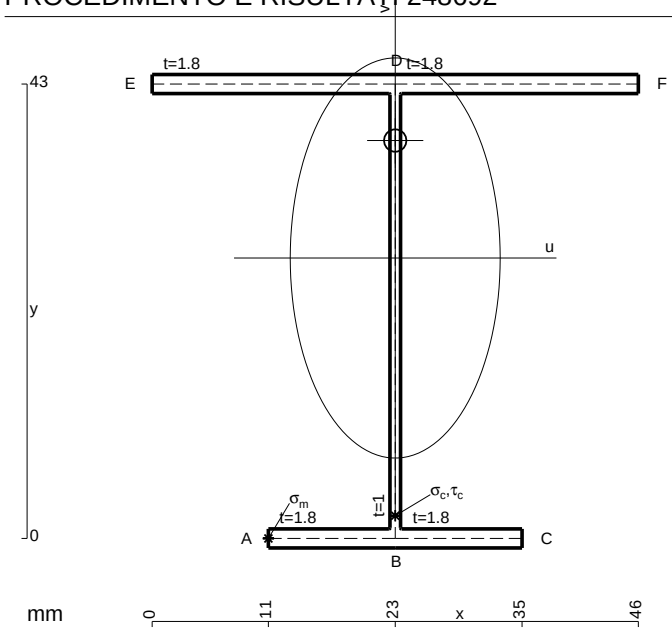
$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (x/b)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b)\ Fb\ 1/EJ\ = 1/2\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x/b)\ Fb\ 1/EJ\ dx = [\ x - 1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

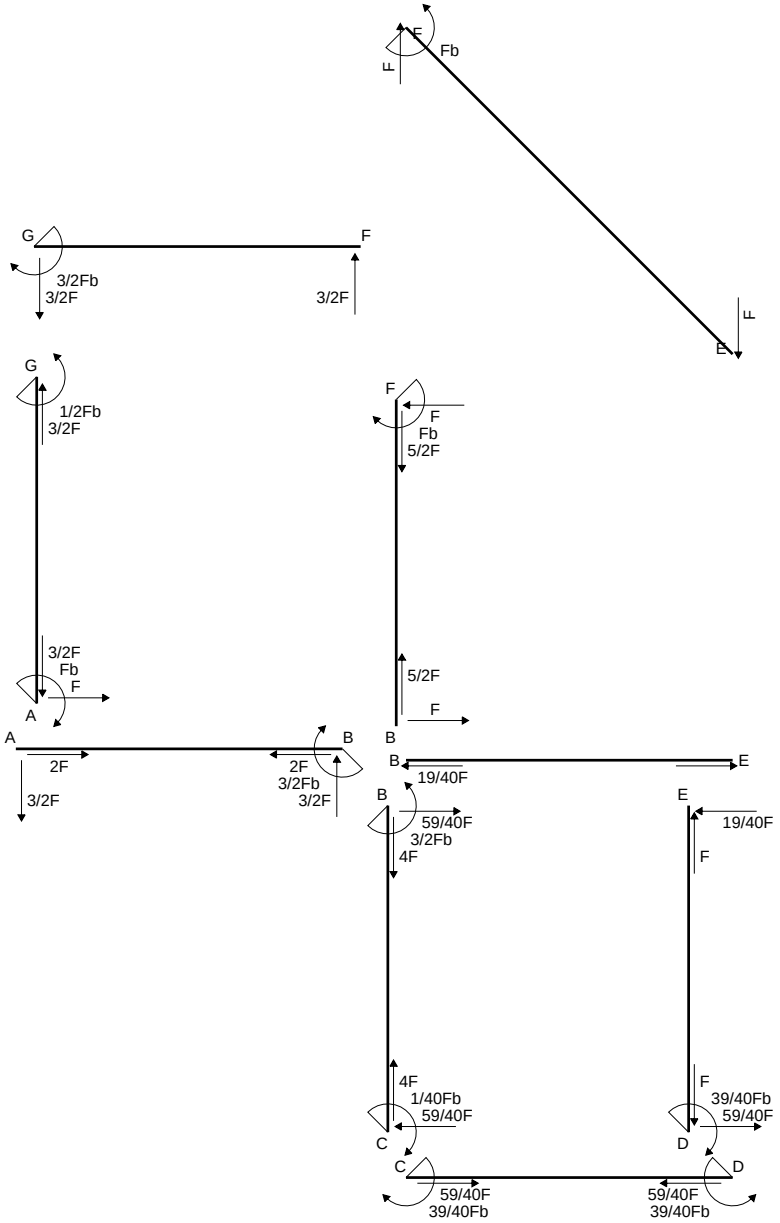
$= (\ b - 1/2\ b\ )\ Fb\ 1/EJ\ = 1/2\ \ Fb^2/EJ$

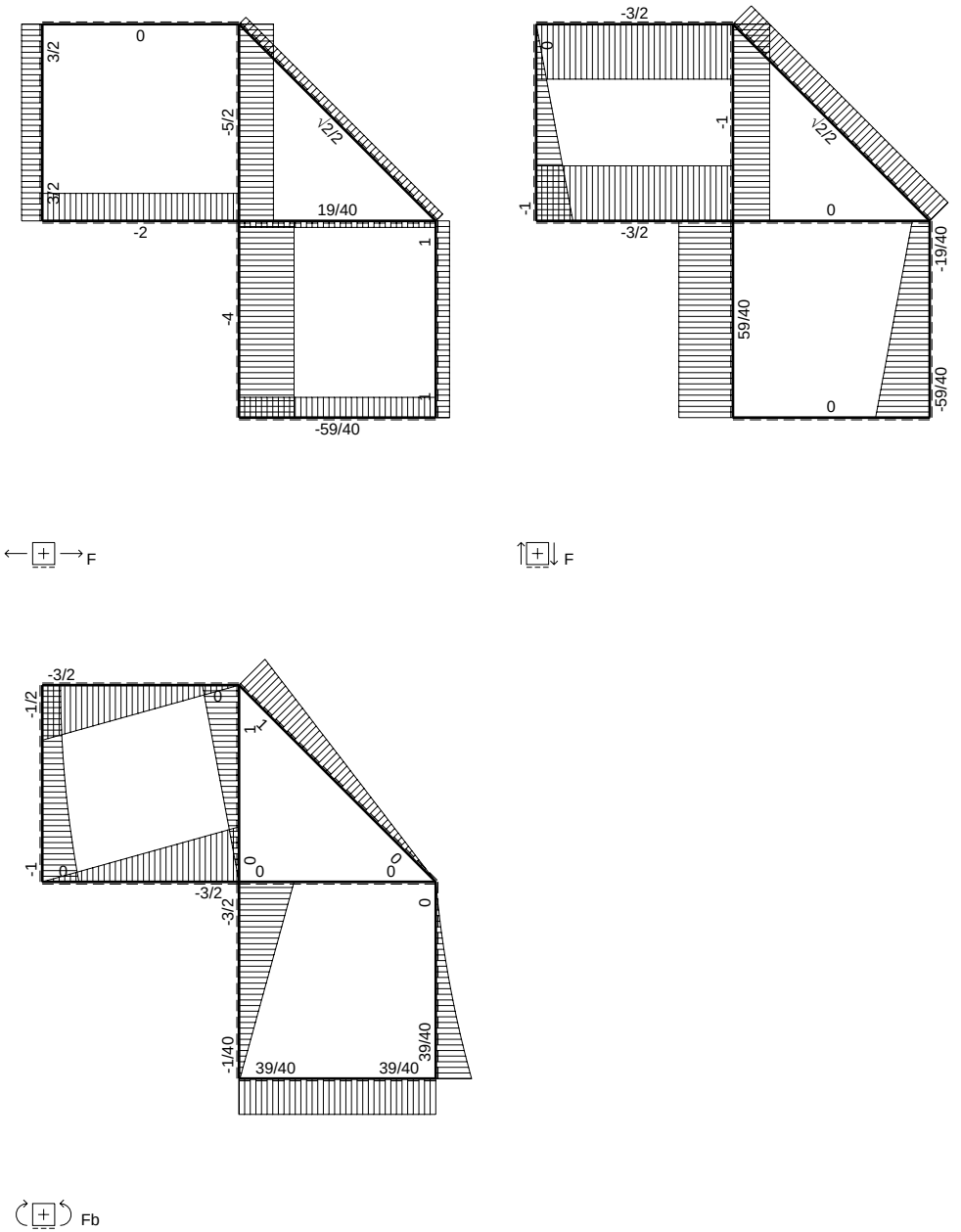


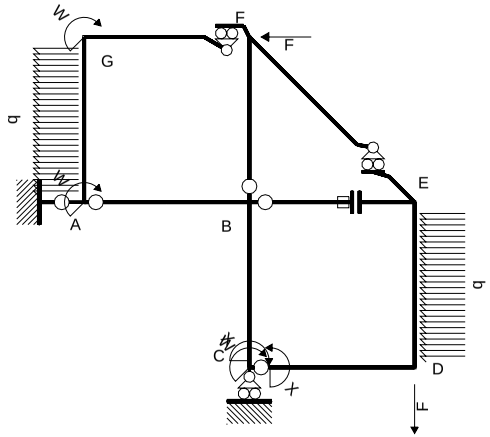
A = 169. mm^2
J_u = 60580. mm^4
J_v = 16674. mm^4
J_t = 150.4 mm^4
y_o = 11.11 mm
y_g = 26.54 mm
T_y = -470. N
M_x = -542850. Nmm
x_m = 11. mm
u_m = -12. mm
v_m = -26.54 mm
$\sigma_m = -Mv/J_u$ = -237.8 N/mm^2
x_c = 23. mm
v_c = -26.54 mm
$\sigma_c = -Mv/J_u$ = -237.8 N/mm^2
$\tau_c = TS^*/tJ_u$ = 8.894 N/mm^2
$\tau_g = TS^*/tJ_u$ = 8.894 N/mm^2
t_c = 470. mm
$\sigma_o = \sqrt{\sigma^2 + 3\tau^2}$ = 238.3 N/mm^2

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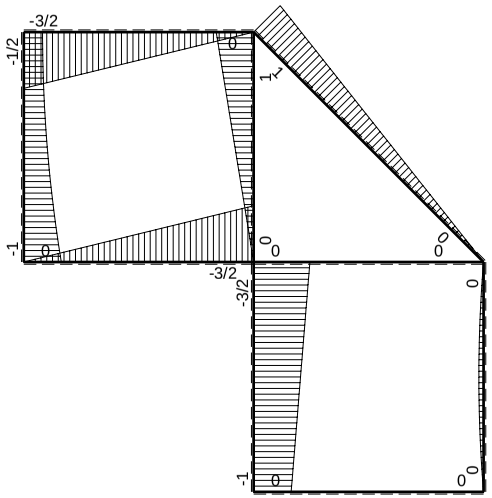
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3/2Fb
3/2F
3/2F
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E
G
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3/2F
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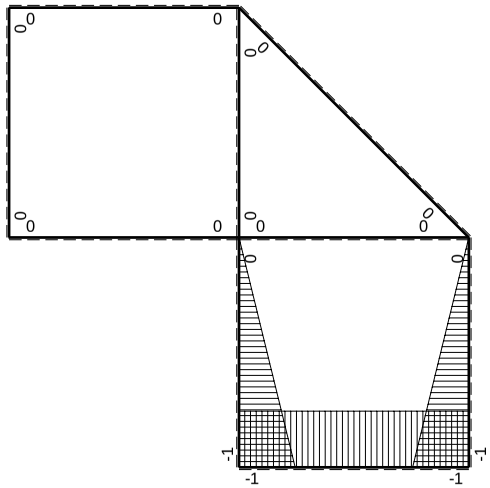

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-4
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-59/40
F
-3/2
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-1
√2/2
-1
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-3/2
-19/40
59/40
-59/40
0
F
-3/2
-1/2
0
1
1
0
0
0
0
-1
0
-3/2
-3/2
0
0
-1/40
39/40
39/40
39/40
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0		
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx^2/b	x^2/b^2	7/12Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE 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
ED b	x/b	1/2Fx-1/2qx^2	1/2Fx^2/b-1/2qx^3/b	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-3/2Fx	0	0	0	0
GF b	0	3/2Fb-3/2Fx	0	0		
GA b	0	-1/2Fb-1/2qx^2	0	0	0	0
AG b	0	Fb-Fx+1/2qx^2	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				13/8Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-39/40Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b)\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

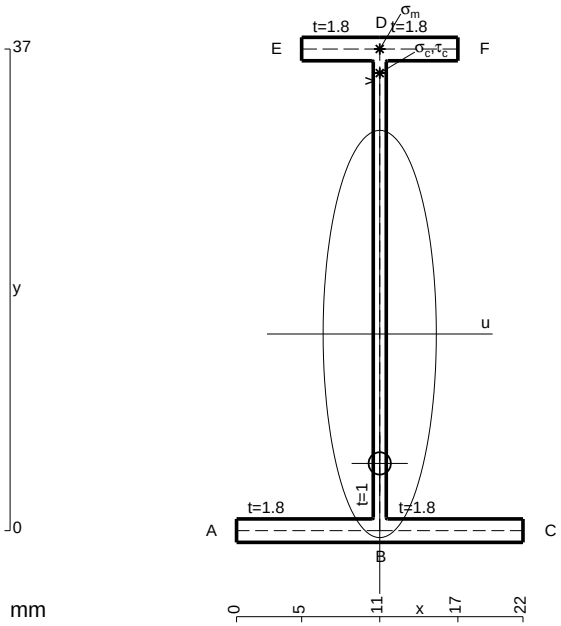
$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2\ x/b - x^2/b^2 +1/2\ x^3/b^3)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/3\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b -1/3\ b +1/8\ b)\ Fb\ 1/EJ\ = 1/24\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x^2/b^2 -1/2\ x^3/b^3)\ Fb\ 1/EJ\ dx = [1/6\ x^3/b^2 -1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

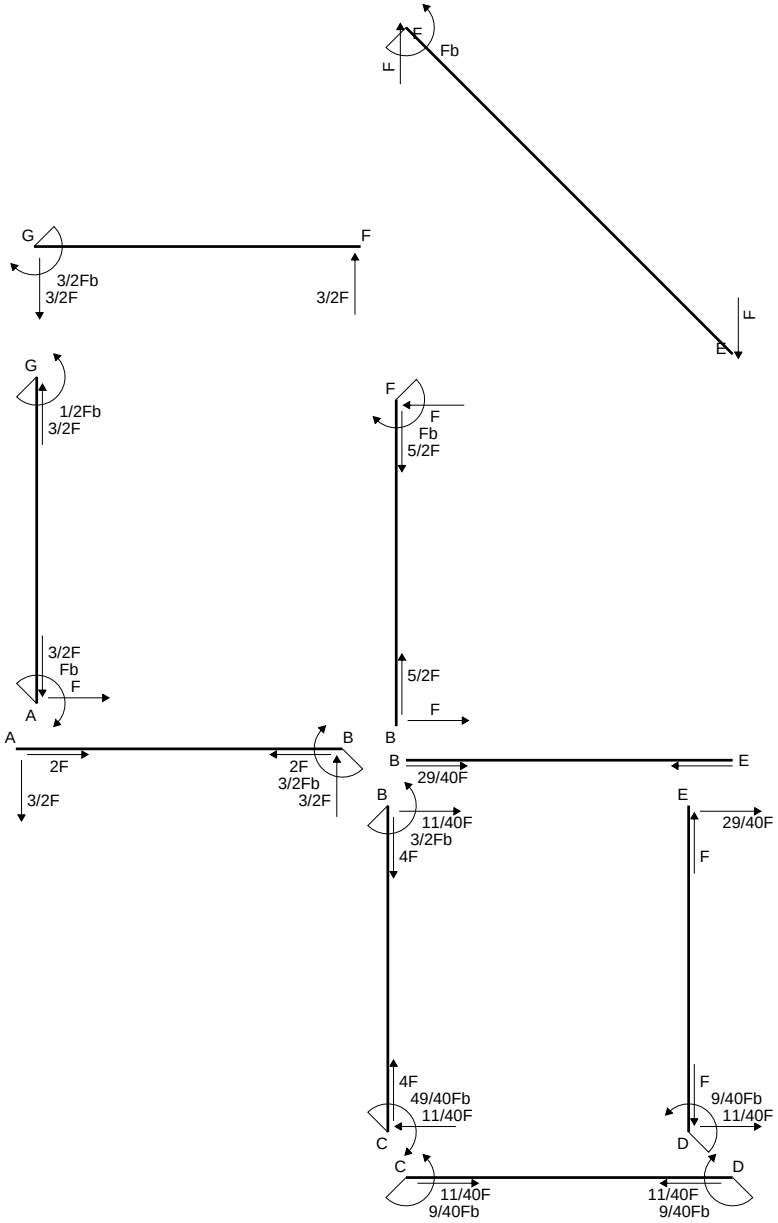
$= (1/6\ b -1/8\ b)\ Fb\ 1/EJ\ = 1/24\ Fb^2/EJ$

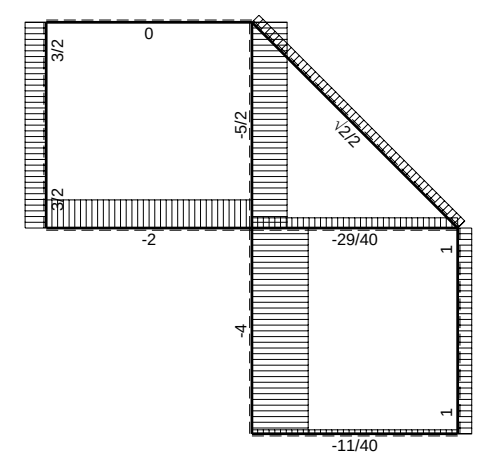


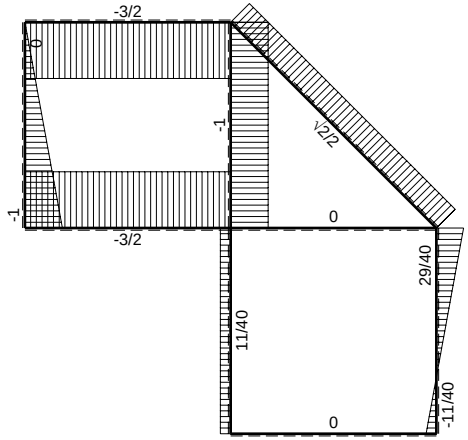
A = 98.2 mm^2
J_u = 24038. mm^4
J_v = 1856. mm^4
J_t = 78.43 mm^4
y_o = -9.943 mm
y_g = 15.11 mm
T_y = -615. N
M_x = -215250. Nmm
x_m = 11. mm
y_m = 37. mm
v_m = 21.89 mm
$\sigma_m = -Mv/J_u$ = 196. N/mm^2
y_c = 2. mm
u_c = -11. mm
v_c = -13.11 mm
$\sigma_c = -Mv/J_u$ = 196. N/mm^2
$\tau_c = TS^*/tJ_u$ = 12.1 N/mm^2
$\tau_g = TS^*/tJ_u$ = 12.1 N/mm^2
t_c = 410. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 197.1 N/mm^2

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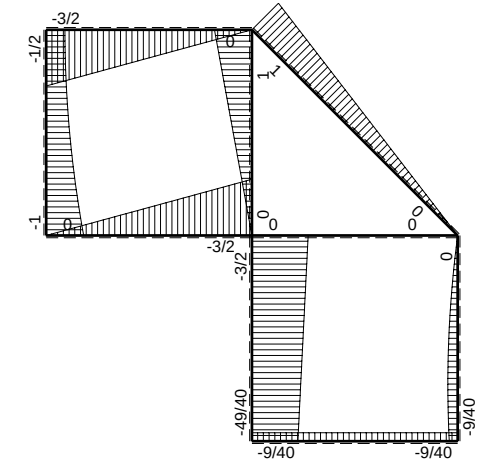

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Fb
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G
F
3/2Fb
3/2F
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G
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3/2F
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2F
2F
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3/2Fb
3/2F
3/2F
B
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3/2Fb
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4F
4F
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9/40Fb
11/40F
11/40F
C
D
C
D
11/40F
11/40F
9/40Fb
9/40Fb


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-4
1
-11/40

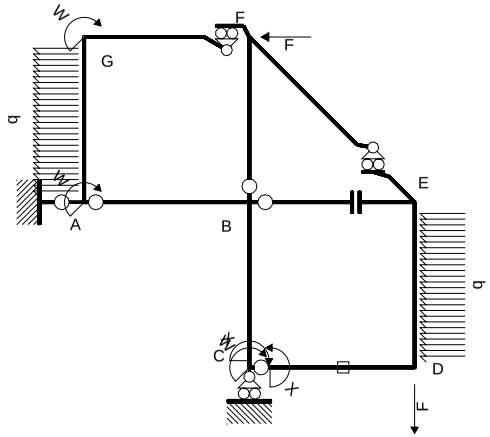

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-3/2
29/40
11/40
-11/40
0

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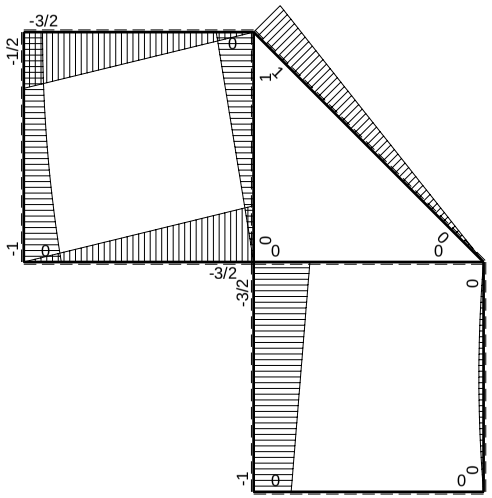
F


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-9/40

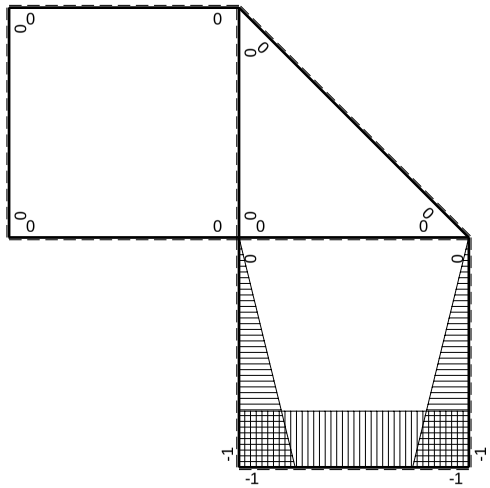
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0		
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx^2/b	x^2/b^2	7/12Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE 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
ED b	x/b	1/2Fx-1/2qx^2	1/2Fx^2/b-1/2qx^3/b	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-3/2Fx	0	0	0	0
GF b	0	3/2Fb-3/2Fx	0	0		
GA b	0	-1/2Fb-1/2qx^2	0	0	0	0
AG b	0	Fb-Fx+1/2qx^2	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				-Fb^2/EJ	
	totali				-3/8Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				9/40Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

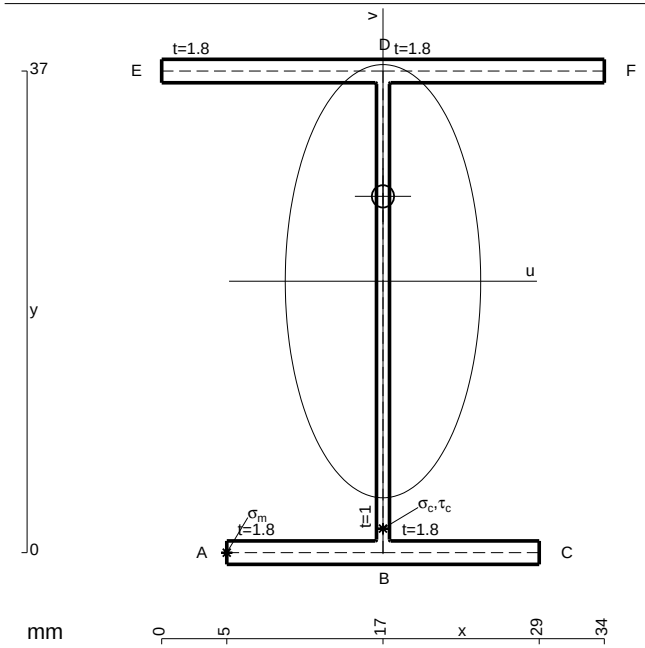
$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2\ x/b - x^2/b^2 +1/2\ x^3/b^3)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/3\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b -1/3\ b +1/8\ b\ )\ Fb\ 1/EJ\ = 1/24\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x^2/b^2 -1/2\ x^3/b^3)\ Fb\ 1/EJ\ dx = [1/6\ x^3/b^2 -1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

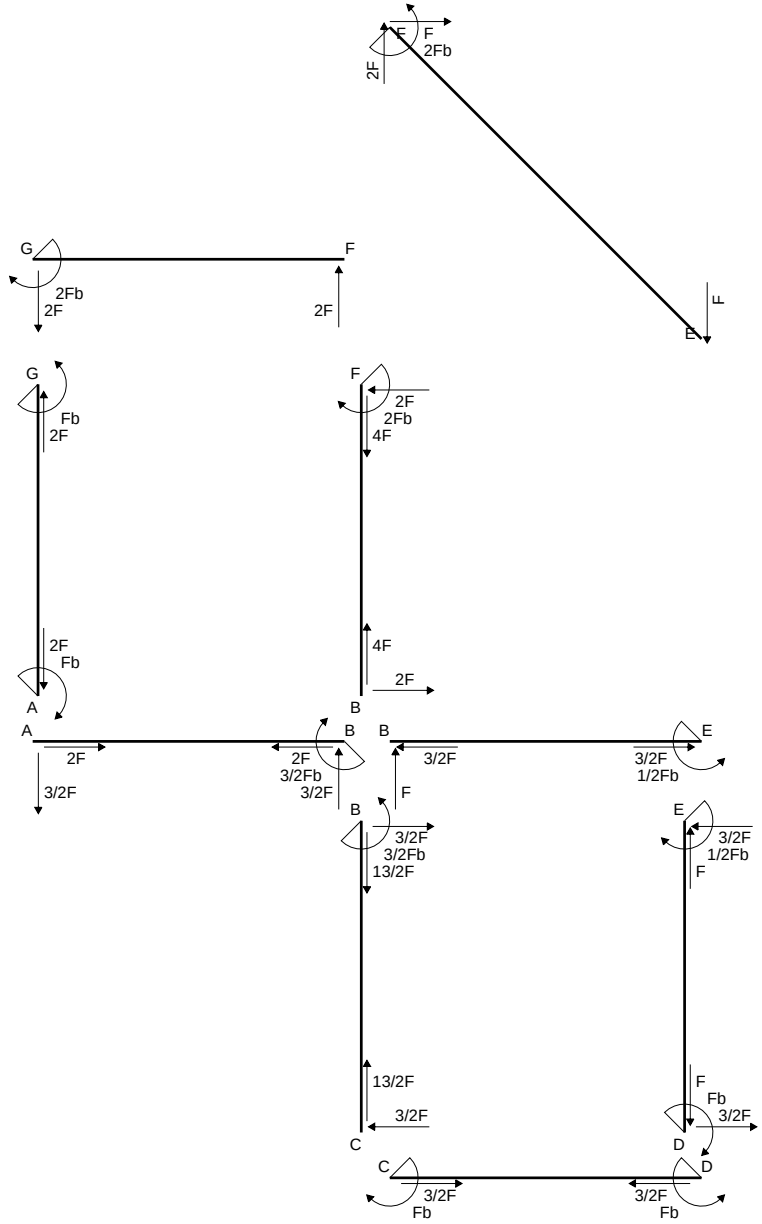
$= (1/6\ b -1/8\ b\ )\ Fb\ 1/EJ\ = 1/24\ \ Fb^2/EJ$

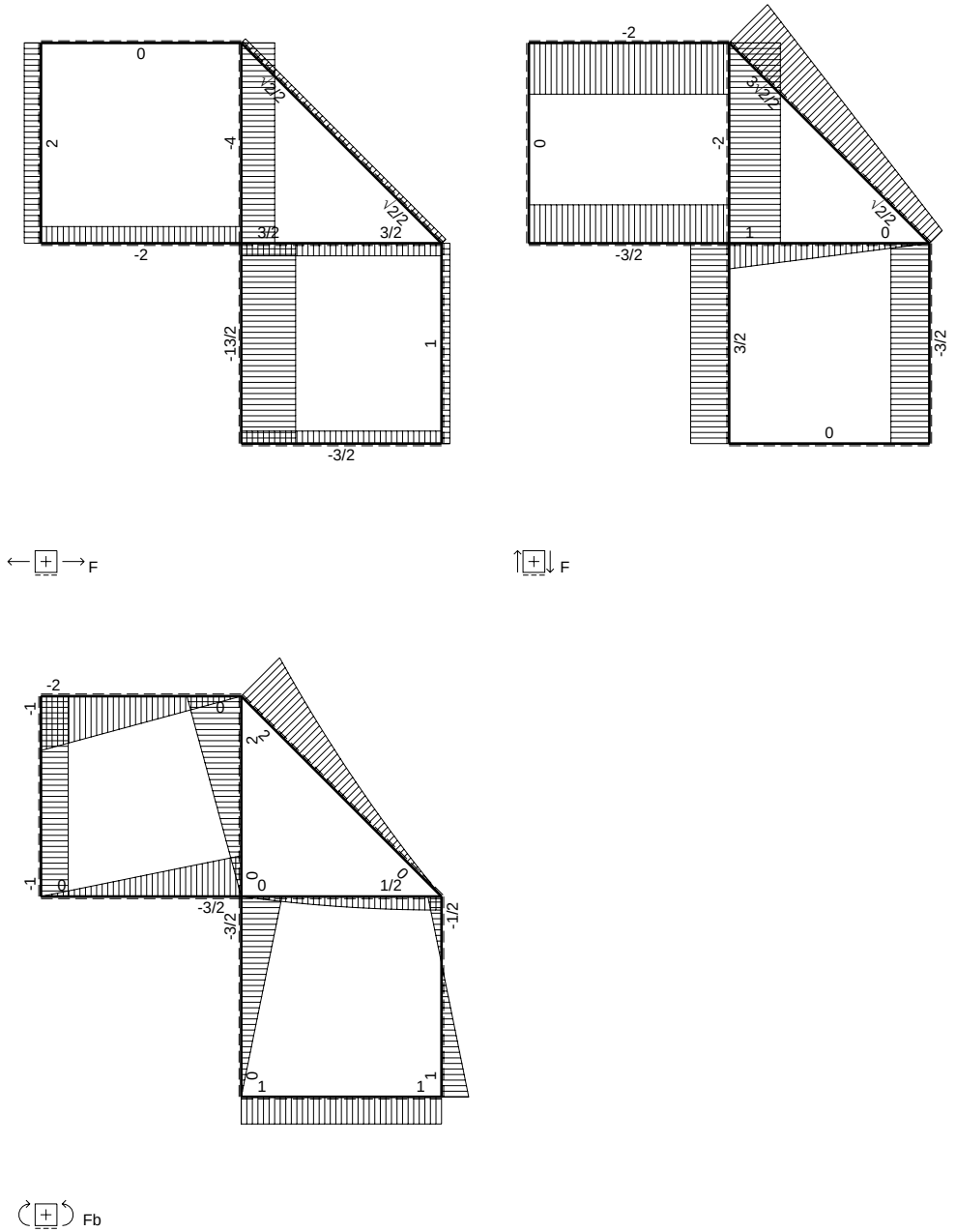


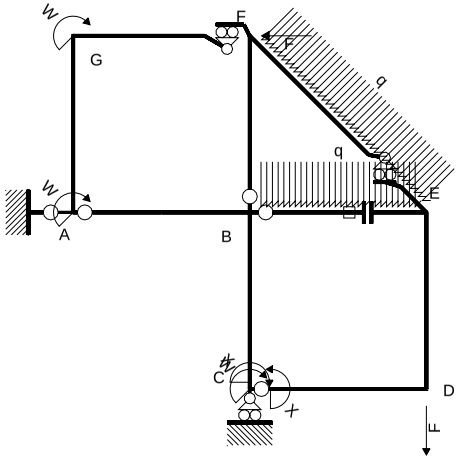
A = 141.4 mm^2
J_u = 39168. mm^4
J_v = 7969. mm^4
J_t = 125.1 mm^4
y_o = 6.518 mm
y_g = 20.85 mm
N = -1320. N
T_y = -990. N
M_x = -376200. Nmm
x_m = 5. mm
u_m = -12. mm
v_m = -20.85 mm
$\sigma_m = N/A - Mv/J_u$ = -209.6 N/mm^2
x_c = 17. mm
v_c = -20.85 mm
$\sigma_c = N/A - Mv/J_u$ = -209.6 N/mm^2
$\tau_c = TS^*/tJ_u$ = 22.77 N/mm^2
$\tau_g = TS^*/tJ_u$ = 22.77 N/mm^2
t_c = 660. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 213.3 N/mm^2

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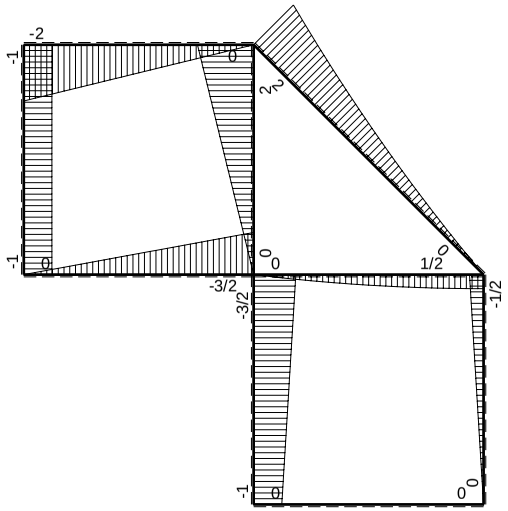
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2Fb
2F
G
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2Fb
2F
2F
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Fb
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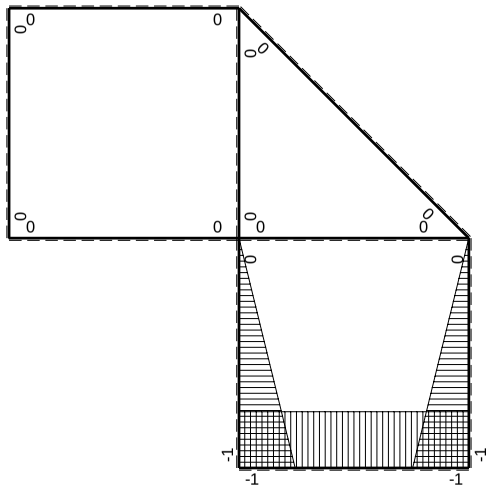

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F
-2
-1
0
2
-1
0
0
0
1/2
-3/2
-3/2
-1/2
0
1
1
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0		
BC b	-x/b	-3/2Fb+1/2Fx	$3/2Fx-1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	$Fb-1/2Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE 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
ED b	x/b	1/2Fb-1/2Fx	$1/2Fx-1/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx+1/2qx^2$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	$Fx-1/2qx^2$	0	0	0	0
EB b	0	$-1/2Fb+1/2qx^2$	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$5/3Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b)\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

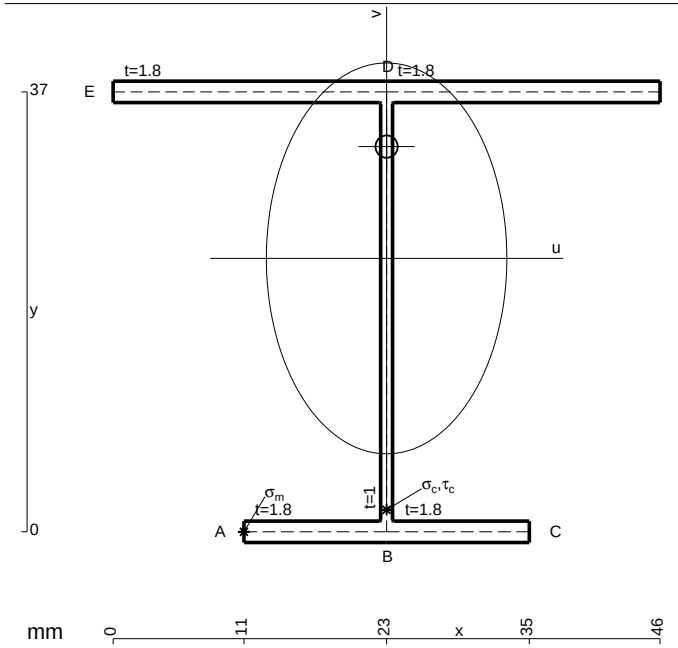
$L^{Xo}_{DE} = \int_o^b (1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b -1/6\ b)\ Fb\ 1/EJ\ = 1/12\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b -1/6\ b)\ Fb\ 1/EJ\ = 1/12\ Fb^2/EJ$

PROCEDIMENTO E RISULTATI 242068 CI02.xxxx.132

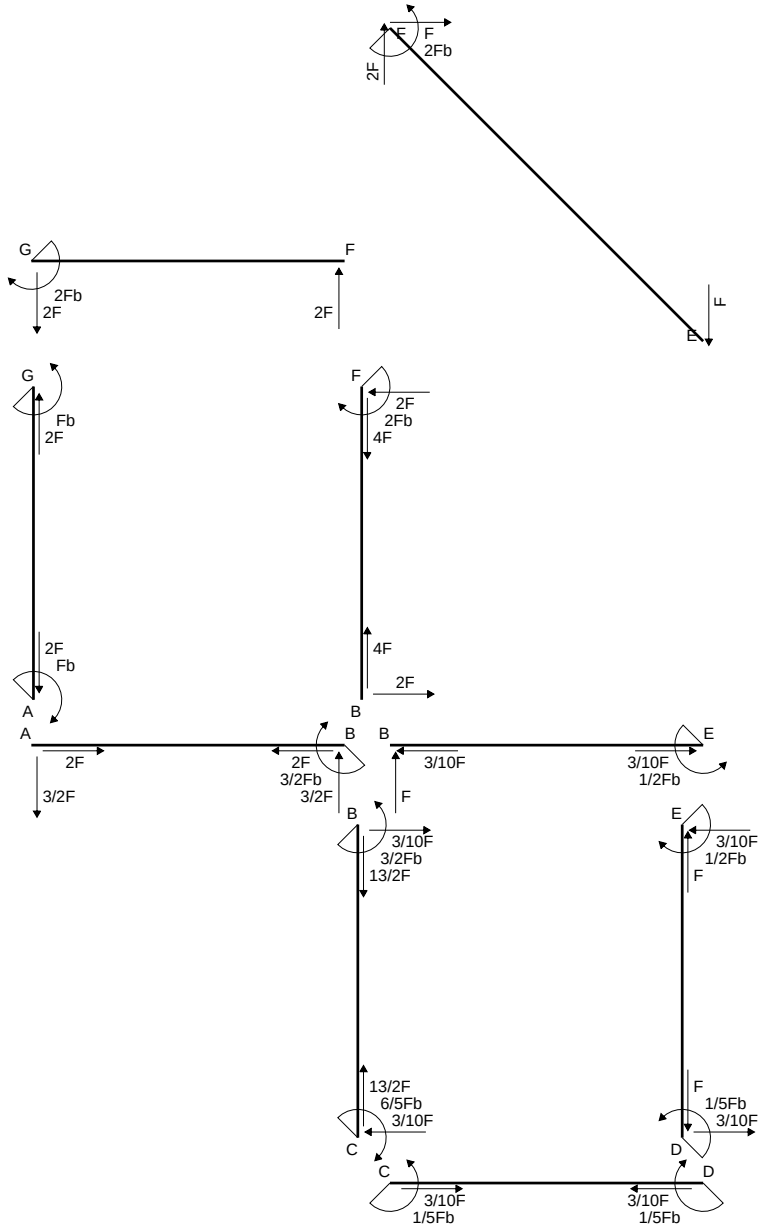


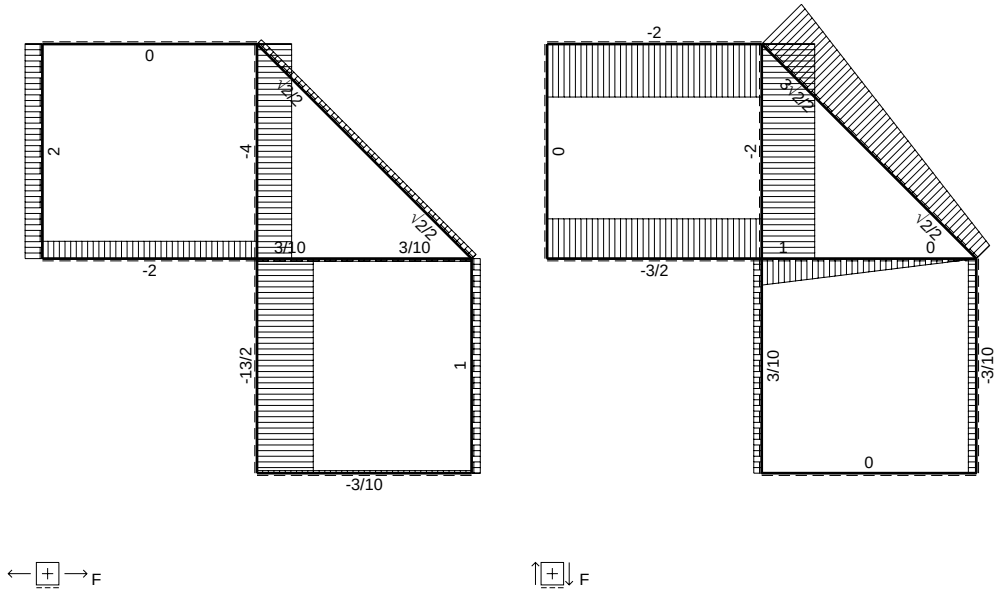
A = 163. mm^2
J_u = 44052. mm^4
J_v = 16674. mm^4
J_t = 148.4 mm^4
y_o = 9.404 mm
y_g = 22.99 mm
N = 346.5 N
T_y = 1039. N
M_x = 411600. Nmm
x_m = 11. mm
u_m = -12. mm
v_m = -22.99 mm
$\sigma_m = N/A - Mv/J_u$ = 217. N/mm^2
x_c = 23. mm
v_c = -22.99 mm
$\sigma_c = N/A - Mv/J_u$ = 217. N/mm^2
$\tau_c = TS^*/tJ_u$ = 23.44 N/mm^2
$\tau_g = TS^*/tJ_u$ = 23.44 N/mm^2
t_c = 490. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 220.7 N/mm^2

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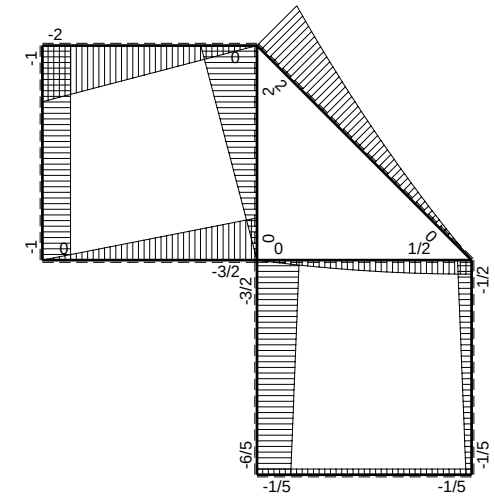
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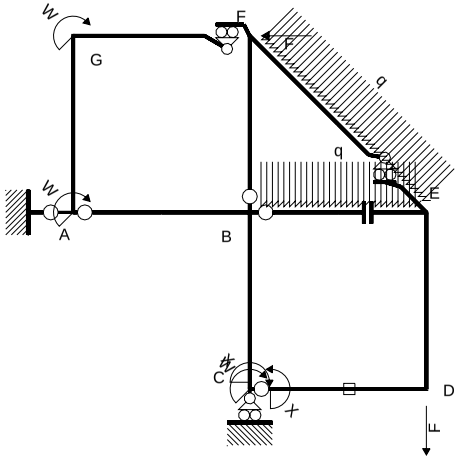

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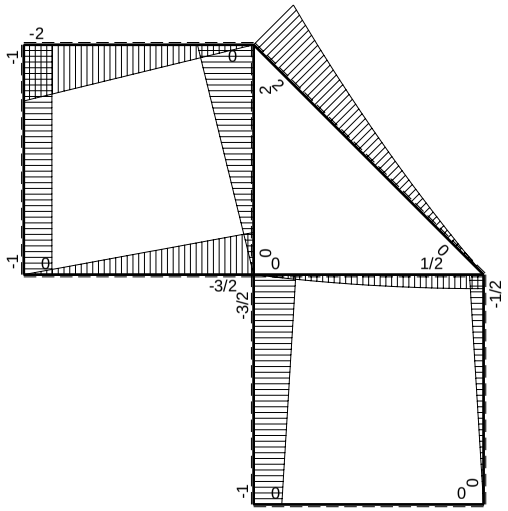
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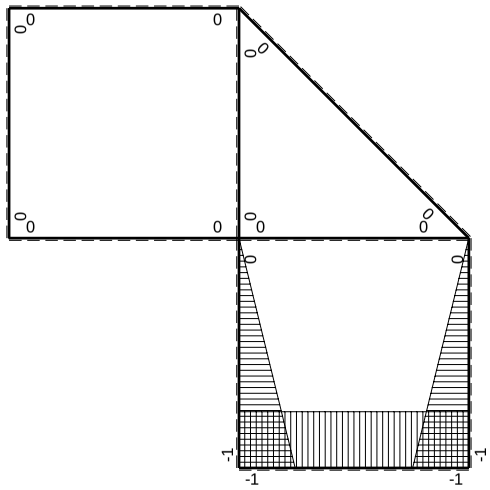
Fb



Schema di calcolo iperstatico



M_o flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0		
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx^2/b	x^2/b^2	7/12Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE 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
ED b	x/b	1/2Fb-1/2Fx	1/2Fx-1/2Fx^2/b	x^2/b^2		
EF √2b	0	√2/2Fx+1/2qx^2	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	Fx-1/2qx^2	0	0	0	0
EB b	0	-1/2Fb+1/2qx^2	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				-Fb^2/EJ	
	totali				-1/3Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				1/5Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

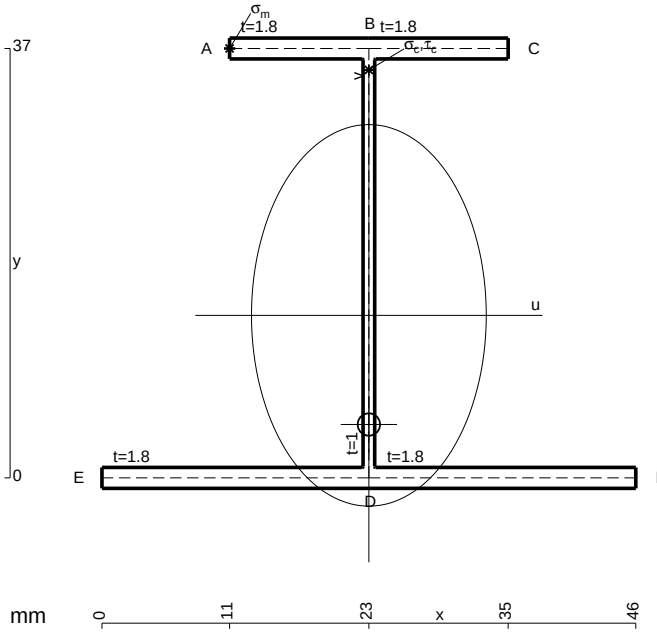
$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/12\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

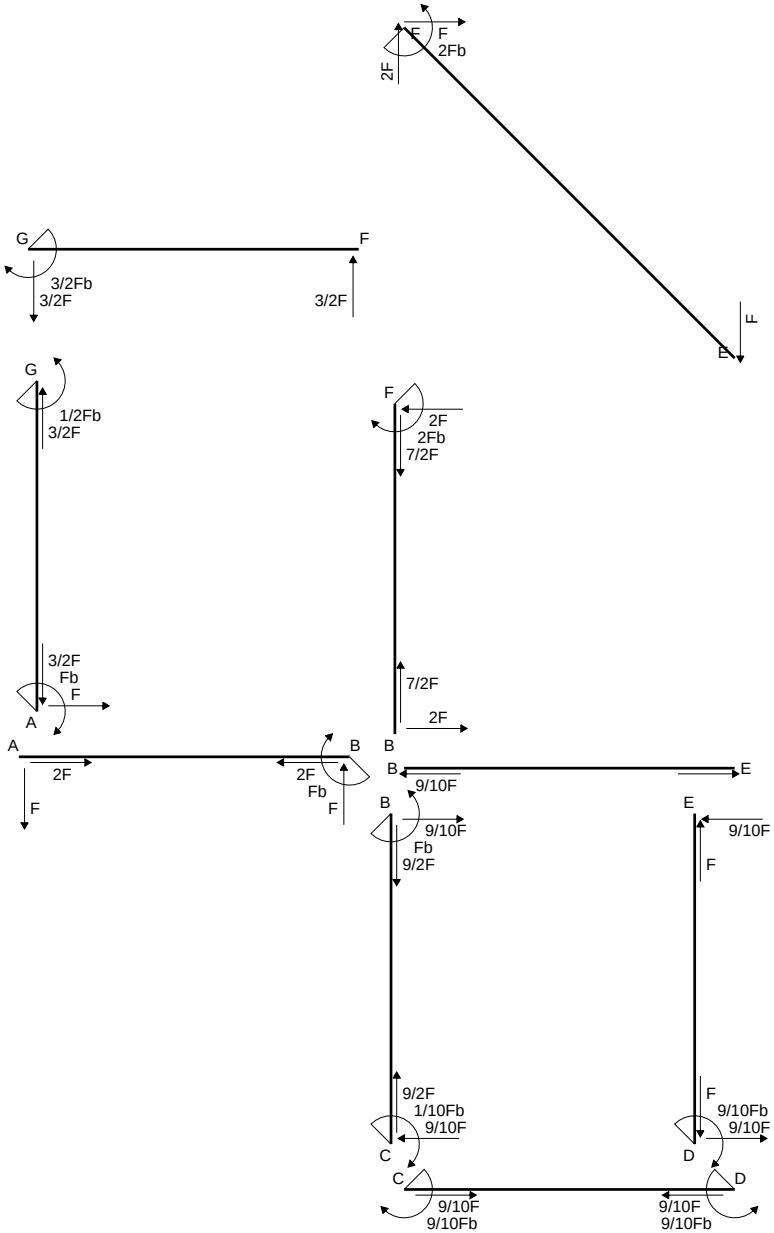
$= (1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/12\ Fb^2/EJ$

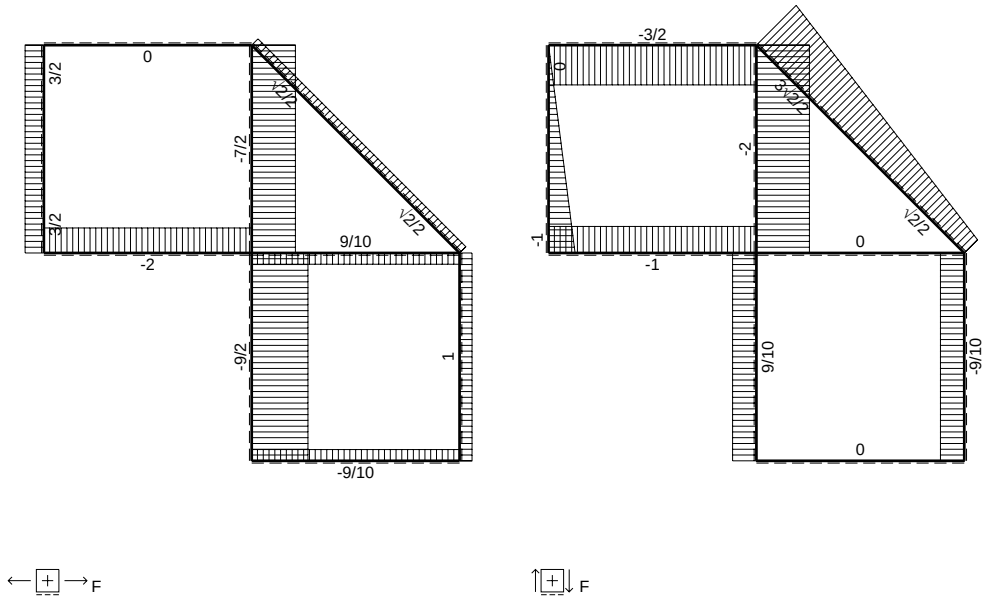


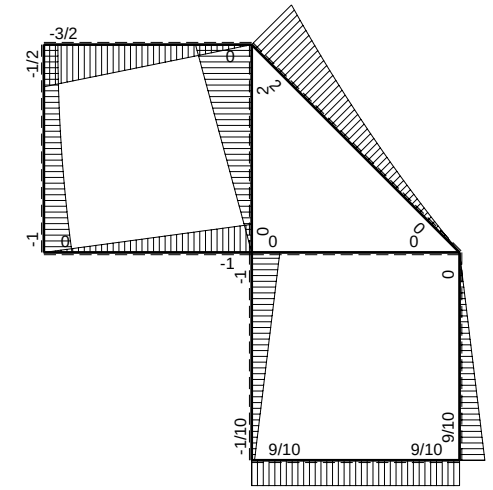
A = 163. mm^2
J_u = 44052. mm^4
J_v = 16674. mm^4
J_t = 148.4 mm^4
y_o = -9.404 mm
y_g = 14.01 mm
N = -1840. N
T_y = -920. N
M_x = 414000. Nmm
x_m = 11. mm
y_m = 37. mm
u_m = -12. mm
v_m = 22.99 mm
$\sigma_m = N/A - Mv/J_u$ = -227.4 N/mm^2
x_c = 23. mm
y_c = 37. mm
v_c = 22.99 mm
$\sigma_c = N/A - Mv/J_u$ = -227.4 N/mm^2
$\tau_c = TS^*/tJ_u$ = 20.75 N/mm^2
$\tau_g = TS^*/tJ_u$ = 20.75 N/mm^2
t_c = 460. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 230.2 N/mm^2

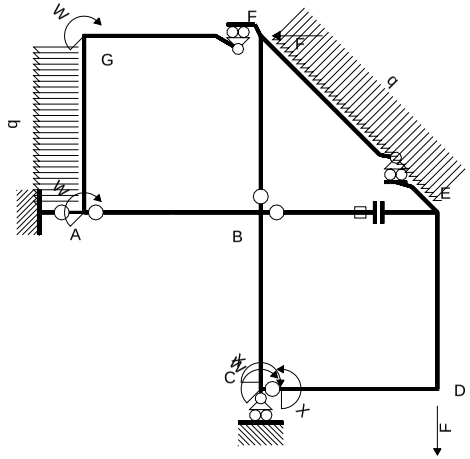
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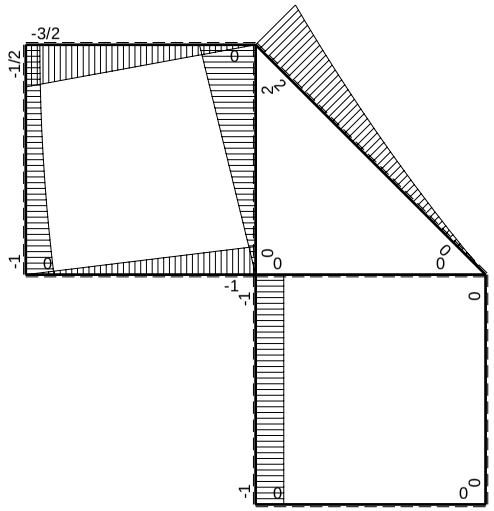

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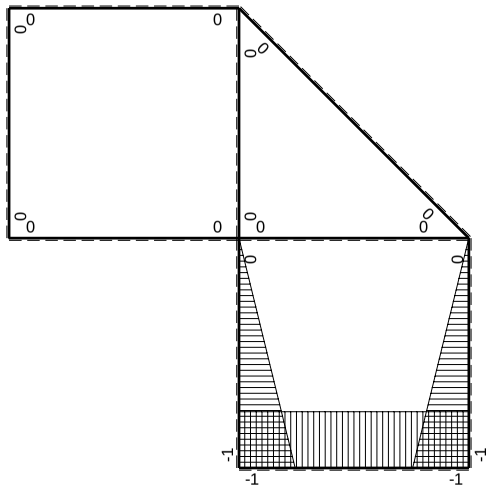

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Fb



Schema di calcolo iperstatico



M_o flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-Fx	0	0	0	0
BA b	0	Fb-Fx	0	0		
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb	Fb-Fx	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	0	0	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx+1/2qx^2$	0	0	0	0
FG b	0	-3/2Fx	0	0	0	0
GF b	0	3/2Fb-3/2Fx	0	0		
GA b	0	$-1/2Fb-1/2qx^2$	0	0	0	0
AG b	0	$Fb-Fx+1/2qx^2$	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$3/2Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				-9/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b)\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b)\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

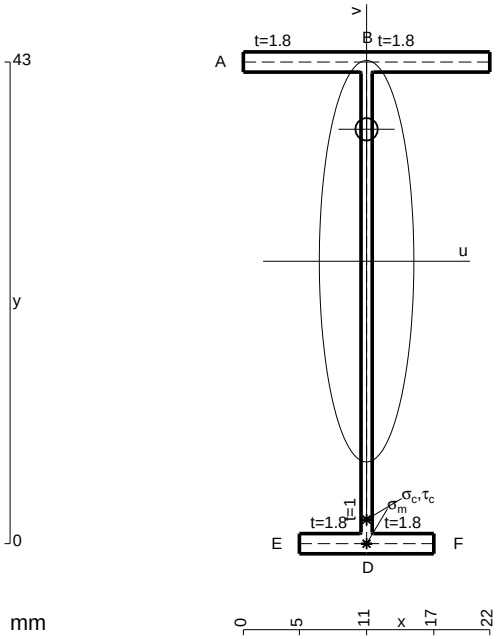
$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (x/b)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b)\ Fb\ 1/EJ\ = 1/2\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x/b)\ Fb\ 1/EJ\ dx = [\ x -1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

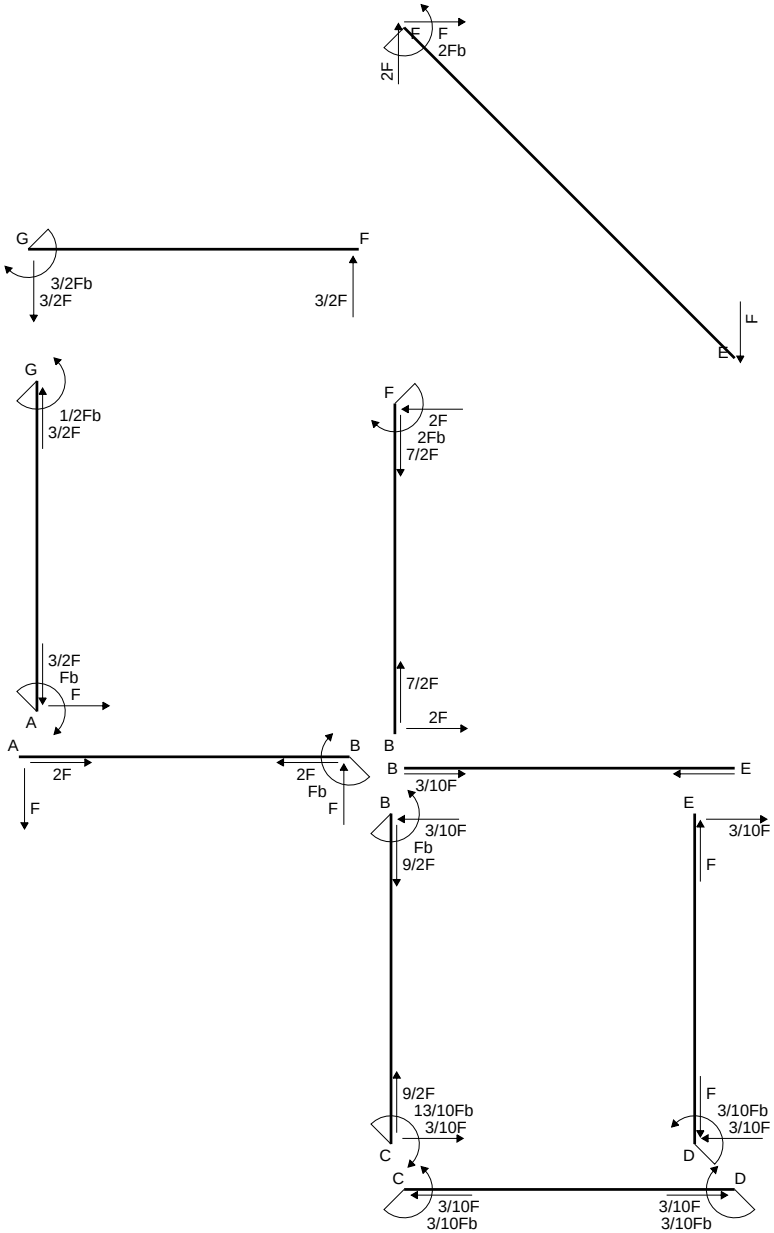
$= (\ b -1/2\ b)\ Fb\ 1/EJ\ = 1/2\ Fb^2/EJ$

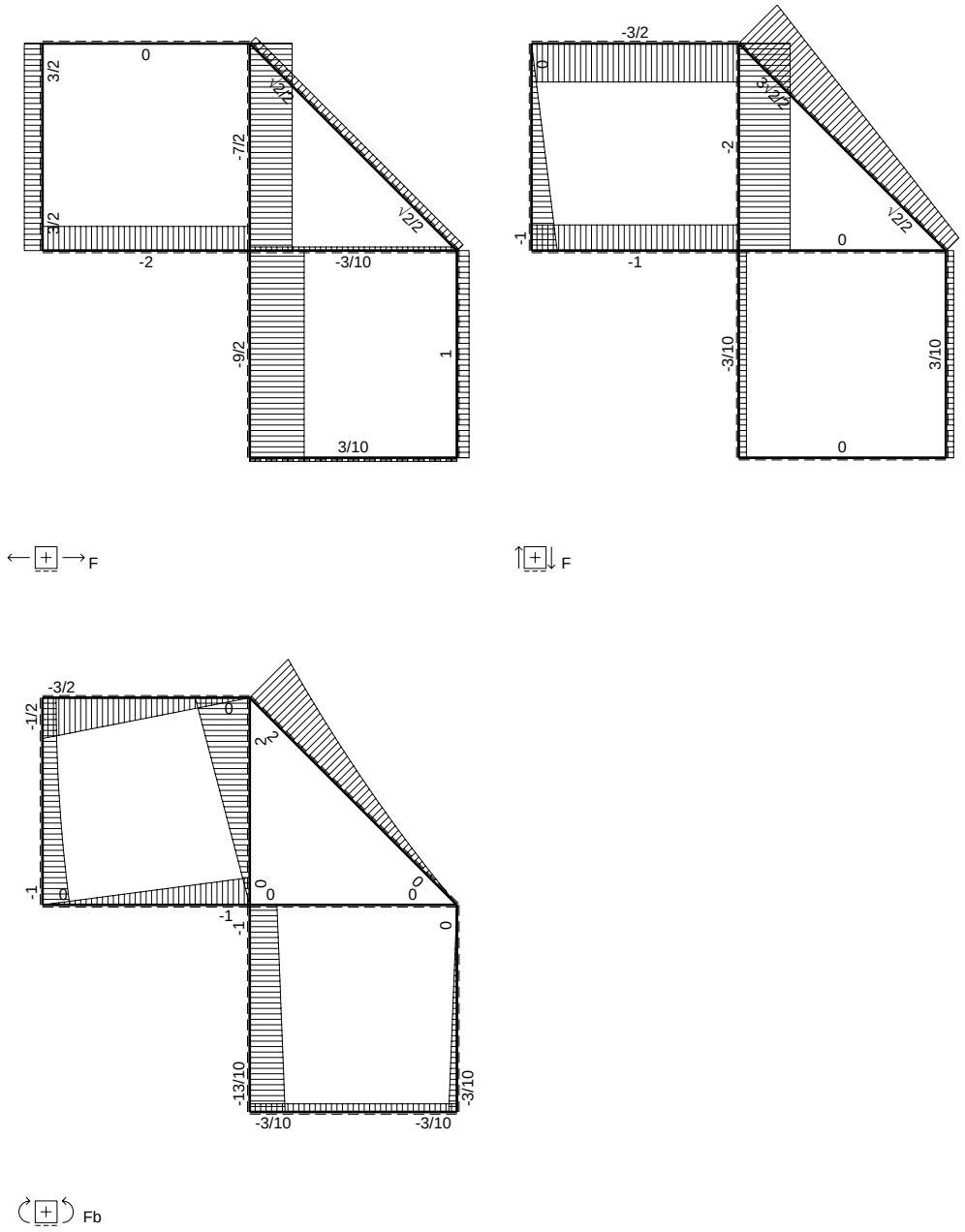


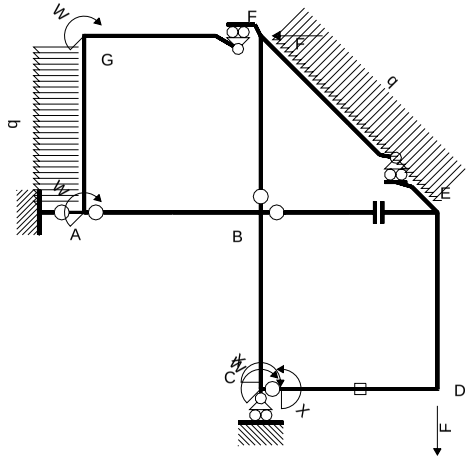
A = 104.2 mm^2
J_u = 33478. mm^4
J_v = 1856. mm^4
J_t = 80.43 mm^4
y_o = 11.78 mm
y_g = 25.21 mm
N = 190.9 N
T_y = 572.8 N
M_x = 307800. Nmm
x_m = 11. mm
v_m = -25.21 mm
$\sigma_m = N/A - Mv/J_u$ = 233.7 N/mm^2
y_c = 3. mm
u_c = -11. mm
v_c = -22.21 mm
$\sigma_c = N/A - Mv/J_u$ = 233.7 N/mm^2
$\tau_c = TS^*/tJ_u$ = 9.318 N/mm^2
$\tau_g = TS^*/tJ_u$ = 9.318 N/mm^2
t_c = 270. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 234.2 N/mm^2

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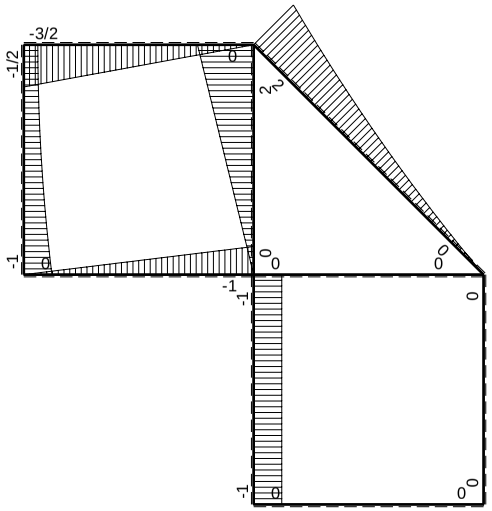
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3/10F
3/10Fb

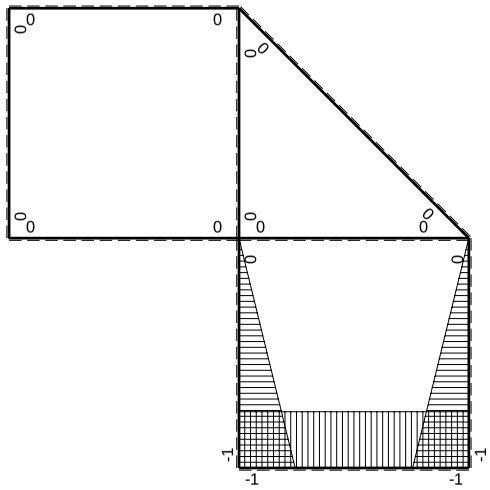

0
3/2
-7/2
√2/2
3/2
-2
-3/10
-9/2
1
3/10
F
-3/2
0
-2
√2/2
-1
0
-1
-3/10
3/10
0
F
-3/2
-1/2
0
√2
-1
0
0
0
-1
-1
0
-13/10
-3/10
-3/10
-3/10
Fb



Schema di calcolo iperstatico



M_o flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-Fx	0	0	0	0
BA b	0	Fb-Fx	0	0		
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb	Fb-Fx	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	0	0	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx+1/2qx^2$	0	0	0	0
FG b	0	-3/2Fx	0	0	0	0
GF b	0	3/2Fb-3/2Fx	0	0		
GA b	0	$-1/2Fb-1/2qx^2$	0	0	0	0
AG b	0	$Fb-Fx+1/2qx^2$	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/2Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				3/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

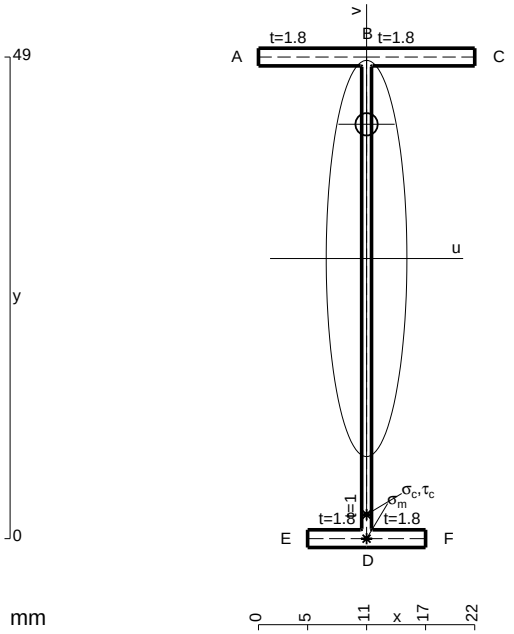
$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (x/b)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b)\ Fb\ 1/EJ\ = 1/2\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x/b)\ Fb\ 1/EJ\ dx = [\ x -1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

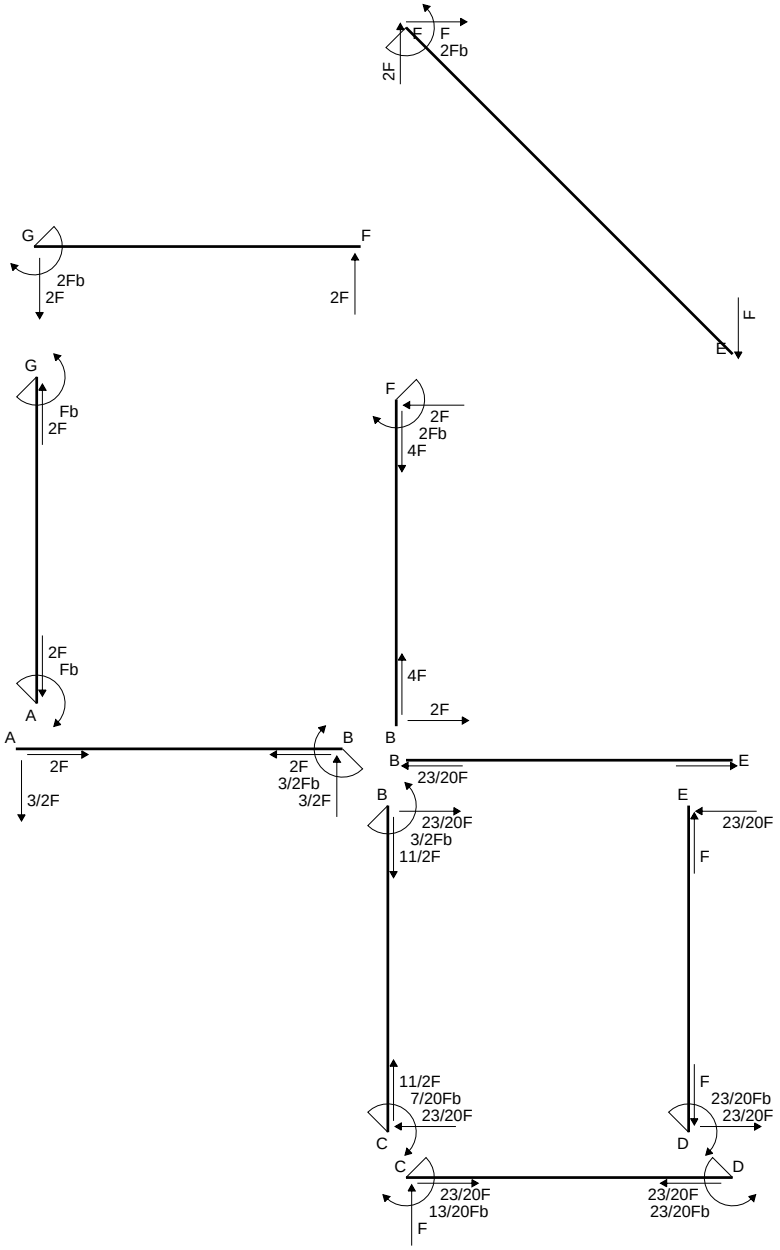
$= (\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 1/2\ Fb^2/EJ$

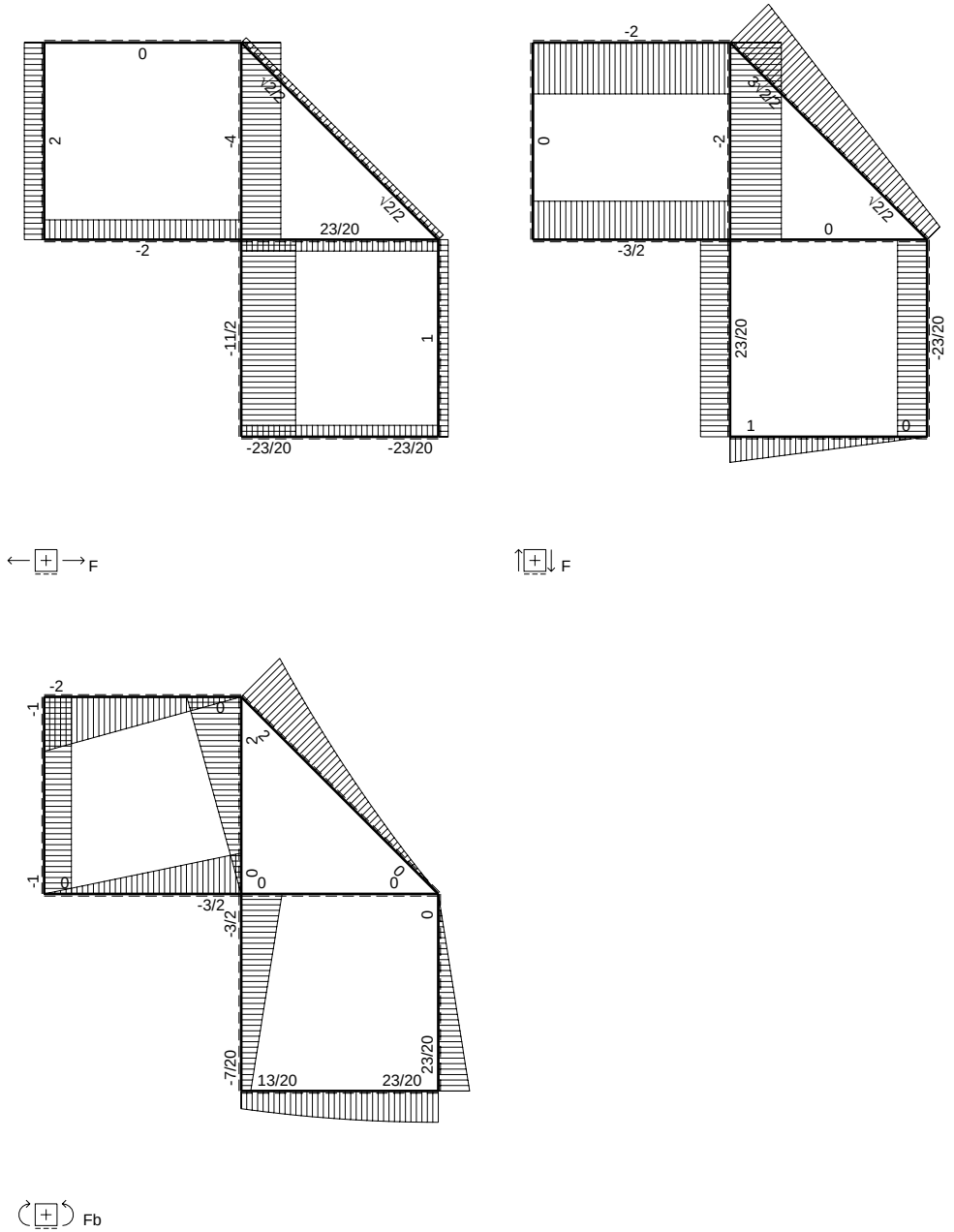


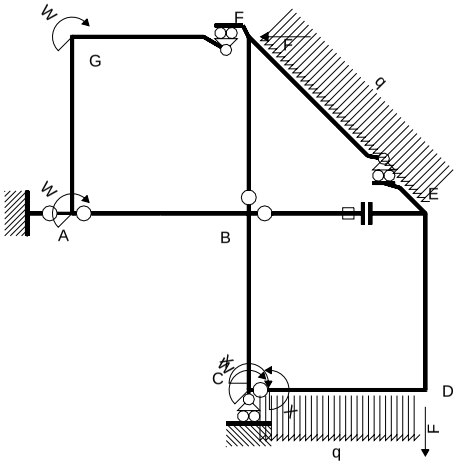
A = 110.2 mm^2
J_u = 44775. mm^4
J_v = 1856. mm^4
J_t = 82.43 mm^4
y_o = 13.66 mm
y_g = 28.5 mm
N = 155.6 N
T_y = 466.7 N
M_x = 303600. Nmm
x_m = 11. mm
v_m = -28.5 mm
$\sigma_m = N/A - Mv/J_u$ = 194.7 N/mm^2
y_c = 3. mm
u_c = -11. mm
v_c = -25.5 mm
$\sigma_c = N/A - Mv/J_u$ = 194.7 N/mm^2
$\tau_c = TS^*/tJ_u$ = 6.417 N/mm^2
$\tau_g = TS^*/tJ_u$ = 6.417 N/mm^2
t_c = 220. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 195. N/mm^2

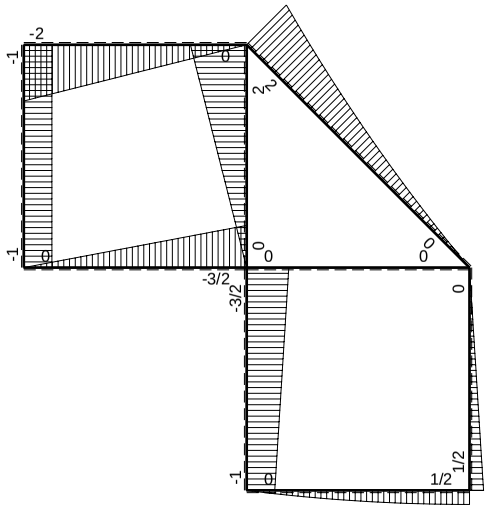
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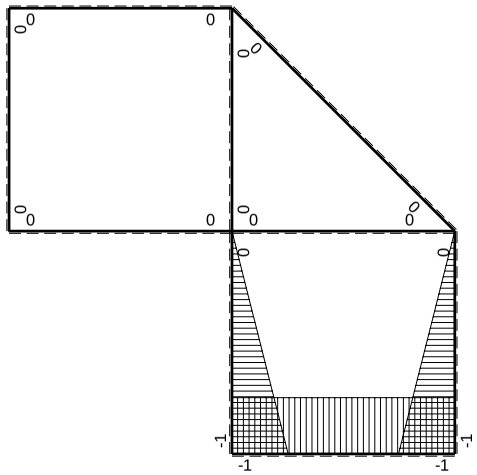

F
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Fb
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2F
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A
B
B
2F
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2F
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3/2F
3/2F
23/20F
B
E
23/20F
23/20F
3/2Fb
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F
11/2F
7/20Fb
23/20F
F
23/20Fb
23/20F
C
D
C
D
23/20F
13/20Fb
23/20F
23/20Fb
F


0
2
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√2/2
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√2/2
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0
23/20
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0
F
-2
-1
0
2
-1
0
0
0
0
-3/2
-3/2
0
-7/20
13/20
23/20
23/20
Fb





M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0		
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx^2/b	x^2/b^2	7/12Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	Fx-1/2qx^2	-Fx+1/2Fx^2/b	1	-1/3Fb^2/EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx^2	-1/2Fb+1/2Fx^2/b	1		
DE 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
ED b	x/b	-1/2Fx	-1/2Fx^2/b	x^2/b^2		
EF √2b	0	√2/2Fx+1/2qx^2	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				13/12Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-13/20Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-\ x/b +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/3\ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2 +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

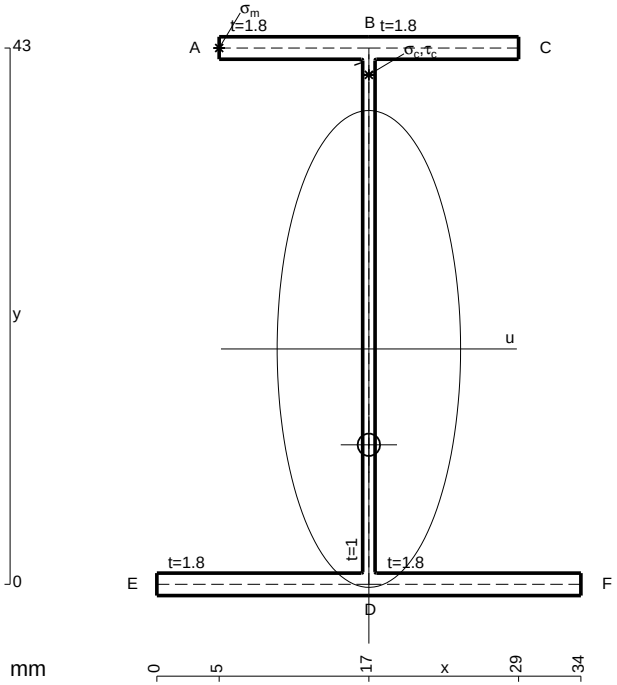
$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/3\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (-1/2 + x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x +1/2\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = -1/6\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (-1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

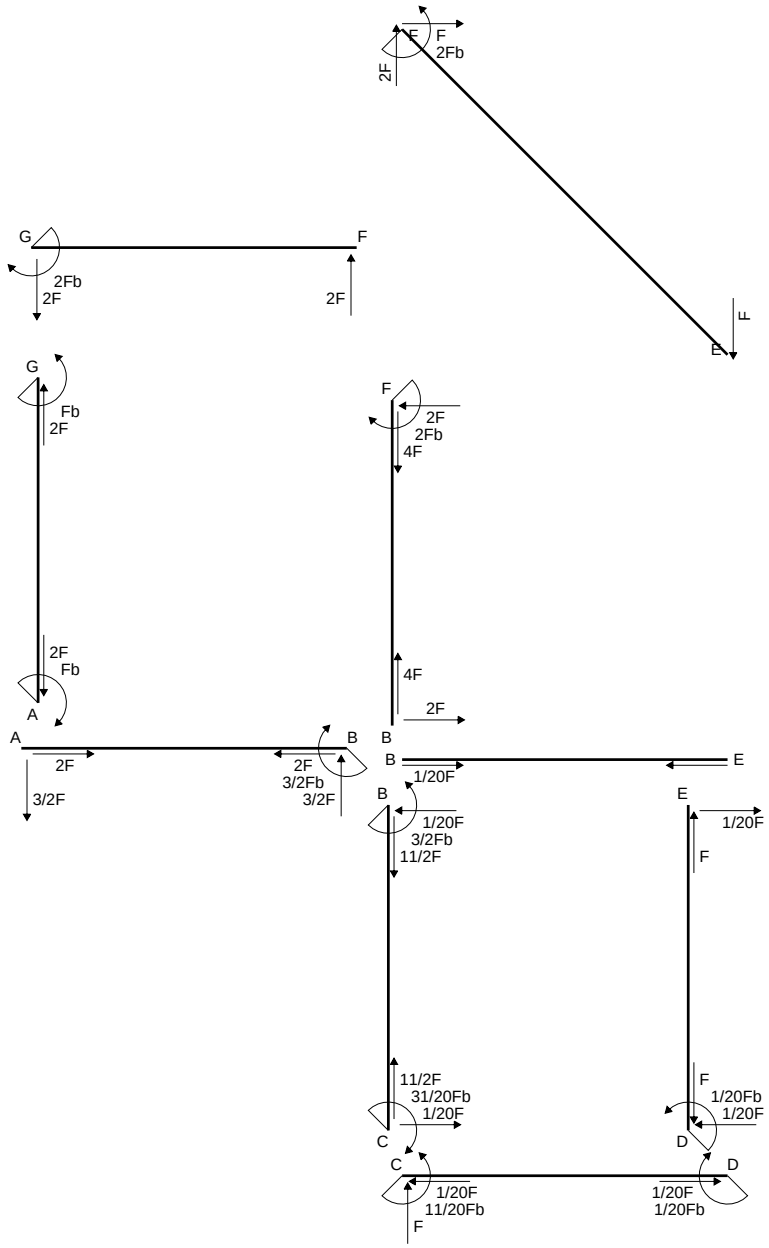
$= (-1/6\ b\ )\ Fb\ 1/EJ\ = -1/6\ Fb^2/EJ$

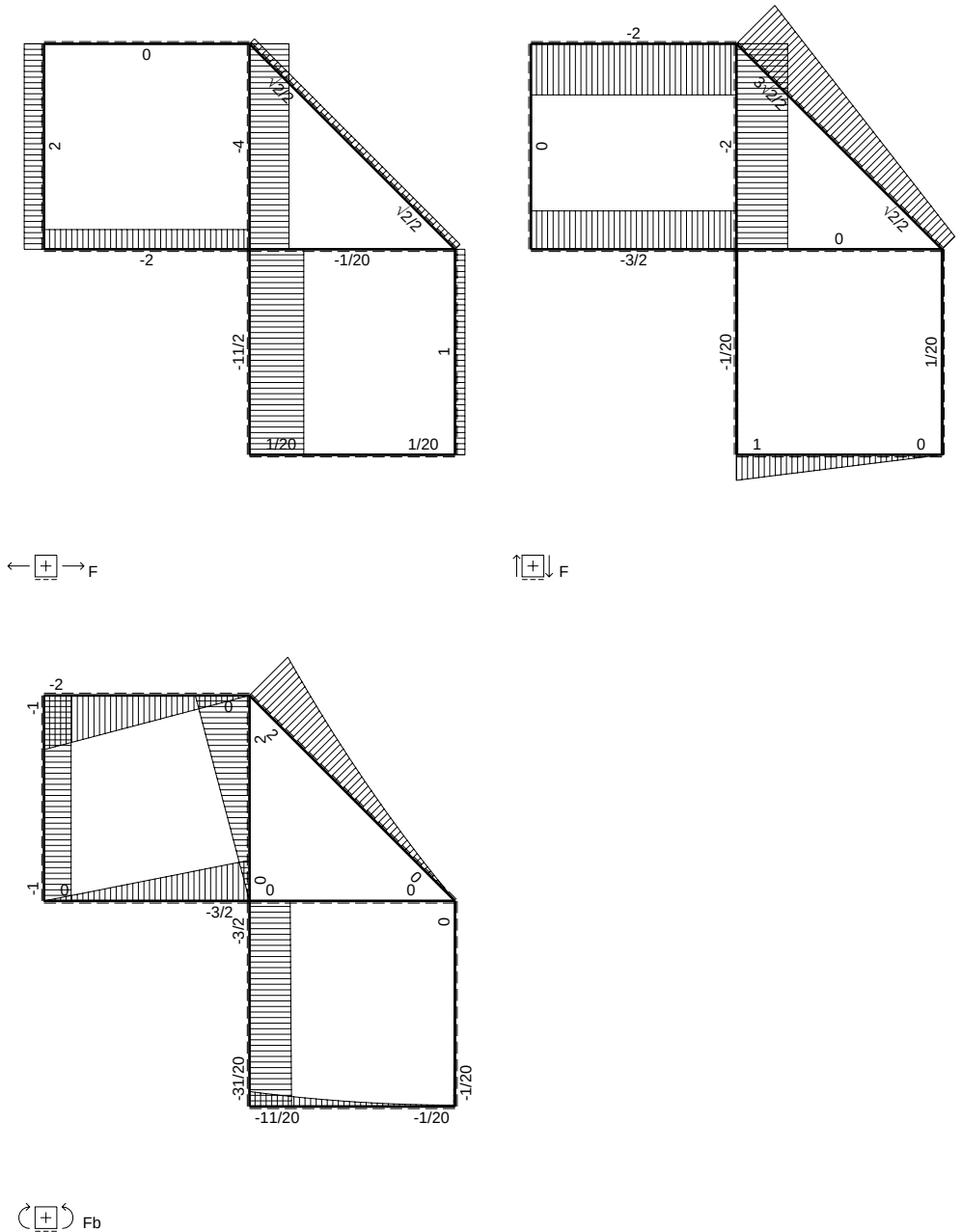


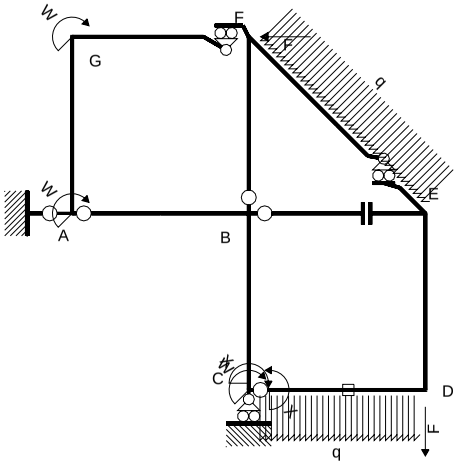
A = 147.4 mm^2
J_u = 53868. mm^4
J_v = 7969. mm^4
J_t = 127.1 mm^4
y_o = -7.686 mm
y_g = 18.87 mm
N = 254.6 N
T_y = 763.7 N
M_x = 468000. Nmm
x_m = 5. mm
y_m = 43. mm
u_m = -12. mm
v_m = 24.13 mm
$\sigma_m = N/A - Mv/J_u$ = -207.9 N/mm^2
x_c = 17. mm
y_c = 43. mm
v_c = 24.13 mm
$\sigma_c = N/A - Mv/J_u$ = -207.9 N/mm^2
$\tau_c = TS^*/tJ_u$ = 14.78 N/mm^2
$\tau_g = TS^*/tJ_u$ = 14.78 N/mm^2
t_c = 360. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 209.4 N/mm^2

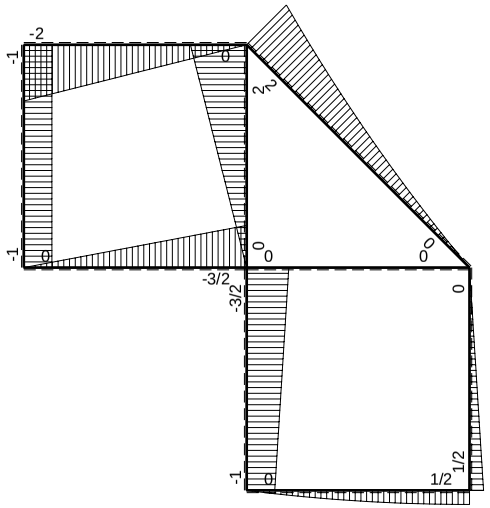
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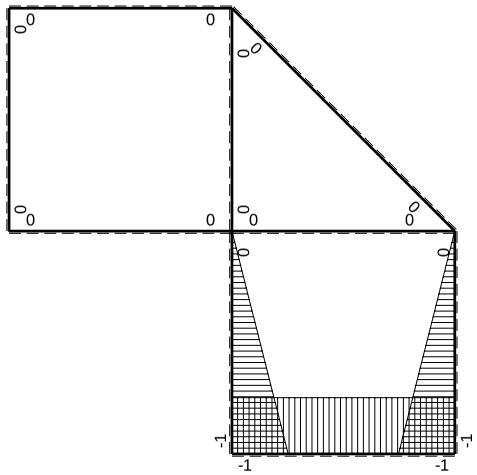

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Fb
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C
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C
D
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11/20Fb
1/20F
1/20Fb
F


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-1/20
-11/2
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1/20
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F
-2
0
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3/2/2
½/2
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1/20
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F
-2
-1
0
2
2
-1
0
0
0
0
-3/2
-3/2
0
-31/20
-1/20
-11/20
-1/20
Fb





M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0		
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx^2/b	x^2/b^2	7/12Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	Fx-1/2qx^2	-Fx+1/2Fx^2/b	1	-1/3Fb^2/EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx^2	-1/2Fb+1/2Fx^2/b	1		
DE 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
ED b	x/b	-1/2Fx	-1/2Fx^2/b	x^2/b^2		
EF √2b	0	√2/2Fx+1/2qx^2	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				-Fb^2/EJ	
	totali				-11/12Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				11/20Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -4/3\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2 +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/2\ x +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -4/3\ \ Fb^2/EJ$

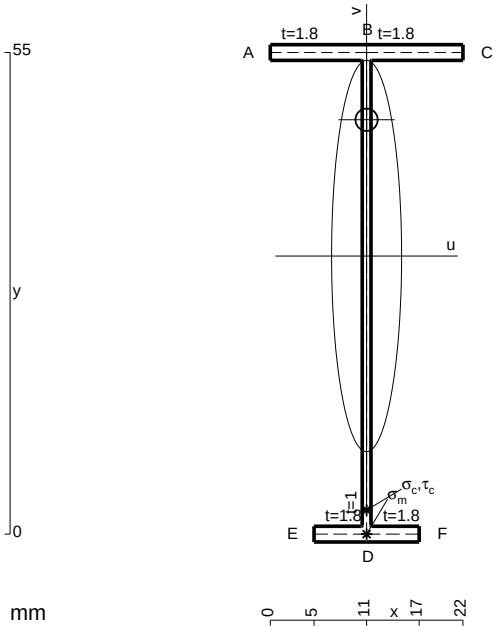
$L^{Xo}_{DE} = \int_o^b (-1/2 + x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/2\ x +1/2\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = -1/6\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (-1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/6\ b\ )\ Fb\ 1/EJ\ = -1/6\ \ Fb^2/EJ$

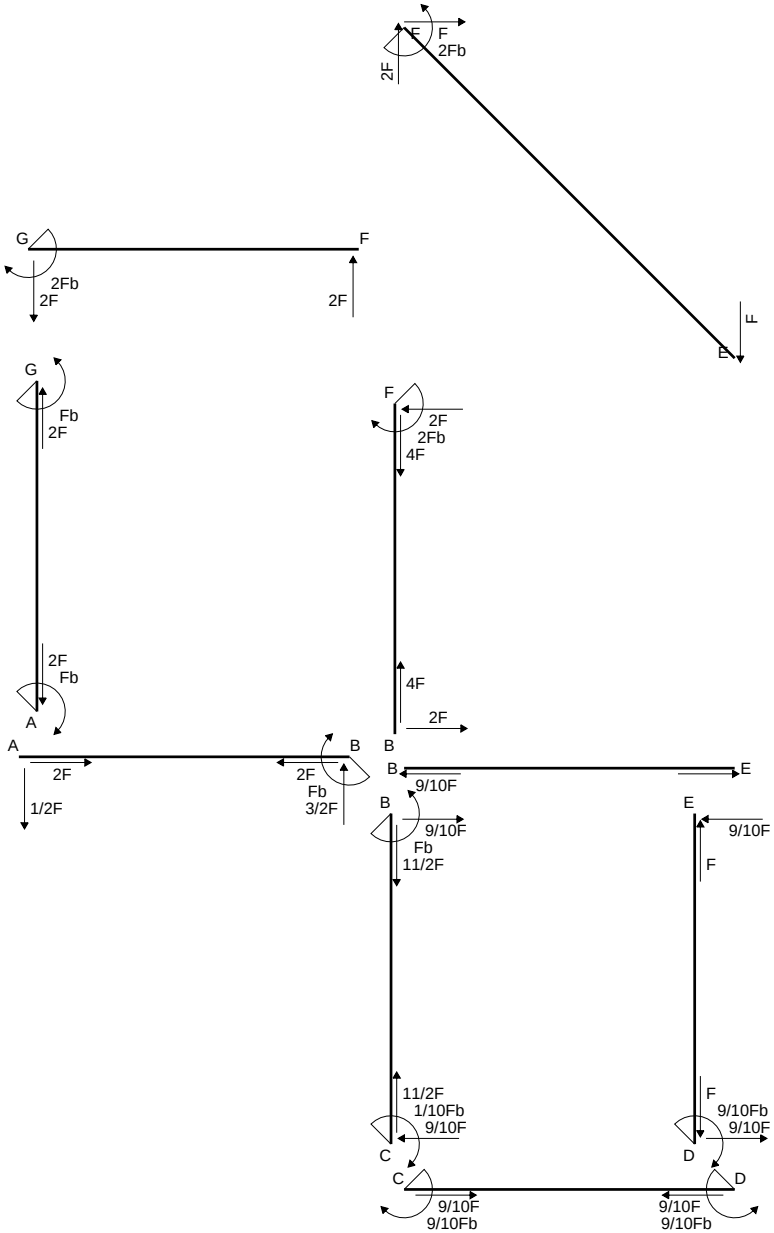
PROCEDIMENTO E RISULTATI 264070 CI02.xxxx.137

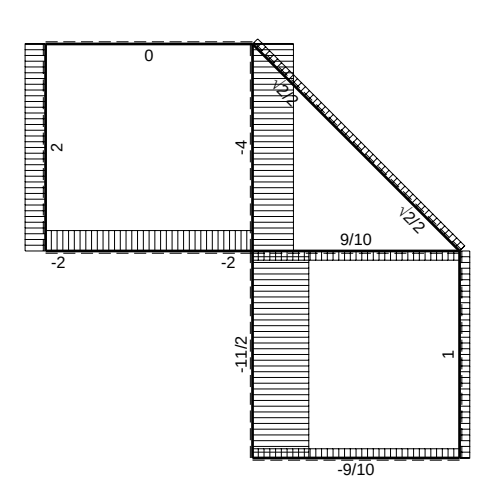


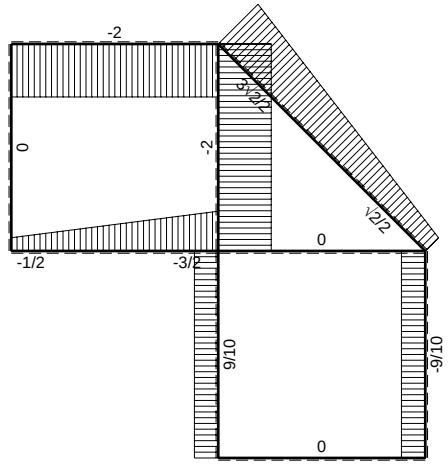
A = 116.2 mm^2
J_u = 58038. mm^4
J_v = 1856. mm^4
J_t = 84.43 mm^4
y_o = 15.56 mm
y_g = 31.76 mm
N = 155.6 N
T_y = 466.7 N
M_x = 387200. Nmm
x_m = 11. mm
v_m = -31.76 mm
$\sigma_m = N/A - Mv/J_u$ = 213.2 N/mm^2
y_c = 3. mm
u_c = -11. mm
v_c = -28.76 mm
$\sigma_c = N/A - Mv/J_u$ = 213.2 N/mm^2
$\tau_c = TS^*/tJ_u$ = 5.516 N/mm^2
$\tau_g = TS^*/tJ_u$ = 5.516 N/mm^2
t_c = 220. mm
$\sigma_o = \sqrt{\sigma^2 + 3\tau^2}$ = 213.4 N/mm^2

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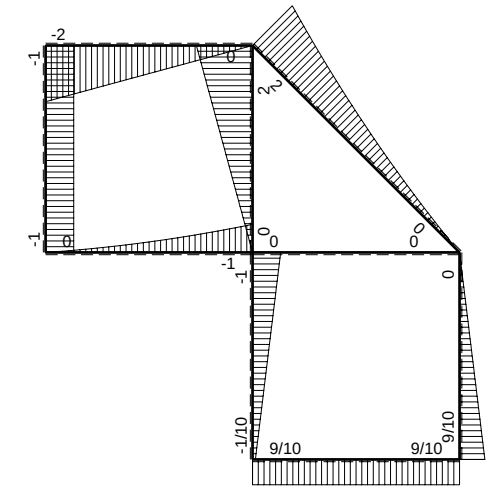






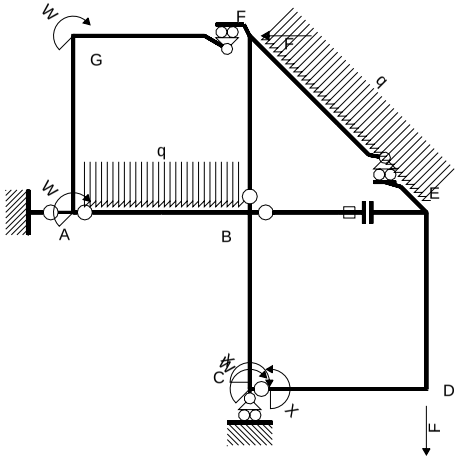
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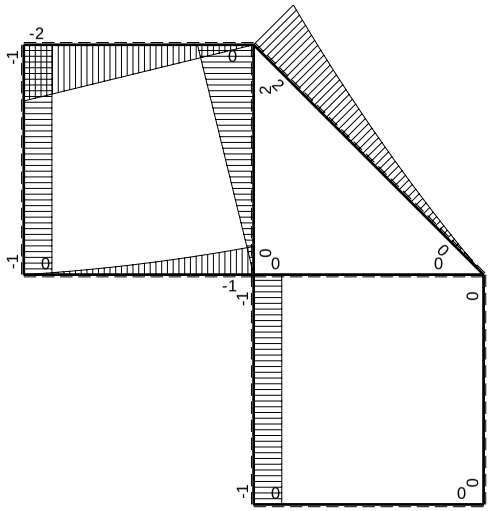


Fb

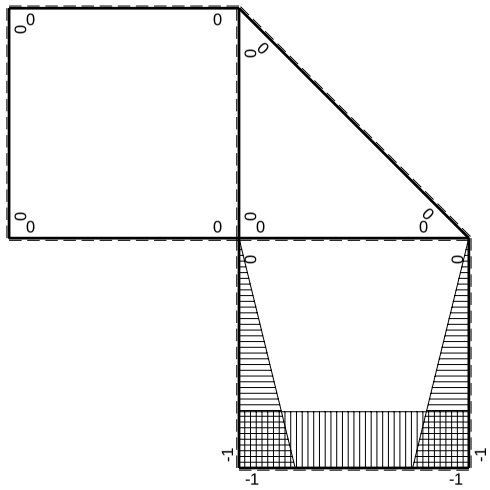
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Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-1/2Fx-1/2qx^2$	0	0	0	0
BA b	0	$Fb-3/2Fx+1/2qx^2$	0	0		
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb	Fb-Fx	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	0	0	x^2/b^2		
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx+1/2qx^2$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$3/2Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				-9/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 - 2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b + 1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b + 1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 - 2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b + 1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b + 1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

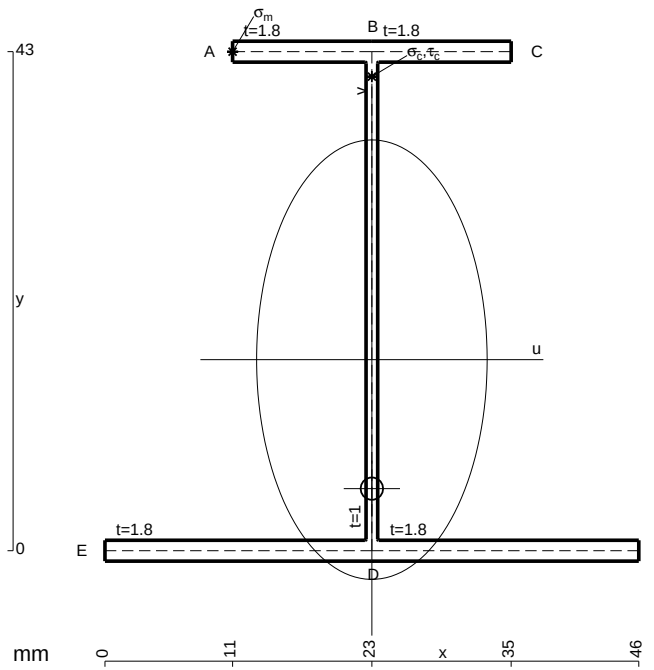
$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (\ x/b\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b\ )\ Fb\ 1/EJ\ = 1/2\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x/b\ )\ Fb\ 1/EJ\ dx = [\ x - 1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

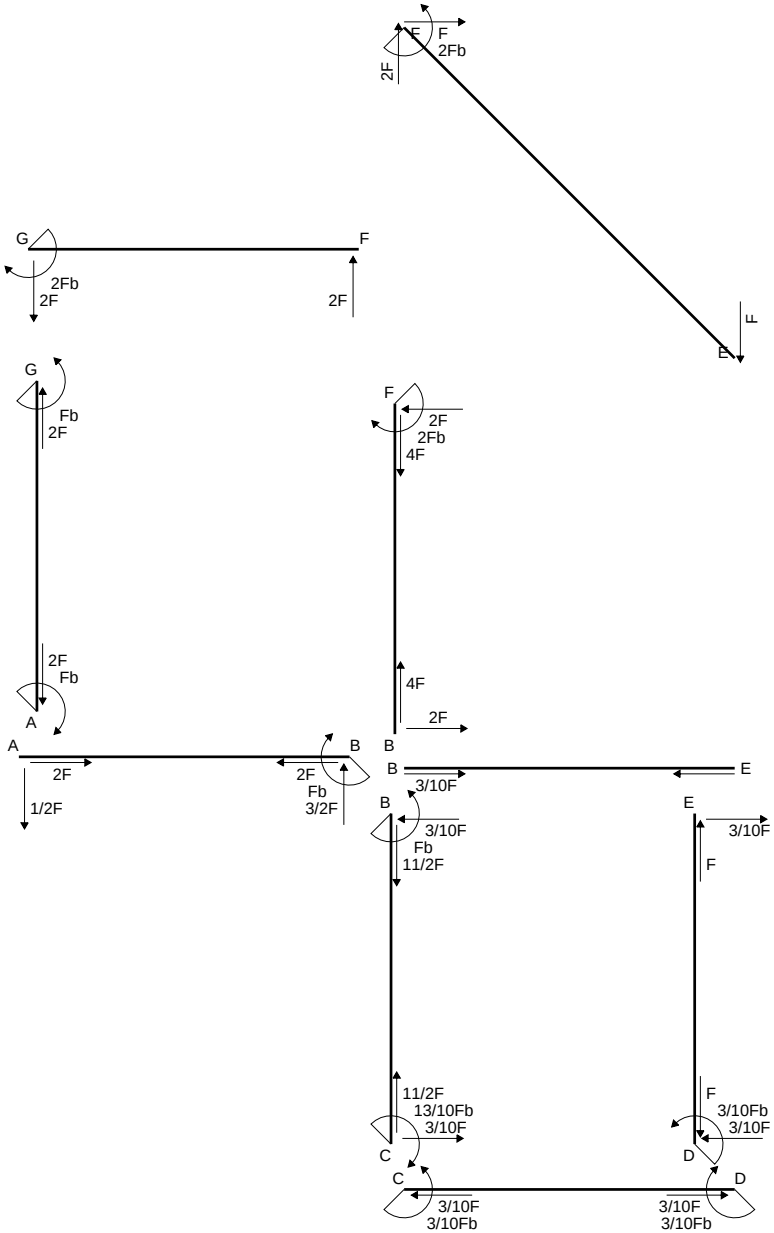
$= (\ b - 1/2\ b\ )\ Fb\ 1/EJ\ = 1/2\ \ Fb^2/EJ$

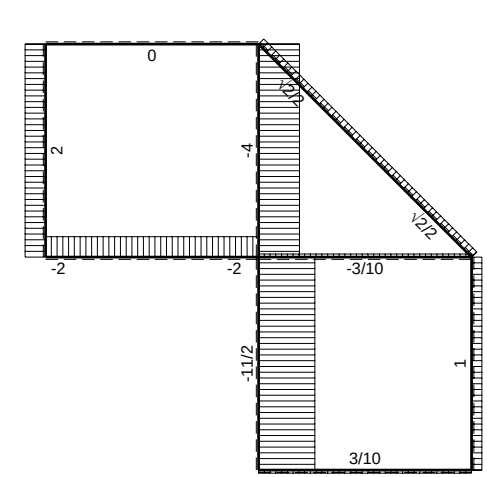


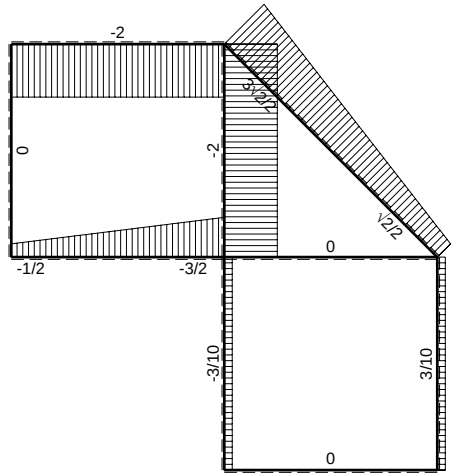
A = 169. mm^2
J_u = 60580. mm^4
J_v = 16674. mm^4
J_t = 150.4 mm^4
y_o = -11.11 mm
y_g = 16.46 mm
N = 254.6 N
T_y = 763.7 N
M_x = 525600. Nmm
x_m = 11. mm
y_m = 43. mm
u_m = -12. mm
v_m = 26.54 mm
$\sigma_m = N/A - Mv/J_u$ = -228.7 N/mm^2
x_c = 23. mm
y_c = 43. mm
v_c = 26.54 mm
$\sigma_c = N/A - Mv/J_u$ = -228.7 N/mm^2
$\tau_c = TS^*/tJ_u$ = 14.45 N/mm^2
$\tau_g = TS^*/tJ_u$ = 14.45 N/mm^2
t_c = 360. mm
$\sigma_o = \sqrt{\sigma^2 + 3\tau^2}$ = 230.1 N/mm^2

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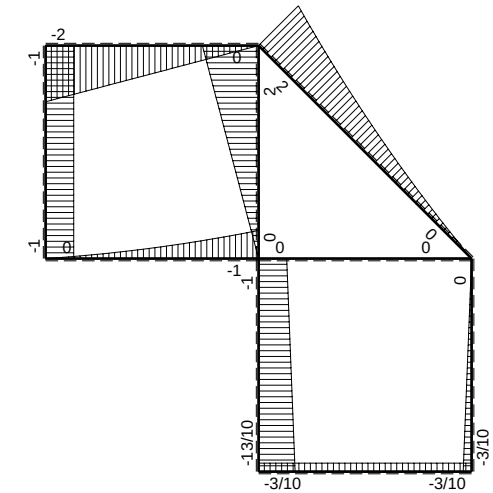

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13/10Fb
3/10F
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C
D
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D
3/10F
3/10Fb
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3/10

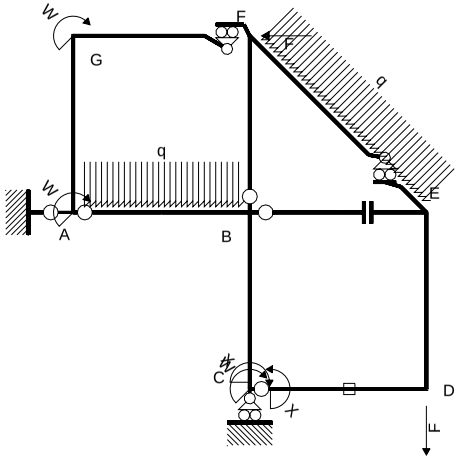

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3/2
1/2
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-3/2
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-3/10
3/10
0

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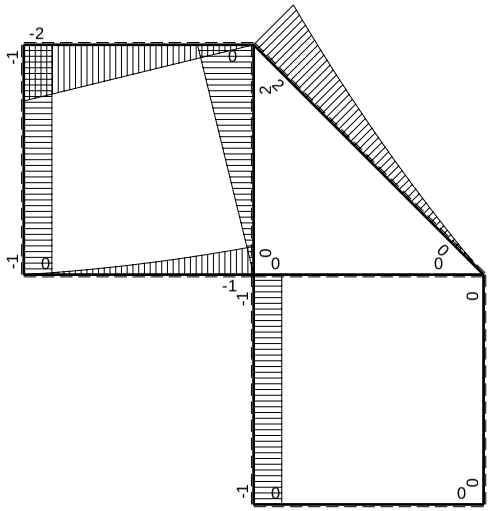
F


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-3/10
-3/10
-3/10

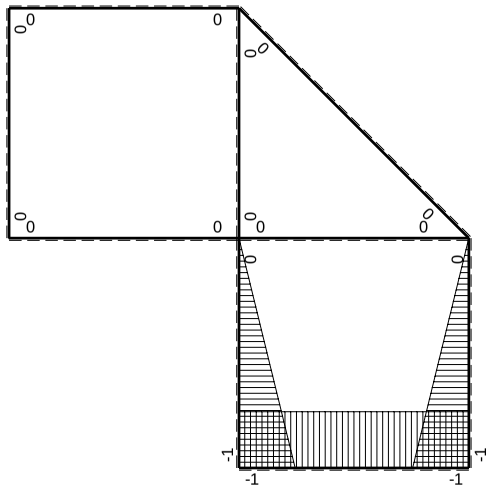
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-1/2Fx-1/2qx^2$	0	0	0	0
BA b	0	$Fb-3/2Fx+1/2qx^2$	0	0		
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb	Fb-Fx	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	0	0	x^2/b^2		
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx+1/2qx^2$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/2Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				3/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

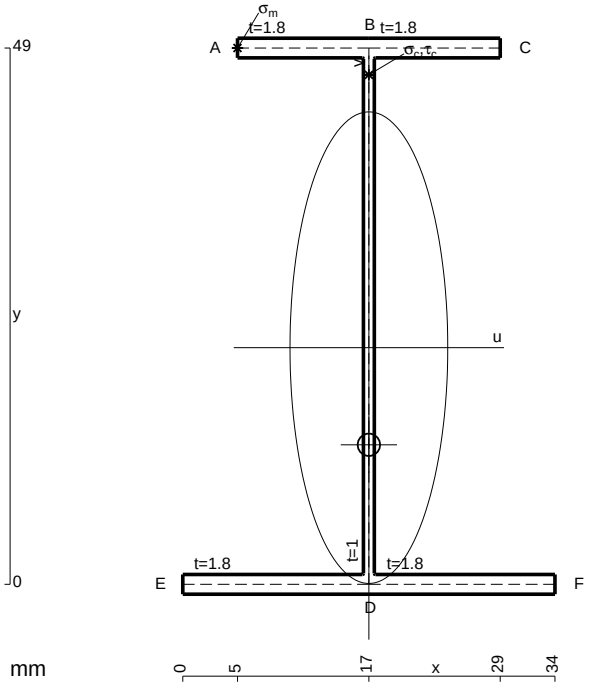
$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (\ x/b\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b\ )\ Fb\ 1/EJ\ = 1/2\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x/b\ )\ Fb\ 1/EJ\ dx = [\ x -1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

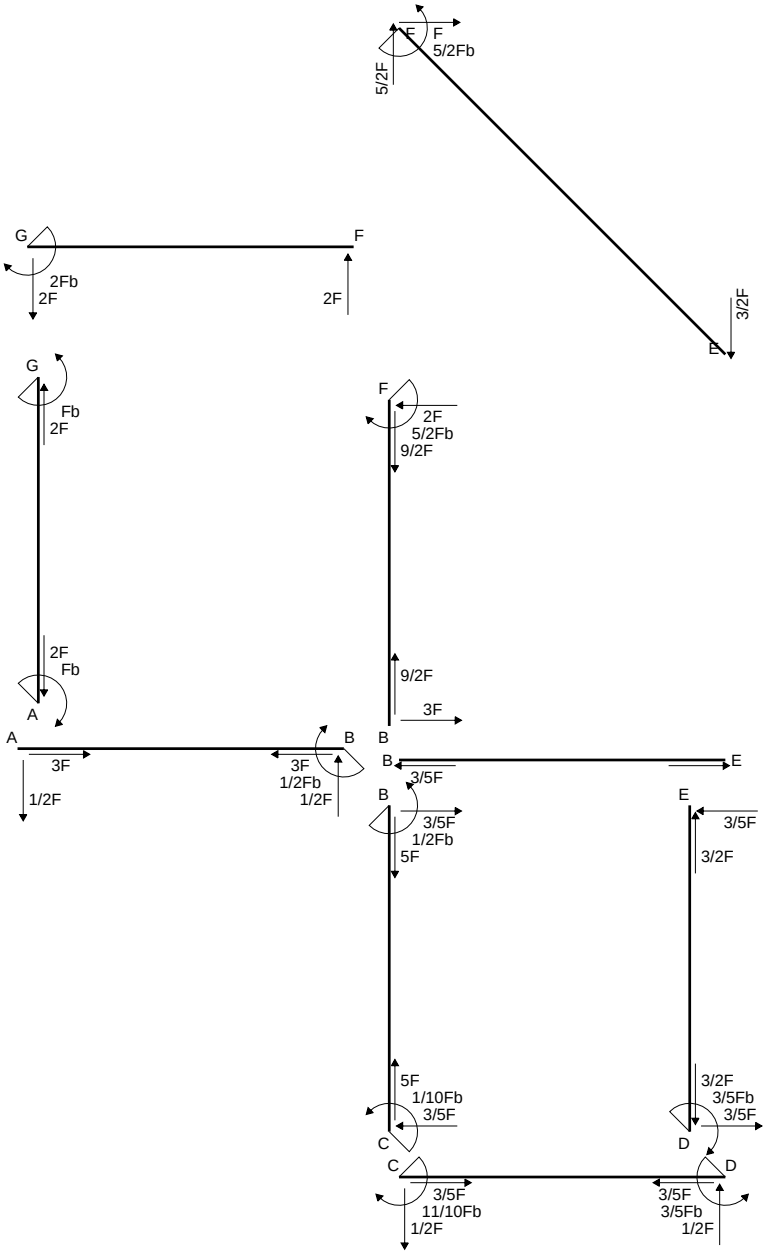
$= (\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 1/2\ \ Fb^2/EJ$

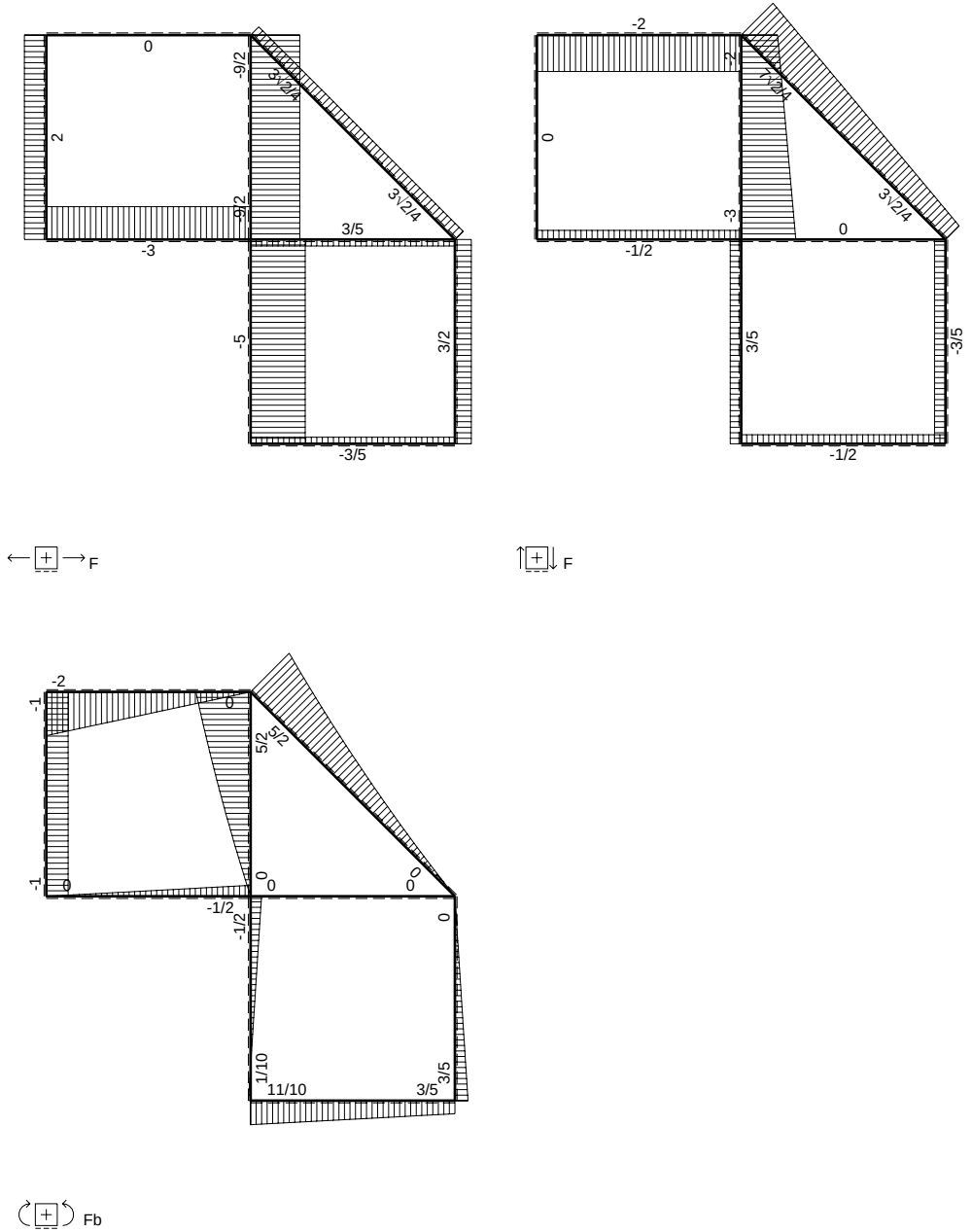


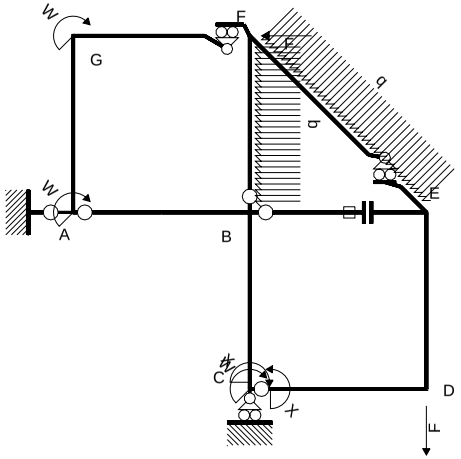
A = 153.4 mm^2
J_u = 71202. mm^4
J_v = 7969. mm^4
J_t = 129.1 mm^4
y_o = -8.875 mm
y_g = 21.63 mm
N = 254.6 N
T_y = 763.7 N
M_x = 626400. Nmm
x_m = 5. mm
y_m = 49. mm
u_m = -12. mm
v_m = 27.37 mm
$\sigma_m = N/A - Mv/J_u$ = -239.2 N/mm^2
x_c = 17. mm
y_c = 49. mm
v_c = 27.37 mm
$\sigma_c = N/A - Mv/J_u$ = -239.2 N/mm^2
$\tau_c = TS^*/tJ_u$ = 12.68 N/mm^2
$\tau_g = TS^*/tJ_u$ = 12.68 N/mm^2
t_c = 360. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 240.2 N/mm^2

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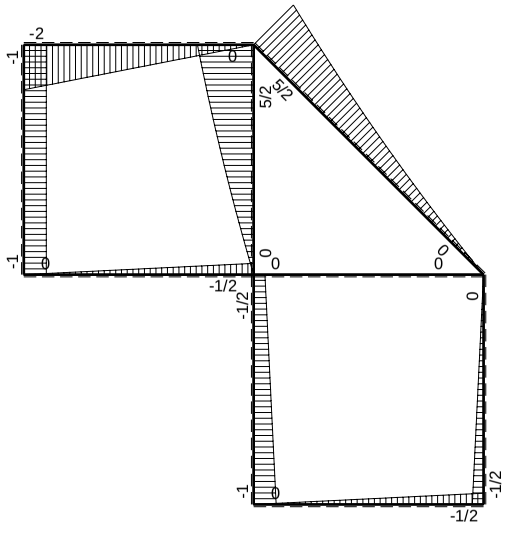
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5/2Fb
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2Fb
2F
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1/2F

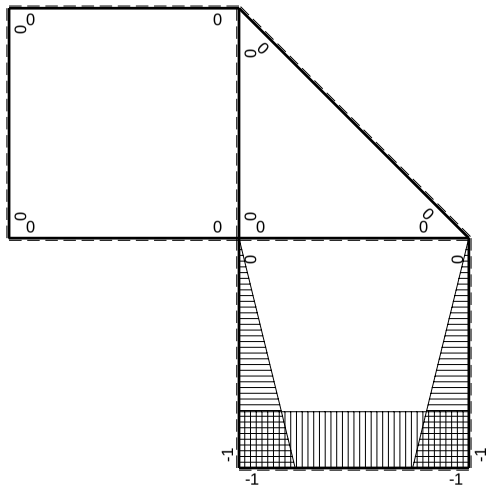

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-1
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0
0
-1/2
-1/2
0
1/10
11/10
3/5
3/5
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-1/2Fx	0	0	0	0
BA b	0	1/2Fb-1/2Fx	0	0		
BC b	-x/b	-1/2Fb-1/2Fx	$1/2Fx+1/2Fx^2/b$	x^2/b^2	$5/12Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb-1/2Fx	$Fb-3/2Fx+1/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	-1/2Fx	1/2Fx	1	$1/4Fb^2/EJ$	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE 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
ED b	x/b	1/2Fx	$1/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$3\sqrt{2}/4Fx+1/2qx^2$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	$5/2Fb-2Fx-1/2qx^2$	0	0	0	0
BF b	0	$-3Fx+1/2qx^2$	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$11/6Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-11/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2\ )\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (1/2\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b +1/6\ b\ )\ Fb\ 1/EJ\ = 5/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -3/2\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x -3/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -3/4\ b +1/6\ b\ )\ Fb\ 1/EJ\ = 5/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (1/2\ x/b\ )\ Fb\ 1/EJ\ dx = [1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b\ )\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (1/2 -1/2\ x/b\ )\ Fb\ 1/EJ\ dx = [1/2\ x -1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

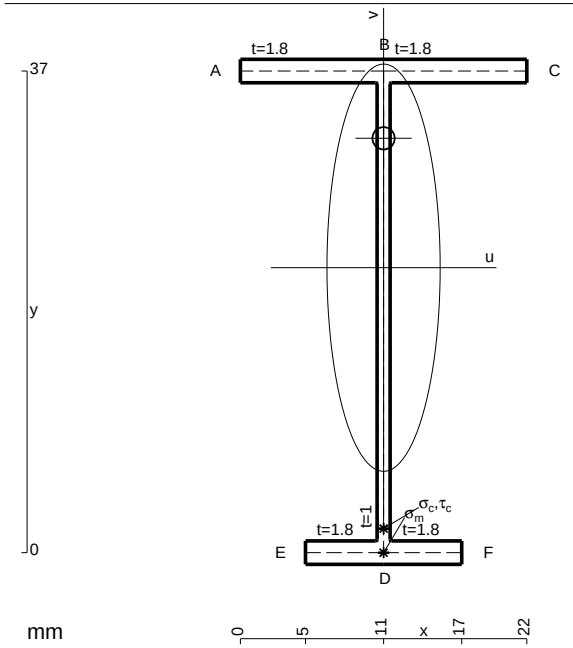
$= (1/2\ b -1/4\ b\ )\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2 -\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x -1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

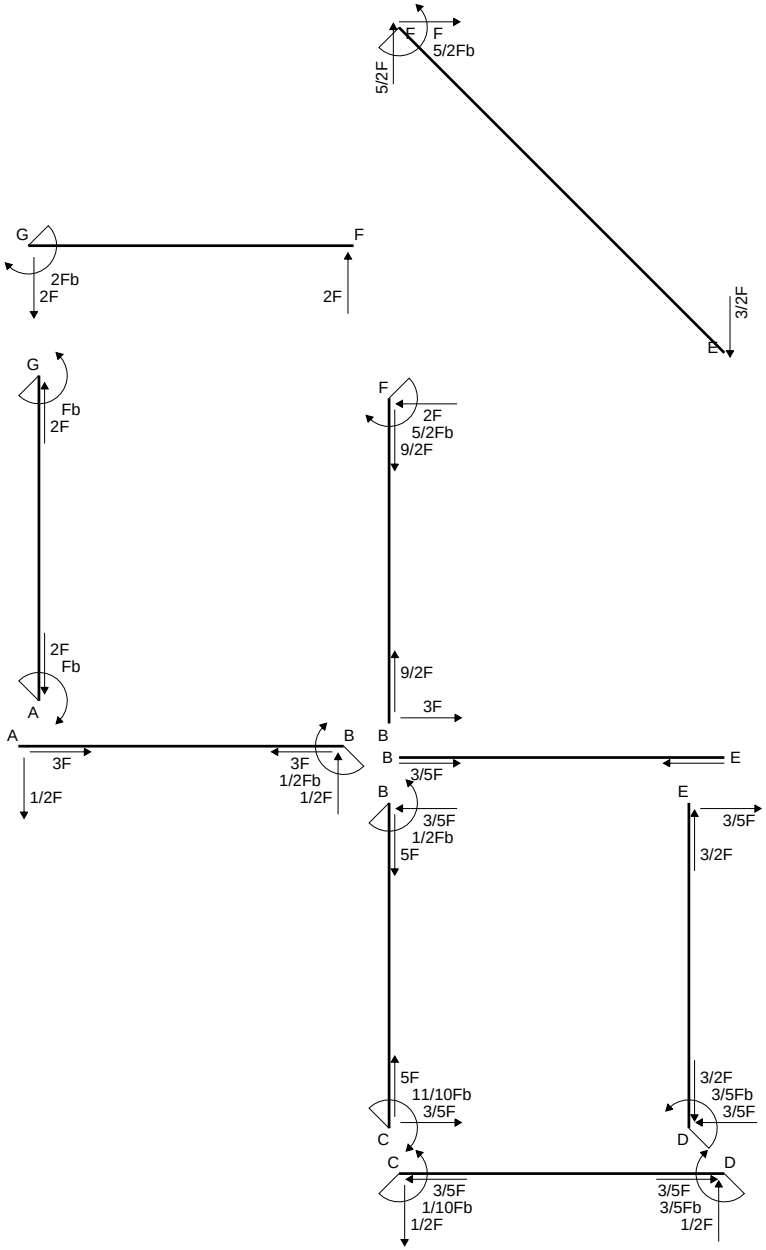
$= (1/6\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

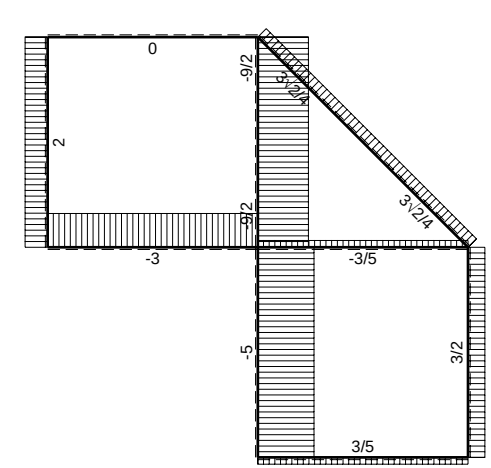


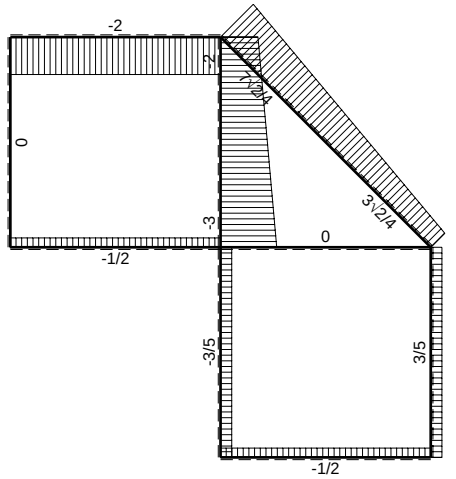
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J_u = 24038. mm^4
J_v = 1856. mm^4
J_t = 78.43 mm^4
y_o = 9.943 mm
y_g = 21.89 mm
N = 254.6 N
T_y = 594. N
M_x = 210000. Nmm
x_m = 11. mm
v_m = -21.89 mm
$\sigma_m = N/A - Mv/J_u$ = 193.8 N/mm^2
y_c = 3. mm
u_c = -11. mm
v_c = -18.89 mm
$\sigma_c = N/A - Mv/J_u$ = 193.8 N/mm^2
$\tau_c = TS^*/tJ_u$ = 11.68 N/mm^2
$\tau_g = TS^*/tJ_u$ = 11.68 N/mm^2
t_c = 240. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 194.9 N/mm^2

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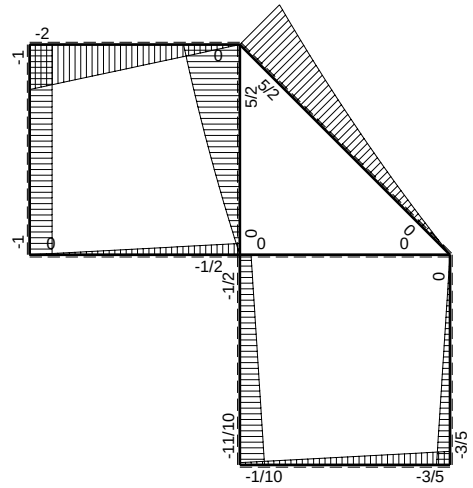

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G
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3/5F
C
D
C
D
3/5F
1/10Fb
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3/5F
3/5Fb
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3/2
3/5

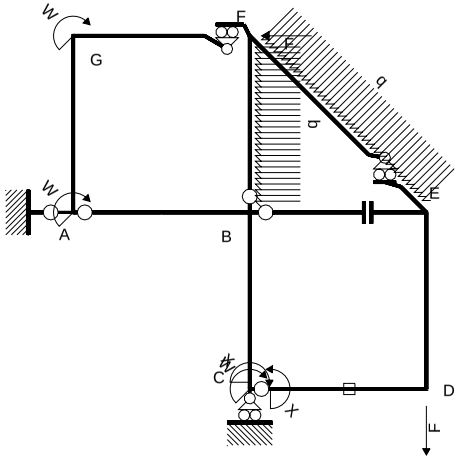

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-1/2
-3/5
3/5
-1/2

F

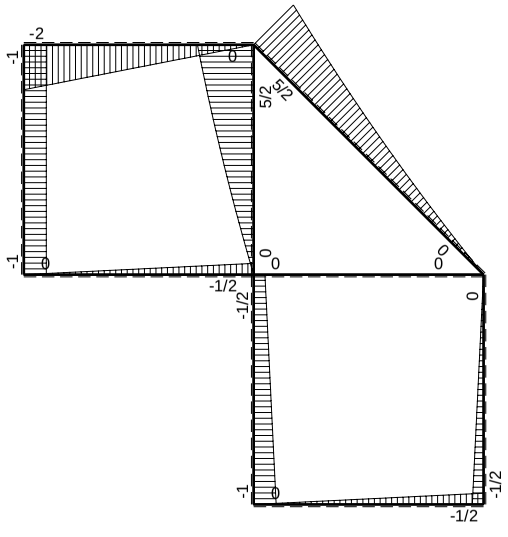
F


-2
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5/2
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-11/10
-3/5
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-3/5

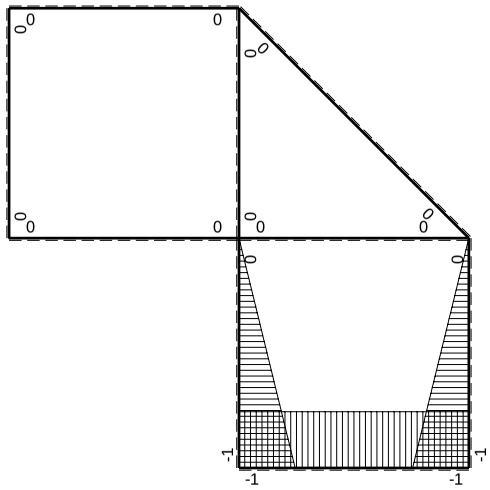
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-1/2Fx	0	0	0	0
BA b	0	1/2Fb-1/2Fx	0	0		
BC b	-x/b	-1/2Fb-1/2Fx	1/2Fx+1/2Fx^2/b	x^2/b^2	5/12Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb-1/2Fx	Fb-3/2Fx+1/2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb^2/EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE 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
ED b	x/b	1/2Fx	1/2Fx^2/b	x^2/b^2		
EF √2b	0	3√2/4Fx+1/2qx^2	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	5/2Fb-2Fx-1/2qx^2	0	0	0	0
BF b	0	-3Fx+1/2qx^2	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				-Fb^2/EJ	
	totali				-1/6Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				1/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (1/2\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b +1/6\ b\ )\ Fb\ 1/EJ\ = 5/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -3/2\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x -3/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -3/4\ b +1/6\ b\ )\ Fb\ 1/EJ\ = 5/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (1/2\ x/b\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = [1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (1/4\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -3/4\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (1/2 -1/2\ x/b\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = [1/2\ x -1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/E$

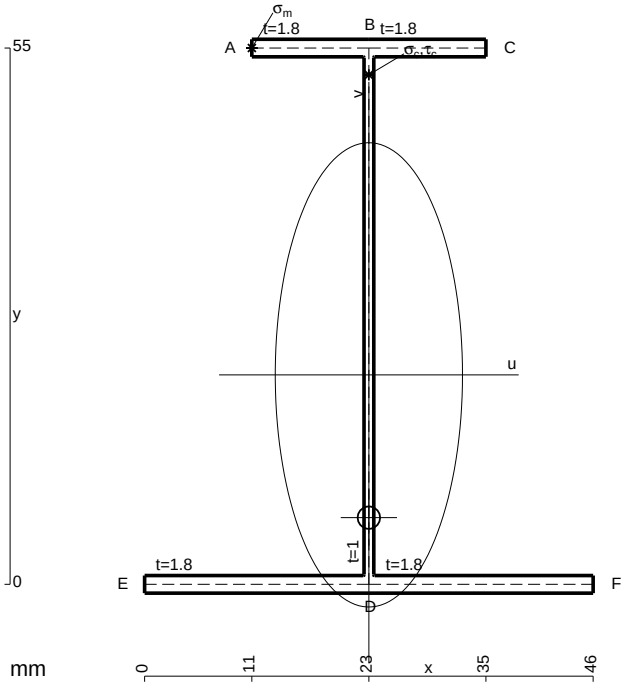
$= (1/2\ b -1/4\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -3/4\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2 - x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x -1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = 1/6\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

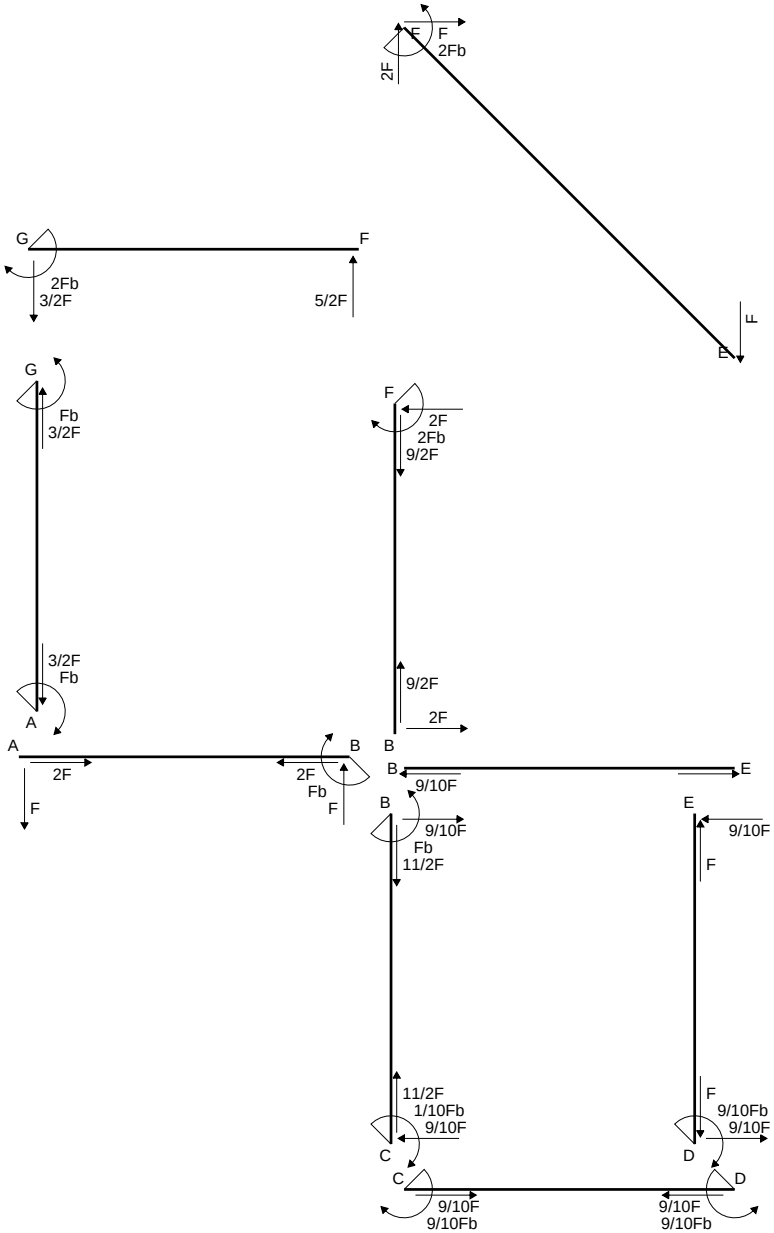
$= (1/6\ b\ )\ Fb\ 1/EJ\ = 1/6\ \ Fb^2/EJ$

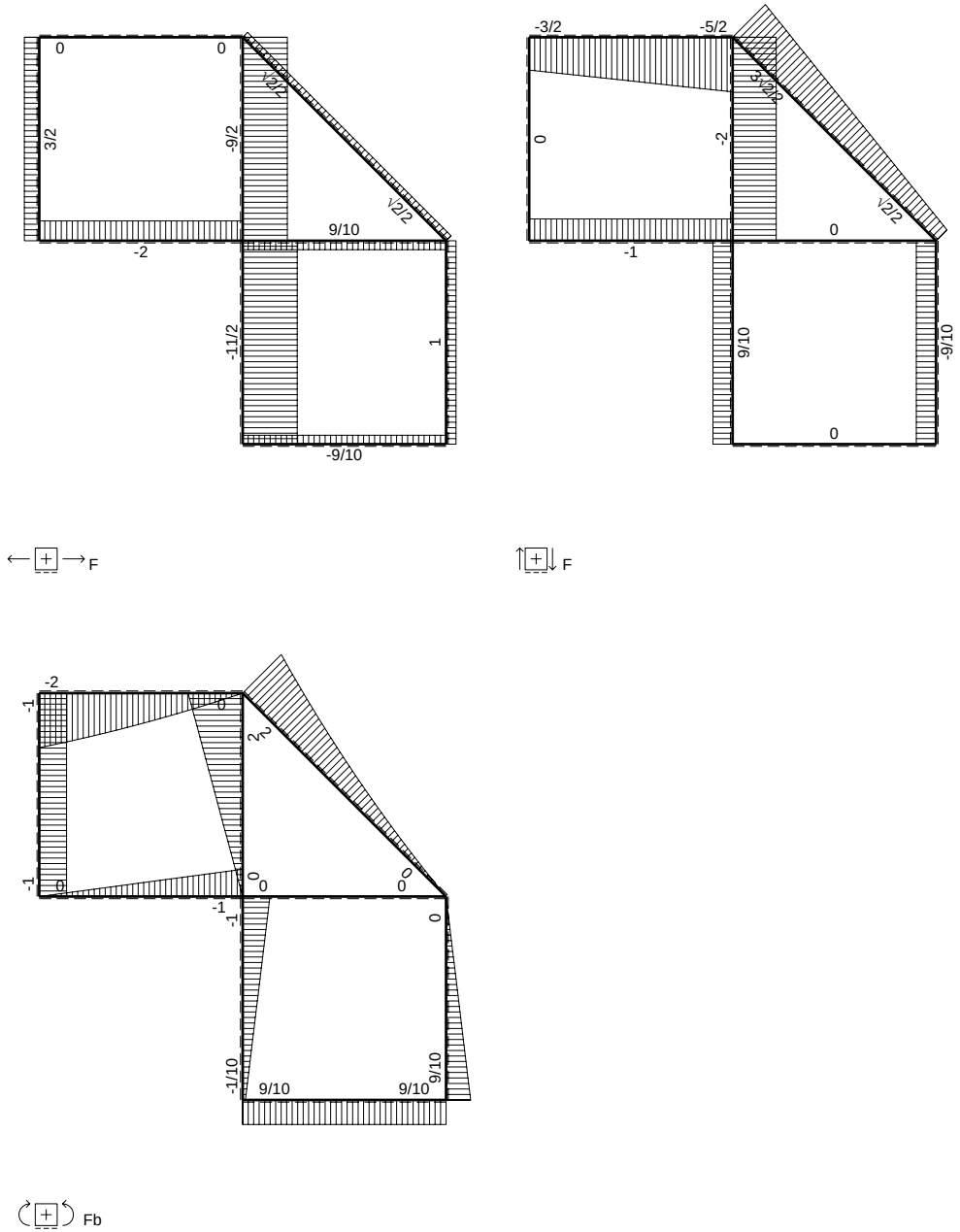


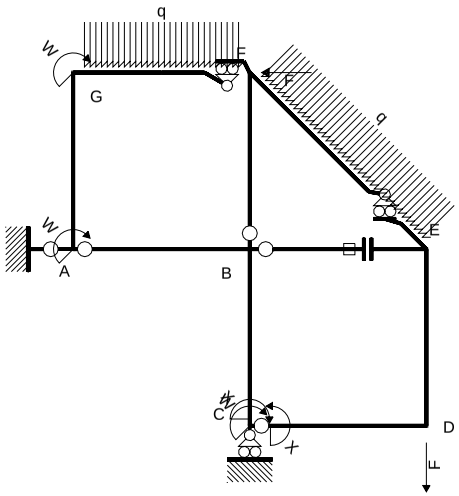
A = 181. mm^2
J_u = 102600. mm^4
J_v = 16674. mm^4
J_t = 154.4 mm^4
y_o = -14.64 mm
y_g = 21.48 mm
N = 477.3 N
T_y = 1114. N
M_x = 641250. Nmm
x_m = 11. mm
y_m = 55. mm
u_m = -12. mm
v_m = 33.52 mm
$\sigma_m = N/A - Mv/J_u$ = -206.8 N/mm^2
x_c = 23. mm
y_c = 55. mm
v_c = 33.52 mm
$\sigma_c = N/A - Mv/J_u$ = -206.8 N/mm^2
$\tau_c = TS^*/tJ_u$ = 15.72 N/mm^2
$\tau_g = TS^*/tJ_u$ = 15.72 N/mm^2
t_c = 450. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 208.6 N/mm^2

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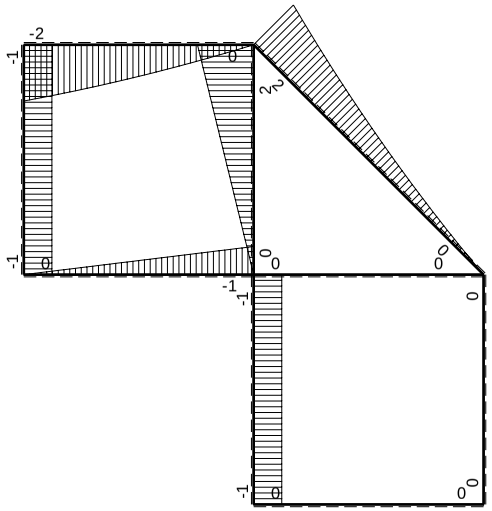
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F
F
2Fb
2F
G
F
2Fb
3/2F
5/2F
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E
G
Fb
3/2F
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2F
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9/10Fb

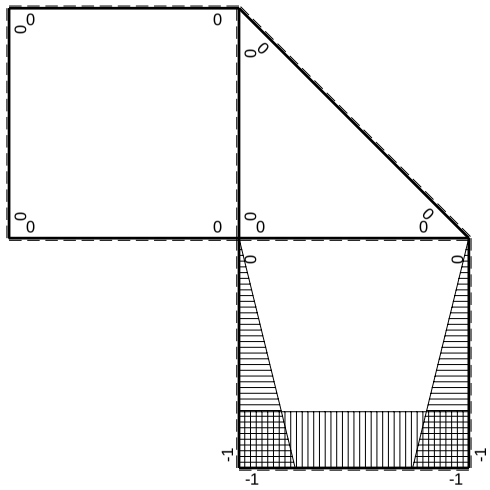

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-3/2
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√2/2
0
-1
9/10
-9/10
0
F
F
-2
-1
0
0
0
0
0
-1
-1
0
-1/10
9/10
9/10
9/10
Fb



Schema di calcolo iperstatico



M_o flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-Fx	0	0	0	0
BA b	0	Fb-Fx	0	0		
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb	Fb-Fx	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	0	0	x^2/b^2		
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx+1/2qx^2$	0	0	0	0
FG b	0	$-5/2Fx+1/2qx^2$	0	0	0	0
GF b	0	$2Fb-3/2Fx-1/2qx^2$	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$3/2Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				-9/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

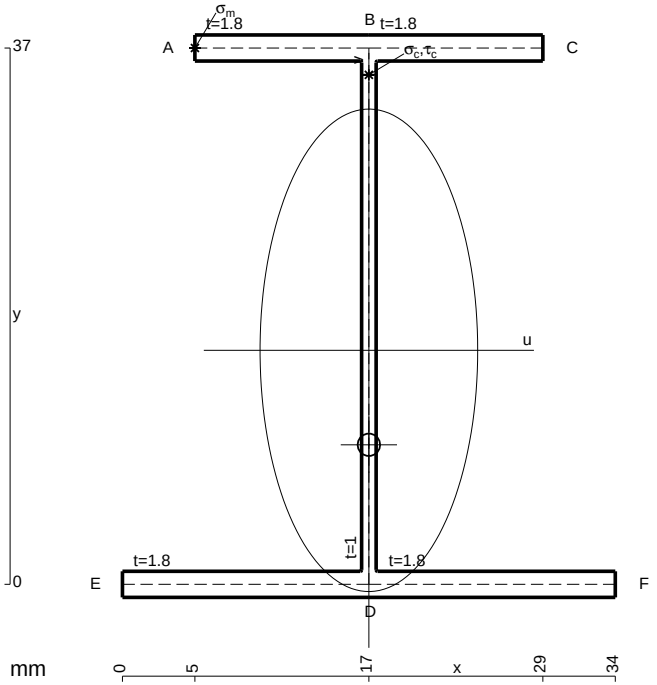
$L^{Xo}_{BC} = \int_o^b (\ x/b\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b\ )\ Fb\ 1/EJ\ = 1/2\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x/b\ )\ Fb\ 1/EJ\ dx = [\ x -1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 1/2\ \ Fb^2/EJ$

PROCEDIMENTO E RISULTATI 218087 CI02.xxxx.142

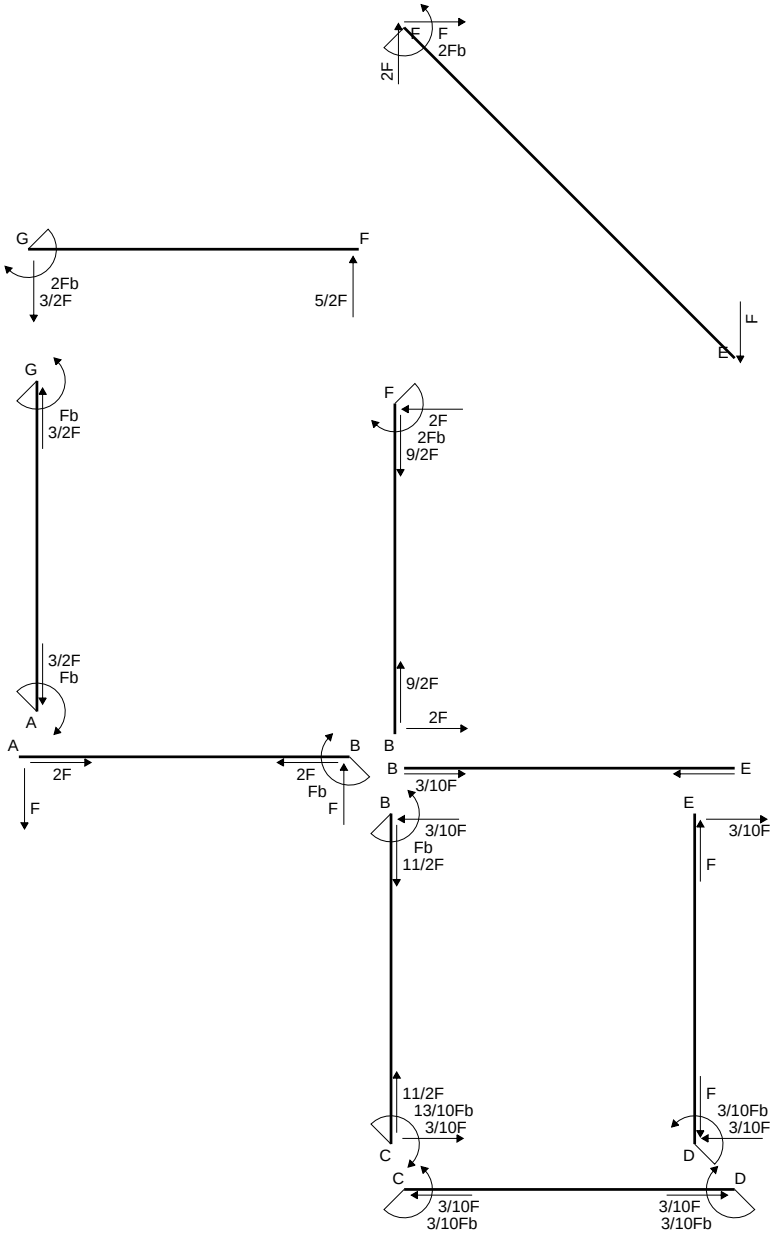


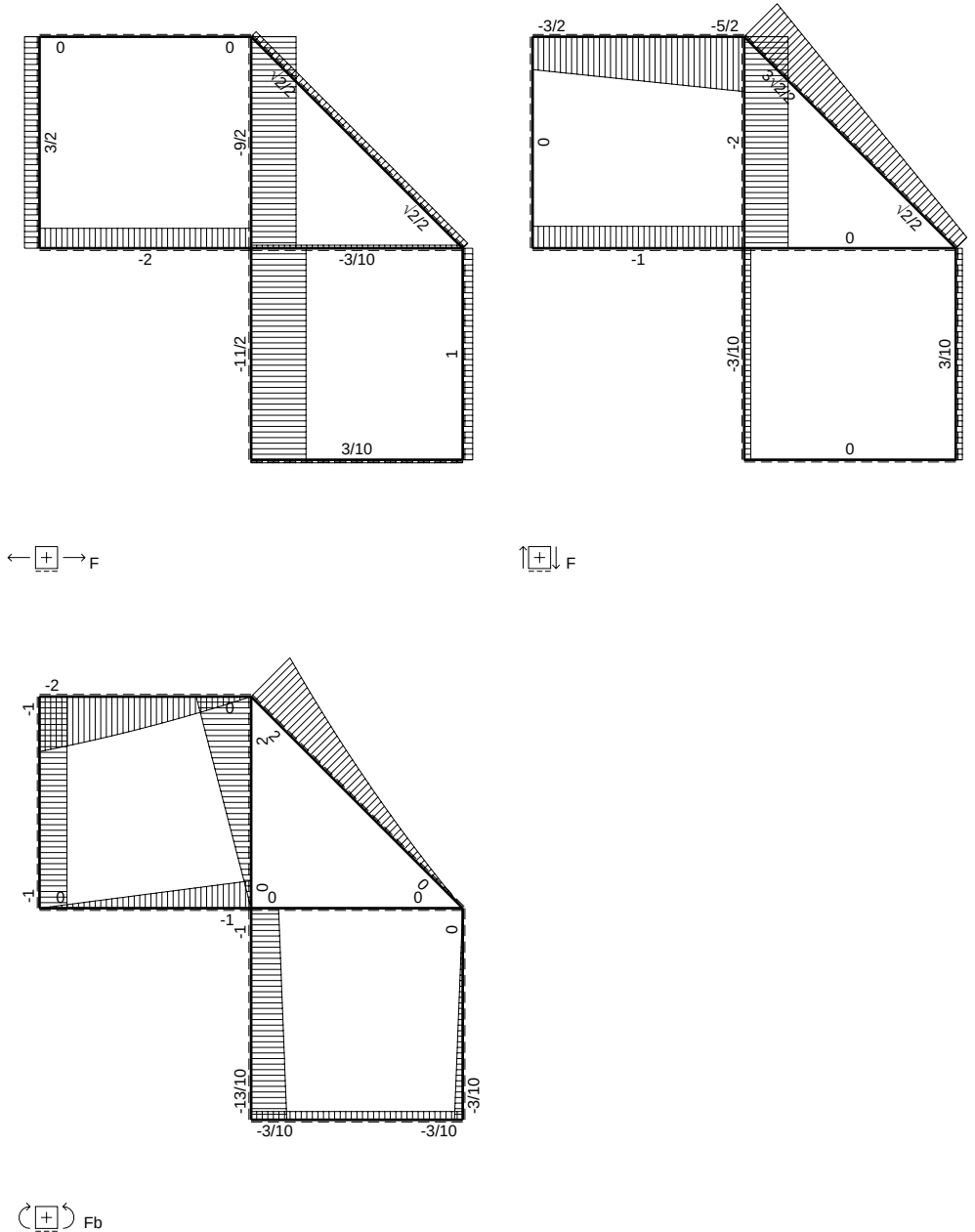
A = 141.4 mm^2
J_u = 39168. mm^4
J_v = 7969. mm^4
J_t = 125.1 mm^4
y_o = -6.518 mm
y_g = 16.15 mm
N = -2025. N
T_y = -900. N
M_x = 378000. Nmm
x_m = 5. mm
y_m = 37. mm
u_m = -12. mm
v_m = 20.85 mm
$\sigma_m = N/A - Mv/J_u$ = -215.6 N/mm^2
x_c = 17. mm
y_c = 37. mm
v_c = 20.85 mm
$\sigma_c = N/A - Mv/J_u$ = -215.6 N/mm^2
$\tau_c = TS^*/tJ_u$ = 20.7 N/mm^2
$\tau_g = TS^*/tJ_u$ = 20.7 N/mm^2
t_c = 450. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 218.6 N/mm^2

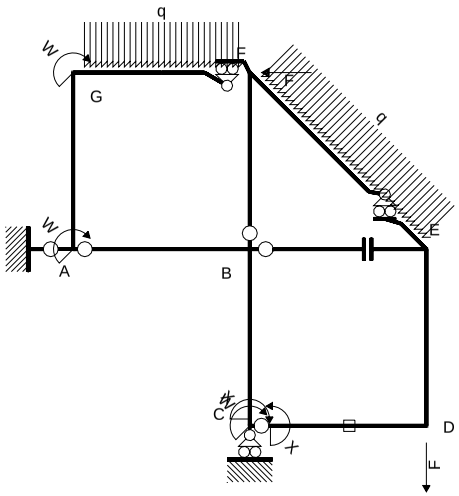
@ Adolfo Zavelani Rossi, Politecnico di Milano, vers.27.03.13 16.04.26

CI02.xxxx.142

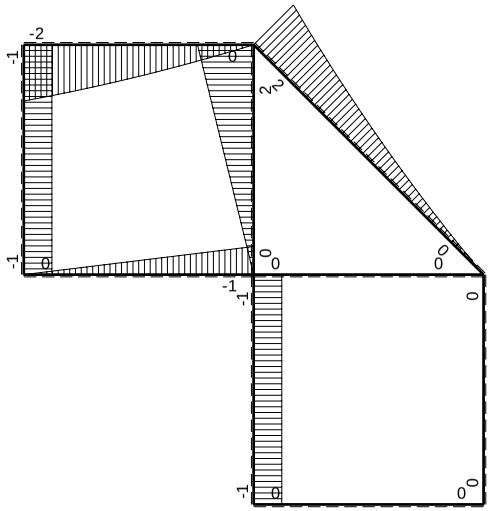
@ Adolfo Zavelani Rossi, Politecnico di Milano, vers.27.03.13 16.04.26


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G
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2Fb
3/2F
5/2F
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E
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Fb
3/2F
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2Fb
9/2F
3/2F
Fb
A
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2F
A
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3/10Fb

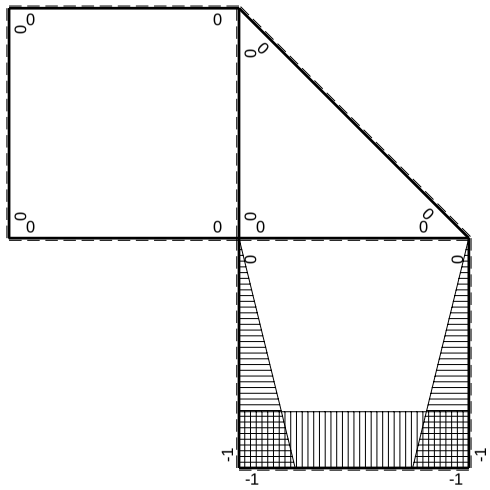

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3/2
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-3/10
-3/10
Fb



Schema di calcolo iperstatico



M_o flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-Fx	0	0	0	0
BA b	0	Fb-Fx	0	0		
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb	Fb-Fx	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	0	0	x^2/b^2		
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx+1/2qx^2$	0	0	0	0
FG b	0	$-5/2Fx+1/2qx^2$	0	0	0	0
GF b	0	$2Fb-3/2Fx-1/2qx^2$	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/2Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				3/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

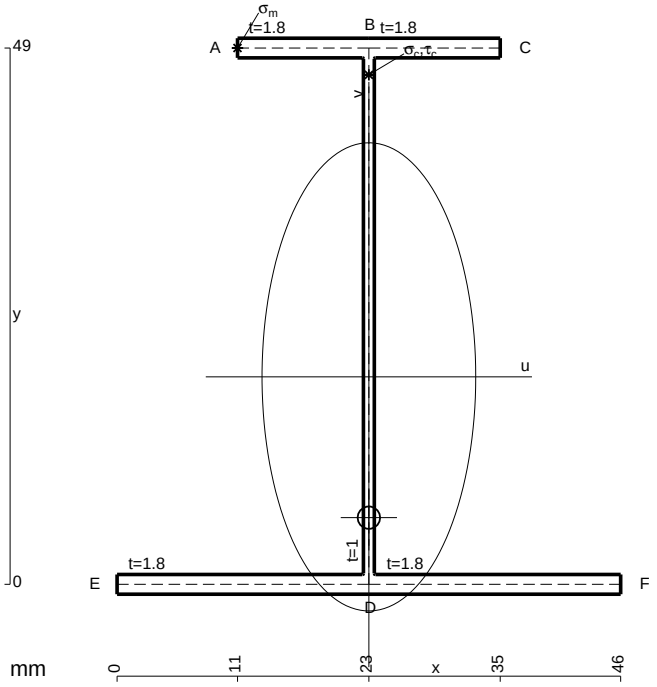
$L^{Xo}_{BC} = \int_o^b (\ x/b\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b\ )\ Fb\ 1/EJ\ = 1/2\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x/b\ )\ Fb\ 1/EJ\ dx = [\ x -1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 1/2\ \ Fb^2/EJ$

PROCEDIMENTO E RISULTATI 249121 CI02.xxxx.143

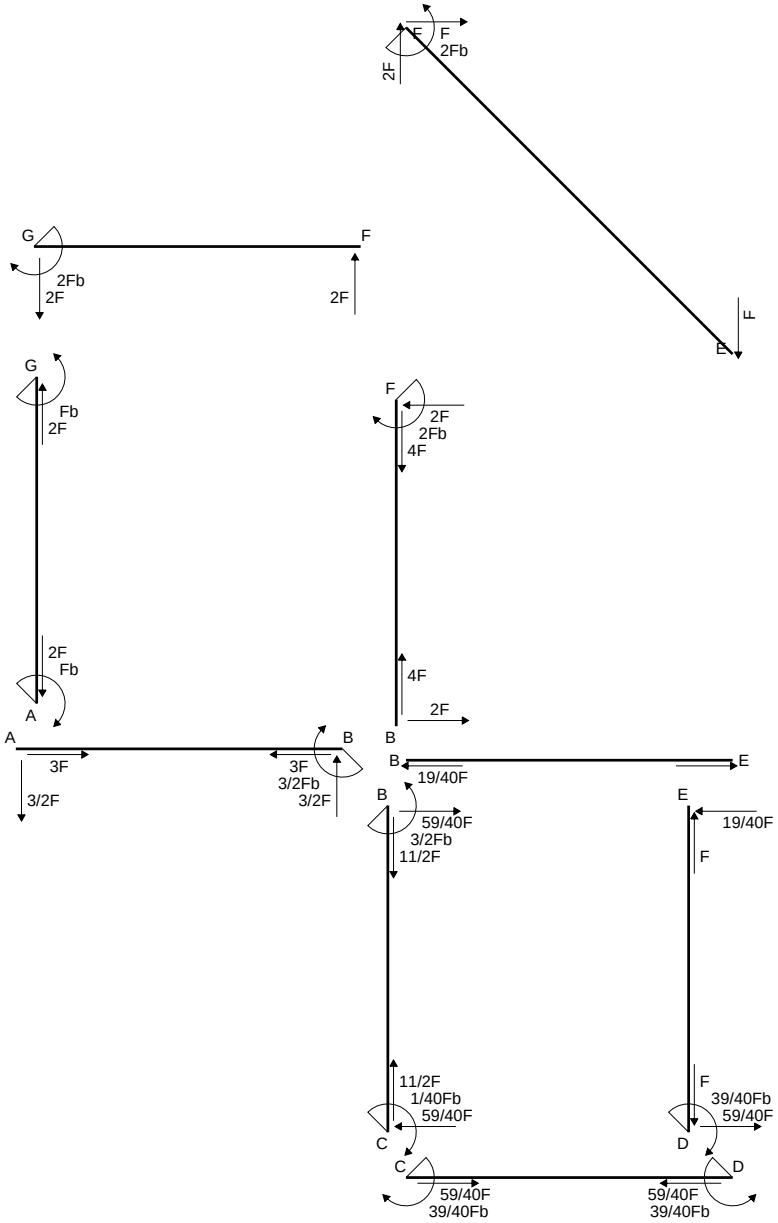


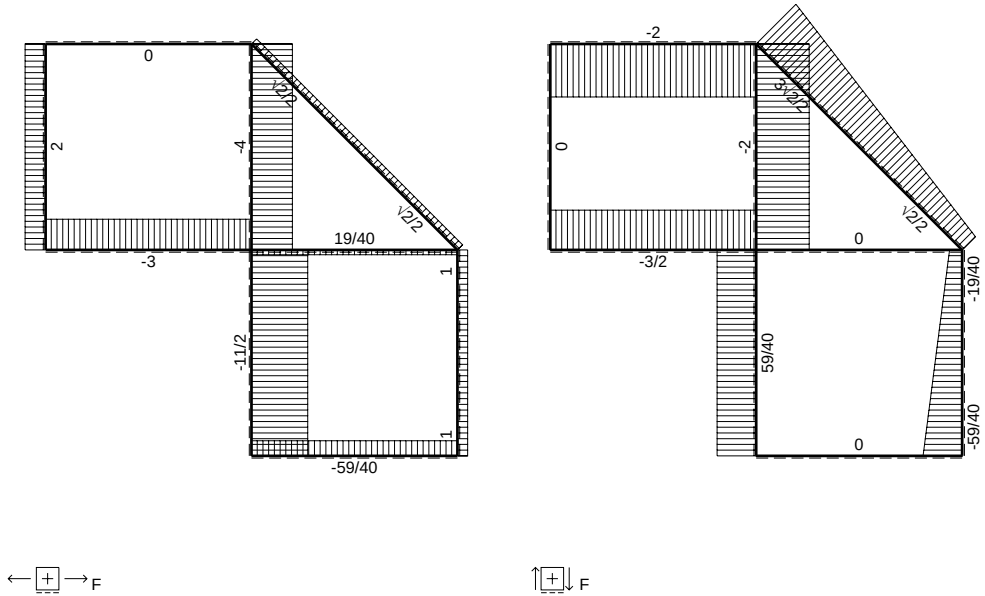
A = 175. mm^2
J_u = 80057. mm^4
J_v = 16674. mm^4
J_t = 152.4 mm^4
y_o = -12.86 mm
y_g = 18.96 mm
N = -2205. N
T_y = -980. N
M_x = 578200. Nmm
x_m = 11. mm
y_m = 49. mm
u_m = -12. mm
v_m = 30.04 mm
$\sigma_m = N/A - Mv/J_u$ = -229.6 N/mm^2
x_c = 23. mm
y_c = 49. mm
v_c = 30.04 mm
$\sigma_c = N/A - Mv/J_u$ = -229.6 N/mm^2
$\tau_c = TS^*/tJ_u$ = 15.89 N/mm^2
$\tau_g = TS^*/tJ_u$ = 15.89 N/mm^2
t_c = 490. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 231.2 N/mm^2

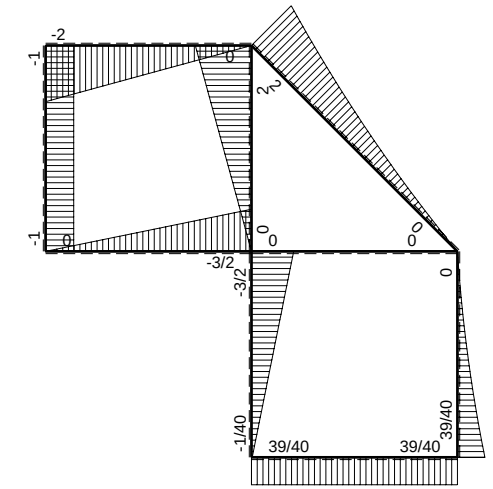
@ Adolfo Zavelani Rossi, Politecnico di Milano, vers.27.03.13 16.04.26

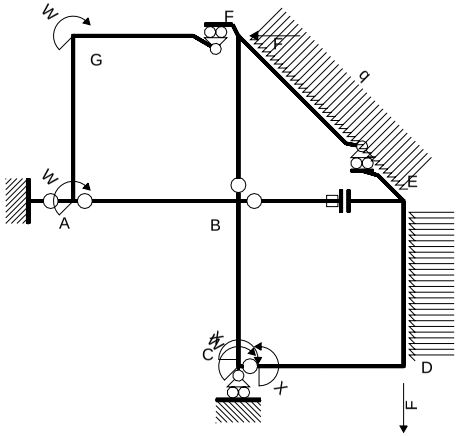
CI02.xxxx.143

@ Adolfo Zavelani Rossi, Politecnico di Milano, vers.27.03.13 16.04.26

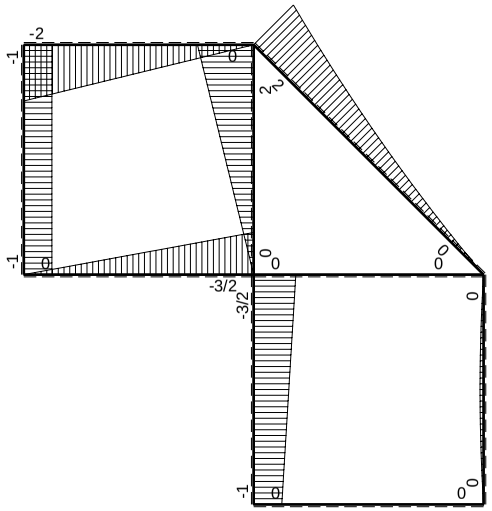

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F
39/40Fb
59/40F
C
D
C
D
59/40F
39/40Fb
59/40F
39/40Fb


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-4
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-3
1
-11/2
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-59/40
F
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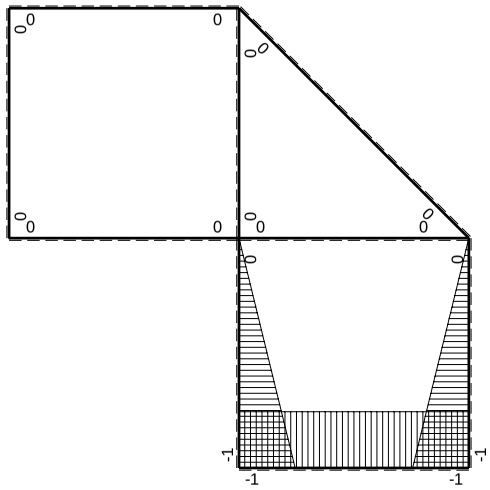

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-1
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-3/2
-3/2
0
-1/40
39/40
39/40
39/40
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0		
BC b	-x/b	-3/2Fb+1/2Fx	$3/2Fx-1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	$Fb-1/2Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE 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
ED b	x/b	$1/2Fx-1/2qx^2$	$1/2Fx^2/b-1/2qx^3/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx+1/2qx^2$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$13/8Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-39/40Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b)\ Fb\ 1/EJ\ = 7/12\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ \ Fb^2/EJ$

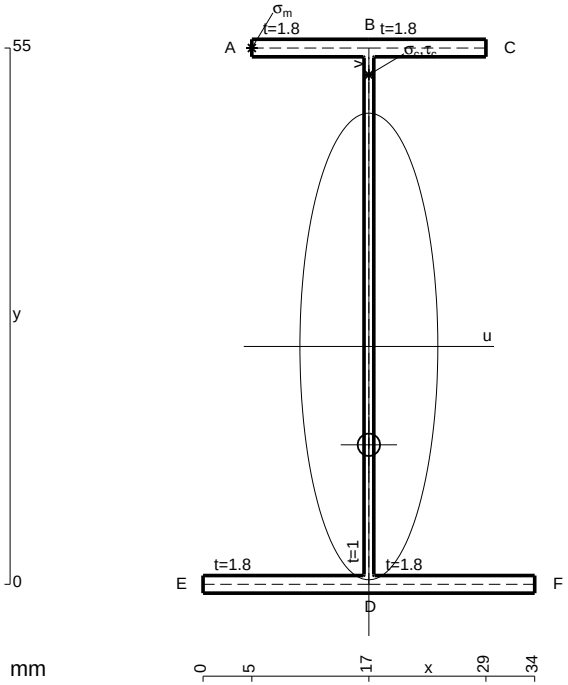
$L^{Xo}_{DE} = \int_o^b (1/2\ x/b - x^2/b^2 +1/2\ x^3/b^3)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/3\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b -1/3\ b +1/8\ b)\ Fb\ 1/EJ\ = 1/24\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x^2/b^2 -1/2\ x^3/b^3)\ Fb\ 1/EJ\ dx = [1/6\ x^3/b^2 -1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (1/6\ b -1/8\ b)\ Fb\ 1/EJ\ = 1/24\ \ Fb^2/EJ$

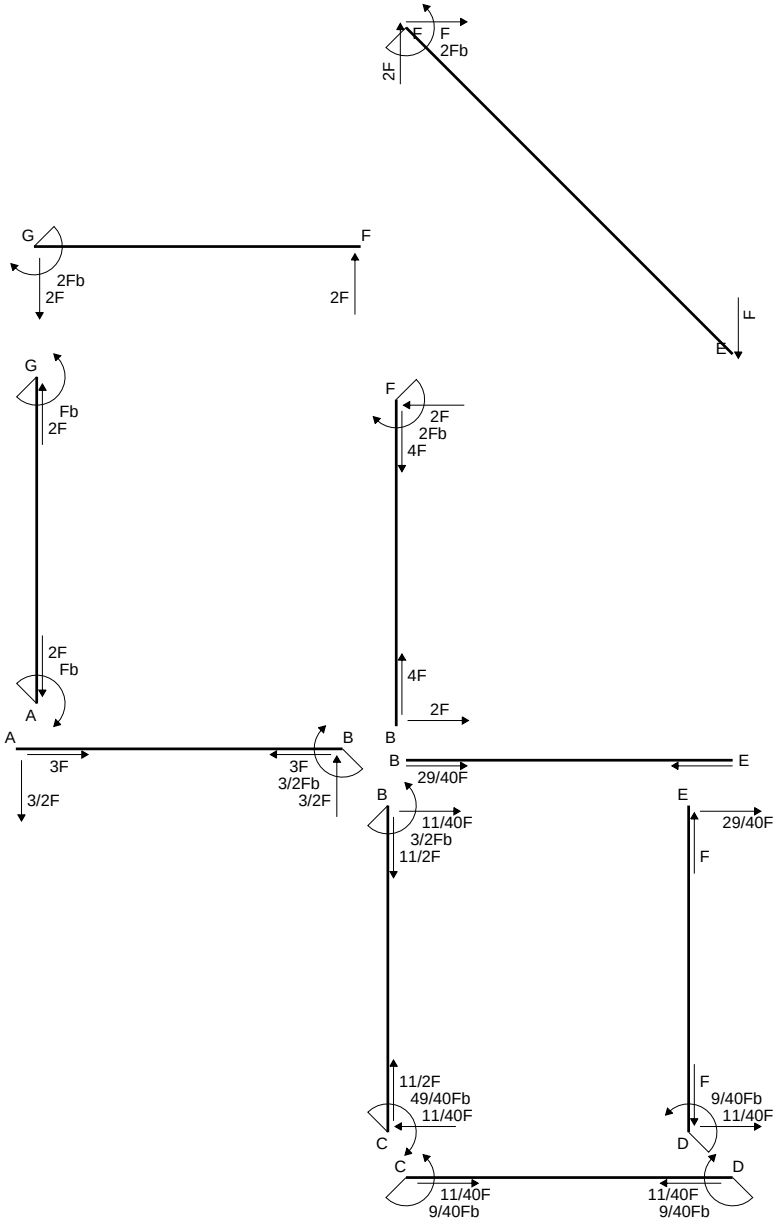
PROCEDIMENTO E RISULTATI 239853 CI02.xxxx.144

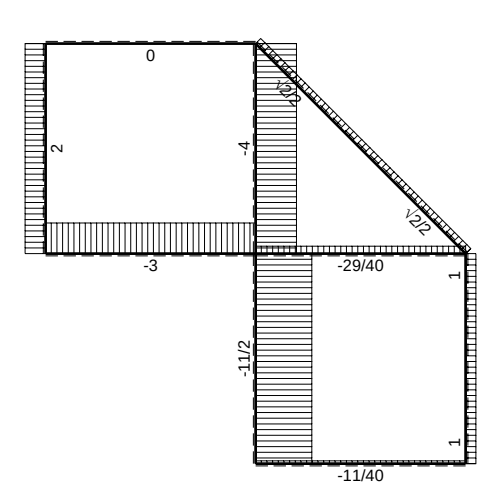


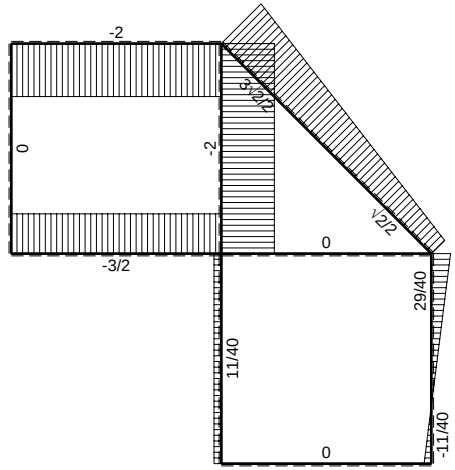
A = 159.4 mm^2
J_u = 91280. mm^4
J_v = 7969. mm^4
J_t = 131.1 mm^4
y_o = -10.08 mm
y_g = 24.39 mm
N = -1880. N
T_y = -940. N
M_x = 676800. Nmm
x_m = 5. mm
y_m = 55. mm
u_m = -12. mm
v_m = 30.61 mm
$\sigma_m = N/A - Mv/J_u$ = -238.7 N/mm^2
x_c = 17. mm
y_c = 55. mm
v_c = 30.61 mm
$\sigma_c = N/A - Mv/J_u$ = -238.7 N/mm^2
$\tau_c = TS^*/tJ_u$ = 13.62 N/mm^2
$\tau_g = TS^*/tJ_u$ = 13.62 N/mm^2
t_c = 470. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 239.9 N/mm^2

CI02.xxxx.144

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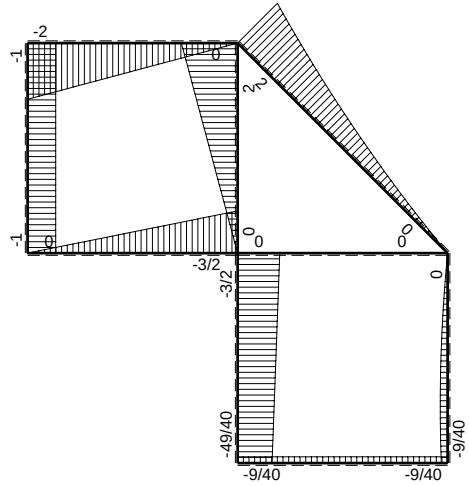

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11/40F
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C
D
C
D
11/40F
9/40Fb
11/40F
9/40Fb


0
2
-4
√2/2
-3
-29/40
1
-11/2
1
-11/40

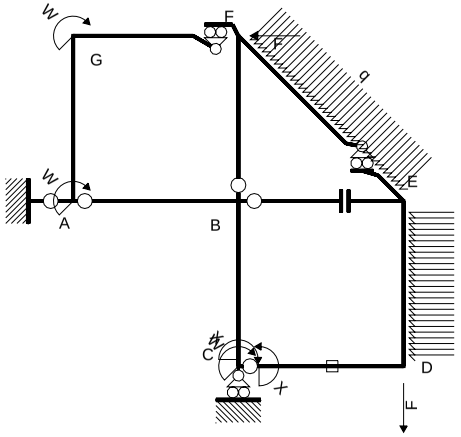

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29/40
11/40
0
-11/40

F

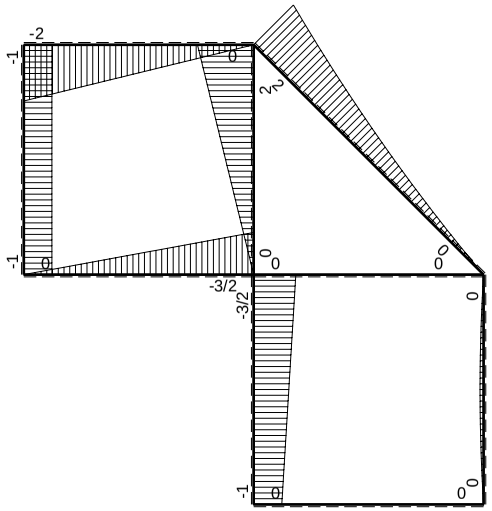
F


-2
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0
2√2
-1
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0
0
0
-3/2
-3/2
0
-49/40
-9/40
-9/40
-9/40

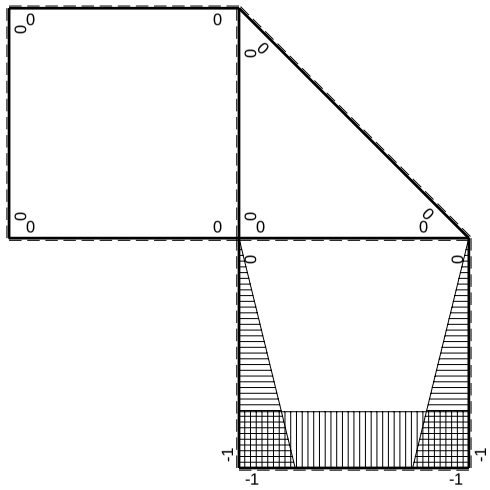
Fb



Schema di calcolo iperstatico



M_o flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0		
BC b	-x/b	-3/2Fb+1/2Fx	$3/2Fx-1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+1/2Fx	$Fb-1/2Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	$-1/2Fx+1/2qx^2$	$1/2Fx-Fx^2/b+1/2qx^3/b$	$1-2x/b+x^2/b^2$	$1/24Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$1/2Fx-1/2qx^2$	$1/2Fx^2/b-1/2qx^3/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx+1/2qx^2$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-3/8Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				$9/40Fb$	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b)\ Fb\ 1/EJ\ = 7/12\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

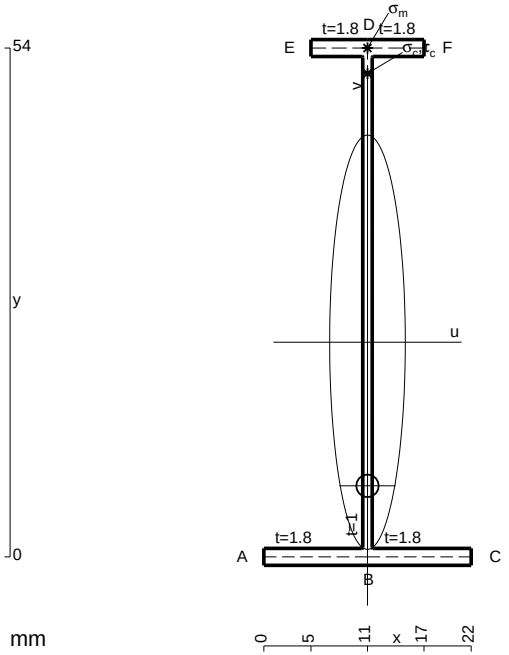
$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2\ x/b - x^2/b^2 +1/2\ x^3/b^3)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/3\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b -1/3\ b +1/8\ b)\ Fb\ 1/EJ\ = 1/24\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x^2/b^2 -1/2\ x^3/b^3)\ Fb\ 1/EJ\ dx = [1/6\ x^3/b^2 -1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

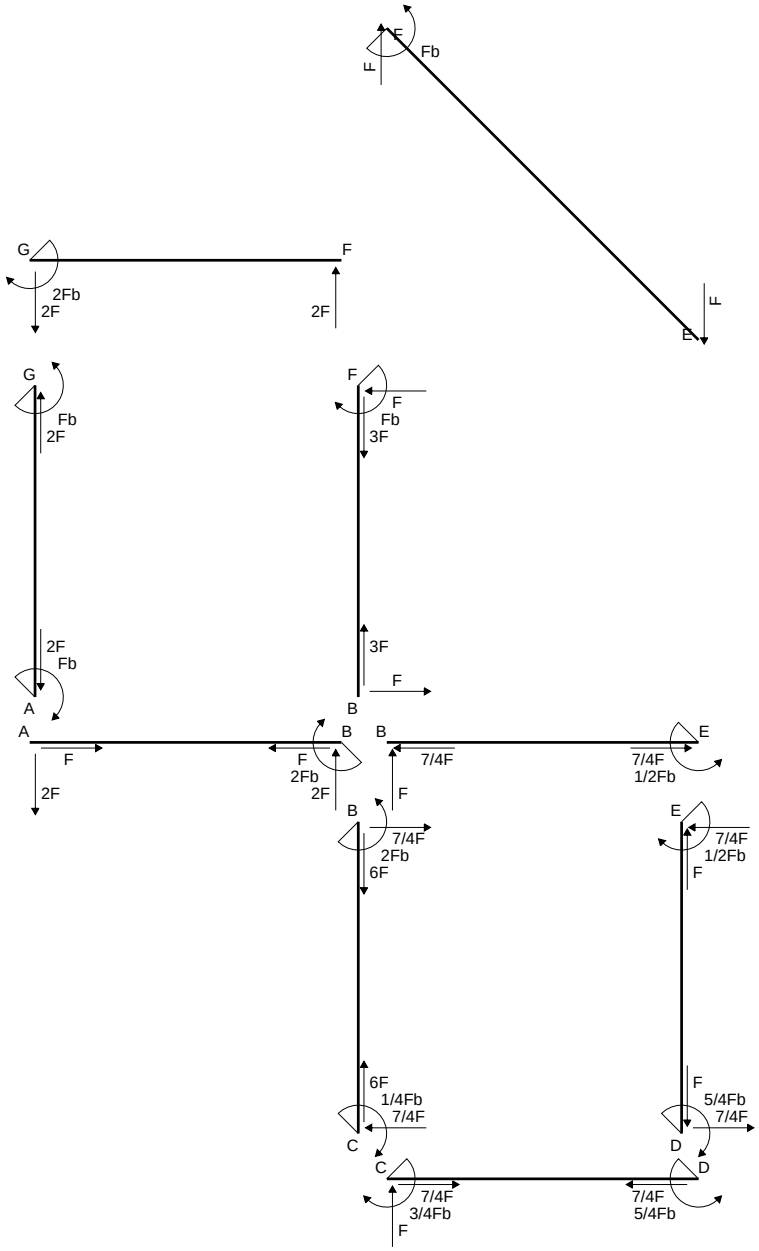
$= (1/6\ b -1/8\ b)\ Fb\ 1/EJ\ = 1/24\ \ Fb^2/EJ$

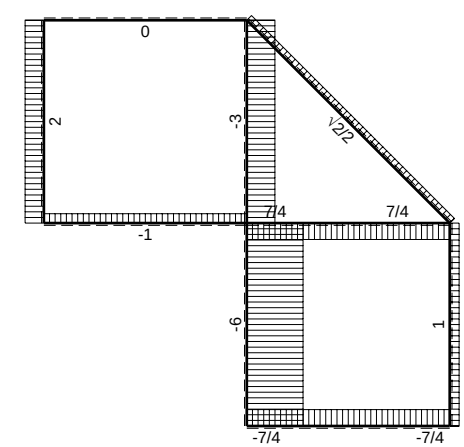


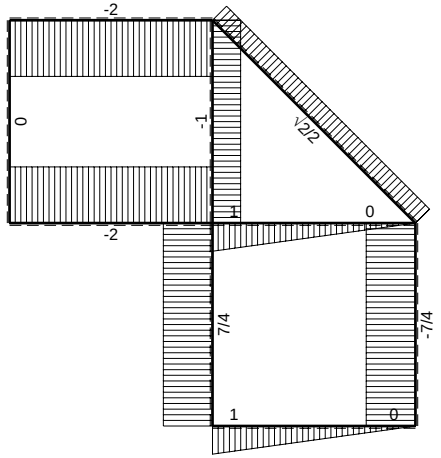
A = 115.2 mm^2
J_u = 55687. mm^4
J_v = 1856. mm^4
J_t = 84.1 mm^4
y_o = -15.24 mm
y_g = 22.78 mm
N = 162.6 N
T_y = 487.9 N
M_x = 349600. Nmm
x_m = 11. mm
y_m = 54. mm
v_m = 31.22 mm
$\sigma_m = N/A - Mv/J_u$ = -194.6 N/mm^2
y_c = 2. mm
u_c = -11. mm
v_c = -20.78 mm
$\sigma_c = N/A - Mv/J_u$ = -194.6 N/mm^2
$\tau_c = TS^*/tJ_u$ = 5.908 N/mm^2
$\tau_g = TS^*/tJ_u$ = 5.908 N/mm^2
t_c = 230. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 194.8 N/mm^2

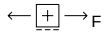
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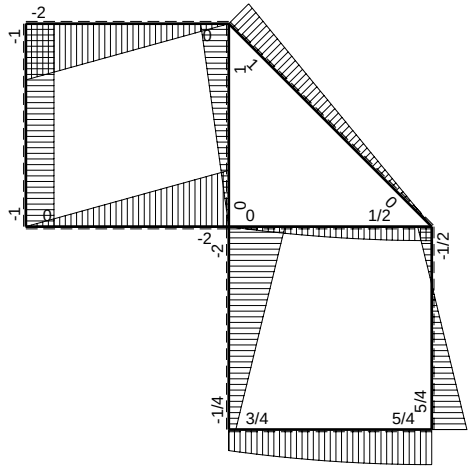






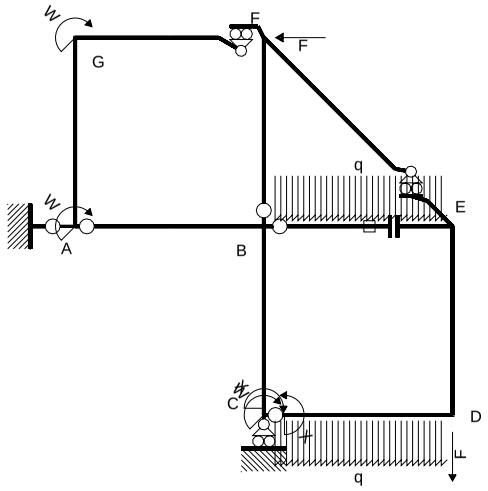


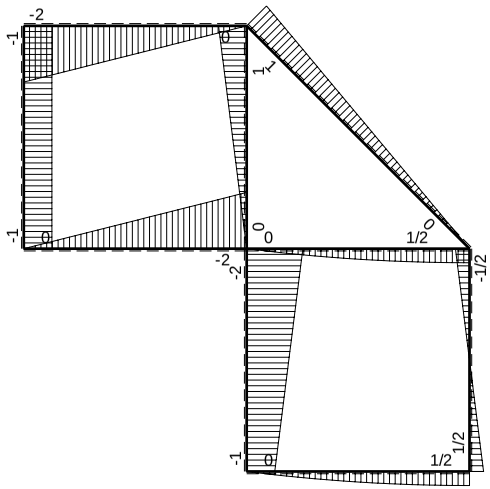




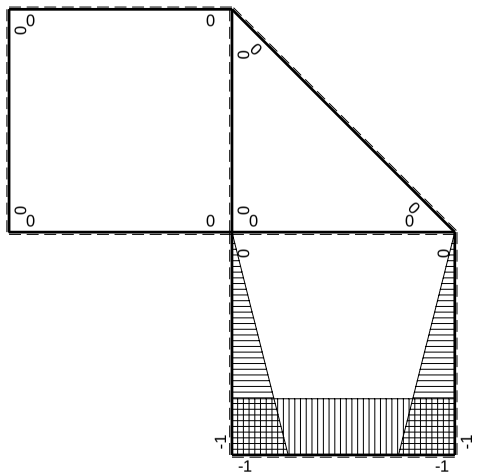


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M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0		
BC b	-x/b	-2Fb+Fx	2Fx-Fx^2/b	x^2/b^2	2/3Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	Fx-1/2qx^2	-Fx+1/2Fx^2/b	1	-1/3Fb^2/EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx^2	-1/2Fb+1/2Fx^2/b	1		
DE b	-1+x/b	1/2Fb-Fx	-1/2Fb+3/2Fx-Fx^2/b	1-2x/b+x^2/b^2	-1/12Fb^2/EJ	1/3Xb/EJ
ED b	x/b	1/2Fb-Fx	1/2Fx-Fx^2/b	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	Fx-1/2qx^2	0	0	0	0
EB b	0	-1/2Fb+1/2qx^2	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				5/4Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-3/4Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (2\ x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ \ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-\ x/b +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/3\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2 +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

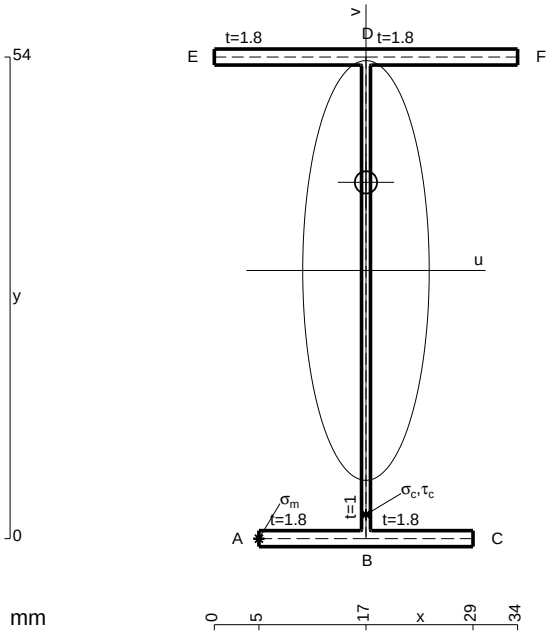
$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/3\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (-1/2 +3/2\ x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x +3/4\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +3/4\ b -1/3\ b\ )\ Fb\ 1/EJ\ = -1/12\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

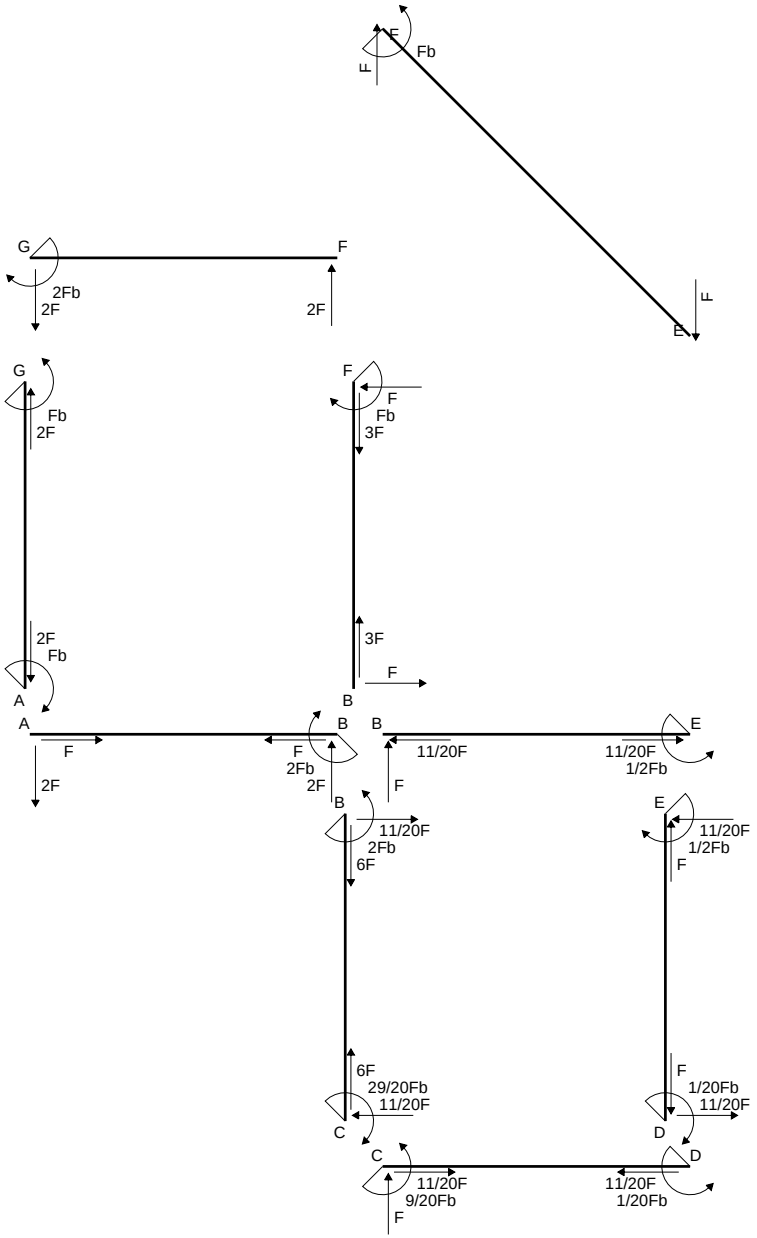
$= (1/4\ b -1/3\ b\ )\ Fb\ 1/EJ\ = -1/12\ \ Fb^2/EJ$

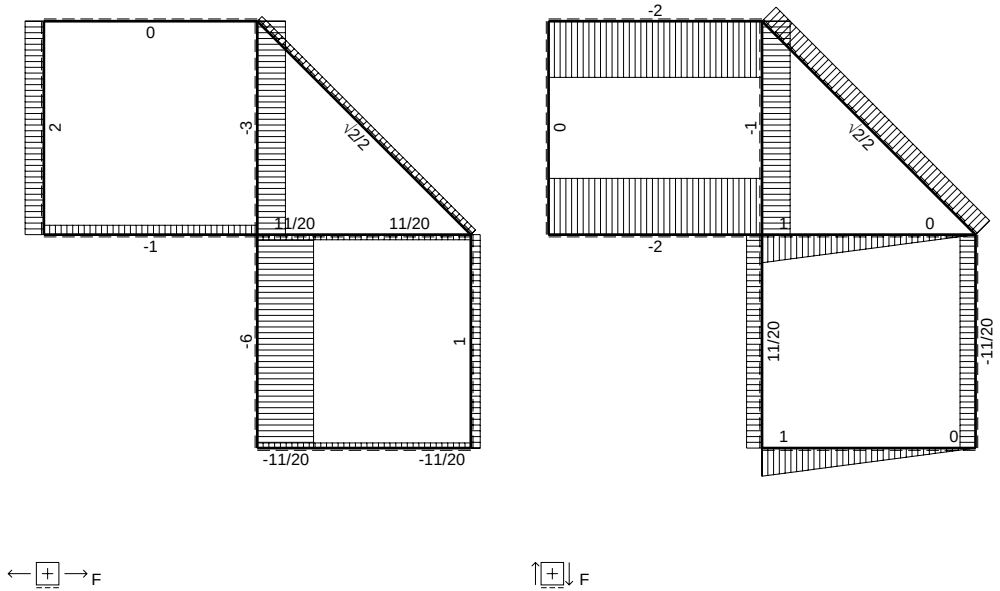


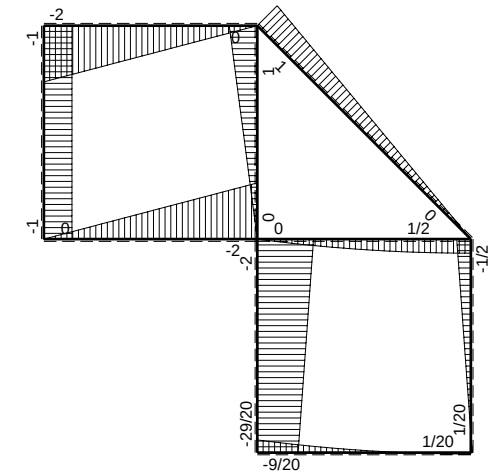
A = 158.4 mm^2
J_u = 87739. mm^4
J_v = 7969. mm^4
J_t = 130.8 mm^4
y_o = 9.881 mm
y_g = 30.07 mm
N = -370. N
T_y = -740. N
M_x = -599400. Nmm
x_m = 5. mm
u_m = -12. mm
v_m = -30.07 mm
$\sigma_m = N/A - Mv/J_u$ = -207.8 N/mm^2
x_c = 17. mm
v_c = -30.07 mm
$\sigma_c = N/A - Mv/J_u$ = -207.8 N/mm^2
$\tau_c = TS^*/tJ_u$ = 10.96 N/mm^2
$\tau_g = TS^*/tJ_u$ = 10.96 N/mm^2
t_c = 370. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 208.6 N/mm^2

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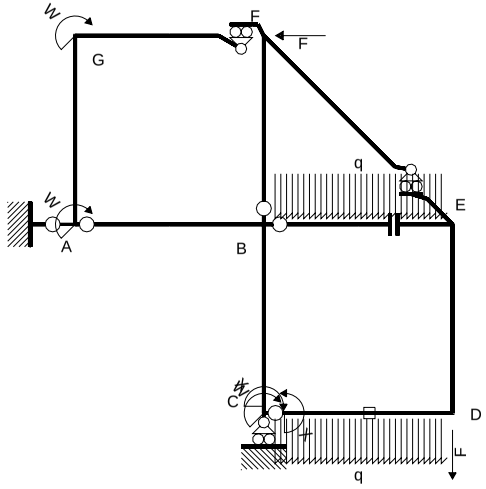
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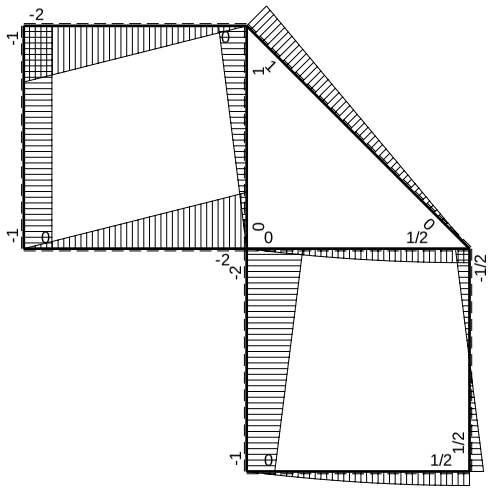

E
Fb
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2Fb
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3F
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A
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1/2Fb
6F
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6F
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11/20F
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D
C
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11/20F
9/20Fb
1/20Fb
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√2/2
11/20
11/20
-1
-6
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√2/2
1
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-2
11/20
-11/20
1
0
F
F

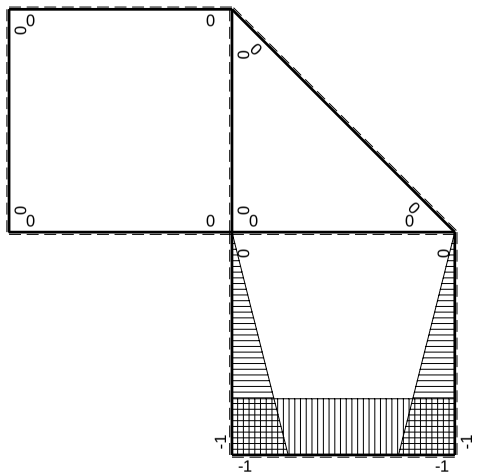

-2
-1
0
1
√2
-1
0
0
0
1/2
-2
-2
-1/2
-29/20
1/20
1/20
-9/20


Fb





M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0		
BC b	-x/b	-2Fb+Fx	2Fx-Fx^2/b	x^2/b^2	2/3Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	Fb-Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	Fx-1/2qx^2	-Fx+1/2Fx^2/b	1	-1/3Fb^2/EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx^2	-1/2Fb+1/2Fx^2/b	1		
DE b	-1+x/b	1/2Fb-Fx	-1/2Fb+3/2Fx-Fx^2/b	1-2x/b+x^2/b^2	-1/12Fb^2/EJ	1/3Xb/EJ
ED b	x/b	1/2Fb-Fx	1/2Fx-Fx^2/b	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	Fx-1/2qx^2	0	0	0	0
EB b	0	-1/2Fb+1/2qx^2	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				-Fb^2/EJ	
	totali				-3/4Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				9/20Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (2\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -4/3\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2 +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/2\ x +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

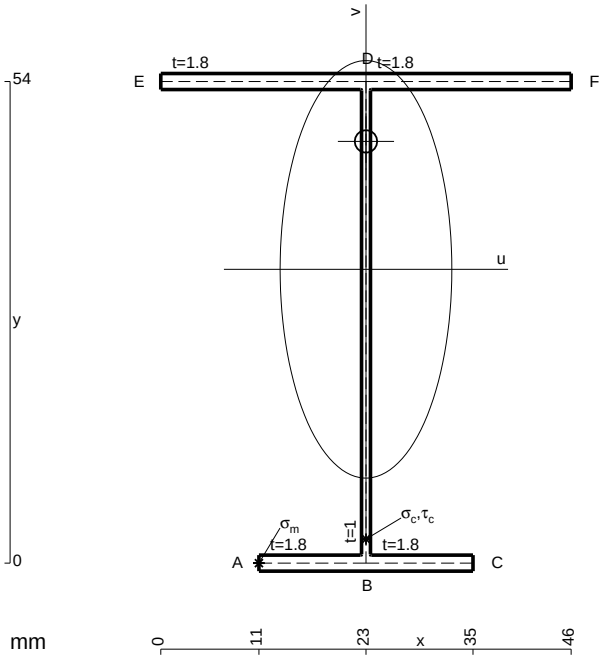
$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -4/3\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (-1/2 +3/2\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/2\ x +3/4\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +3/4\ b -1/3\ b\ )\ Fb\ 1/EJ\ = -1/12\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

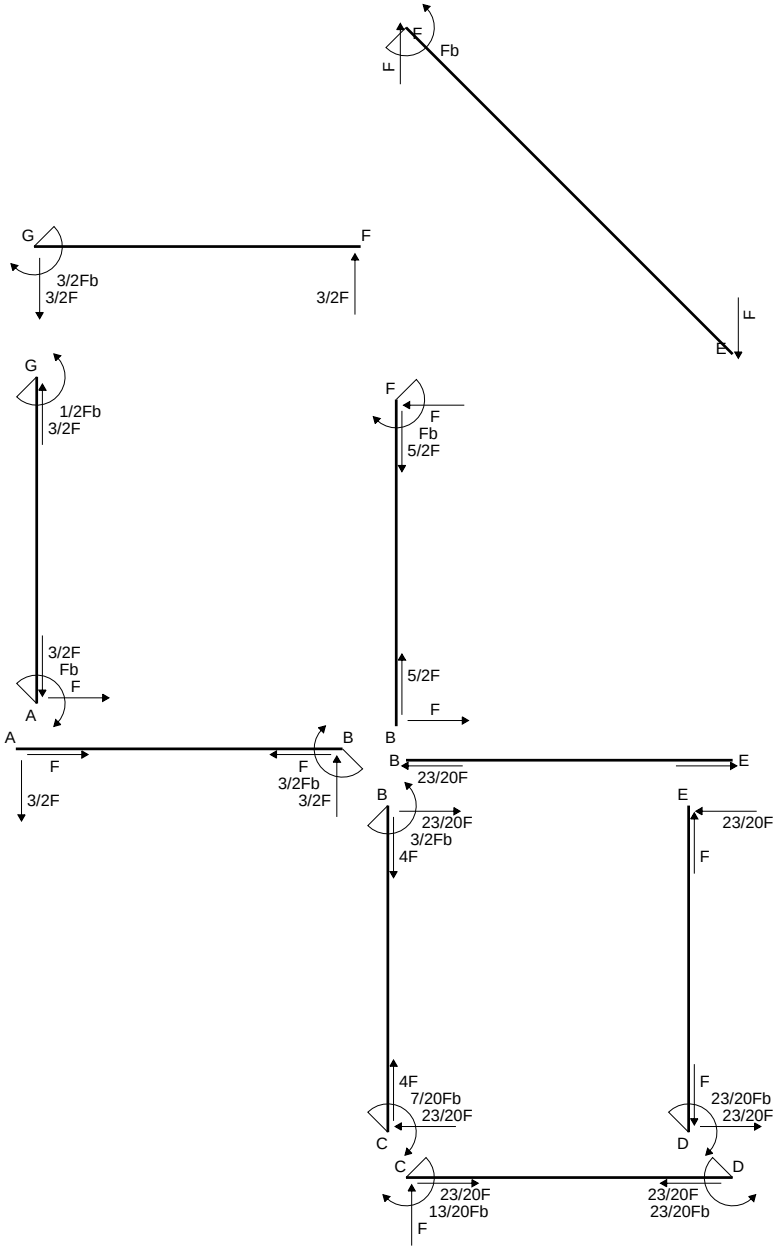
$= (1/4\ b -1/3\ b\ )\ Fb\ 1/EJ\ = -1/12\ \ Fb^2/EJ$

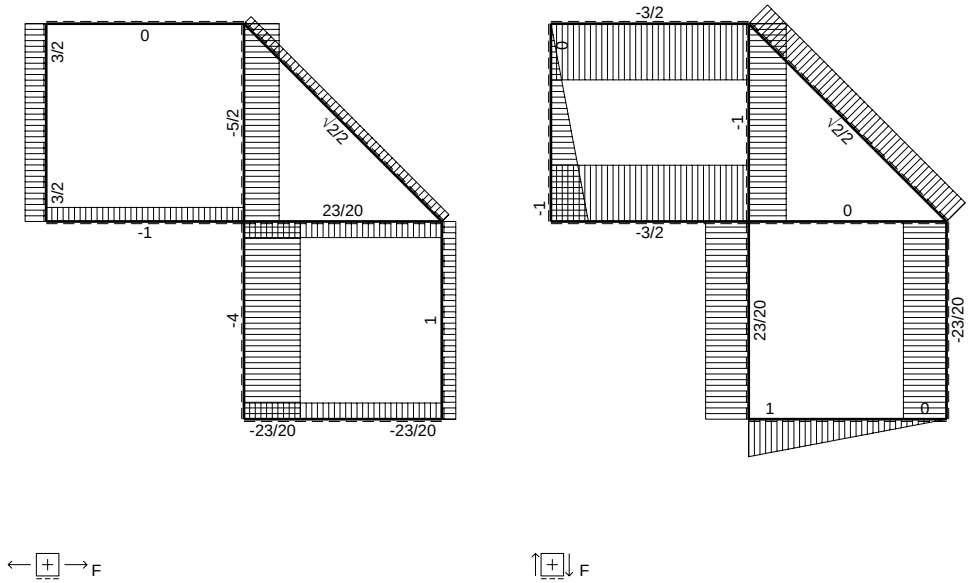


A = 180. mm^2
J_u = 98625. mm^4
J_v = 16674. mm^4
J_t = 154.1 mm^4
y_o = 14.34 mm
y_g = 32.94 mm
N = -370. N
T_y = -740. N
M_x = -636400. Nmm
x_m = 11. mm
u_m = -12. mm
v_m = -32.94 mm
$\sigma_m = N/A - Mv/J_u$ = -214.6 N/mm^2
x_c = 23. mm
v_c = -32.94 mm
$\sigma_c = N/A - Mv/J_u$ = -214.6 N/mm^2
$\tau_c = TS^*/tJ_u$ = 10.68 N/mm^2
$\tau_g = TS^*/tJ_u$ = 10.68 N/mm^2
t_c = 370. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 215.4 N/mm^2

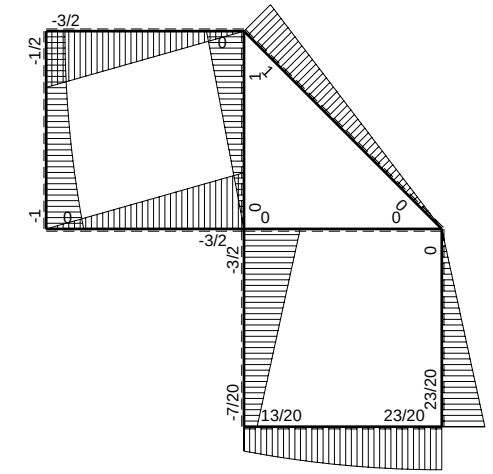
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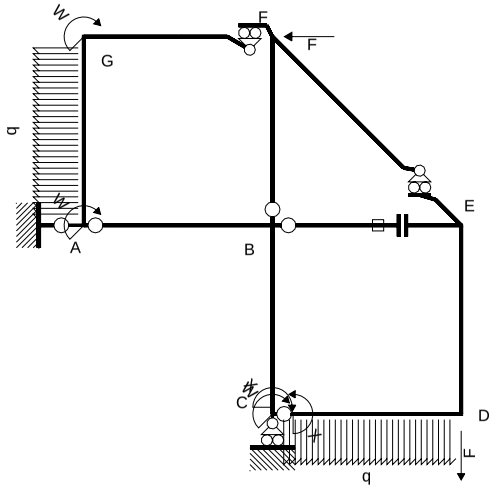

F
Fb
F
G
F
3/2Fb
3/2F
3/2F
F
G
1/2Fb
3/2F
F
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Fb
5/2F
3/2F
Fb
F
A
5/2F
F
A
B
B
B
E
F
3/2F
3/2Fb
3/2F
23/20F
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23/20F
3/2Fb
4F
E
23/20F
F
4F
7/20Fb
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F
23/20F
23/20Fb

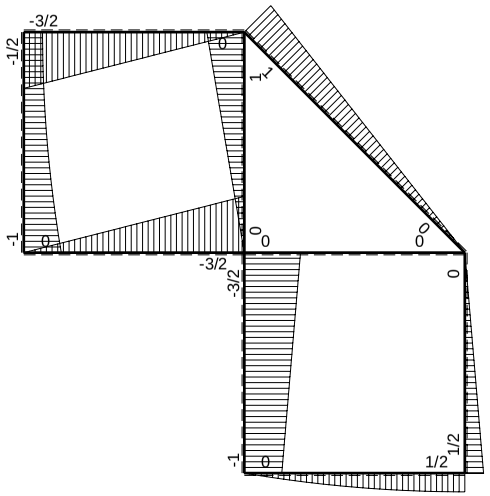

3/2
0
-5/2
√2/2
3/2
23/20
-1
-4
1
-23/20
-23/20
-3/2
0
-1
√2/2
-1
0
-3/2
23/20
-23/20
1
0

F F

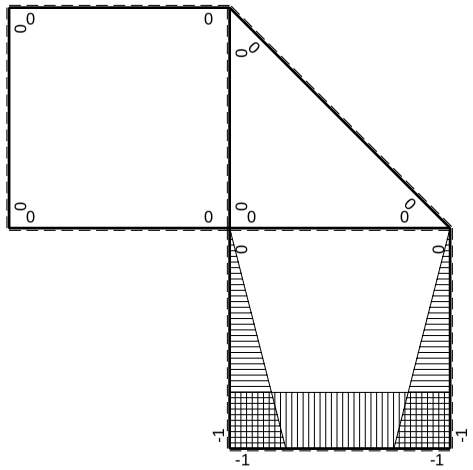

-3/2
-1/2
0
1
-1
0
0
0
0
-3/2
-3/2
0
-7/20
13/20
23/20
23/20

Fb





M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0		
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx^2/b	x^2/b^2	7/12Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	Fx-1/2qx^2	-Fx+1/2Fx^2/b	1	-1/3Fb^2/EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx^2	-1/2Fb+1/2Fx^2/b	1		
DE 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
ED b	x/b	-1/2Fx	-1/2Fx^2/b	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-3/2Fx	0	0	0	0
GF b	0	3/2Fb-3/2Fx	0	0		
GA b	0	-1/2Fb-1/2qx^2	0	0	0	0
AG b	0	Fb-Fx+1/2qx^2	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				13/12Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-13/20Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-\ x/b +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/3\ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2 +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

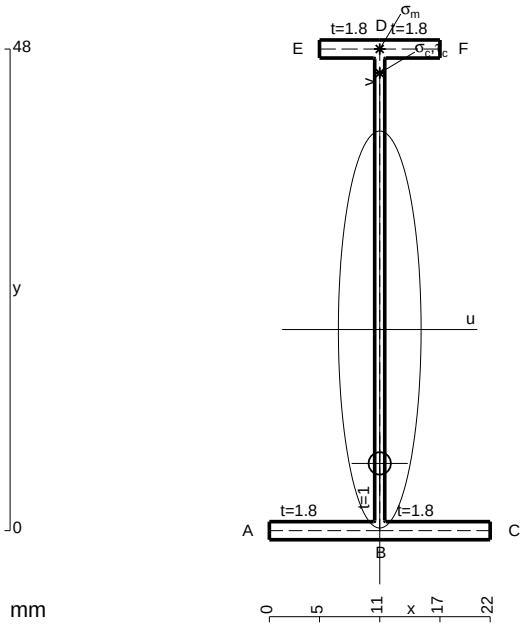
$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/3\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (-1/2 + x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x +1/2\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = -1/6\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (-1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

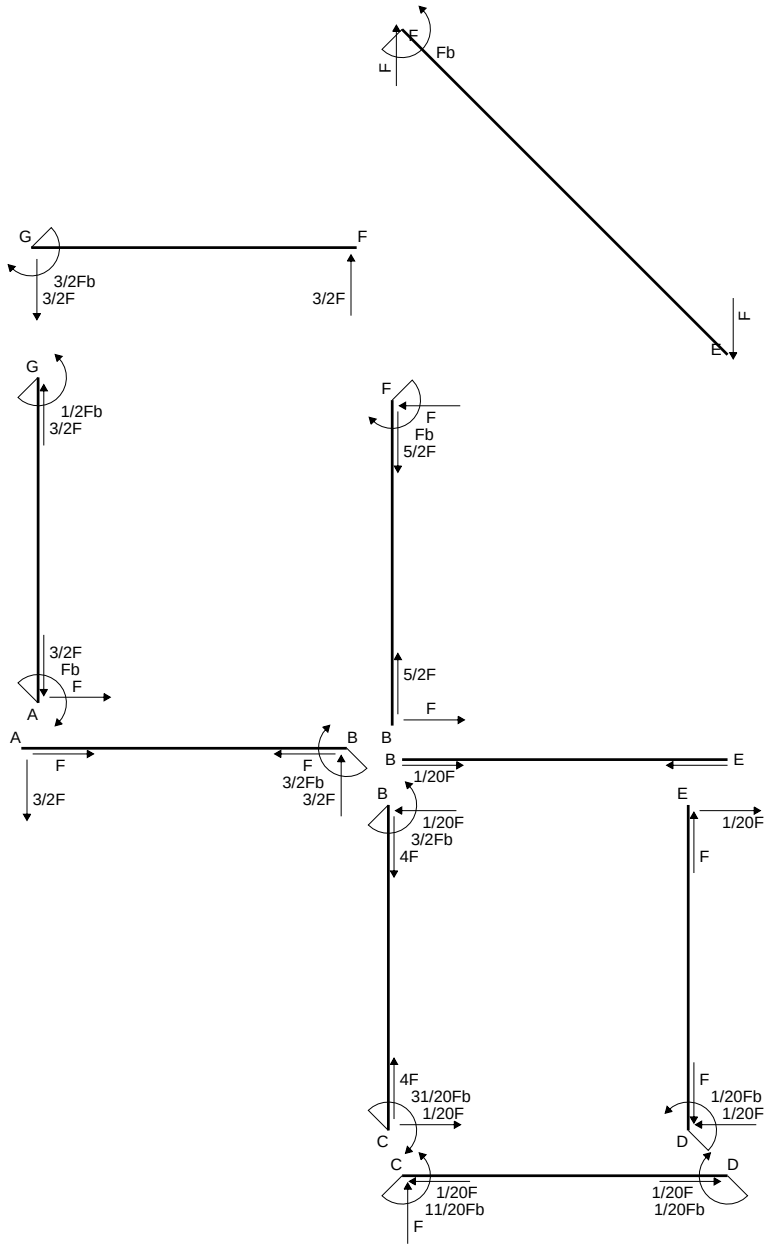
$= (-1/6\ b\ )\ Fb\ 1/EJ\ = -1/6\ Fb^2/EJ$

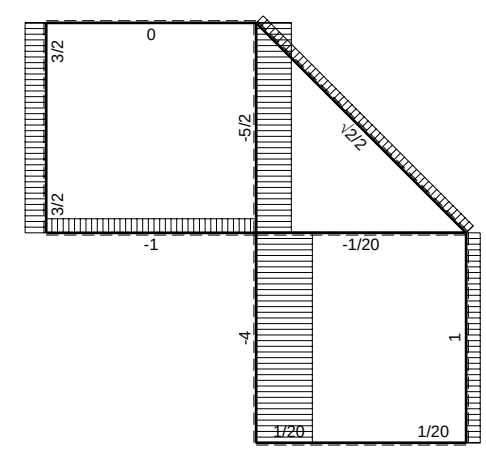


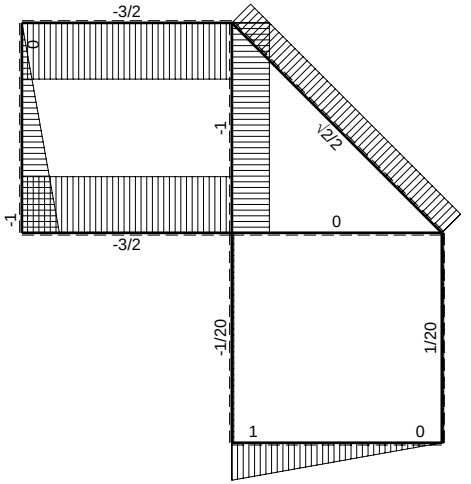
A = 109.2 mm^2
J_u = 42758. mm^4
J_v = 1856. mm^4
J_t = 82.1 mm^4
y_o = -13.34 mm
y_g = 20.04 mm
T_y = -420. N
M_x = -340200. Nmm
x_m = 11. mm
y_m = 48. mm
v_m = 27.96 mm
$\sigma_m = -Mv/J_u$ = 222.4 N/mm^2
y_c = 2. mm
u_c = -11. mm
v_c = -18.04 mm
$\sigma_c = -Mv/J_u$ = 222.4 N/mm^2
$\tau_c = TS^*/tJ_u$ = 5.931 N/mm^2
$\tau_g = TS^*/tJ_u$ = 5.931 N/mm^2
t_c = 280. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 222.7 N/mm^2

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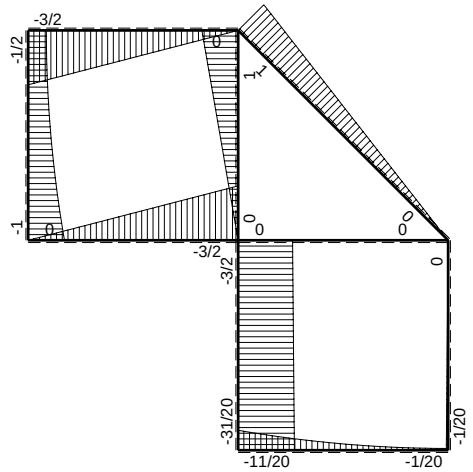






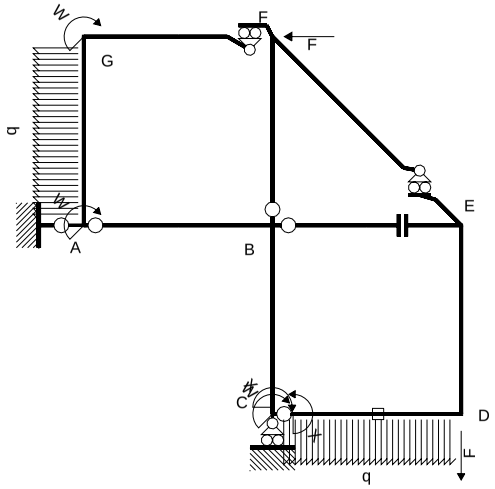
←□→ F

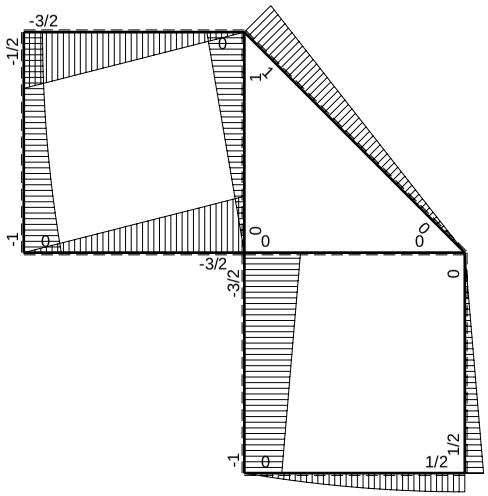
↑□↓ F



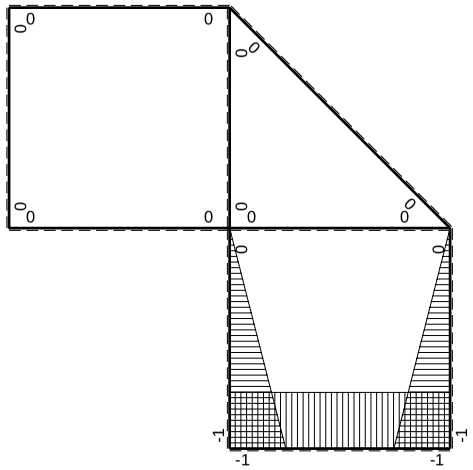
↻□↺ Fb

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M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0		
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx^2/b	x^2/b^2	7/12Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	Fx-1/2qx^2	-Fx+1/2Fx^2/b	1	-1/3Fb^2/EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx^2	-1/2Fb+1/2Fx^2/b	1		
DE 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
ED b	x/b	-1/2Fx	-1/2Fx^2/b	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-3/2Fx	0	0	0	0
GF b	0	3/2Fb-3/2Fx	0	0		
GA b	0	-1/2Fb-1/2qx^2	0	0	0	0
AG b	0	Fb-Fx+1/2qx^2	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				-Fb^2/EJ	
	totali				-11/12Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				11/20Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2\ )\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -4/3\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2 +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/2\ x +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -4/3\ \ Fb^2/EJ$

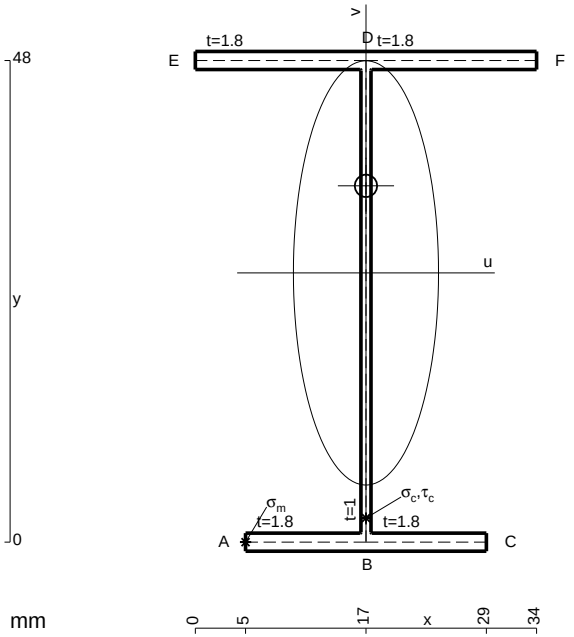
$L^{Xo}_{DE} = \int_o^b (-1/2 + x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/2\ x +1/2\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = -1/6\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (-1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/6\ b\ )\ Fb\ 1/EJ\ = -1/6\ \ Fb^2/EJ$

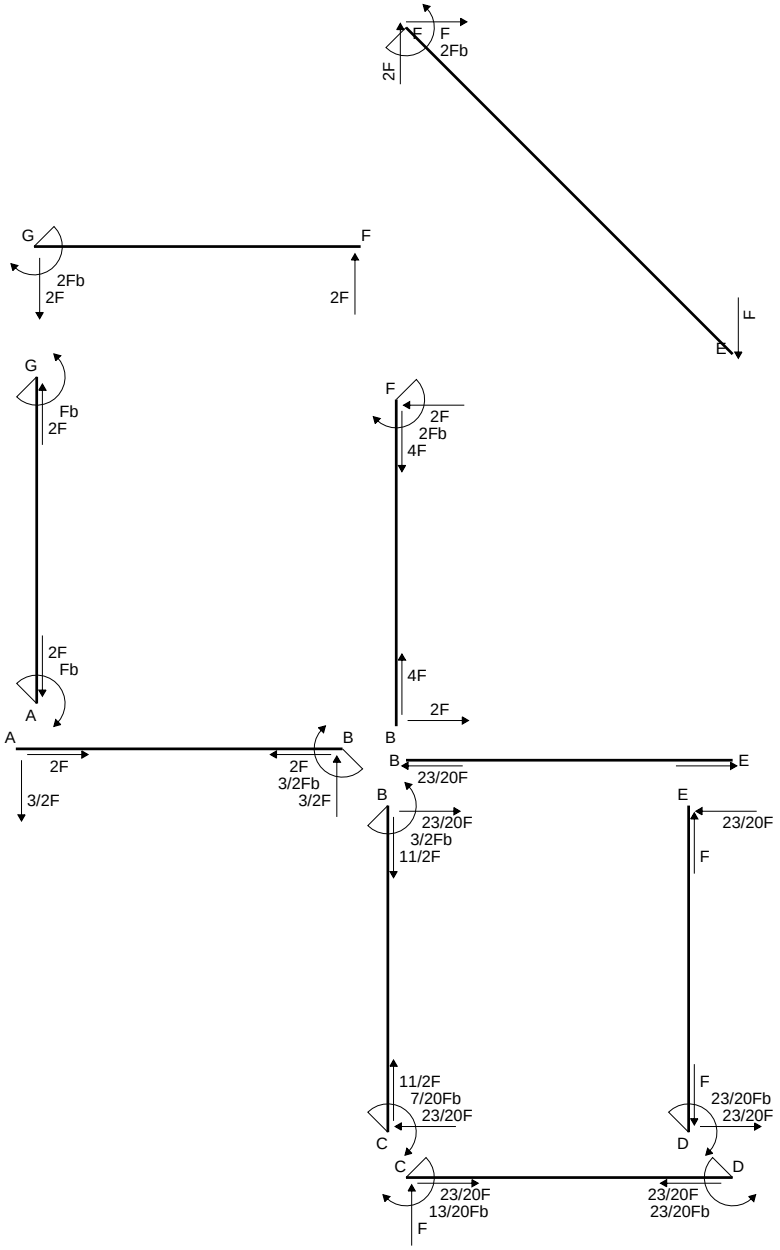
PROCEDIMENTO E RISULTATI 264866 CI02.xxxx.149

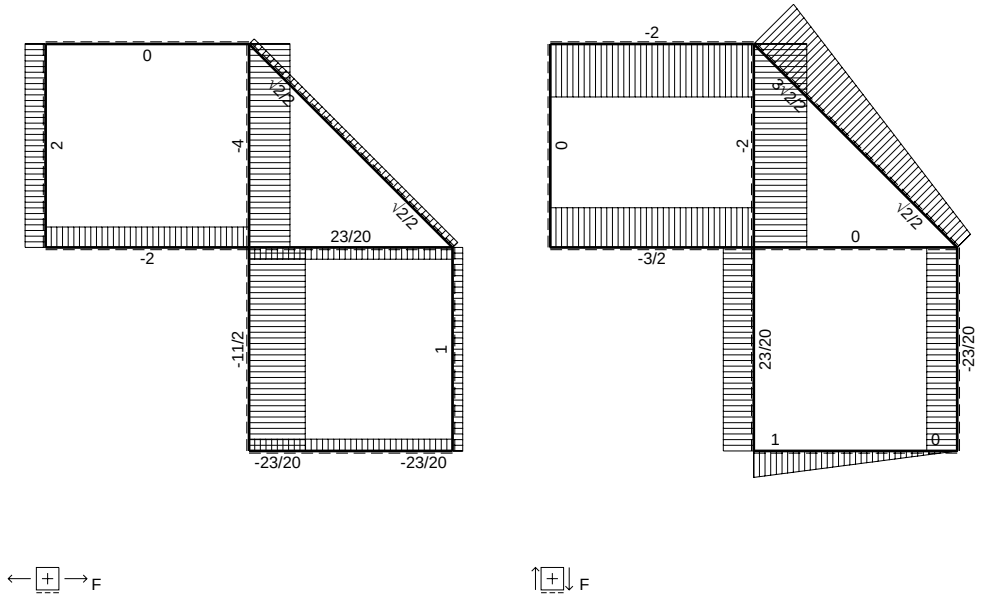


A = 152.4 mm^2
J_u = 68126. mm^4
J_v = 7969. mm^4
J_t = 128.8 mm^4
y_o = 8.676 mm
y_g = 26.83 mm
N = -470. N
T_y = -705. N
M_x = -599250. Nmm
x_m = 5. mm
u_m = -12. mm
v_m = -26.83 mm
$\sigma_m = N/A - Mv/J_u$ = -239.1 N/mm^2
x_c = 17. mm
v_c = -26.83 mm
$\sigma_c = N/A - Mv/J_u$ = -239.1 N/mm^2
$\tau_c = TS^*/tJ_u$ = 12. N/mm^2
$\tau_g = TS^*/tJ_u$ = 12. N/mm^2
t_c = 470. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 240. N/mm^2

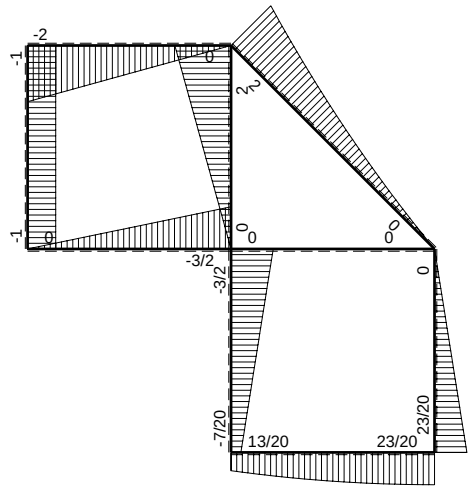
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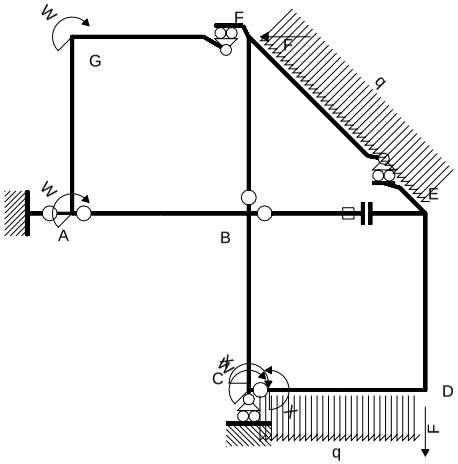

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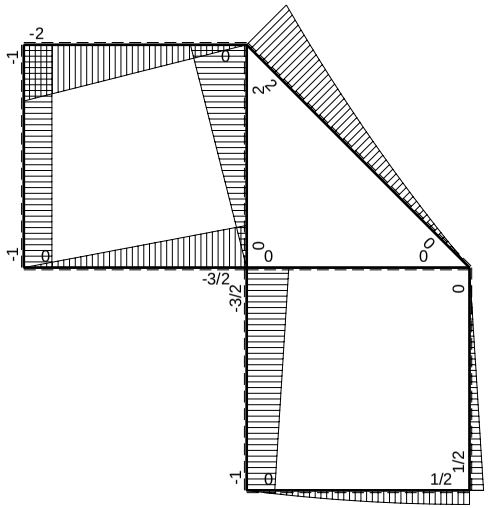

0
2
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-2
23/20
-11/2
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-23/20
-23/20
-2
0
-2
-3/2
0
23/20
1
-23/20
0

F F

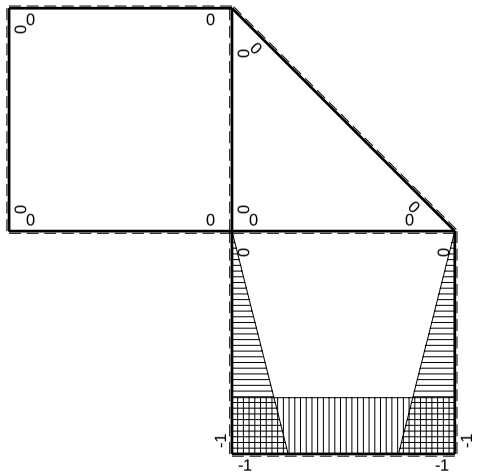

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0
0
-3/2
-3/2
0
-7/20
13/20
23/20
23/20

Fb





M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0		
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx^2/b	x^2/b^2	7/12Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	Fx-1/2qx^2	-Fx+1/2Fx^2/b	1	-1/3Fb^2/EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx^2	-1/2Fb+1/2Fx^2/b	1		
DE 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
ED b	x/b	-1/2Fx	-1/2Fx^2/b	x^2/b^2		
EF √2b	0	√2/2Fx+1/2qx^2	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				13/12Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-13/20Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-\ x/b +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/3\ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2 +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

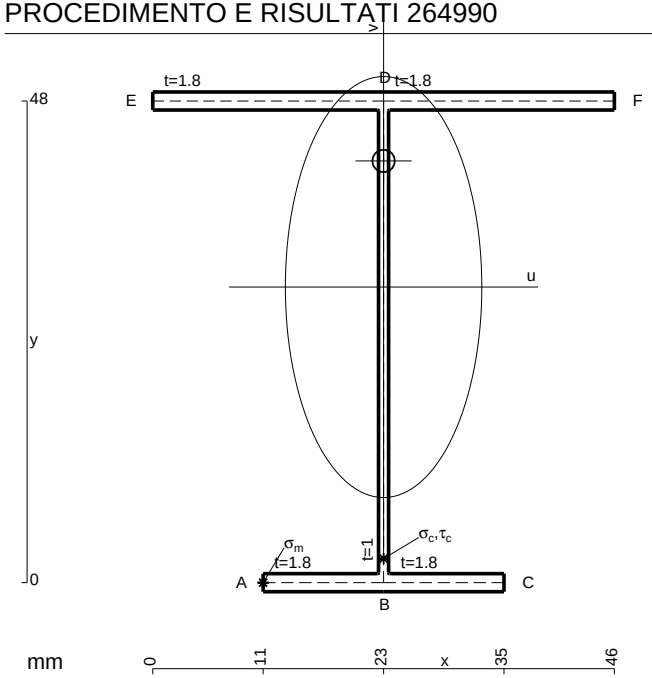
$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/3\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (-1/2 + x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x +1/2\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = -1/6\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (-1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

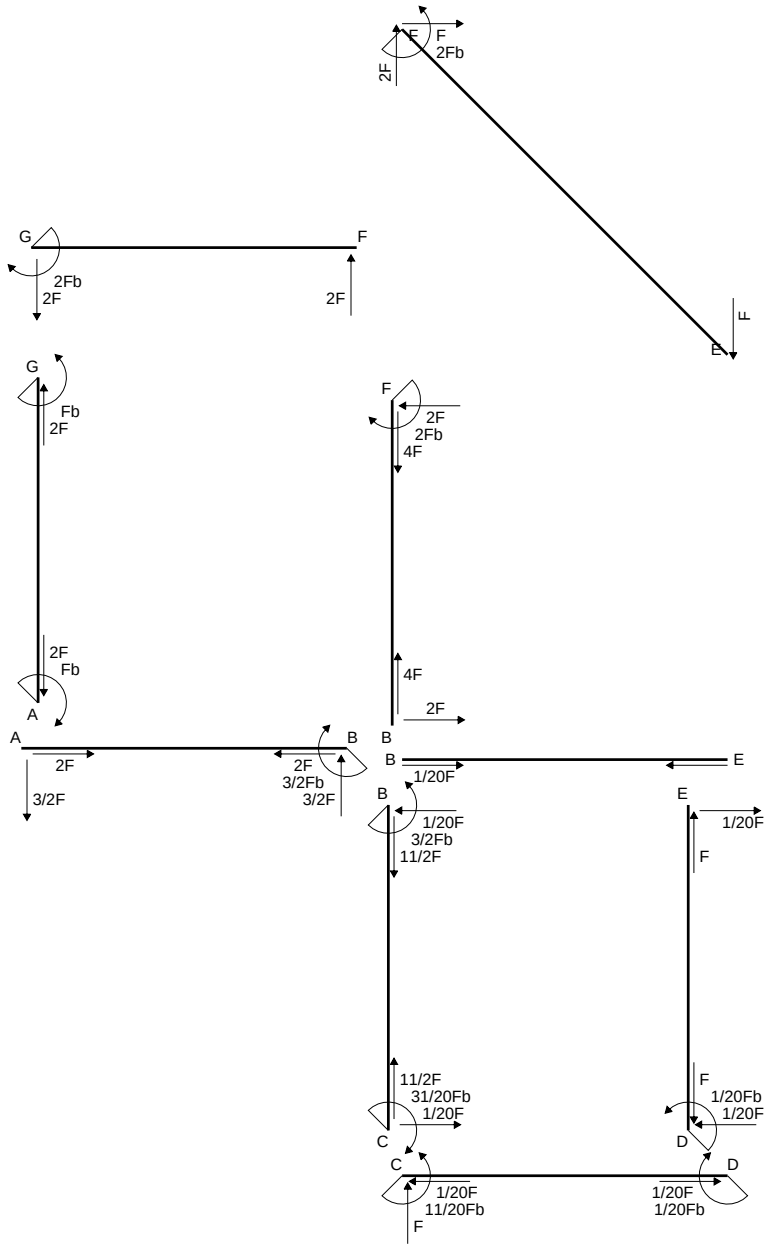
$= (-1/6\ b\ )\ Fb\ 1/EJ\ = -1/6\ Fb^2/EJ$

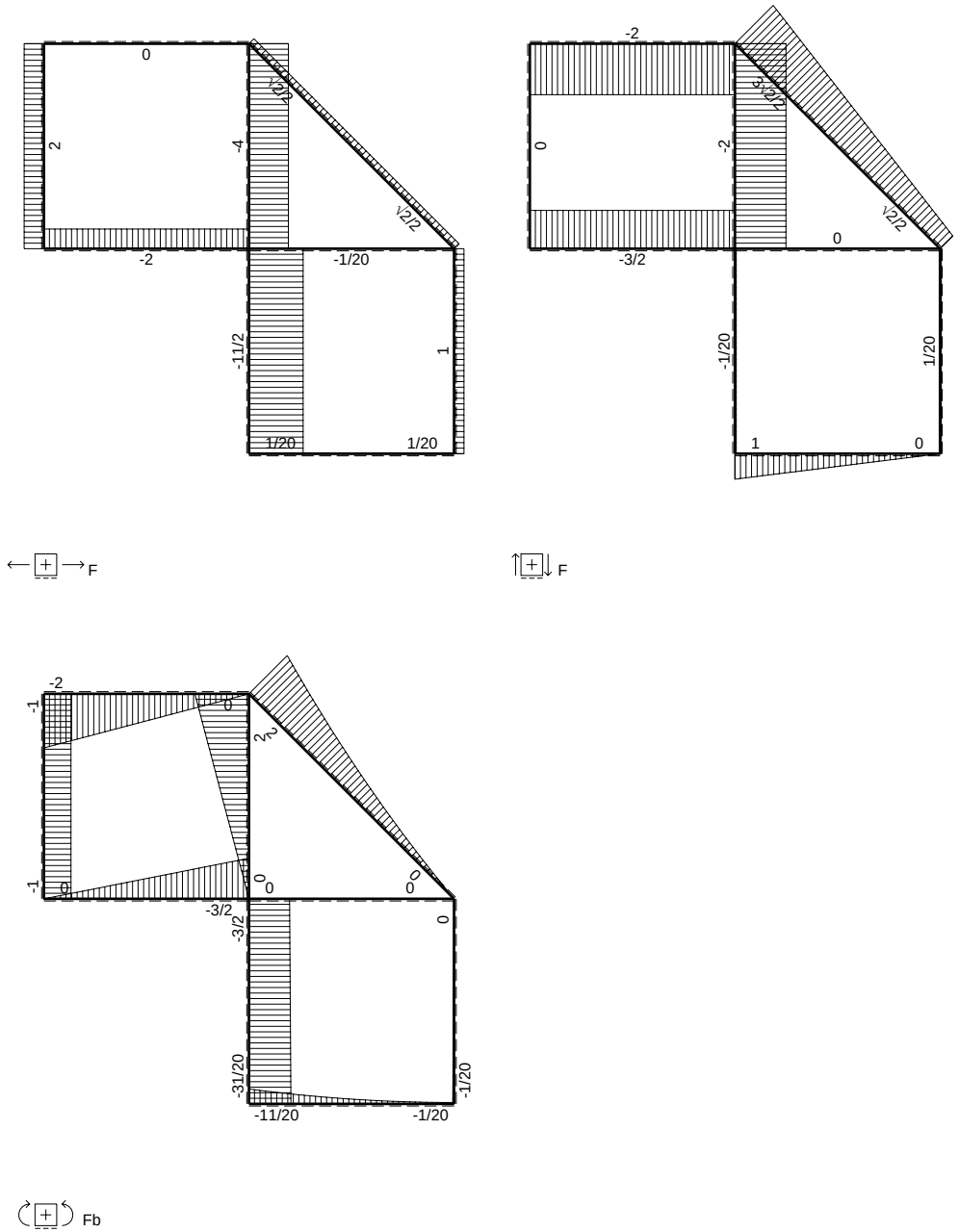


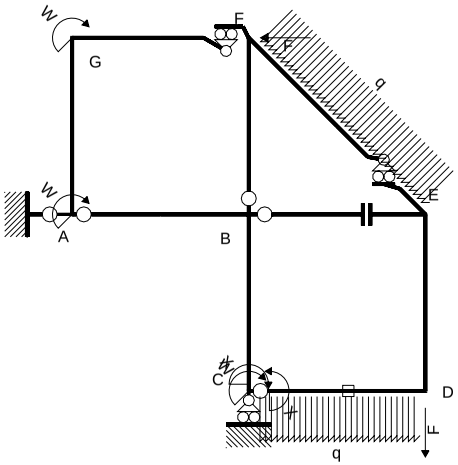
A = 174. mm^2
J_u = 76601. mm^4
J_v = 16674. mm^4
J_t = 152.1 mm^4
y_o = 12.57 mm
y_g = 29.46 mm
N = 403.1 N
T_y = 1209. N
M_x = 513000. Nmm
x_m = 11. mm
u_m = -12. mm
v_m = -29.46 mm
$\sigma_m = N/A - Mv/J_u$ = 199.6 N/mm^2
x_c = 23. mm
v_c = -29.46 mm
$\sigma_c = N/A - Mv/J_u$ = 199.6 N/mm^2
$\tau_c = TS^*/tJ_u$ = 20.09 N/mm^2
$\tau_g = TS^*/tJ_u$ = 20.09 N/mm^2
t_c = 570. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 202.6 N/mm^2

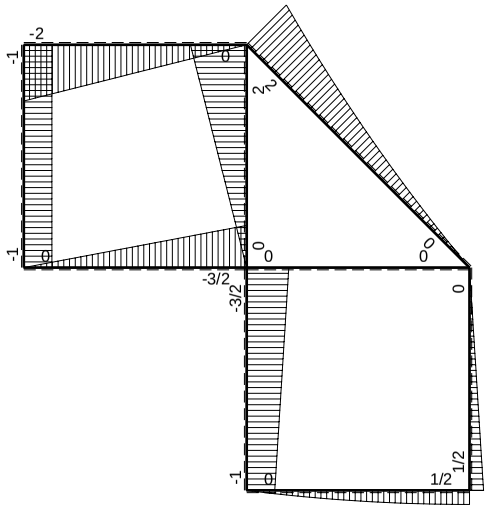
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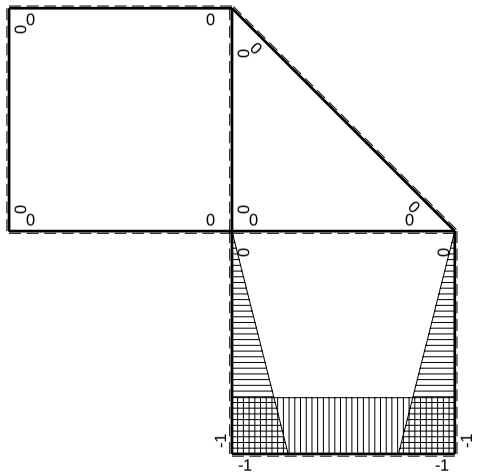

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4F
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B
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E
2F
2F
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1/20
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0
-2
3/2/2
½2/2
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0
2
2
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0
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0
0
-3/2
-3/2
0
-31/20
-1/20
-11/20
-1/20
Fb





M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0		
BC b	-x/b	-3/2Fb+1/2Fx	3/2Fx-1/2Fx^2/b	x^2/b^2	7/12Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb+1/2Fx	Fb-1/2Fx-1/2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	Fx-1/2qx^2	-Fx+1/2Fx^2/b	1	-1/3Fb^2/EJ	Xb/EJ
DC b	1	-1/2Fb+1/2qx^2	-1/2Fb+1/2Fx^2/b	1		
DE 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
ED b	x/b	-1/2Fx	-1/2Fx^2/b	x^2/b^2		
EF √2b	0	√2/2Fx+1/2qx^2	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				-Fb^2/EJ	
	totali				-11/12Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				11/20Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2\ )\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -4/3\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2 +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/2\ x +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -4/3\ \ Fb^2/EJ$

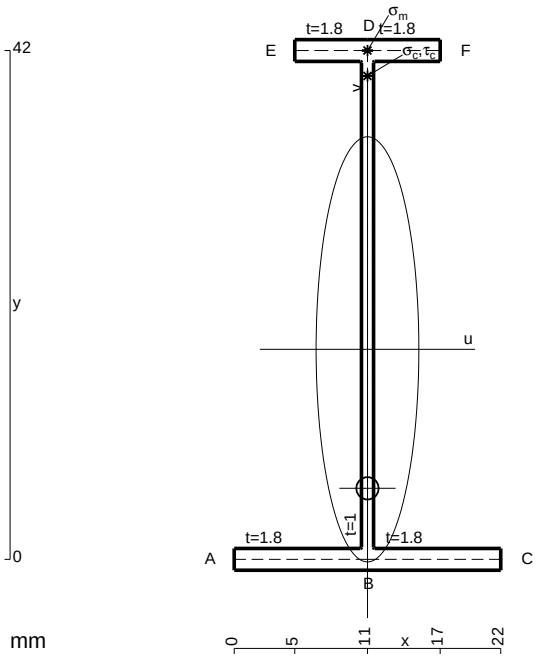
$L^{Xo}_{DE} = \int_o^b (-1/2 + x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/2\ x +1/2\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = -1/6\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (-1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/6\ b\ )\ Fb\ 1/EJ\ = -1/6\ \ Fb^2/EJ$

PROCEDIMENTO E RISULTATI 263702 CI02.xxxx.151

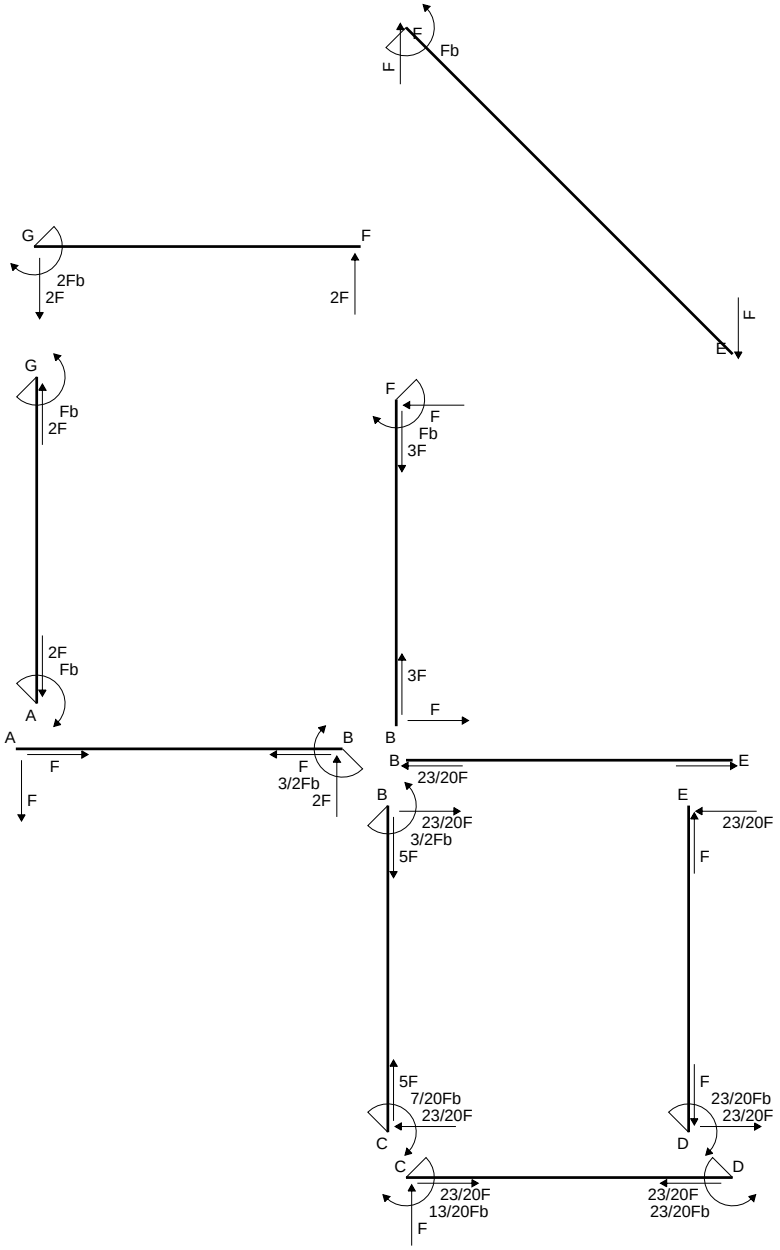


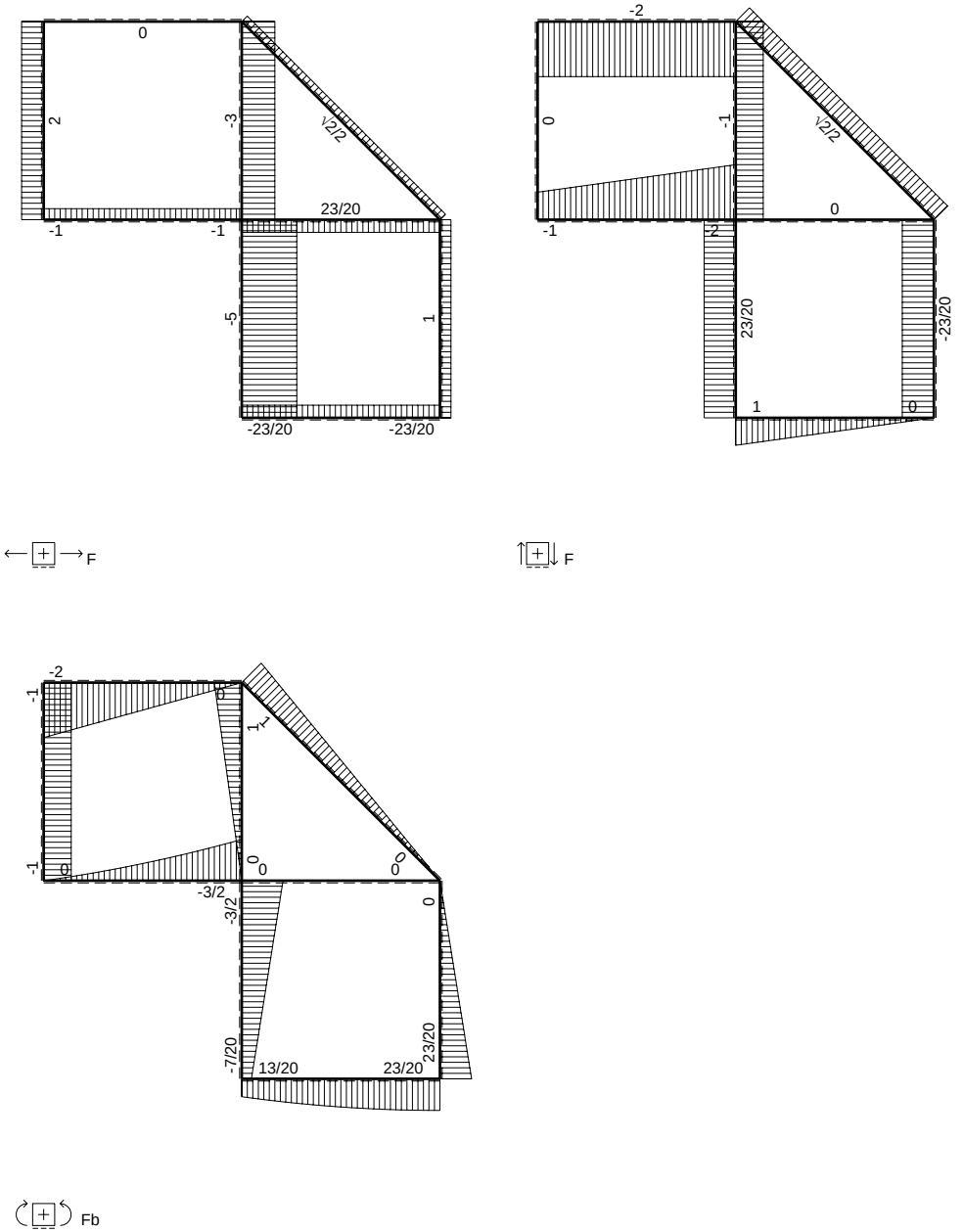
A = 103.2 mm^2
J_u = 31779. mm^4
J_v = 1856. mm^4
J_t = 80.1 mm^4
y_o = -11.47 mm
y_g = 17.34 mm
N = -1160. N
T_y = -580. N
M_x = 255200. Nmm
x_m = 11. mm
y_m = 42. mm
v_m = 24.66 mm
$\sigma_m = N/A - Mv/J_u$ = -209.3 N/mm^2
y_c = 2. mm
u_c = -11. mm
v_c = -15.34 mm
$\sigma_c = N/A - Mv/J_u$ = -209.3 N/mm^2
$\tau_c = TS^*/tJ_u$ = 9.723 N/mm^2
$\tau_g = TS^*/tJ_u$ = 9.723 N/mm^2
t_c = 290. mm
$\sigma_o = \sqrt{\sigma^2 + 3\tau^2}$ = 210. N/mm^2

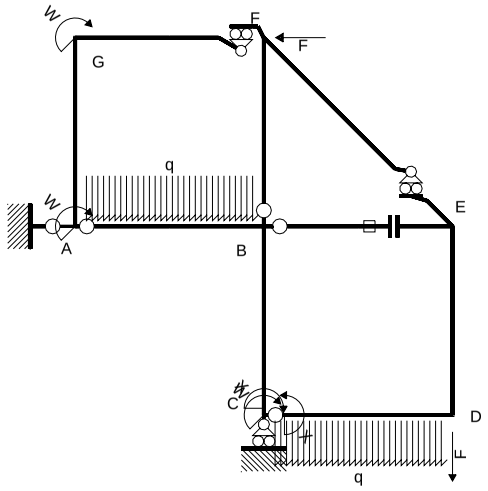
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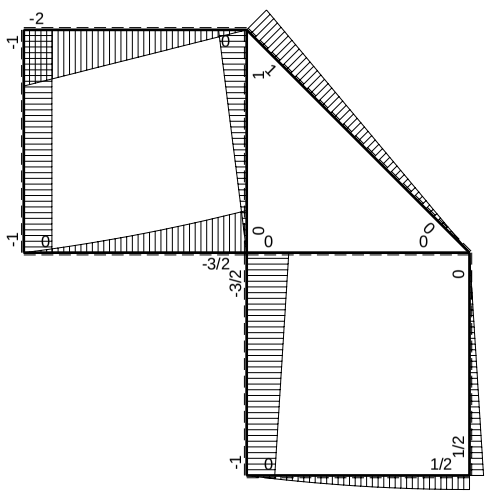
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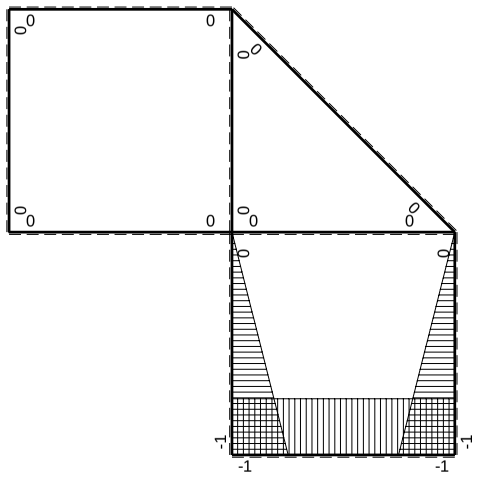

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Fb





M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-Fx-1/2qx^2$	0	0	0	0
BA b	0	$3/2Fb-2Fx+1/2qx^2$	0	0		
BC b	-x/b	$-3/2Fb+1/2Fx$	$3/2Fx-1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	$Fb+1/2Fx$	$Fb-1/2Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	$Fx-1/2qx^2$	$-Fx+1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fb+1/2qx^2$	$-1/2Fb+1/2Fx^2/b$	1		
DE 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
ED b	x/b	$-1/2Fx$	$-1/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-2Fx$	0	0	0	0
GF b	0	$2Fb-2Fx$	0	0		
GA b	0	$-Fb$	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	$Fb-Fx$	0	0	0	0
BF b	0	$-Fx$	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$13/12Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-13/20Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2\ )\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/3\ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2 +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/2\ x +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

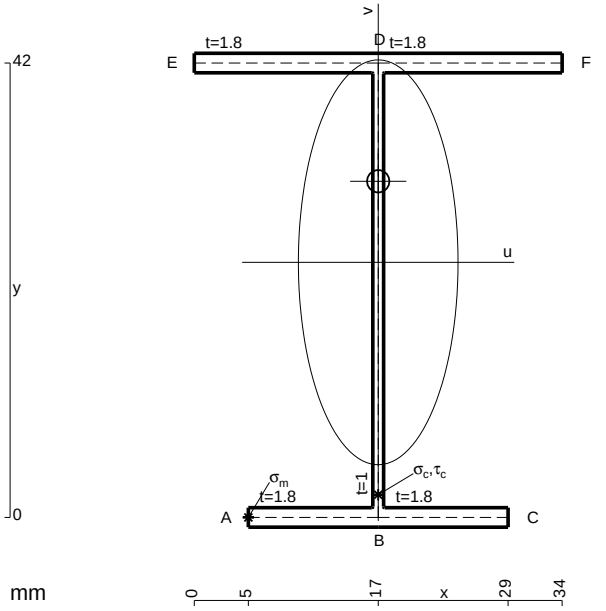
$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/3\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (-1/2 + x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/2\ x +1/2\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = -1/6\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (-1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

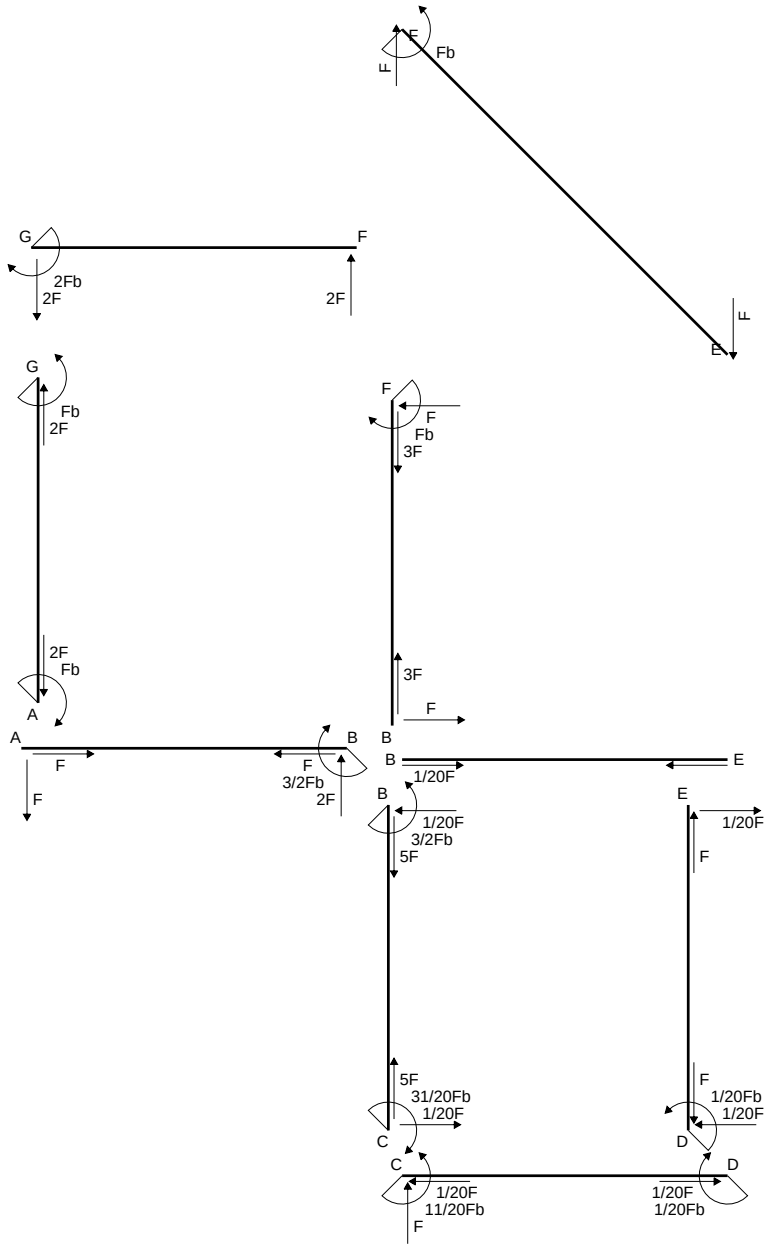
$= (-1/6\ b\ )\ Fb\ 1/EJ\ = -1/6\ Fb^2/EJ$

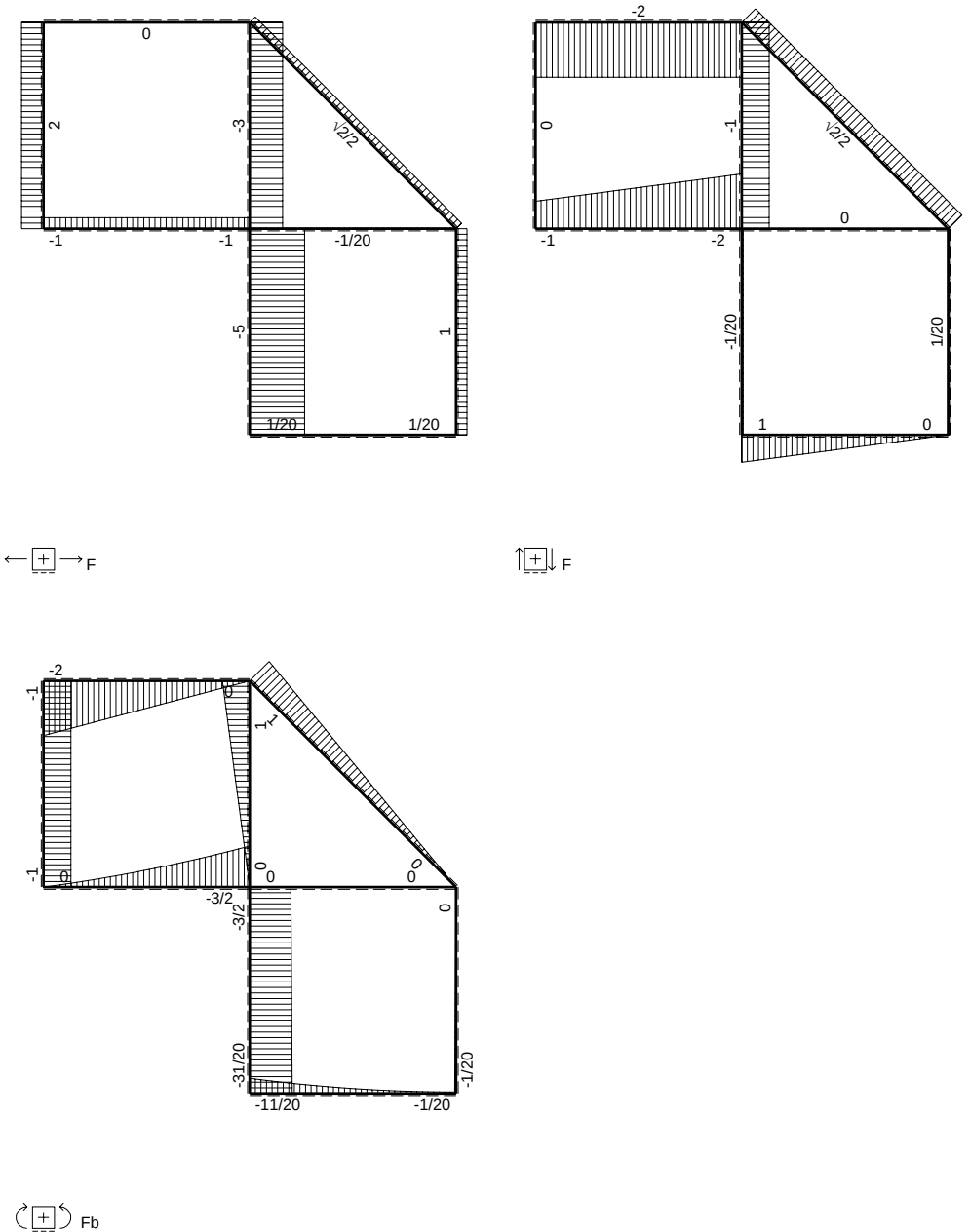


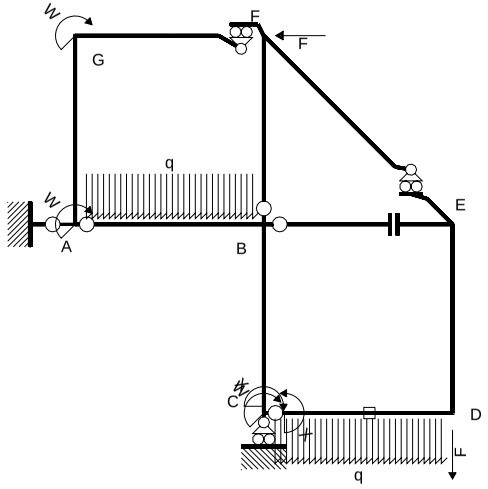
A = 146.4 mm^2
J_u = 51238. mm^4
J_v = 7969. mm^4
J_t = 126.8 mm^4
y_o = 7.49 mm
y_g = 23.58 mm
T_y = -980. N
M_x = -470400. Nmm
x_m = 5. mm
u_m = -12. mm
v_m = -23.58 mm
$\sigma_m = -Mv/J_u$ = -216.5 N/mm^2
x_c = 17. mm
v_c = -23.58 mm
$\sigma_c = -Mv/J_u$ = -216.5 N/mm^2
$\tau_c = TS^*/tJ_u$ = 19.48 N/mm^2
$\tau_g = TS^*/tJ_u$ = 19.48 N/mm^2
t_c = 490. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 219.1 N/mm^2

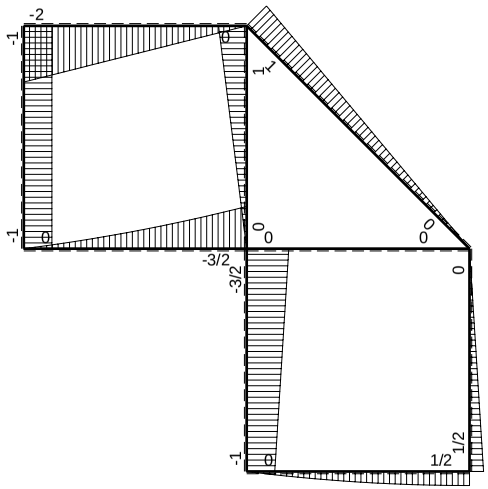
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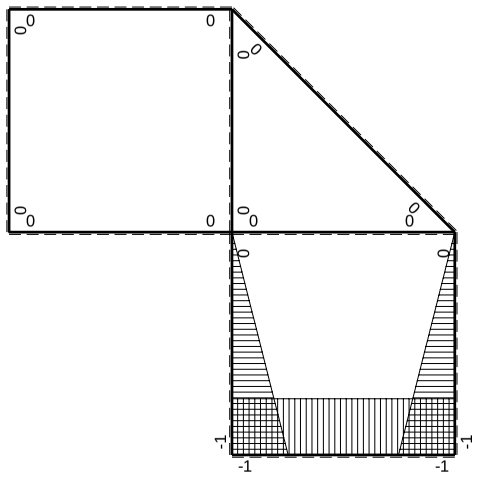

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1/20F
E
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1/20F
3/2Fb
5F
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C
D
1/20F
11/20Fb
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1/20Fb
F


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-3/2
-3/2
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-31/20
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-11/20
-1/20
Fb





M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-Fx-1/2qx^2$	0	0	0	0
BA b	0	$3/2Fb-2Fx+1/2qx^2$	0	0		
BC b	-x/b	$-3/2Fb+1/2Fx$	$3/2Fx-1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	$Fb+1/2Fx$	$Fb-1/2Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	$Fx-1/2qx^2$	$-Fx+1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fb+1/2qx^2$	$-1/2Fb+1/2Fx^2/b$	1		
DE 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
ED b	x/b	$-1/2Fx$	$-1/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-2Fx$	0	0	0	0
GF b	0	$2Fb-2Fx$	0	0		
GA b	0	$-Fb$	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	$Fb-Fx$	0	0	0	0
BF b	0	$-Fx$	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-11/12Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				11/20Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2\ )\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -4/3\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2 +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/2\ x +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -4/3\ \ Fb^2/EJ$

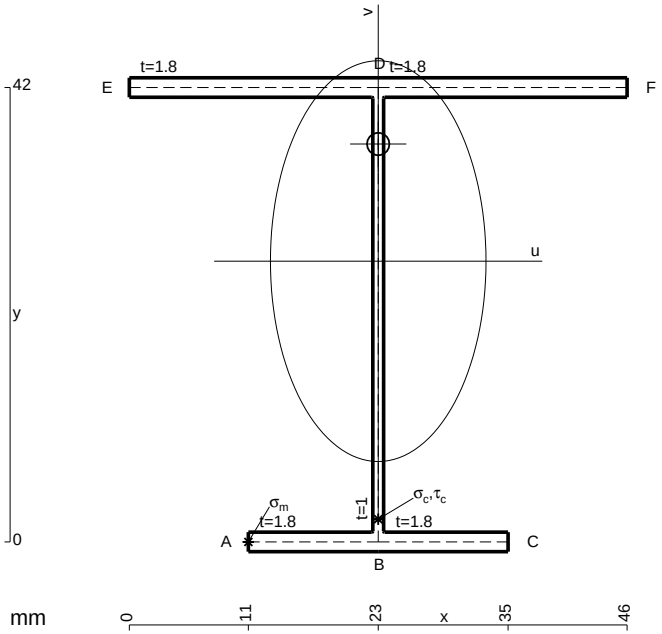
$L^{Xo}_{DE} = \int_o^b (-1/2 + x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/2\ x +1/2\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = -1/6\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (-1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/6\ b\ )\ Fb\ 1/EJ\ = -1/6\ \ Fb^2/EJ$

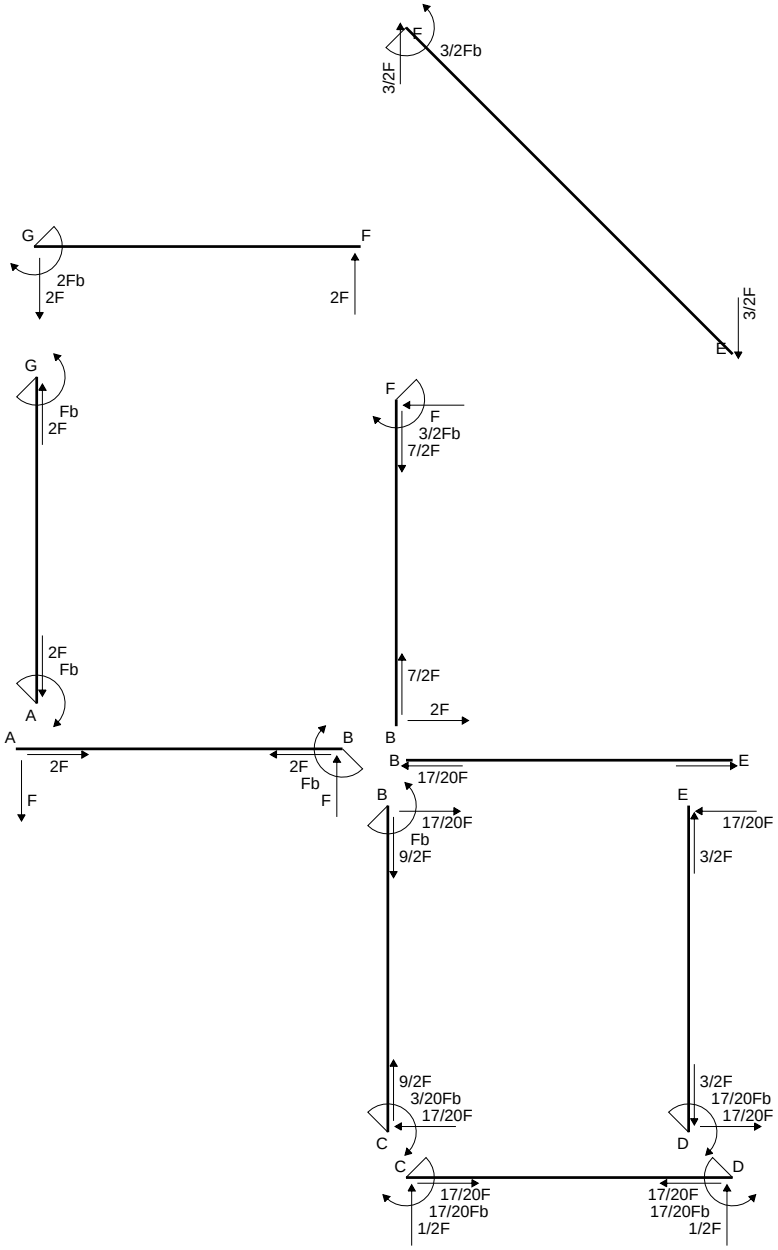
PROCEDIMENTO E RISULTATI 249262 CI02.xxxx.153

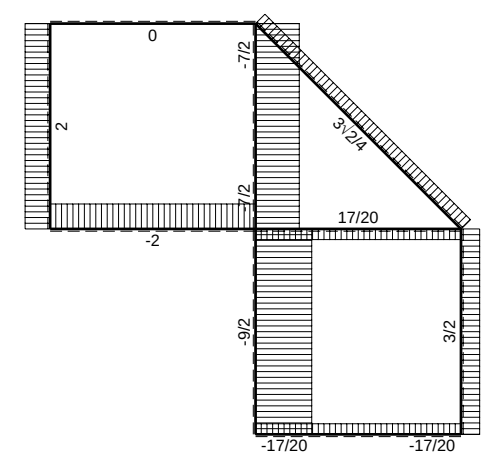


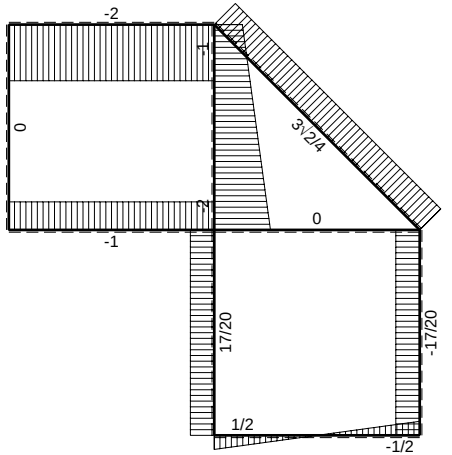
A = 168. mm^2
J_u = 57624. mm^4
J_v = 16674. mm^4
J_t = 150.1 mm^4
y_o = 10.83 mm
y_g = 25.95 mm
T_y = -980. N
M_x = -509600. Nmm
x_m = 11. mm
u_m = -12. mm
v_m = -25.95 mm
$\sigma_m = -Mv/J_u$ = -229.5 N/mm^2
x_c = 23. mm
v_c = -25.95 mm
$\sigma_c = -Mv/J_u$ = -229.5 N/mm^2
$\tau_c = TS^*/tJ_u$ = 19.07 N/mm^2
$\tau_g = TS^*/tJ_u$ = 19.07 N/mm^2
t_c = 490. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 231.9 N/mm^2

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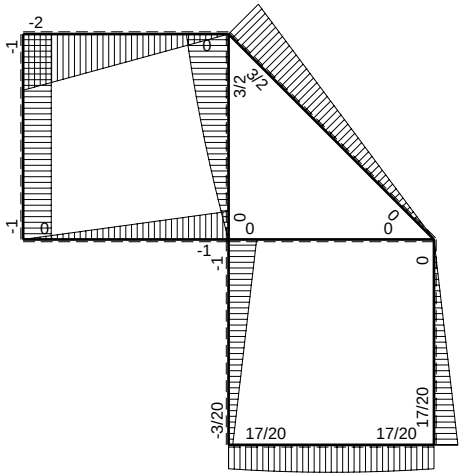

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-17/20
-17/20

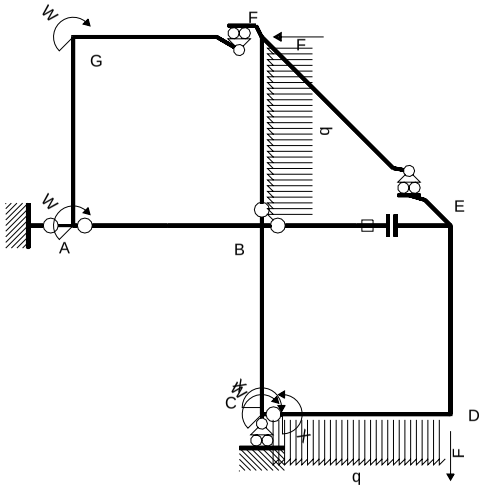

-2
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3√2/4
2
0
-1
17/20
-17/20
1/2
-1/2

F

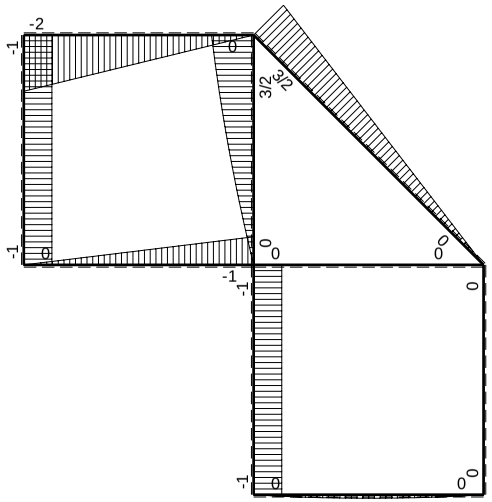
F


-2
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3/2
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-1
-1
0
-3/20
17/20
17/20
17/20

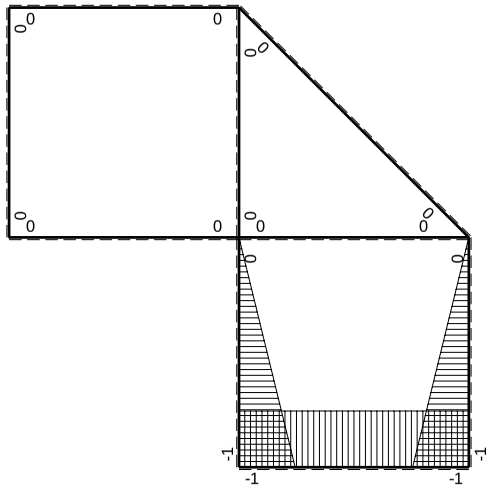
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-Fx	0	0	0	0
BA b	0	Fb-Fx	0	0		
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb	Fb-Fx	$1-2x/b+x^2/b^2$		
CD b	-1	$1/2Fx-1/2qx^2$	$-1/2Fx+1/2Fx^2/b$	1	$-1/12Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fx+1/2qx^2$	$-1/2Fx+1/2Fx^2/b$	1		
DE b	-1+x/b	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	0	0	x^2/b^2		
EF $\sqrt{2}b$	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	$3/2Fb-Fx-1/2qx^2$	0	0	0	0
BF b	0	$-2Fx+1/2qx^2$	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$17/12Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				$-17/20Fb$	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (x/b)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b)\ Fb\ 1/EJ\ = 1/2\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x/b)\ Fb\ 1/EJ\ dx = [\ x -1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

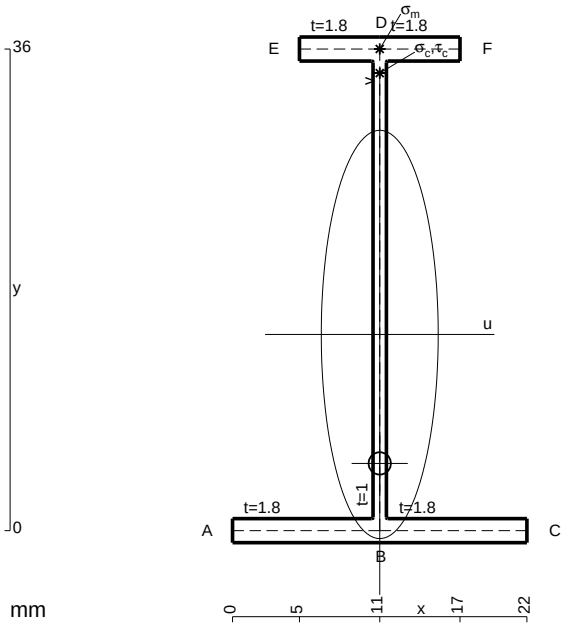
$= (\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 1/2\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-1/2\ x/b +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/4\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/12\ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2\ x/b +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

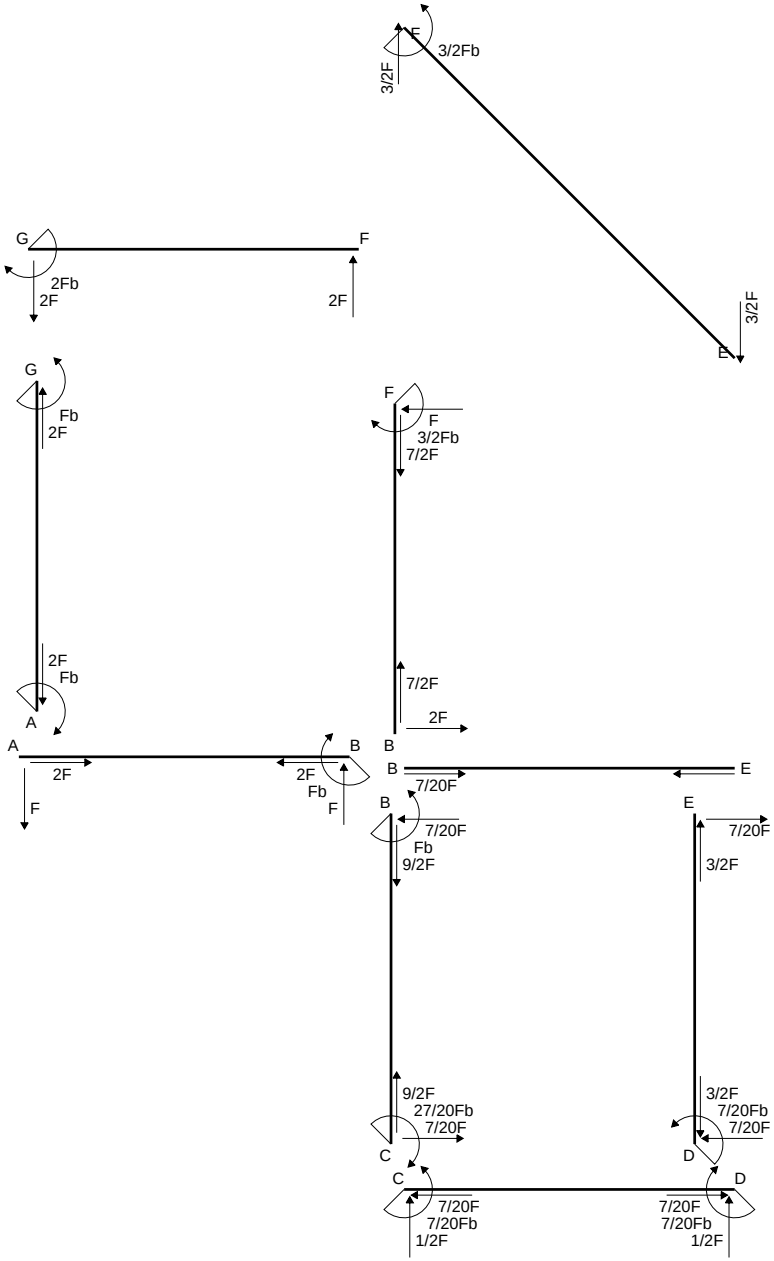
$= (-1/4\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/12\ Fb^2/EJ$

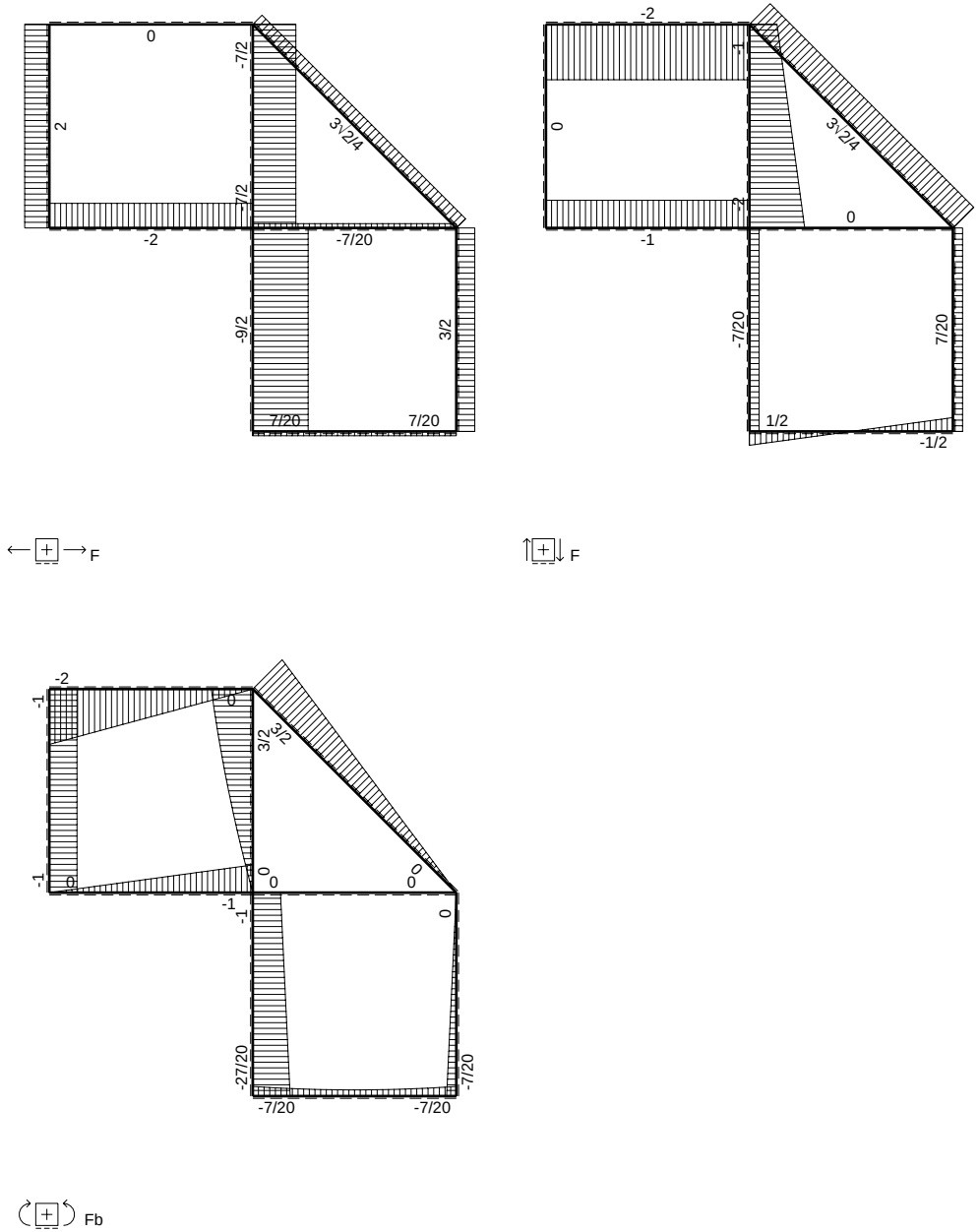


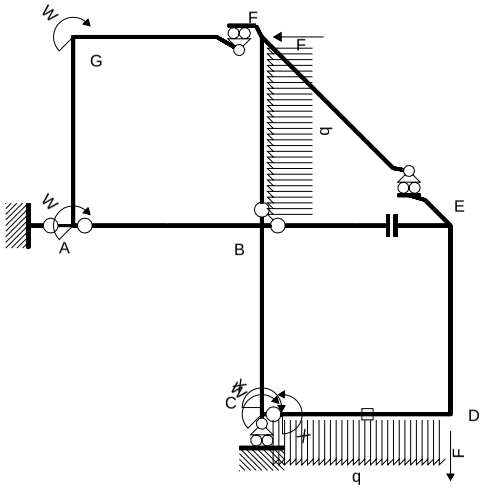
A = 97.2 mm^2
J_u = 22637. mm^4
J_v = 1856. mm^4
J_t = 78.1 mm^4
y_o = -9.64 mm
y_g = 14.67 mm
T_y = -540. N
M_x = -253800. Nmm
x_m = 11. mm
y_m = 36. mm
v_m = 21.33 mm
$\sigma_m = -Mv/J_u$ = 239.2 N/mm^2
y_c = 2. mm
u_c = -11. mm
v_c = -12.67 mm
$\sigma_c = -Mv/J_u$ = 239.2 N/mm^2
$\tau_c = TS^*/tJ_u$ = 10.99 N/mm^2
$\tau_g = TS^*/tJ_u$ = 10.99 N/mm^2
t_c = 270. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 239.9 N/mm^2

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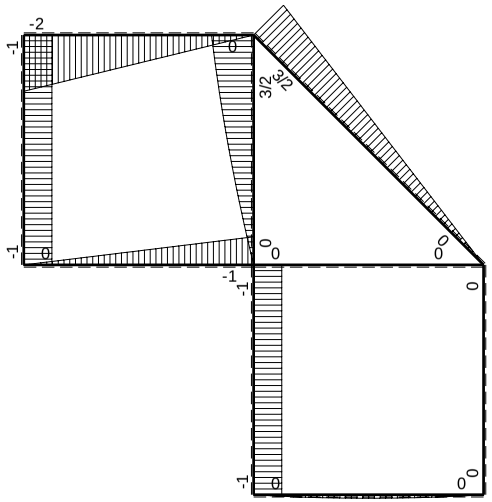
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E
3/2Fb
3/2F
G
F
2Fb
2F
2F
3/2F
G
Fb
2F
F
F
3/2Fb
7/2F
2F
Fb
7/2F
2F
A
B
B
2F
2F
Fb
F
B
E
7/20F
F
B
E
7/20F
Fb
9/2F
3/2F
9/2F
27/20Fb
7/20F
3/2F
7/20Fb
7/20F
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D
C
D
7/20F
7/20Fb
1/2F
7/20F
7/20Fb
1/2F

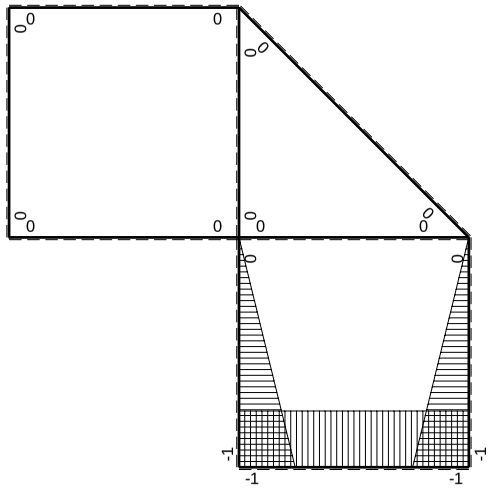

0
-7/2
2
3√2/4
-7/2
-2
-7/20
-9/2
3/2
7/20
7/20
-2
-1
0
3√2/4
-2
0
-1
-7/20
7/20
1/2
-1/2
F
F
-2
-1
0
3/2
√2
-1
0
0
0
0
-1
-1
0
-27/20
-7/20
-7/20
-7/20
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-Fx	0	0	0	0
BA b	0	Fb-Fx	0	0		
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb	Fb-Fx	$1-2x/b+x^2/b^2$		
CD b	-1	$1/2Fx-1/2qx^2$	$-1/2Fx+1/2Fx^2/b$	1	$-1/12Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fx+1/2qx^2$	$-1/2Fx+1/2Fx^2/b$	1		
DE b	-1+x/b	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	0	0	x^2/b^2		
EF $\sqrt{2}b$	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	$3/2Fb-Fx-1/2qx^2$	0	0	0	0
BF b	0	$-2Fx+1/2qx^2$	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-7/12Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				7/20Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2\ )\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (x/b\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b\ )\ Fb\ 1/EJ\ = 1/2\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x/b\ )\ Fb\ 1/EJ\ dx = [\ x -1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 1/2\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-1/2\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

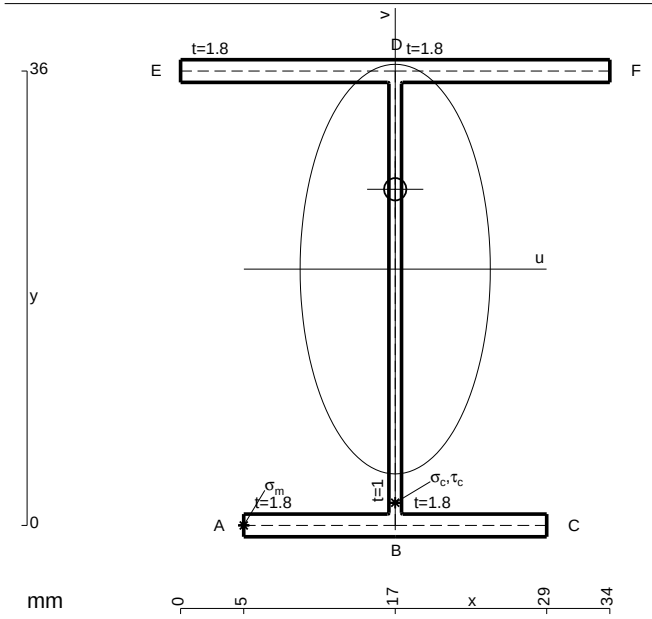
$= [-1/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (-1/4\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -13/12\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

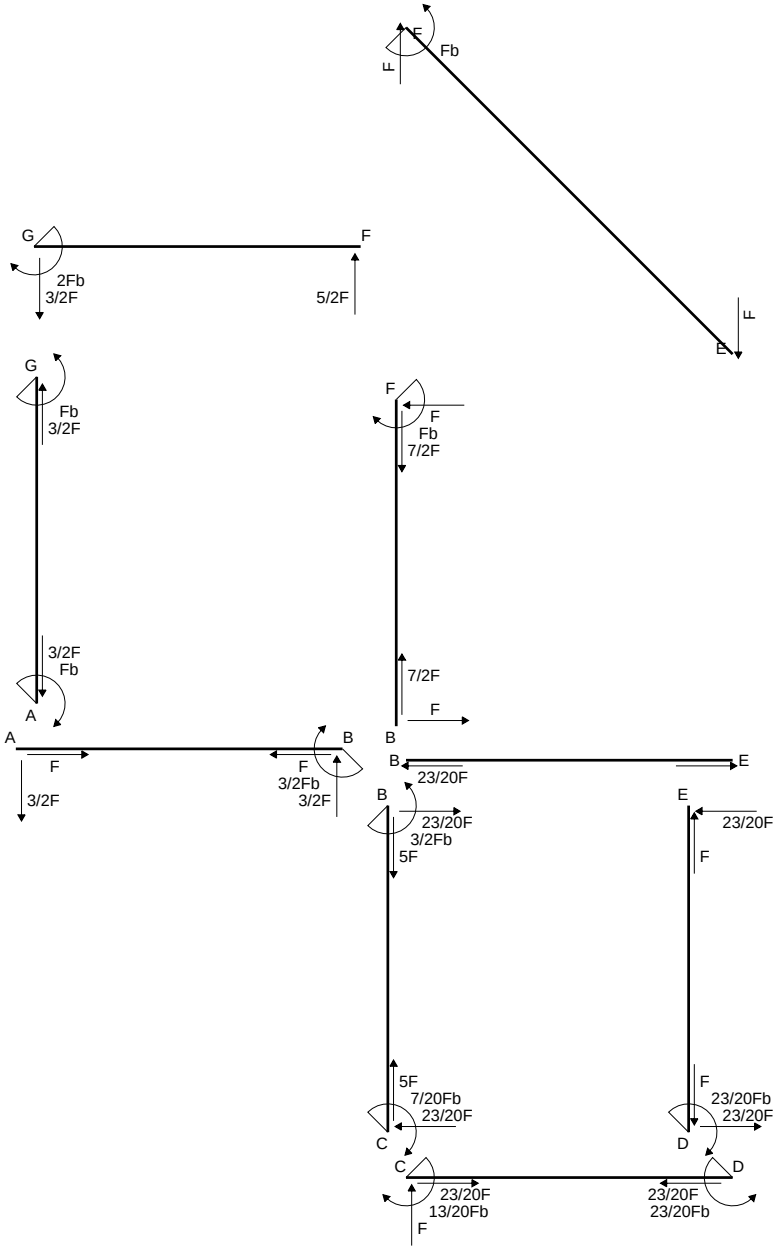
$= (-1/4\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -13/12\ \ Fb^2/EJ$

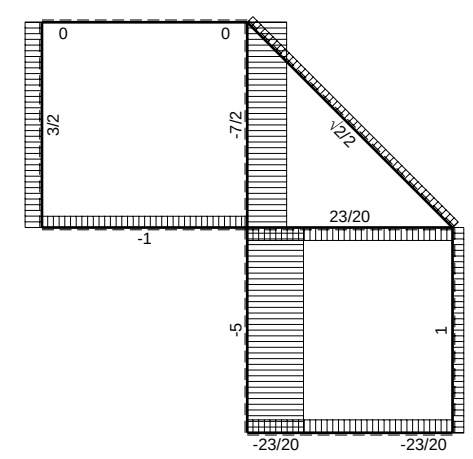


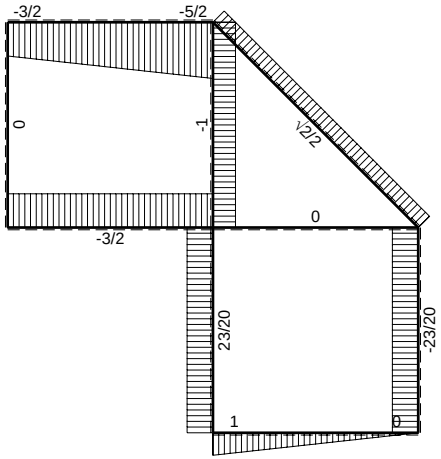
A = 140.4 mm^2
J_u = 36966. mm^4
J_v = 7969. mm^4
J_t = 124.8 mm^4
y_o = 6.325 mm
y_g = 20.31 mm
T_y = -700. N
M_x = -357000. Nmm
x_m = 5. mm
u_m = -12. mm
v_m = -20.31 mm
$\sigma_m = -Mv/J_u$ = -196.1 N/mm^2
x_c = 17. mm
v_c = -20.31 mm
$\sigma_c = -Mv/J_u$ = -196.1 N/mm^2
$\tau_c = TS^*/tJ_u$ = 16.61 N/mm^2
$\tau_g = TS^*/tJ_u$ = 16.61 N/mm^2
t_c = 350. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 198.2 N/mm^2

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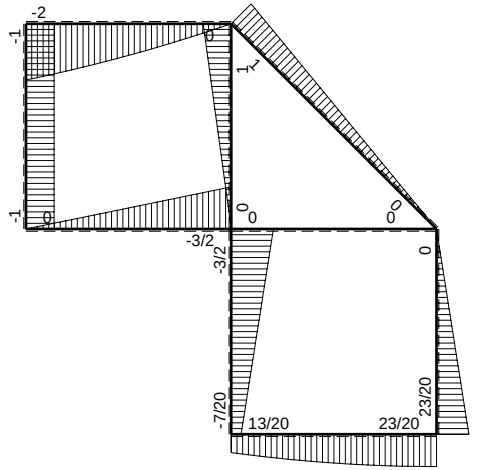

F
Fb
F
G
F
2Fb
3/2F
5/2F
F
E
G
Fb
3/2F
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F
Fb
7/2F
3/2F
Fb
A
7/2F
F
A
B
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B
E
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3/2Fb
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B
23/20F
3/2Fb
5F
E
23/20F
F
5F
7/20Fb
23/20F
F
23/20Fb
23/20F
C
D
C
D
23/20F
13/20Fb
F
23/20F
23/20Fb


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0
3/2
-7/2
½/2
23/20
-1
-5
1
-23/20
-23/20

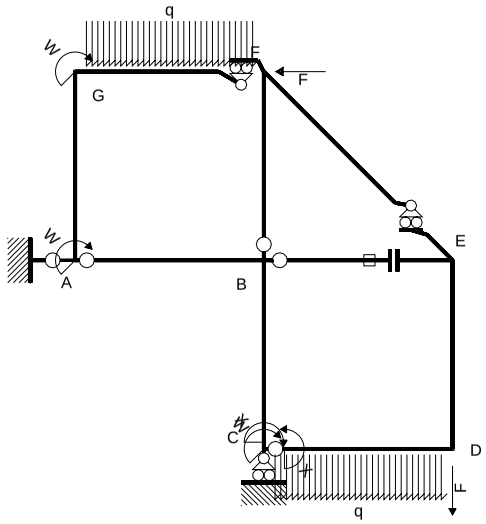

-3/2
-5/2
0
-1
½/2
0
-3/2
23/20
-23/20
1
0

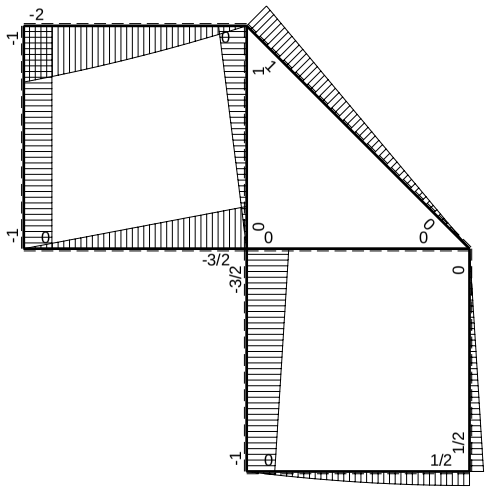
←□→ F

↑□↓ F

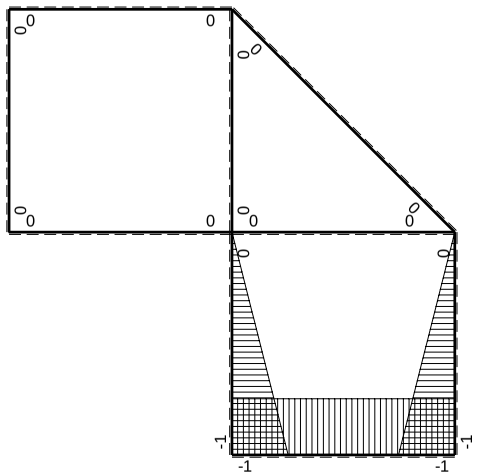

-2
-1
0
1
-1
0
0
0
0
-3/2
-3/2
0
-7/20
13/20
23/20
23/20

↻□↺ Fb





M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0		
BC b	-x/b	-3/2Fb+1/2Fx	$3/2Fx-1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+1/2Fx	$Fb-1/2Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	$Fx-1/2qx^2$	$-Fx+1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fb+1/2qx^2$	$-1/2Fb+1/2Fx^2/b$	1		
DE b	-1+x/b	1/2Fb-1/2Fx	$-1/2Fb+Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	-1/2Fx	$-1/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-5/2Fx+1/2qx^2$	0	0	0	0
GF b	0	$2Fb-3/2Fx-1/2qx^2$	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$13/12Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				-13/20Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b)\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-\ x/b +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +1/6\ b)\ Fb\ 1/EJ\ = -1/3\ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2 +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

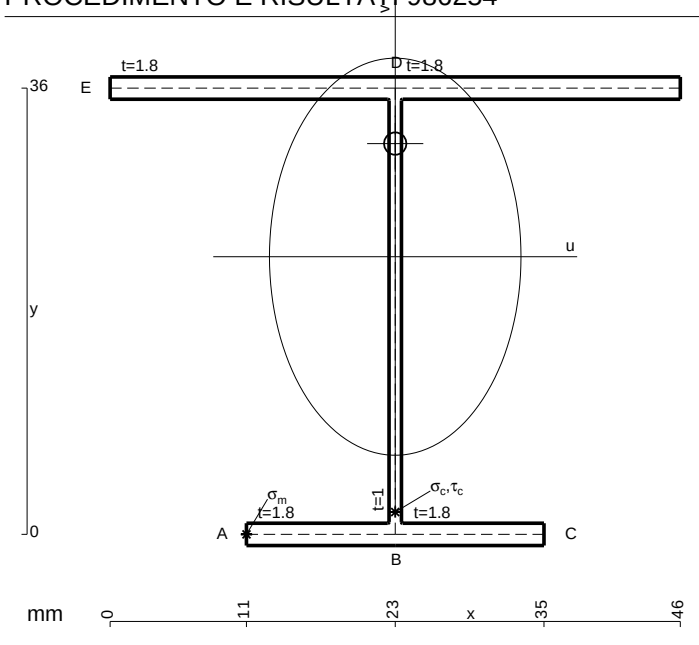
$= (-1/2\ b +1/6\ b)\ Fb\ 1/EJ\ = -1/3\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (-1/2 + x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x +1/2\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +1/2\ b -1/6\ b)\ Fb\ 1/EJ\ = -1/6\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (-1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

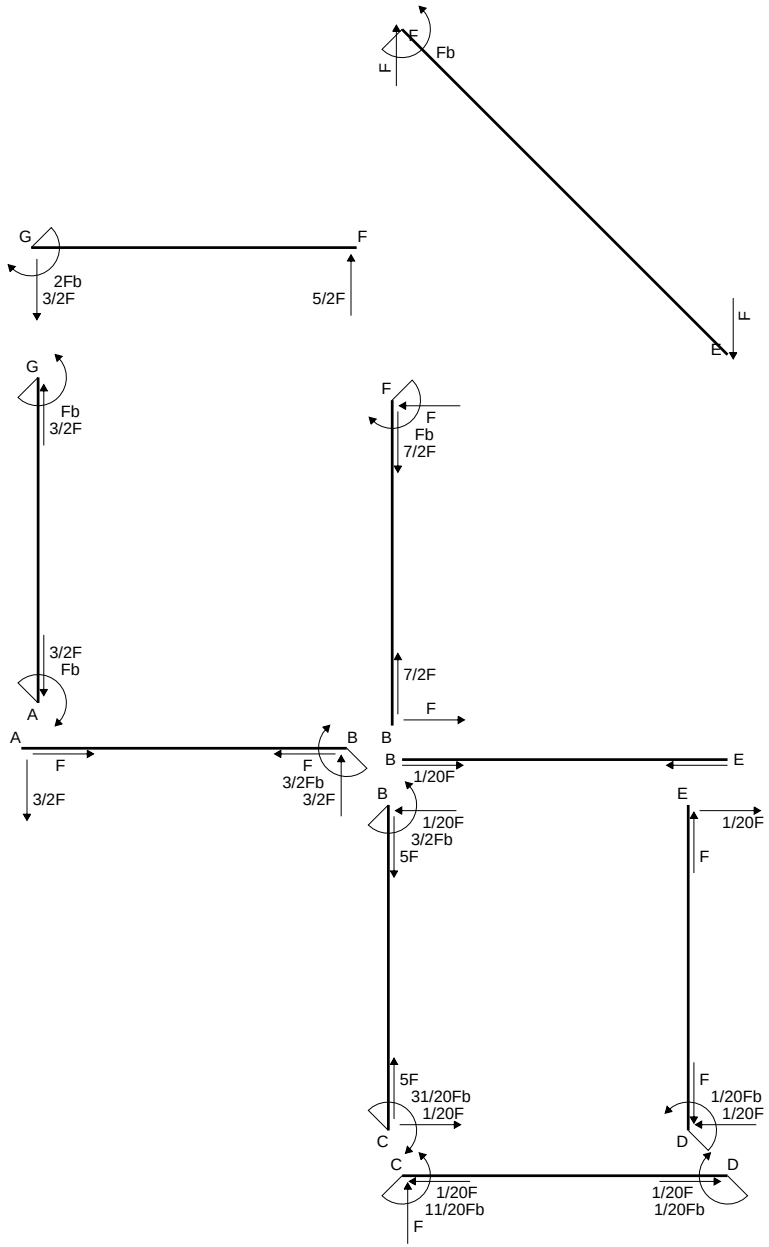
$= (-1/6\ b)\ Fb\ 1/EJ\ = -1/6\ Fb^2/EJ$

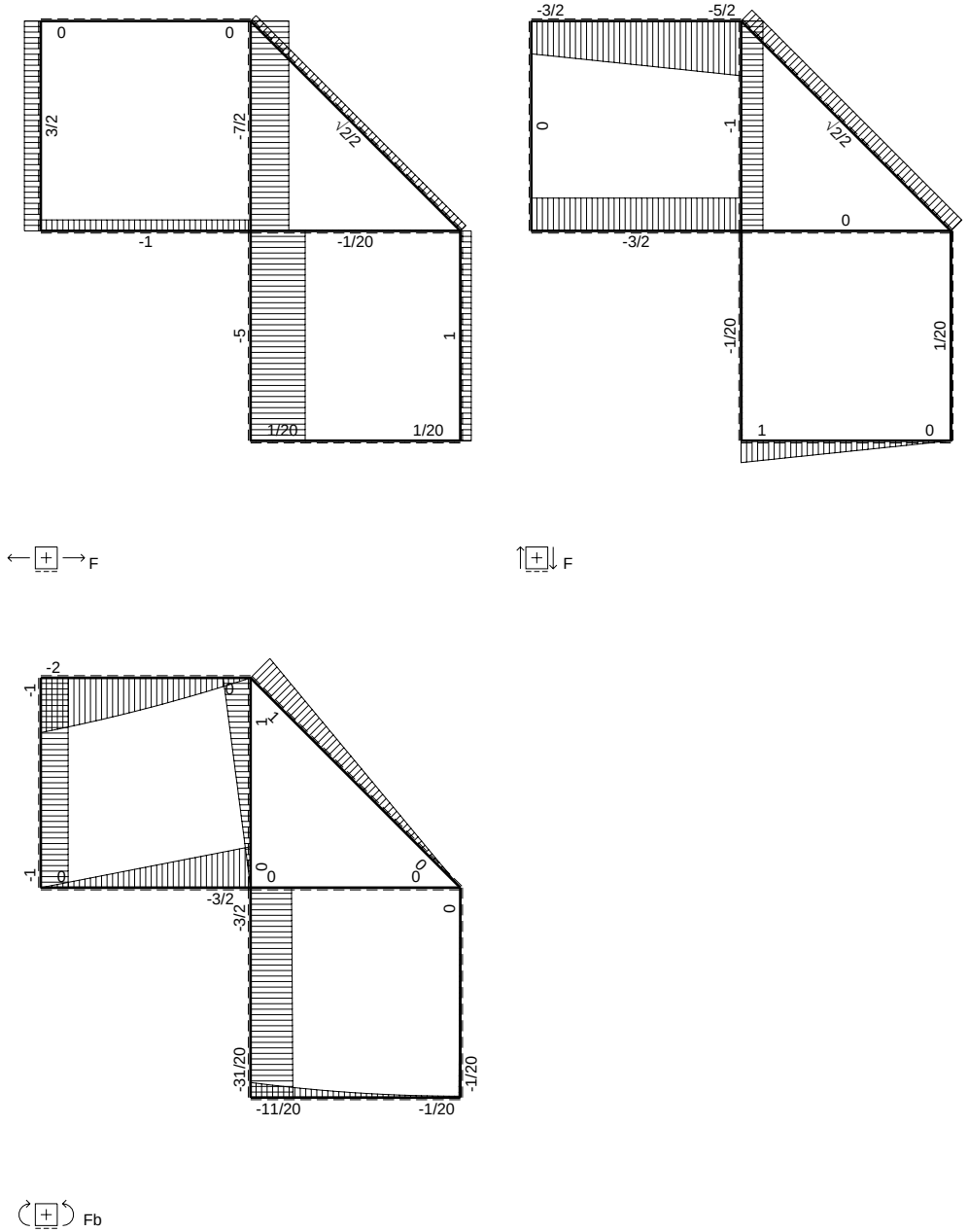


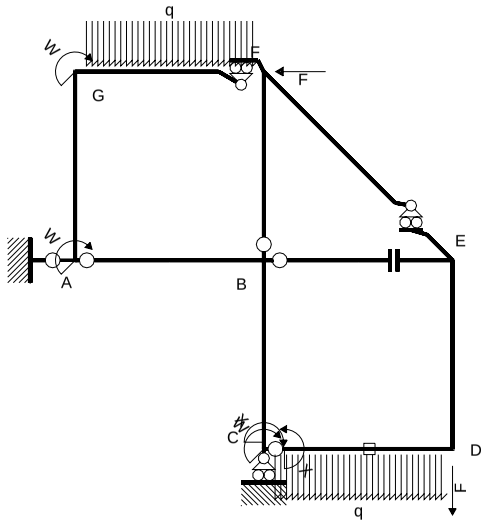
A = 162. mm^2
J_u = 41576. mm^4
J_v = 16674. mm^4
J_t = 148.1 mm^4
y_o = 9.123 mm
y_g = 22.4 mm
T_y = -540. N
M_x = -388800. Nmm
x_m = 11. mm
u_m = -12. mm
v_m = -22.4 mm
$\sigma_m = -Mv/J_u$ = -209.5 N/mm^2
x_c = 23. mm
v_c = -22.4 mm
$\sigma_c = -Mv/J_u$ = -209.5 N/mm^2
$\tau_c = TS^*/tJ_u$ = 12.57 N/mm^2
$\tau_g = TS^*/tJ_u$ = 12.57 N/mm^2
t_c = 360. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 210.6 N/mm^2

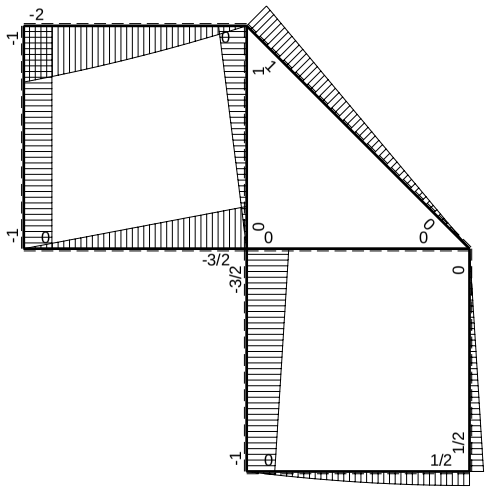
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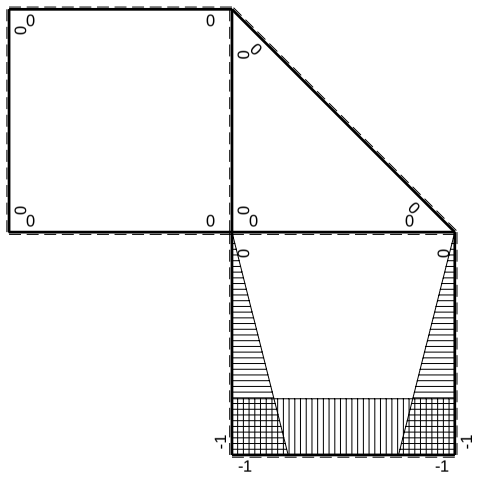

E
Fb
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2Fb
3/2F
5/2F
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E
G
Fb
3/2F
F
F
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7/2F
3/2F
Fb
A
7/2F
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B
E
F
3/2Fb
3/2F
1/20F
3/2F
B
E
1/20F
1/20F
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5F
F
31/20Fb
1/20Fb
1/20F
1/20F
C
D
C
D
1/20F
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1/20Fb
F


0
0
3/2
-7/2
√2/2
-1
-1/20
-5
1
1/20
1/20
F
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0
1
1
-1
0
0
0
0
-3/2
-3/2
0
-31/20
-1/20
-11/20
-1/20
Fb





M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-3/2Fx	0	0	0	0
BA b	0	3/2Fb-3/2Fx	0	0		
BC b	-x/b	-3/2Fb+1/2Fx	$3/2Fx-1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb+1/2Fx	$Fb-1/2Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	$Fx-1/2qx^2$	$-Fx+1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fb+1/2qx^2$	$-1/2Fb+1/2Fx^2/b$	1		
DE b	-1+x/b	1/2Fb-1/2Fx	$-1/2Fb+Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$-1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	-1/2Fx	$-1/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-5/2Fx+1/2qx^2$	0	0	0	0
GF b	0	$2Fb-3/2Fx-1/2qx^2$	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-11/12Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				11/20Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -4/3\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2 +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/2\ x +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

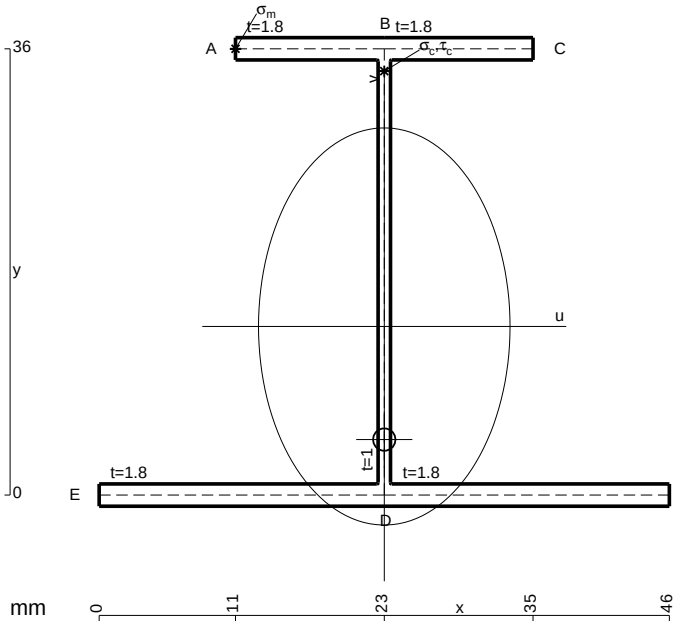
$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -4/3\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (-1/2 + x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/2\ x +1/2\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = -1/6\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (-1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

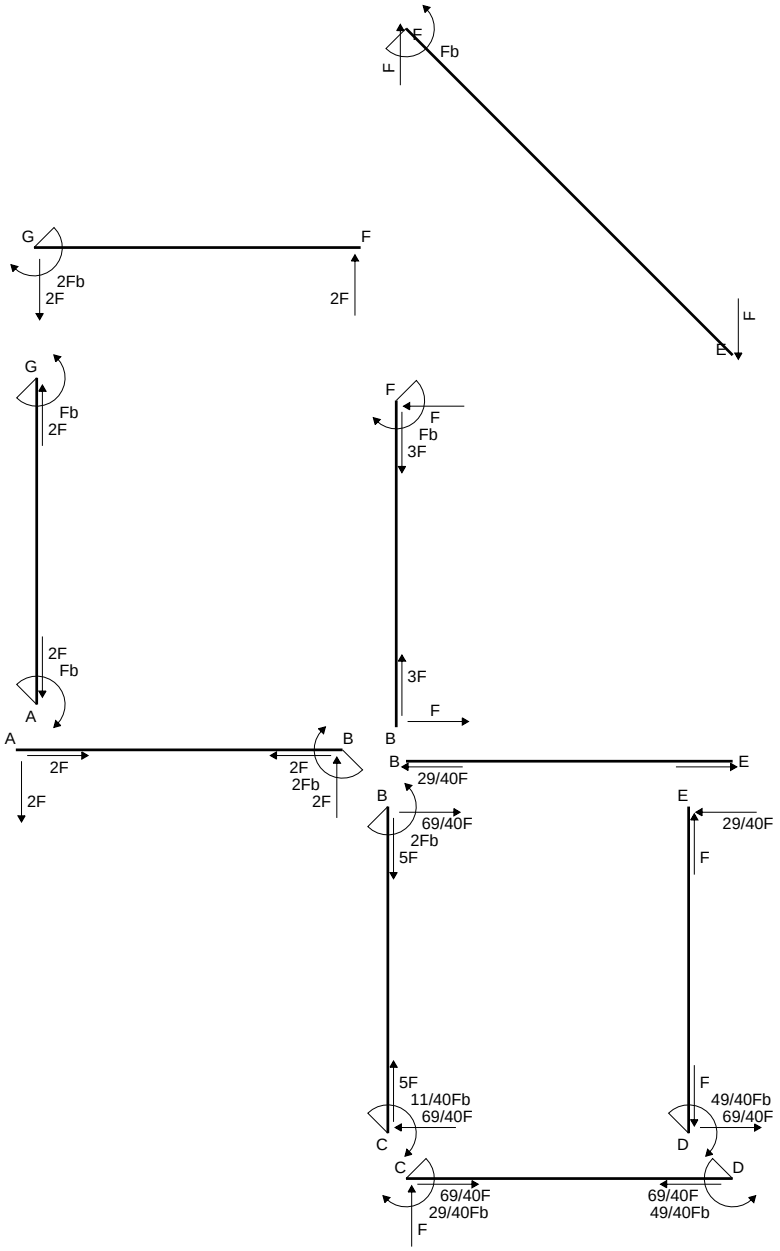
$= (-1/6\ b\ )\ Fb\ 1/EJ\ = -1/6\ \ Fb^2/EJ$

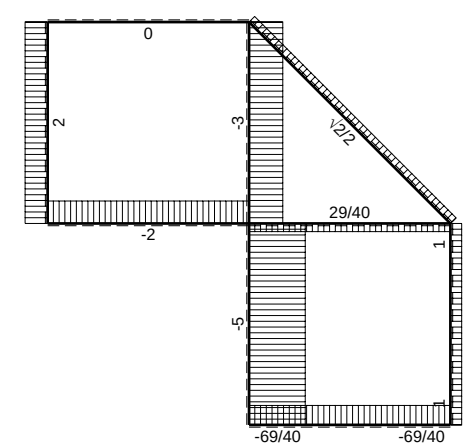


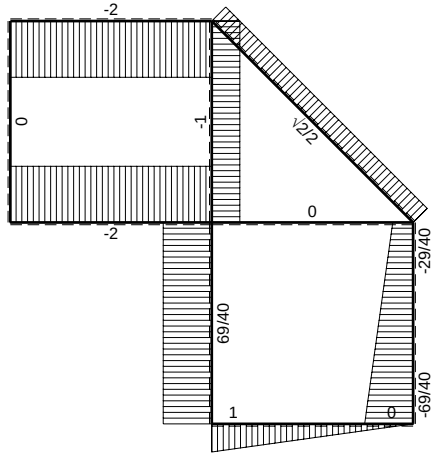
A = 162. mm^2
J_u = 41576. mm^4
J_v = 16674. mm^4
J_t = 148.1 mm^4
y_o = -9.123 mm
y_g = 13.6 mm
T_y = -525. N
M_x = -399000. Nmm
x_m = 11. mm
y_m = 36. mm
u_m = -12. mm
v_m = 22.4 mm
$\sigma_m = -Mv/J_u$ = 215. N/mm^2
x_c = 23. mm
y_c = 36. mm
v_c = 22.4 mm
$\sigma_c = -Mv/J_u$ = 215. N/mm^2
$\tau_c = TS^*/tJ_u$ = 12.22 N/mm^2
$\tau_g = TS^*/tJ_u$ = 12.22 N/mm^2
t_c = 350. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 216. N/mm^2

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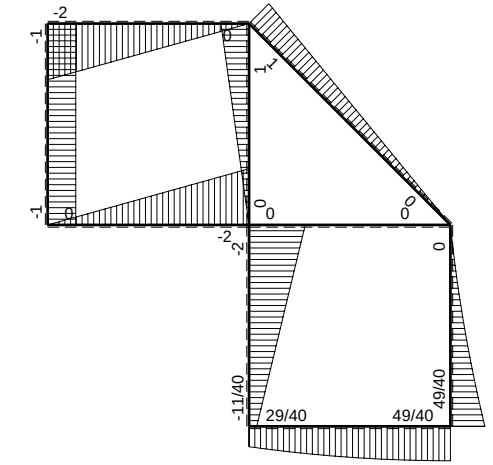

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Fb
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3F
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B
2F
2F
2Fb
2F
2F
B
E
29/40F
B
69/40F
2Fb
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29/40Fb
69/40F
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-69/40
-69/40

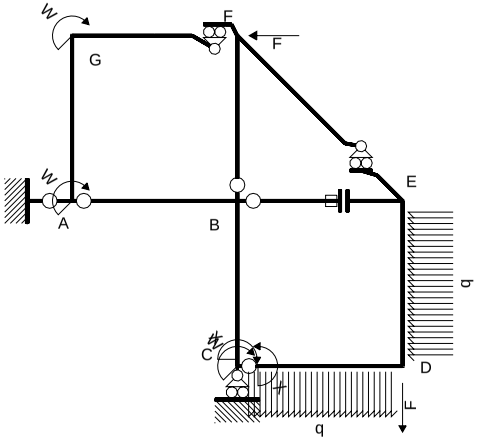

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-69/40

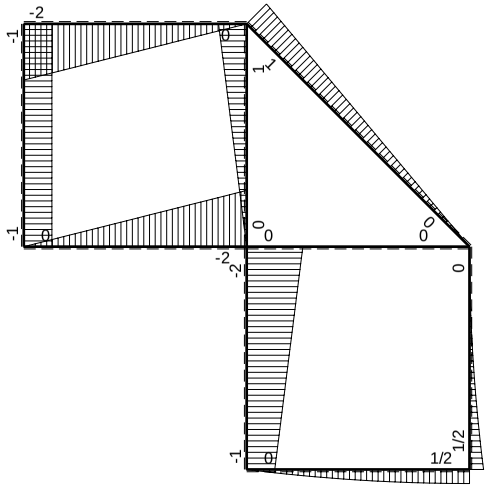
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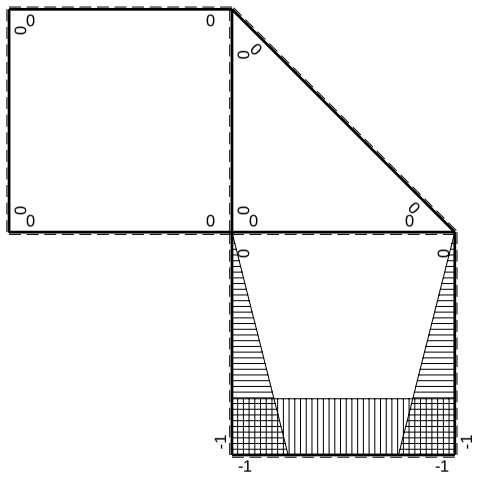

-2
-1
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-1
-1
0
0
0
0
-2
-2
0
-11/40
29/40
49/40
49/40

Fb





M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

PROCEDIMENTO E RISULTATI 214984 CI02.xxxx.158

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Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0		
BC b	-x/b	-2Fb+Fx	$2Fx-Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	$Fb-Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	$Fx-1/2qx^2$	$-Fx+1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fb+1/2qx^2$	$-1/2Fb+1/2Fx^2/b$	1		
DE 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
ED b	x/b	$-1/2qx^2$	$-1/2qx^3/b$	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$29/24Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-29/40Fb	

PROCEDIMENTO E RISULTATI 214984 CI02.xxxx.158

Sviluppi di calcolo iperstatica

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$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (2\ x/b - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ \ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-\ x/b +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/3\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2 +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/2\ x +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/3\ \ Fb^2/EJ$

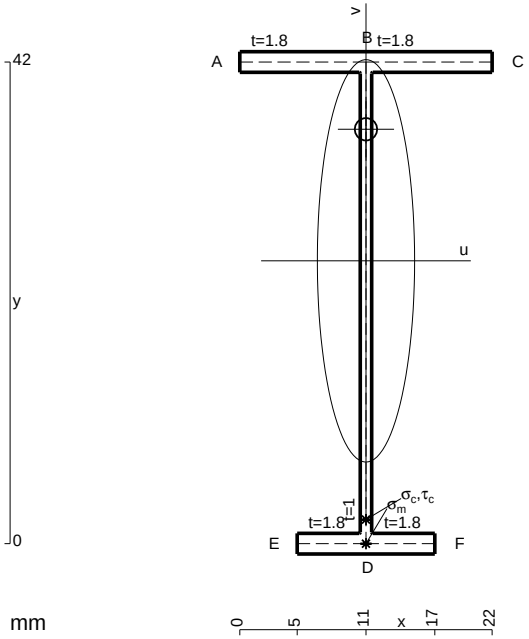
$L^{Xo}_{DE} = \int_o^b (-1/2 +3/2\ x/b -3/2\ x^2/b^2 +1/2\ x^3/b^3)\ Fb\ 1/EJ\ dx$

$= [-1/2\ x +3/4\ x^2/b -1/2\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

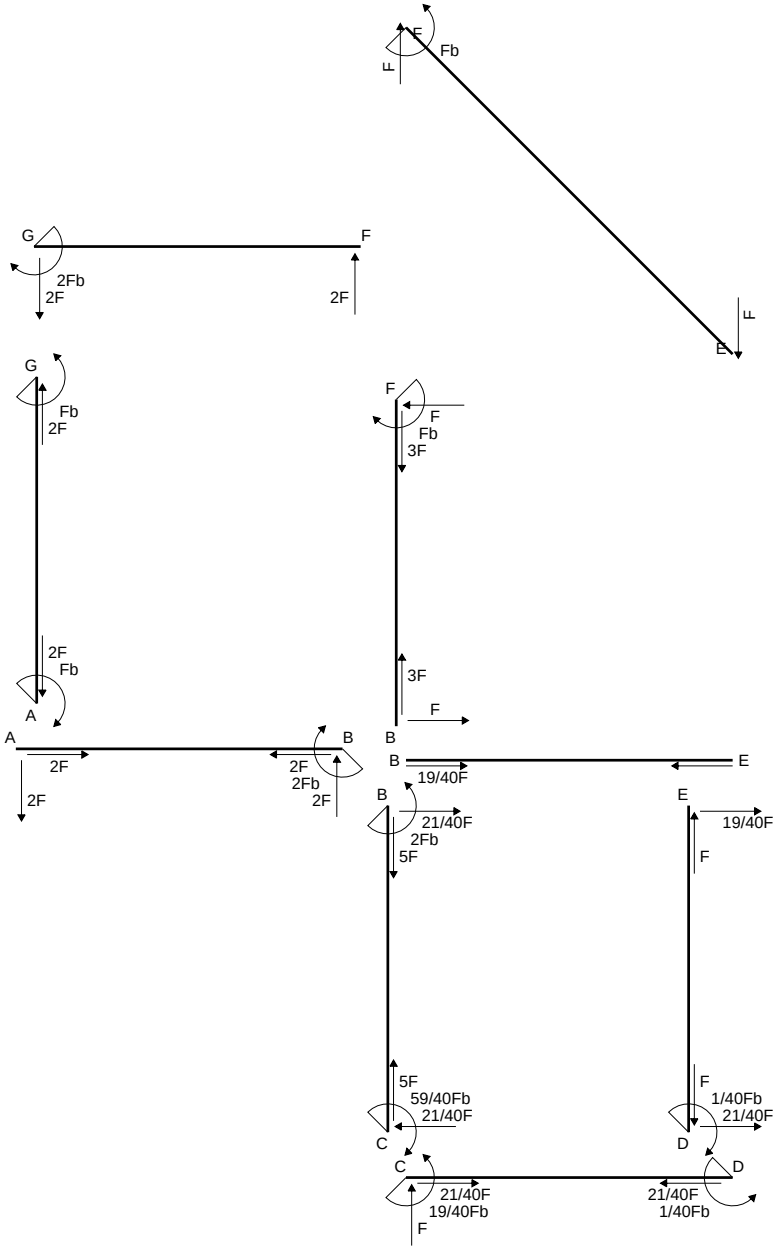
$= (-1/2\ b +3/4\ b -1/2\ b +1/8\ b\ )\ Fb\ 1/EJ\ = -1/8\ \ Fb^2/EJ$

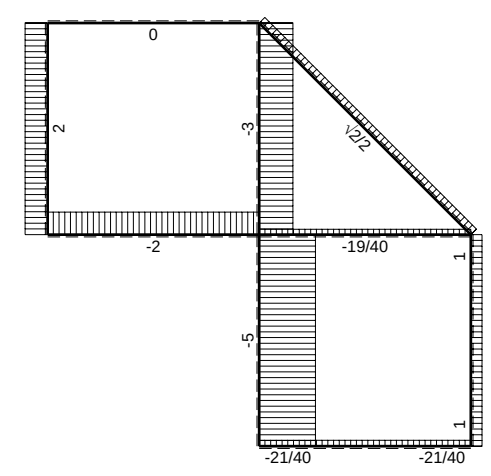
$L^{Xo}_{ED} = \int_o^b (-1/2\ x^3/b^3)\ Fb\ 1/EJ\ dx = [-1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

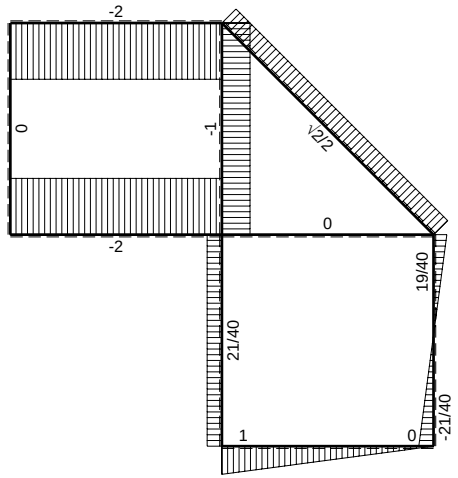
$= (-1/8\ b\ )\ Fb\ 1/EJ\ = -1/8\ \ Fb^2/EJ$



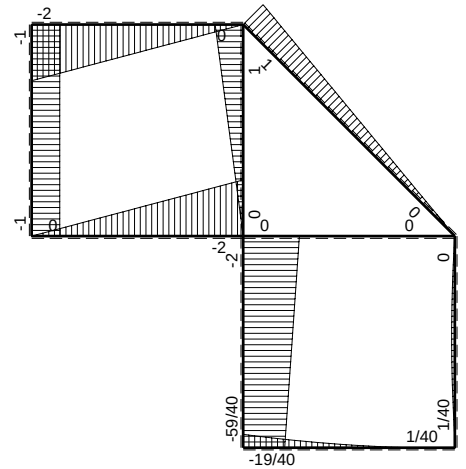
A = 103.2 mm^2
J_u = 31779. mm^4
J_v = 1856. mm^4
J_t = 80.1 mm^4
y_o = 11.47 mm
y_g = 24.66 mm
N = -400. N
T_y = -400. N
M_x = -288000. Nmm
x_m = 11. mm
v_m = -24.66 mm
$\sigma_m = N/A - Mv/J_u$ = -227.4 N/mm^2
y_c = 3. mm
u_c = -11. mm
v_c = -21.66 mm
$\sigma_c = N/A - Mv/J_u$ = -227.4 N/mm^2
$\tau_c = TS^*/tJ_u$ = 6.705 N/mm^2
$\tau_g = TS^*/tJ_u$ = 6.705 N/mm^2
t_c = 200. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 227.7 N/mm^2


F
Fb
F
G
F
2Fb
2F
2F
E
F
G
Fb
2F
F
F
Fb
3F
2F
Fb
A
3F
F
A
B
B
B
E
2F
2F
2Fb
2F
19/40F
B
E
21/40F
19/40F
2Fb
5F
F
5F
F
59/40Fb
1/40Fb
21/40F
21/40F
C
D
C
D
21/40F
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21/40F
1/40Fb
F

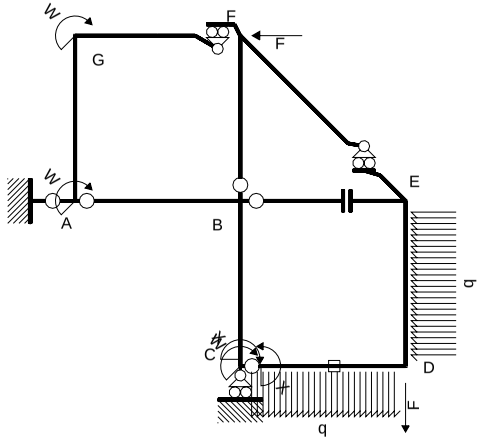

0
2
-3
√2/2
-2
-19/40
1
-5
1
-21/40
-21/40

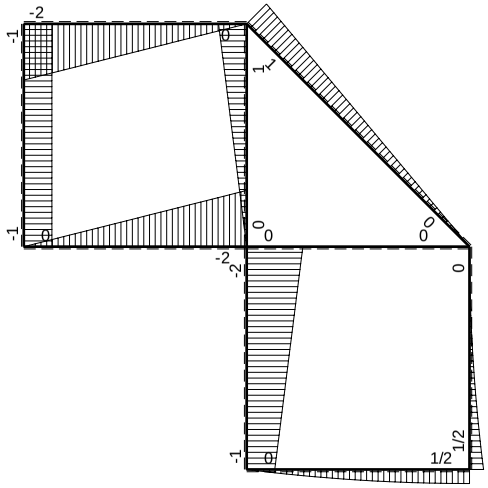

-2
0
-1
√2/2
0
-2
19/40
21/40
-21/40
1
0

F F

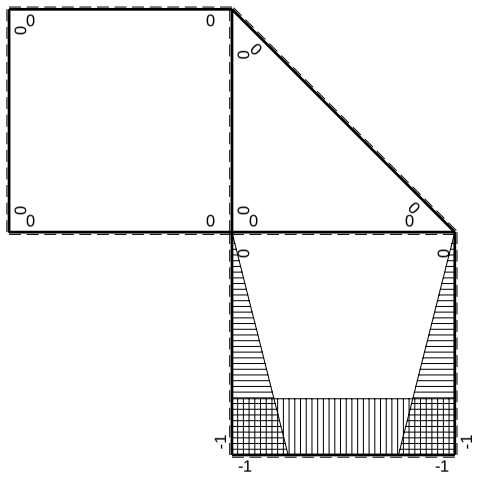

-2
-1
1
-1
0
0
0
0
-2
-2
0
-59/40
1/40
1/40
-19/40

Fb





M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-2Fx	0	0	0	0
BA b	0	2Fb-2Fx	0	0		
BC b	-x/b	-2Fb+Fx	$2Fx-Fx^2/b$	x^2/b^2	$2/3Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb+Fx	$Fb-Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	$Fx-1/2qx^2$	$-Fx+1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fb+1/2qx^2$	$-1/2Fb+1/2Fx^2/b$	1		
DE 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
ED b	x/b	$-1/2qx^2$	$-1/2qx^3/b$	x^2/b^2		
EF √2b	0	√2/2Fx	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-19/24Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				19/40Fb	

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Sviluppi di calcolo iperstatica

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$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2\ )\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (2\ x/b - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x^2/b -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x -1/3\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/3\ b\ )\ Fb\ 1/EJ\ = 2/3\ \ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -4/3\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2 +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/2\ x +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -4/3\ \ Fb^2/EJ$

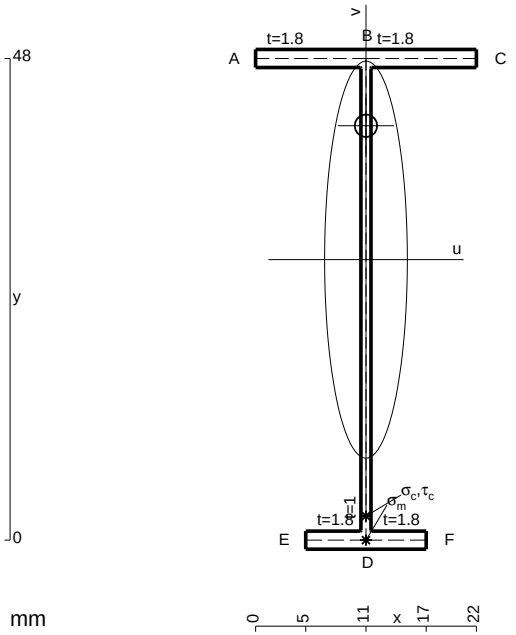
$L^{Xo}_{DE} = \int_o^b (-1/2 +3/2\ x/b -3/2\ x^2/b^2 +1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx$

$= [-1/2\ x +3/4\ x^2/b -1/2\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

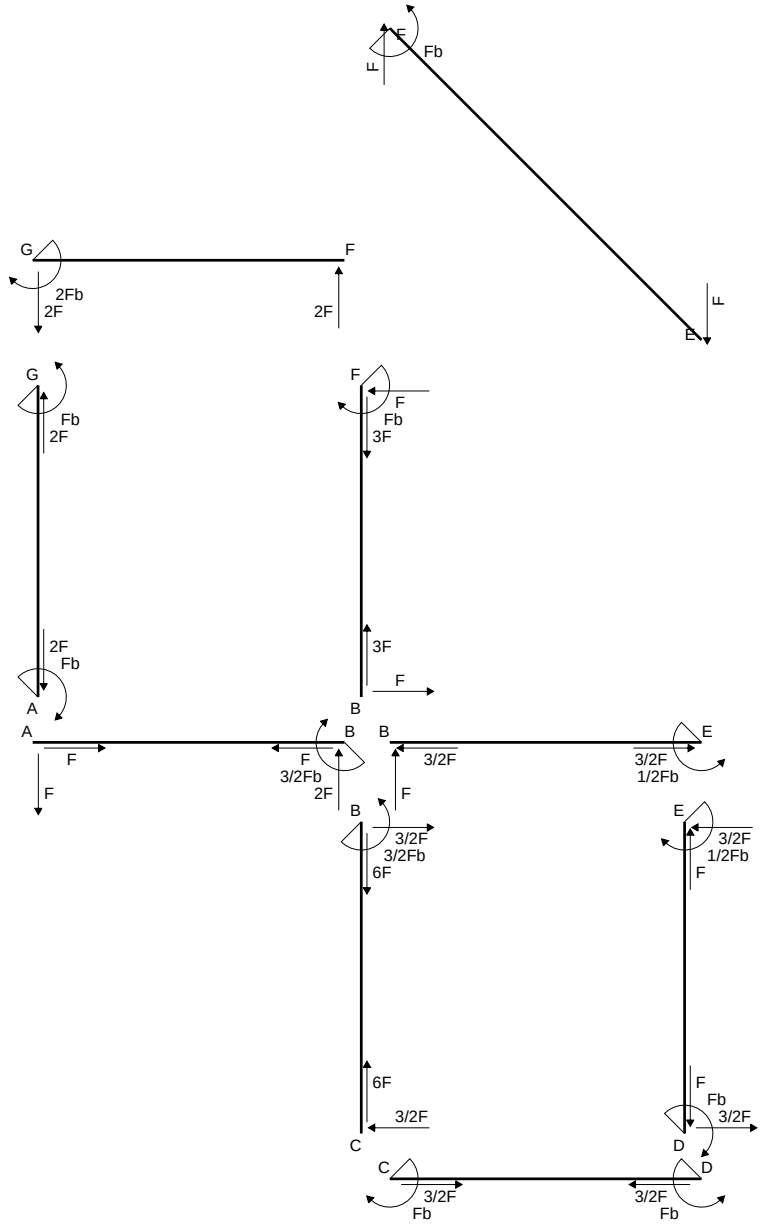
$= (-1/2\ b +3/4\ b -1/2\ b +1/8\ b\ )\ Fb\ 1/EJ\ = -1/8\ \ Fb^2/EJ$

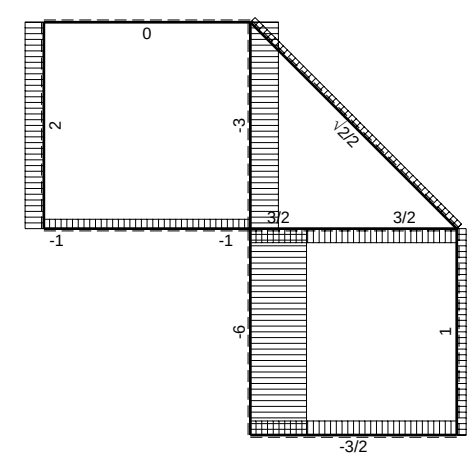
$L^{Xo}_{ED} = \int_o^b (-1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [-1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

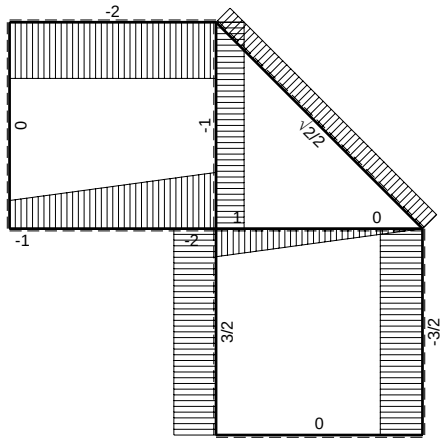
$= (-1/8\ b\ )\ Fb\ 1/EJ\ = -1/8\ \ Fb^2/EJ$

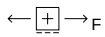


A = 109.2 mm^2
J_u = 42758. mm^4
J_v = 1856. mm^4
J_t = 82.1 mm^4
y_o = 13.34 mm
y_g = 27.96 mm
N = -420. N
T_y = -420. N
M_x = -357000. Nmm
x_m = 11. mm
v_m = -27.96 mm
$\sigma_m = N/A - Mv/J_u$ = -237.3 N/mm^2
y_c = 3. mm
u_c = -11. mm
v_c = -24.96 mm
$\sigma_c = N/A - Mv/J_u$ = -237.3 N/mm^2
$\tau_c = TS^*/tJ_u$ = 5.931 N/mm^2
$\tau_g = TS^*/tJ_u$ = 5.931 N/mm^2
t_c = 210. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 237.5 N/mm^2

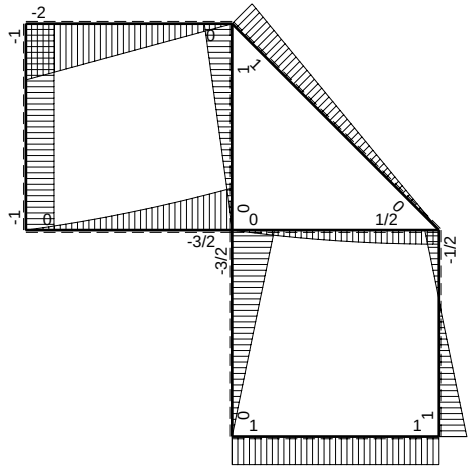






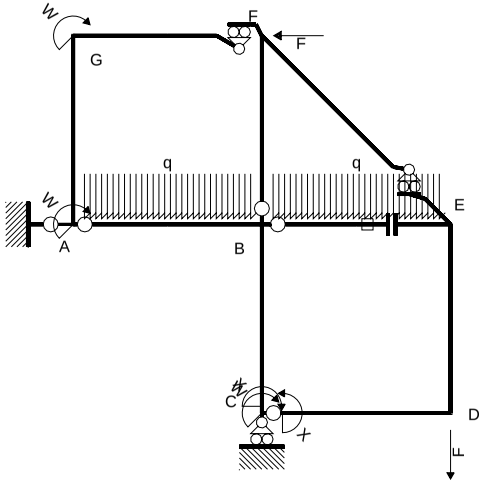




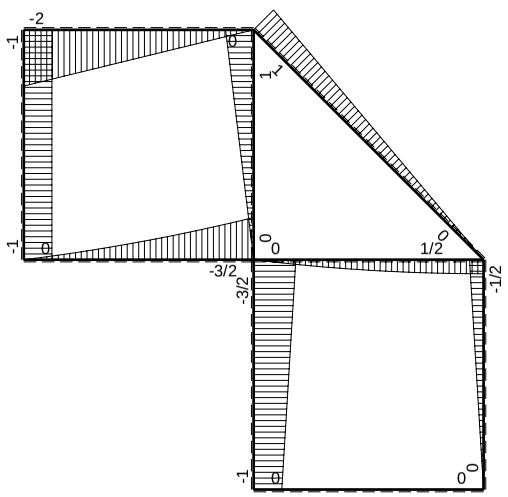




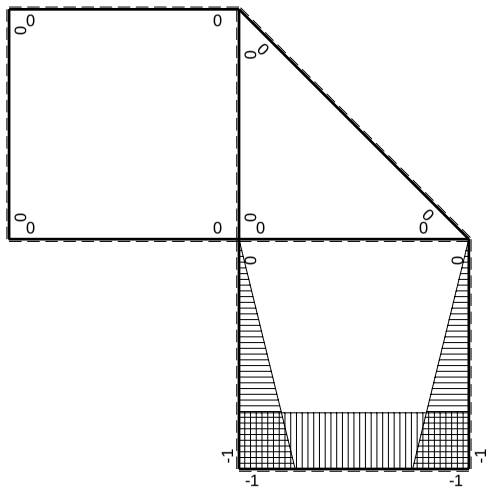
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Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-Fx-1/2qx^2$	0	0	0	0
BA b	0	$3/2Fb-2Fx+1/2qx^2$	0	0		
BC b	-x/b	$-3/2Fb+1/2Fx$	$3/2Fx-1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	$Fb+1/2Fx$	$Fb-1/2Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE 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
ED b	x/b	$1/2Fb-1/2Fx$	$1/2Fx-1/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-2Fx$	0	0	0	0
GF b	0	$2Fb-2Fx$	0	0		
GA b	0	$-Fb$	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	$Fb-Fx$	0	0	0	0
BF b	0	$-Fx$	0	0		
BE b	0	$Fx-1/2qx^2$	0	0	0	0
EB b	0	$-1/2Fb+1/2qx^2$	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$5/3Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

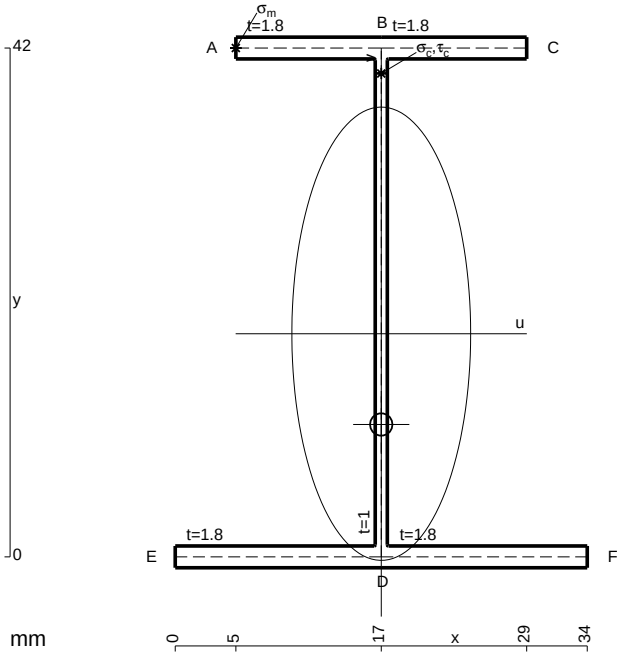
$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/12\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

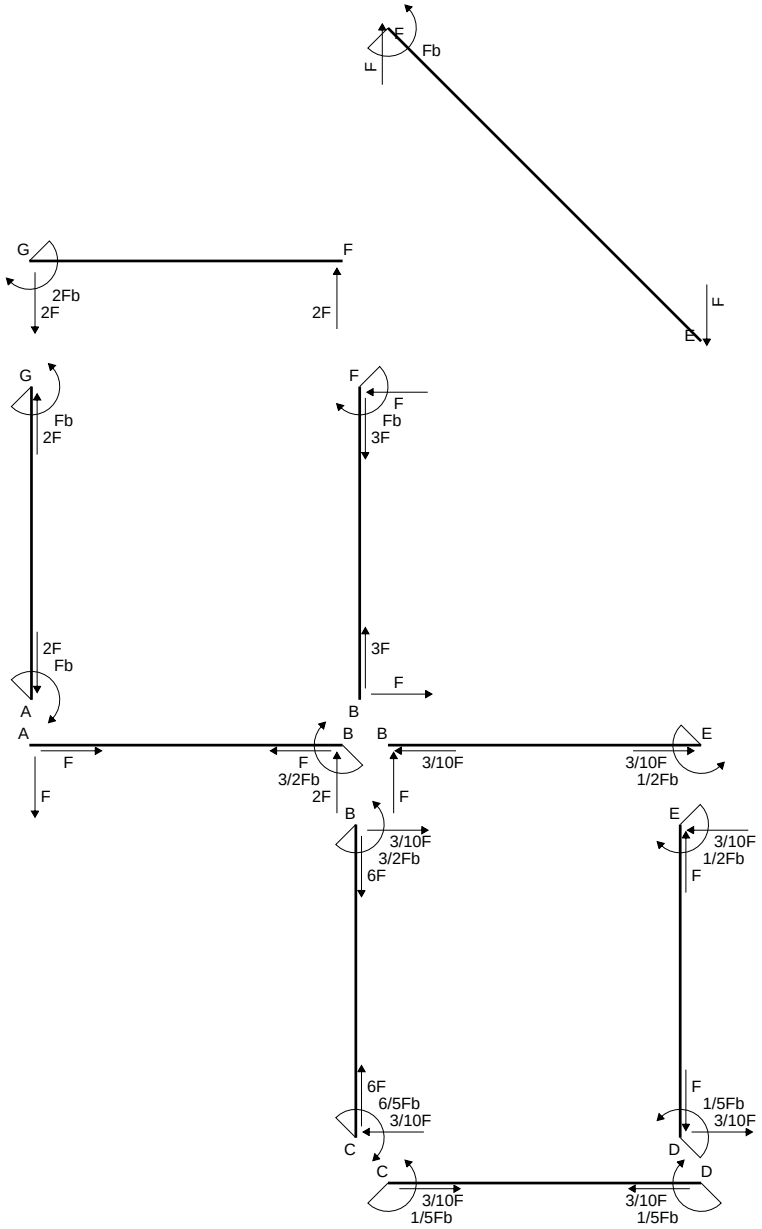
$= (1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 1/12\ \ Fb^2/EJ$

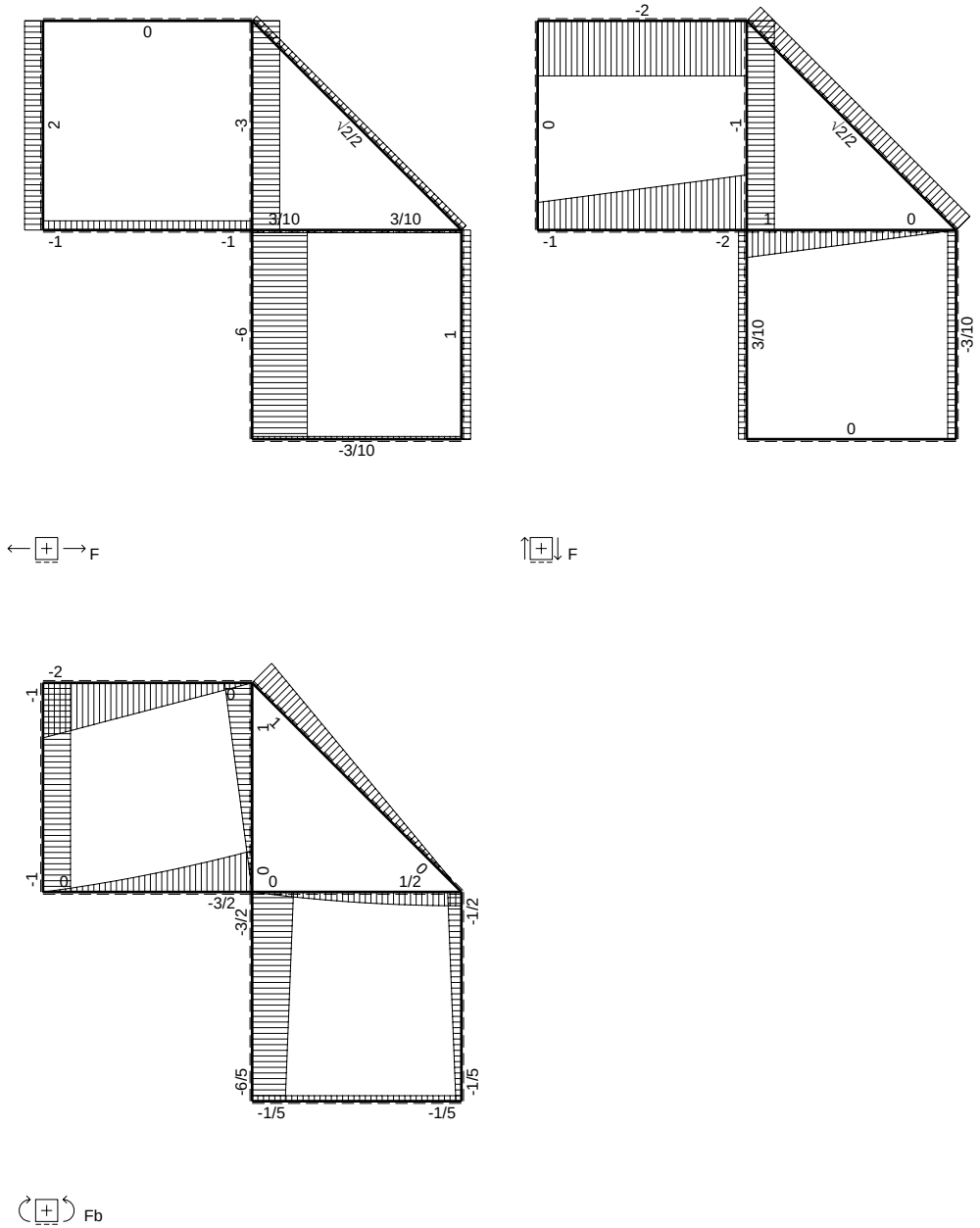


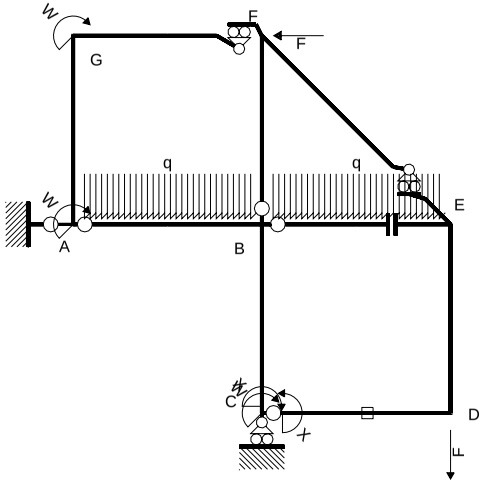
A = 146.4 mm^2
J_u = 51238. mm^4
J_v = 7969. mm^4
J_t = 126.8 mm^4
y_o = -7.49 mm
y_g = 18.42 mm
T_y = -1080. N
M_x = -432000. Nmm
x_m = 5. mm
y_m = 42. mm
u_m = -12. mm
v_m = 23.58 mm
$\sigma_m = -Mv/J_u$ = 198.8 N/mm^2
x_c = 17. mm
y_c = 42. mm
v_c = 23.58 mm
$\sigma_c = -Mv/J_u$ = 198.8 N/mm^2
$\tau_c = TS^*/tJ_u$ = 21.47 N/mm^2
$\tau_g = TS^*/tJ_u$ = 21.47 N/mm^2
t_c = 540. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 202.3 N/mm^2

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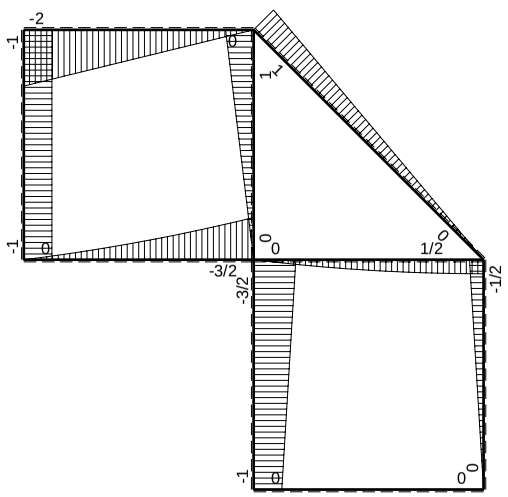
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F
Fb
F
E
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G
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2Fb
2F
2F
G
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Fb
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Fb
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A
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2F
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3/10F
3/10F
3/2Fb
1/2Fb
6F
F
6F
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6/5Fb
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3/10F
1/5Fb
1/5Fb

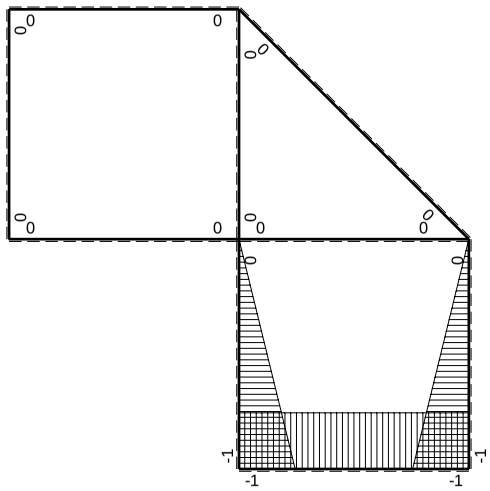

0
2
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√2/2
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3/10
-1
-1
-6
1
-3/10
-2
0
-1
√2/2
1
0
-1
-2
3/10
-3/10
0
F
F
-2
-1
0
1
-1
0
0
0
1/2
-3/2
-3/2
-1/2
-6/5
-1/5
-1/5
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-Fx-1/2qx^2$	0	0	0	0
BA b	0	$3/2Fb-2Fx+1/2qx^2$	0	0		
BC b	-x/b	$-3/2Fb+1/2Fx$	$3/2Fx-1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	$Fb+1/2Fx$	$Fb-1/2Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE 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
ED b	x/b	1/2Fb-1/2Fx	$1/2Fx-1/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	$Fx-1/2qx^2$	0	0	0	0
EB b	0	$-1/2Fb+1/2qx^2$	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/3Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				1/5Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b)\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

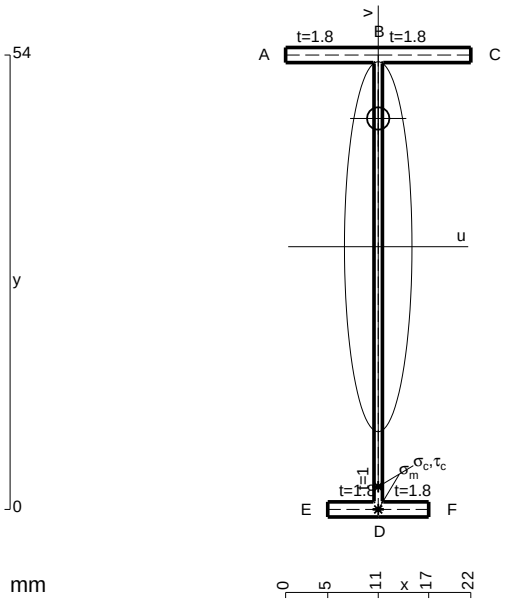
$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b -1/6\ b)\ Fb\ 1/EJ\ = 1/12\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

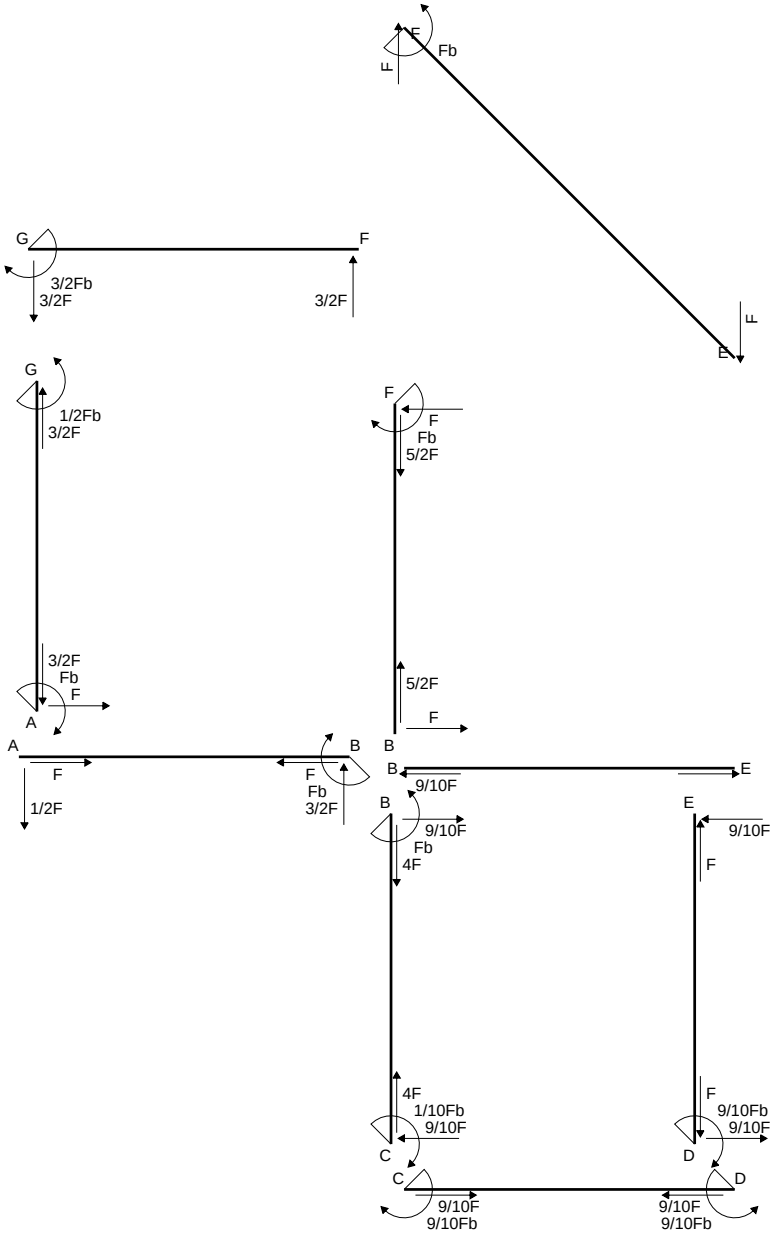
$= (1/4\ b -1/6\ b)\ Fb\ 1/EJ\ = 1/12\ Fb^2/EJ$

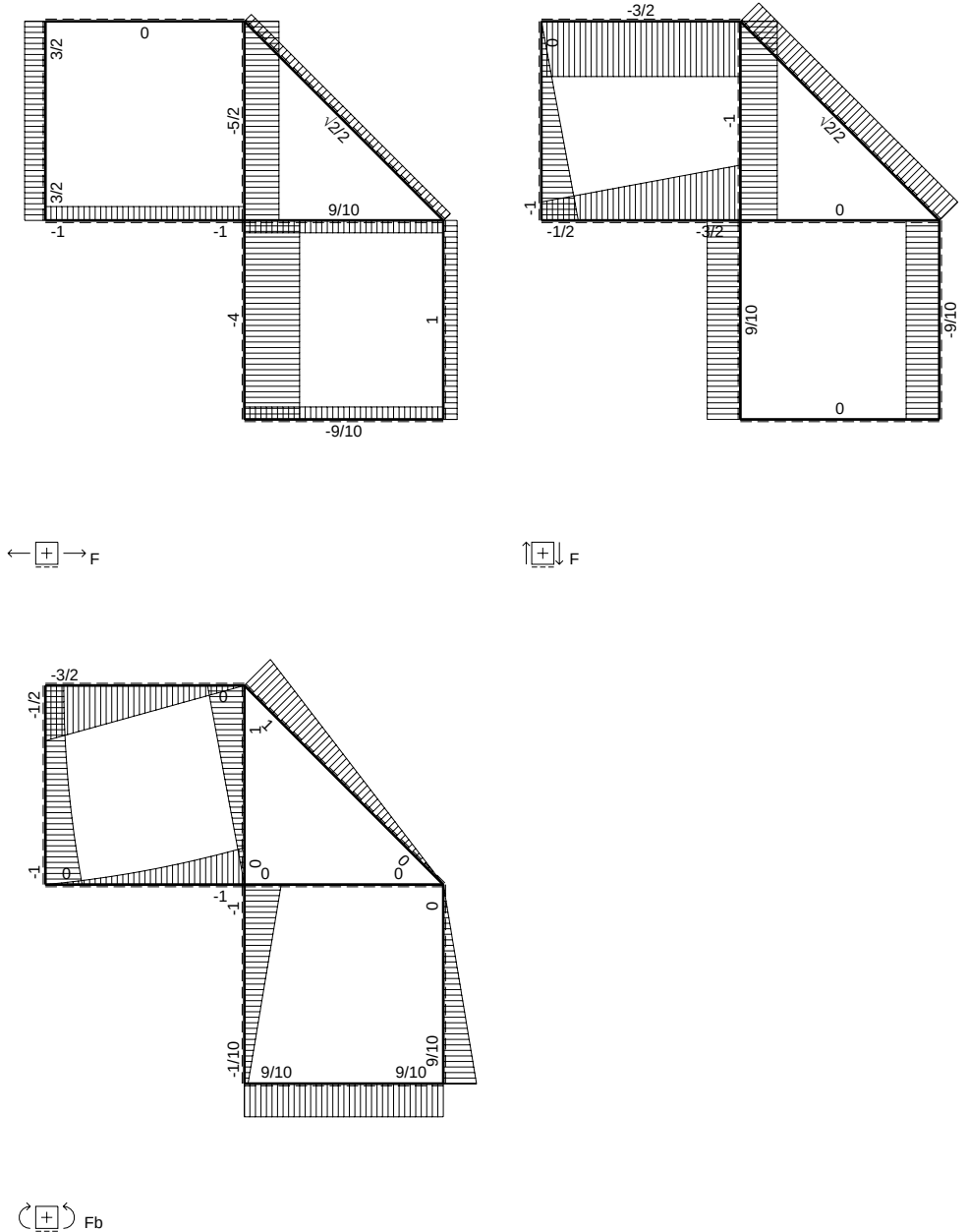


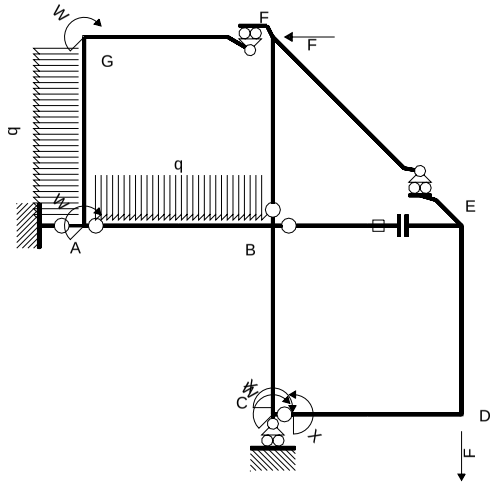
A = 115.2 mm^2
J_u = 55687. mm^4
J_v = 1856. mm^4
J_t = 84.1 mm^4
y_o = 15.24 mm
y_g = 31.22 mm
T_y = -660. N
M_x = -369600. Nmm
x_m = 11. mm
v_m = -31.22 mm
$\sigma_m = -Mv/J_u$ = -207.2 N/mm^2
y_c = 3. mm
u_c = -11. mm
v_c = -28.22 mm
$\sigma_c = -Mv/J_u$ = -207.2 N/mm^2
$\tau_c = TS^*/tJ_u$ = 7.992 N/mm^2
$\tau_g = TS^*/tJ_u$ = 7.992 N/mm^2
t_c = 330. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 207.7 N/mm^2

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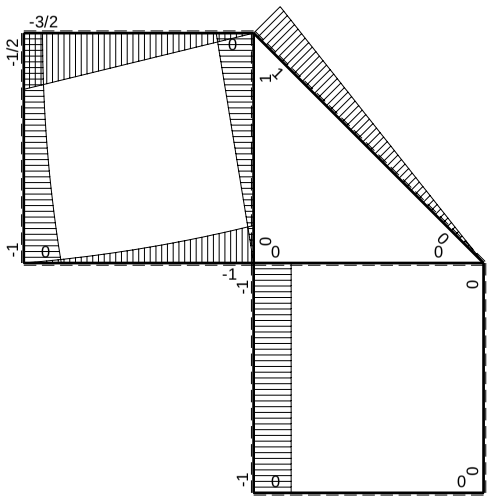
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G
F
3/2Fb
3/2F
3/2F
F
Fb
F
E
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G
1/2Fb
3/2F
F
F
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4F
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9/10F
9/10Fb

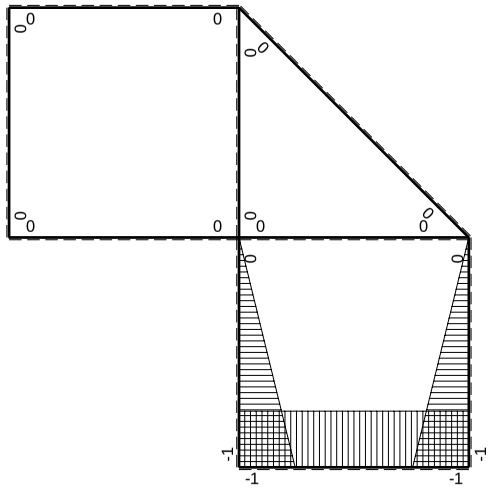

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1/2
-1
0
-1/2
-3/2
9/10
-9/10
0
F
F
-3/2
-1/2
0
1
-1
0
0
0
0
-1
-1
0
-1/10
9/10
9/10
9/10
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-1/2Fx-1/2qx^2$	0	0	0	0
BA b	0	$Fb-3/2Fx+1/2qx^2$	0	0		
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb	Fb-Fx	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	0	0	x^2/b^2		
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-3/2Fx	0	0	0	0
GF b	0	3/2Fb-3/2Fx	0	0		
GA b	0	$-1/2Fb-1/2qx^2$	0	0	0	0
AG b	0	$Fb-Fx+1/2qx^2$	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$3/2Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				-9/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 - 2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b + 1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b + 1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 - 2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b + 1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b + 1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

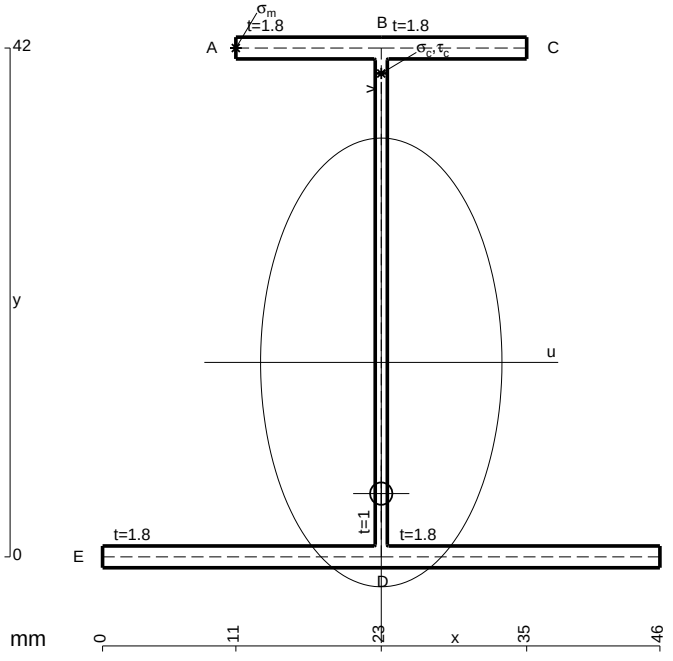
$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (\ x/b\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b)\ Fb\ 1/EJ\ = 1/2\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x/b\ )\ Fb\ 1/EJ\ dx = [\ x - 1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

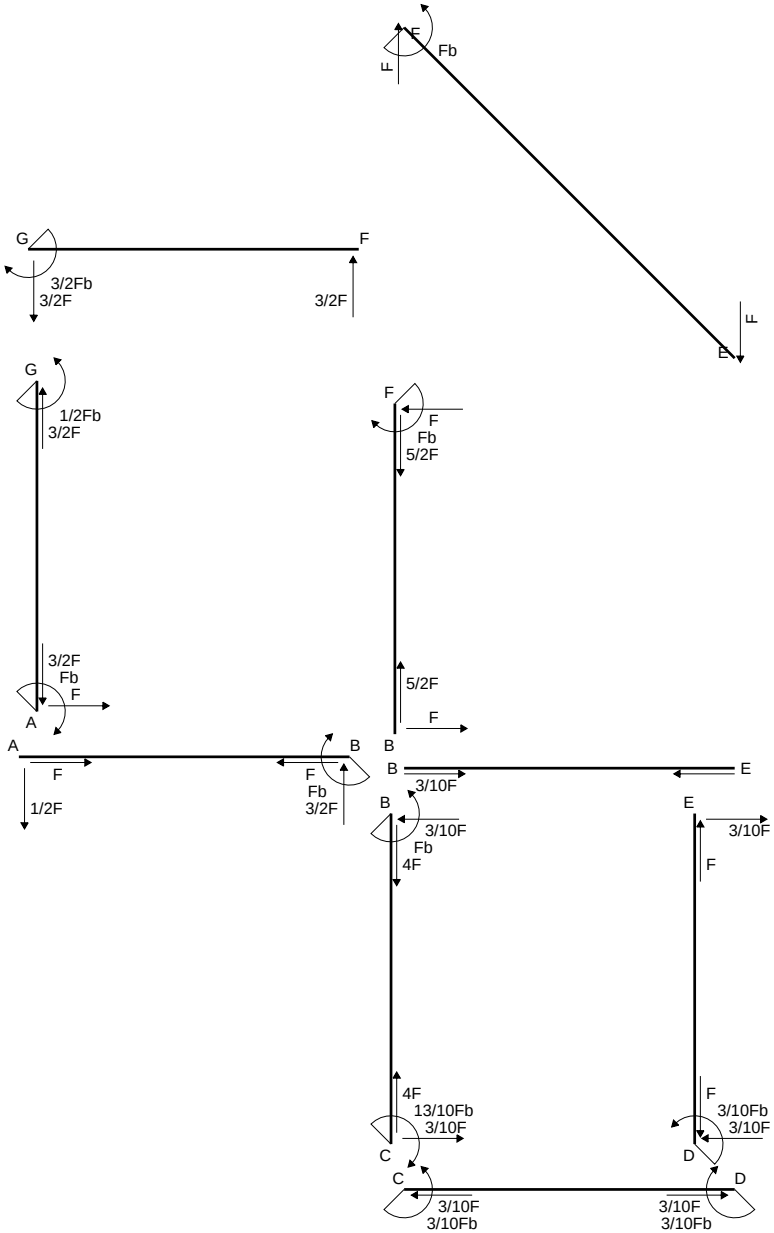
$= (\ b - 1/2\ b\ )\ Fb\ 1/EJ\ = 1/2\ \ Fb^2/EJ$

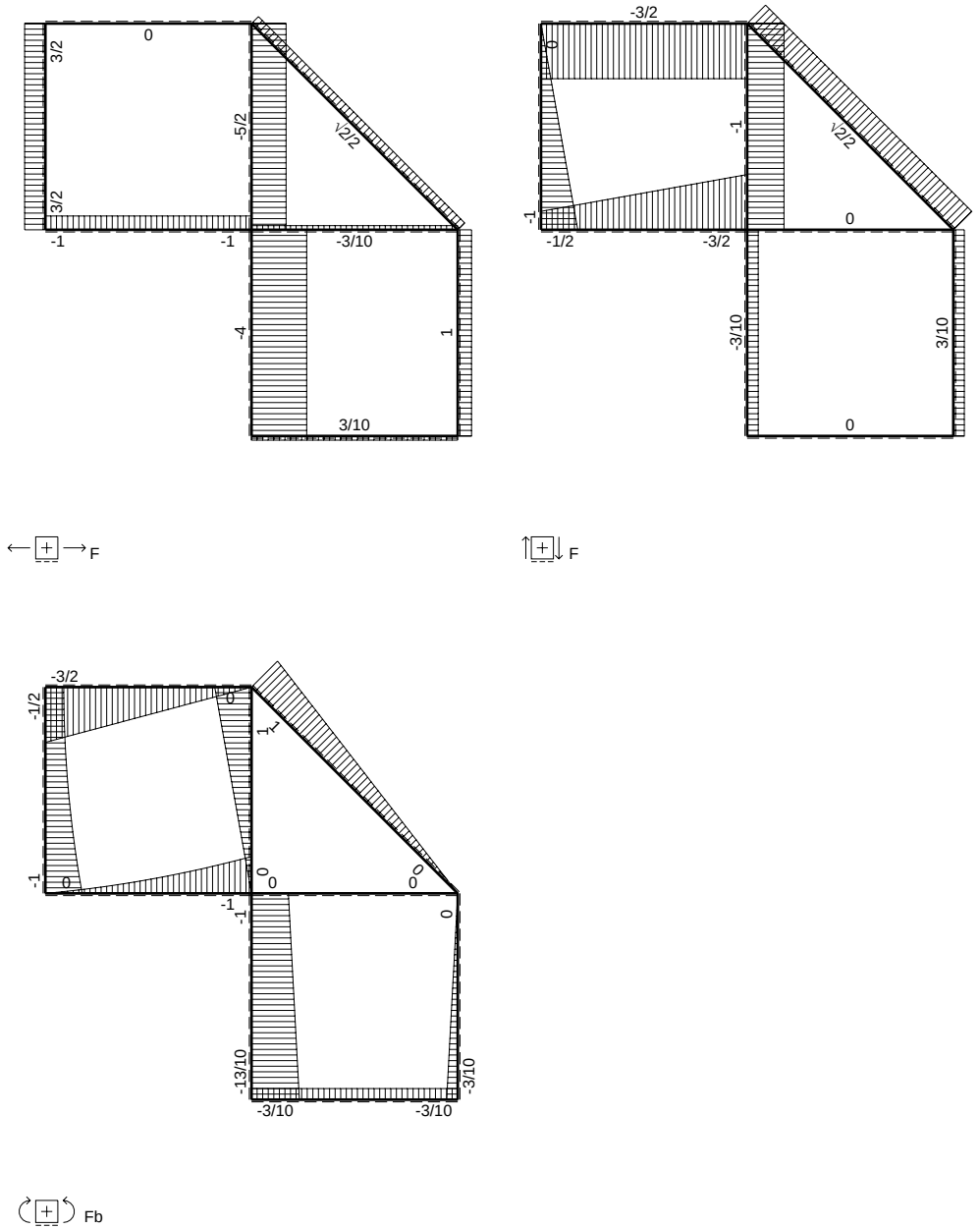


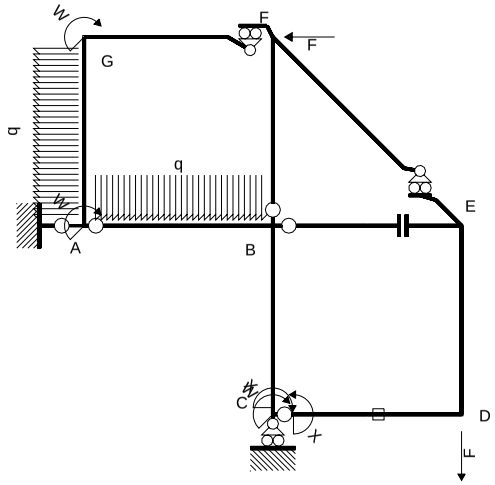
A = 168. mm^2
J_u = 57624. mm^4
J_v = 16674. mm^4
J_t = 150.1 mm^4
y_o = -10.83 mm
y_g = 16.05 mm
T_y = -1005. N
M_x = -482400. Nmm
x_m = 11. mm
y_m = 42. mm
u_m = -12. mm
v_m = 25.95 mm
$\sigma_m = -Mv/J_u$ = 217.2 N/mm^2
x_c = 23. mm
y_c = 42. mm
v_c = 25.95 mm
$\sigma_c = -Mv/J_u$ = 217.2 N/mm^2
$\tau_c = TS^*/tJ_u$ = 19.55 N/mm^2
$\tau_g = TS^*/tJ_u$ = 19.55 N/mm^2
t_c = 670. mm
$\sigma_o = \sqrt{\sigma^2 + 3\tau^2}$ = 219.9 N/mm^2

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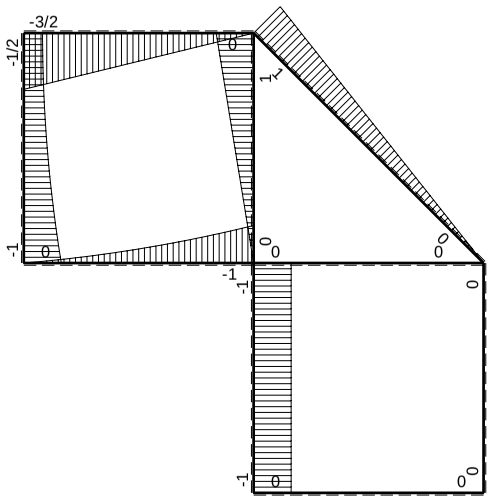
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3/2F
3/2F
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1/2Fb
3/2F
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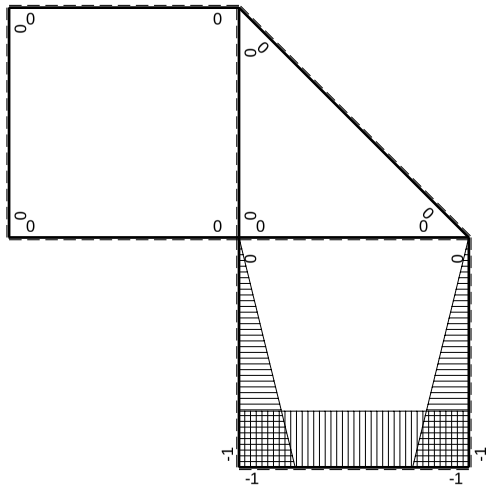

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-1
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0
0
0
-1
-1
0
-13/10
-3/10
-3/10
-3/10
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-1/2Fx-1/2qx^2$	0	0	0	0
BA b	0	$Fb-3/2Fx+1/2qx^2$	0	0		
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb	Fb-Fx	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	0	0	x^2/b^2		
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-3/2Fx	0	0	0	0
GF b	0	3/2Fb-3/2Fx	0	0		
GA b	0	$-1/2Fb-1/2qx^2$	0	0	0	0
AG b	0	$Fb-Fx+1/2qx^2$	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/2Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				3/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

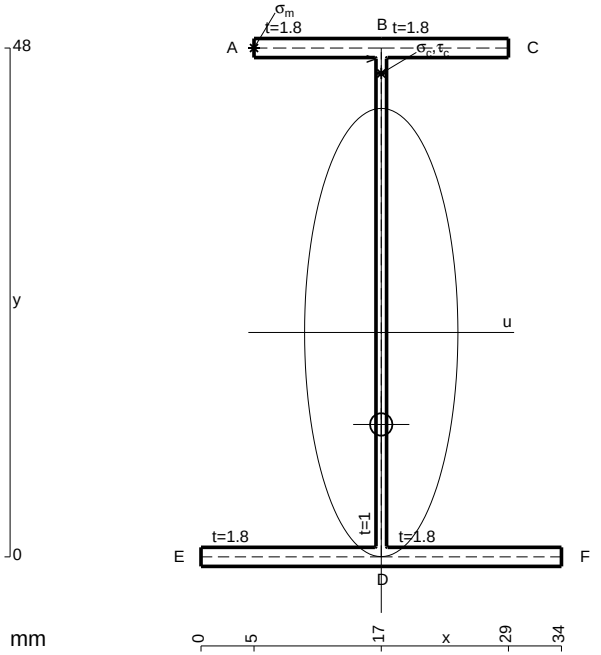
$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (x/b)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b)\ Fb\ 1/EJ\ = 1/2\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x/b)\ Fb\ 1/EJ\ dx = [\ x -1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

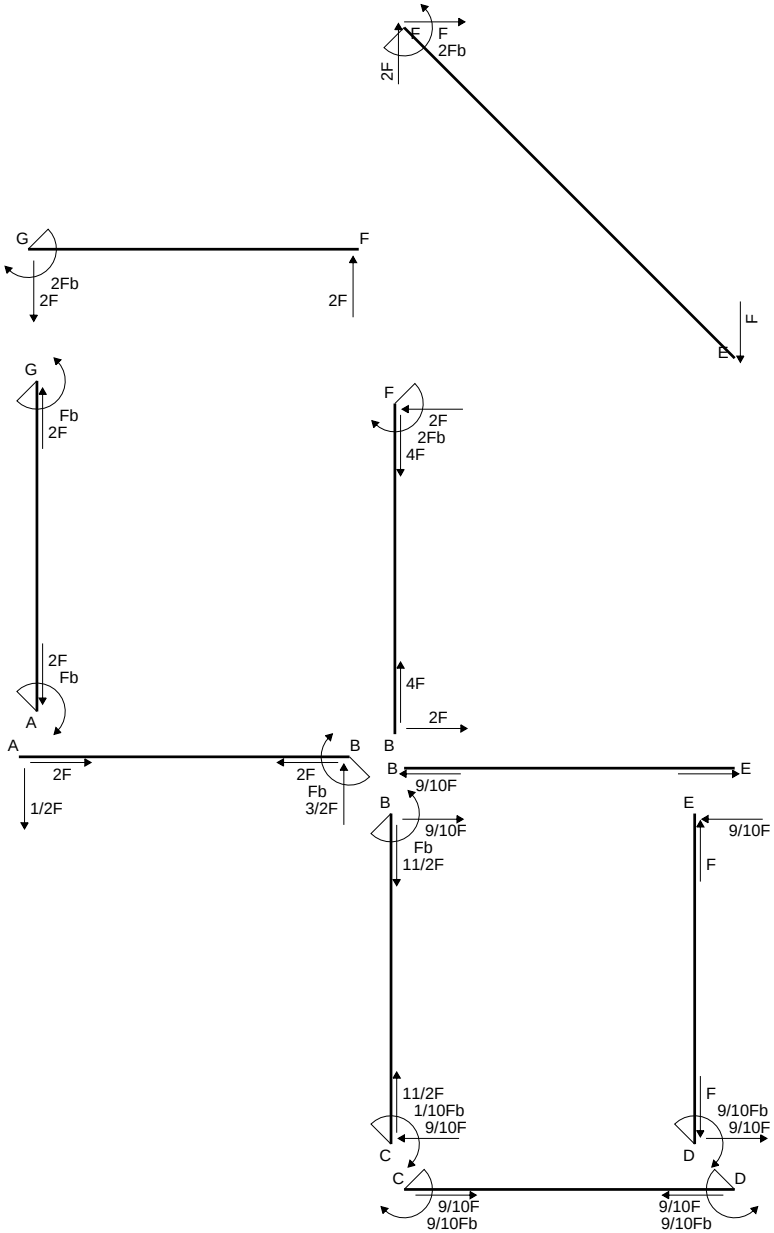
$= (\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 1/2\ \ Fb^2/EJ$

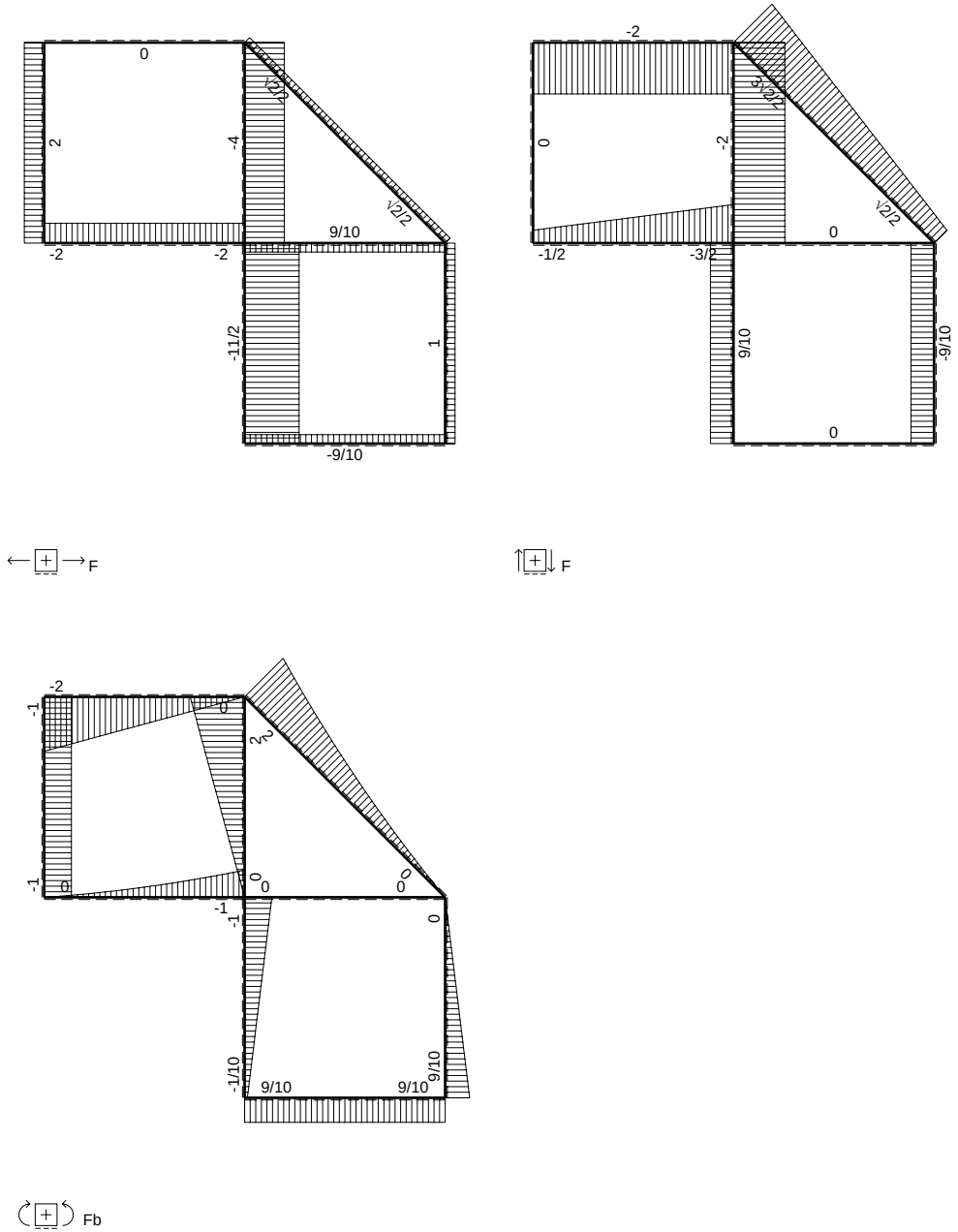


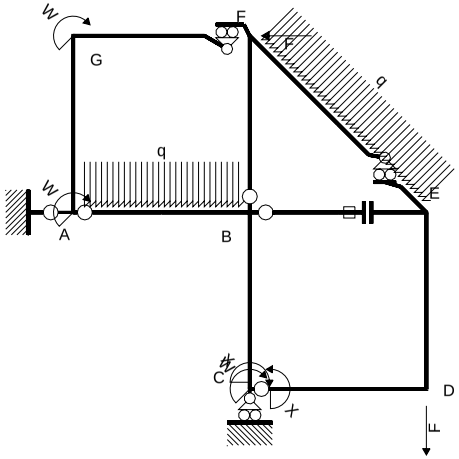
A = 152.4 mm^2
J_u = 68126. mm^4
J_v = 7969. mm^4
J_t = 128.8 mm^4
y_o = -8.676 mm
y_g = 21.17 mm
T_y = -1005. N
M_x = -582900. Nmm
x_m = 5. mm
y_m = 48. mm
u_m = -12. mm
v_m = 26.83 mm
$\sigma_m = -Mv/J_u$ = 229.6 N/mm^2
x_c = 17. mm
y_c = 48. mm
v_c = 26.83 mm
$\sigma_c = -Mv/J_u$ = 229.6 N/mm^2
$\tau_c = TS^*/tJ_u$ = 17.1 N/mm^2
$\tau_g = TS^*/tJ_u$ = 17.1 N/mm^2
t_c = 670. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 231.5 N/mm^2

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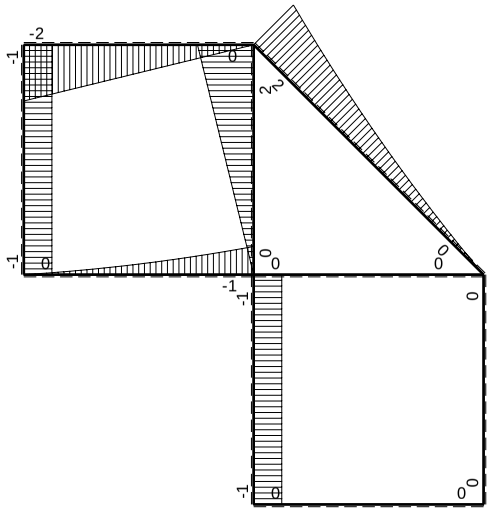
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9/10F
1/2F
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9/10F
9/10F
Fb
11/2F
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11/2F
F
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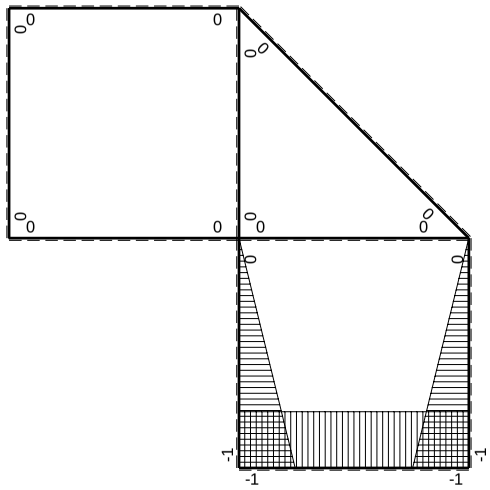

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Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-1/2Fx-1/2qx^2$	0	0	0	0
BA b	0	$Fb-3/2Fx+1/2qx^2$	0	0		
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb	Fb-Fx	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	0	0	x^2/b^2		
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx+1/2qx^2$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$3/2Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				-9/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b)\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b)\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

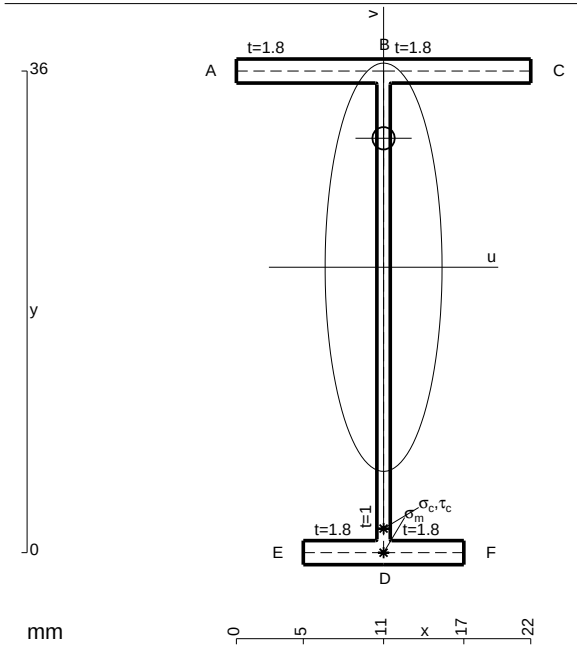
$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (x/b)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b)\ Fb\ 1/EJ\ = 1/2\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x/b)\ Fb\ 1/EJ\ dx = [\ x -1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

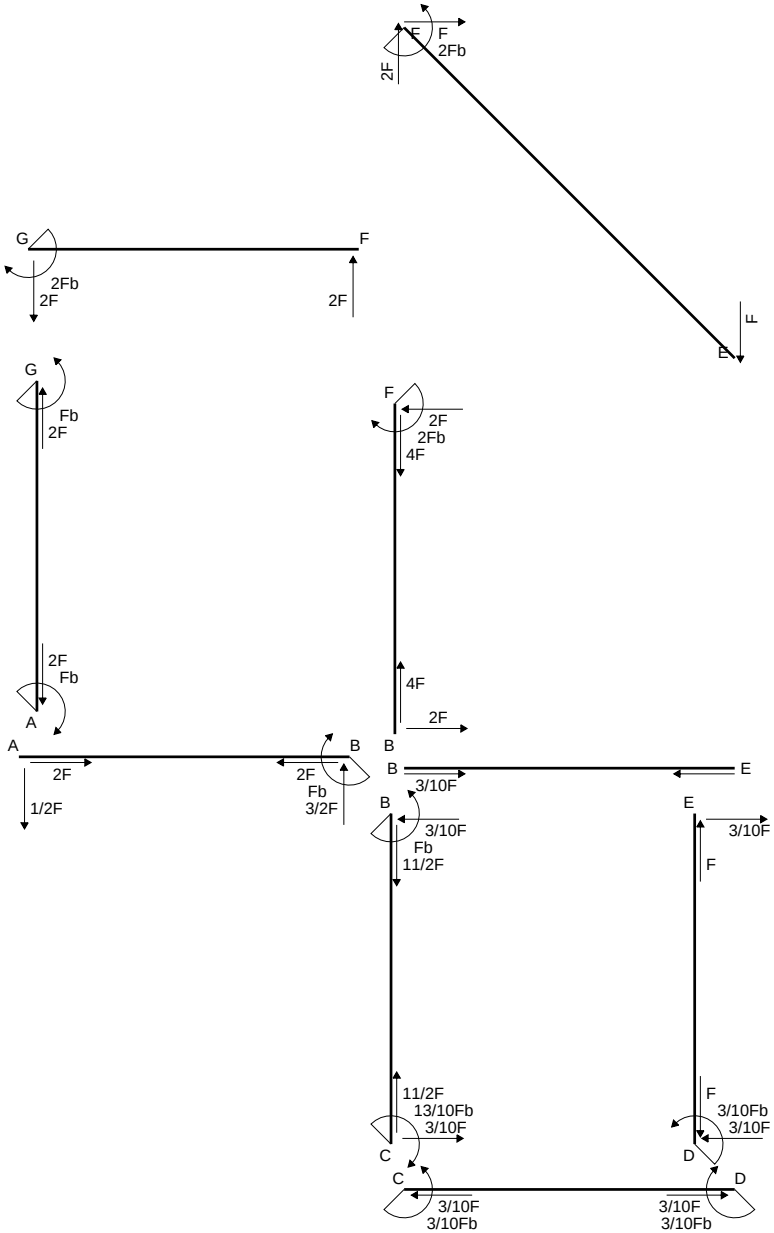
$= (\ b -1/2\ b)\ Fb\ 1/EJ\ = 1/2\ Fb^2/EJ$

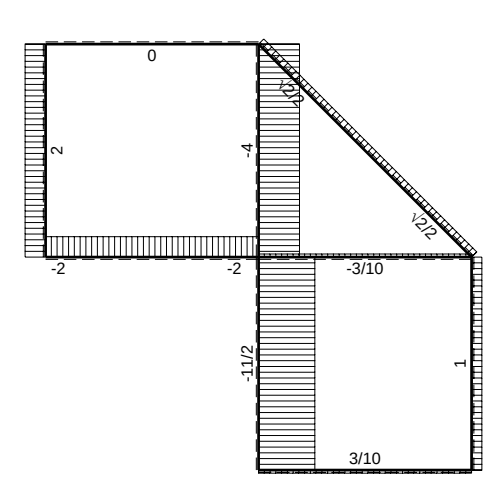


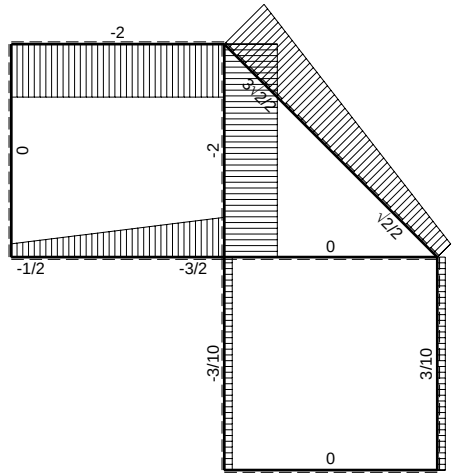
A = 97.2 mm^2
J_u = 22637. mm^4
J_v = 1856. mm^4
J_t = 78.1 mm^4
y_o = 9.64 mm
y_g = 21.33 mm
N = 183.8 N
T_y = 551.5 N
M_x = 244400. Nmm
x_m = 11. mm
v_m = -21.33 mm
$\sigma_m = N/A - Mv/J_u$ = 232.2 N/mm^2
y_c = 3. mm
u_c = -11. mm
v_c = -18.33 mm
$\sigma_c = N/A - Mv/J_u$ = 232.2 N/mm^2
$\tau_c = TS^*/tJ_u$ = 11.23 N/mm^2
$\tau_g = TS^*/tJ_u$ = 11.23 N/mm^2
t_c = 260. mm
$\sigma_o = \sqrt{\sigma^2 + 3\tau^2}$ = 233. N/mm^2

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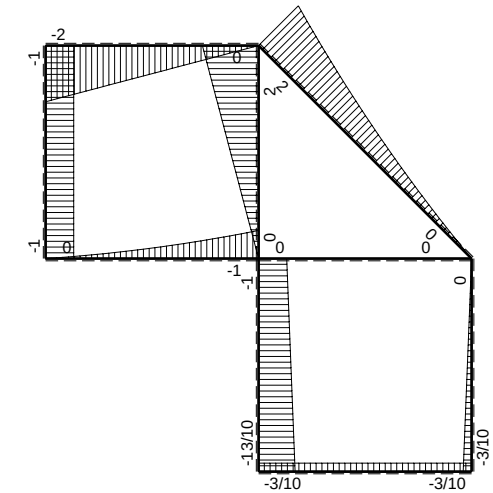






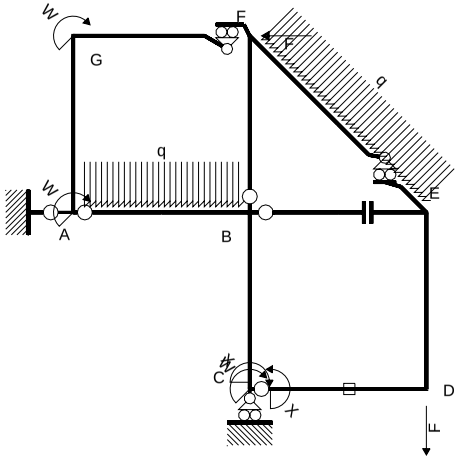
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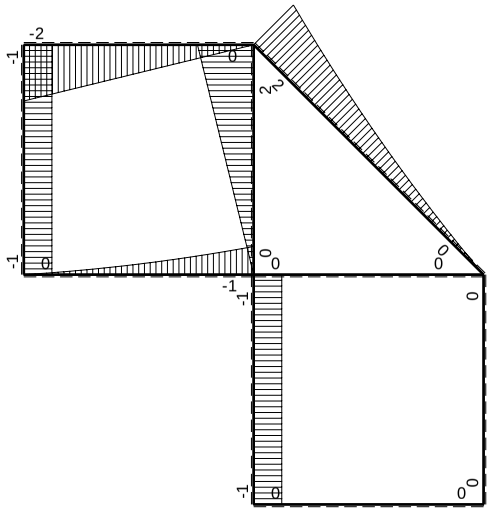


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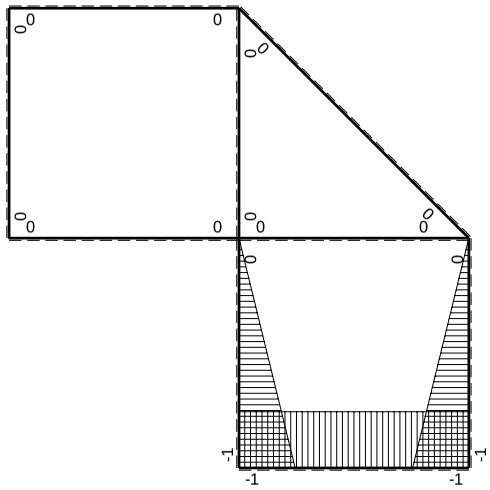
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Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-1/2Fx-1/2qx^2$	0	0	0	0
BA b	0	$Fb-3/2Fx+1/2qx^2$	0	0		
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb	Fb-Fx	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	0	0	x^2/b^2		
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx+1/2qx^2$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	2Fb-2Fx	0	0	0	0
BF b	0	-2Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/2Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				3/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

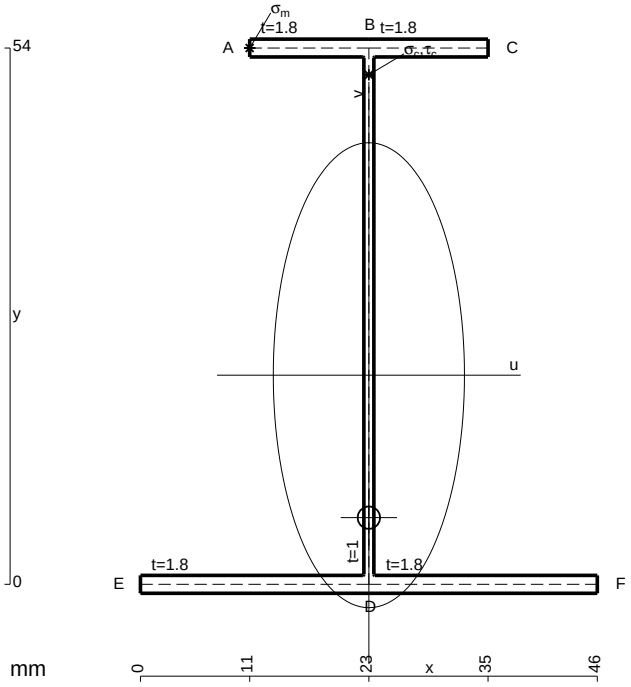
$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (\ x/b\ )\ Fb\ 1/EJ\ dx = [1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b\ )\ Fb\ 1/EJ\ = 1/2\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x/b\ )\ Fb\ 1/EJ\ dx = [\ x -1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

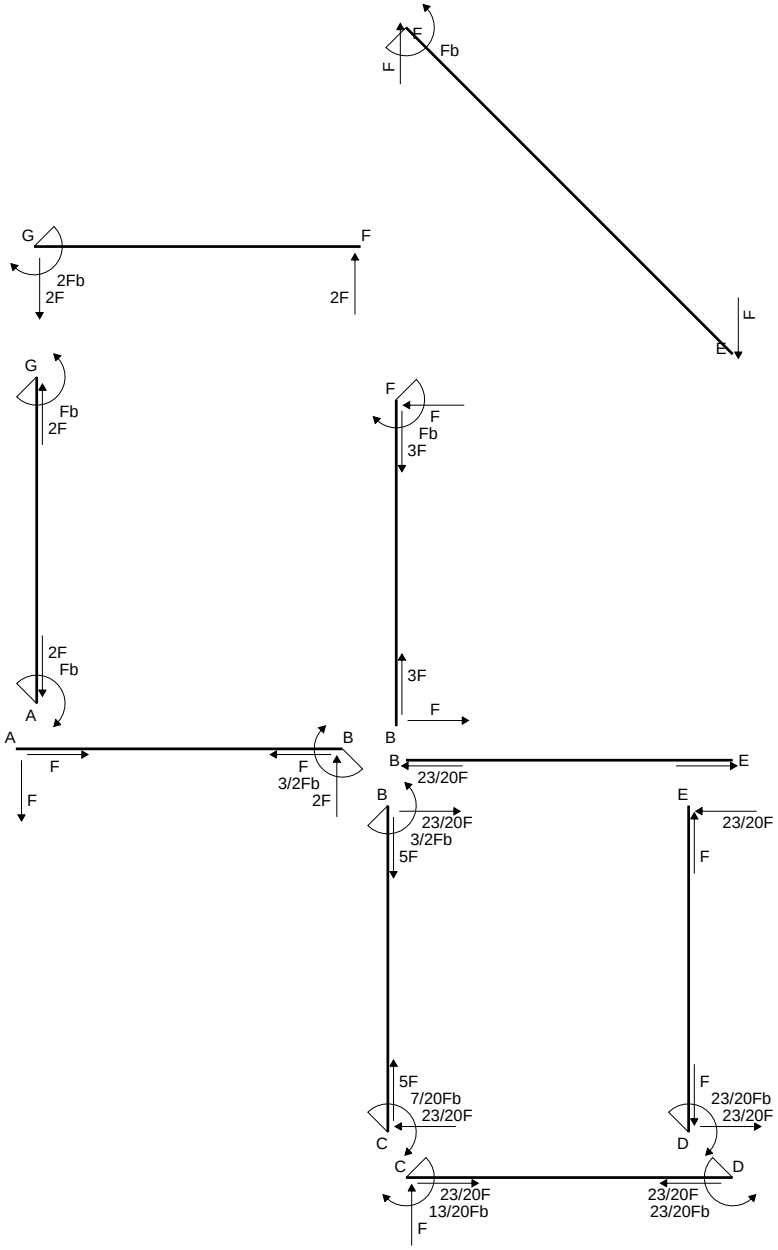
$= (\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 1/2\ \ Fb^2/EJ$

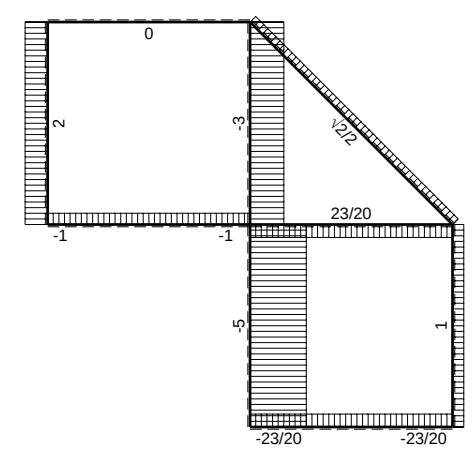


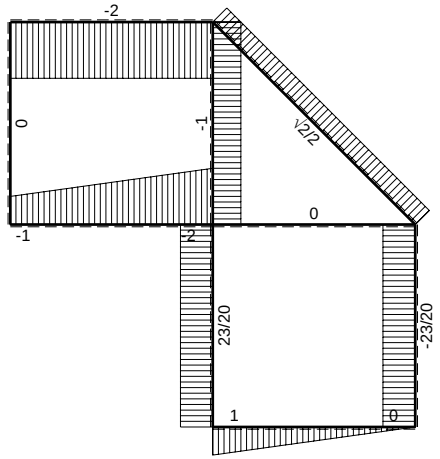
A = 180. mm^2
J_u = 98625. mm^4
J_v = 16674. mm^4
J_t = 154.1 mm^4
y_o = -14.34 mm
y_g = 21.06 mm
N = 275.8 N
T_y = 827.3 N
M_x = 592800. Nmm
x_m = 11. mm
y_m = 54. mm
u_m = -12. mm
v_m = 32.94 mm
$\sigma_m = N/A - Mv/J_u$ = -196.5 N/mm^2
x_c = 23. mm
y_c = 54. mm
v_c = 32.94 mm
$\sigma_c = N/A - Mv/J_u$ = -196.5 N/mm^2
$\tau_c = TS^*/tJ_u$ = 11.94 N/mm^2
$\tau_g = TS^*/tJ_u$ = 11.94 N/mm^2
t_c = 390. mm
$\sigma_o = \sqrt{\sigma^2 + 3\tau^2}$ = 197.5 N/mm^2

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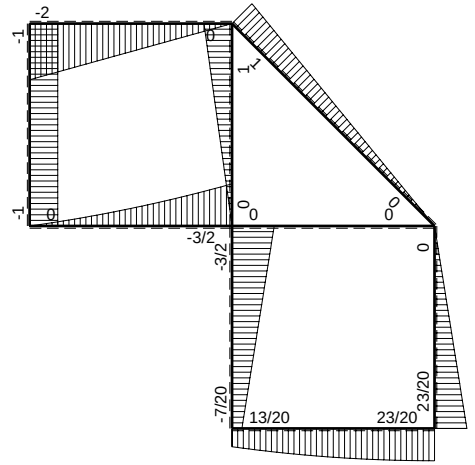

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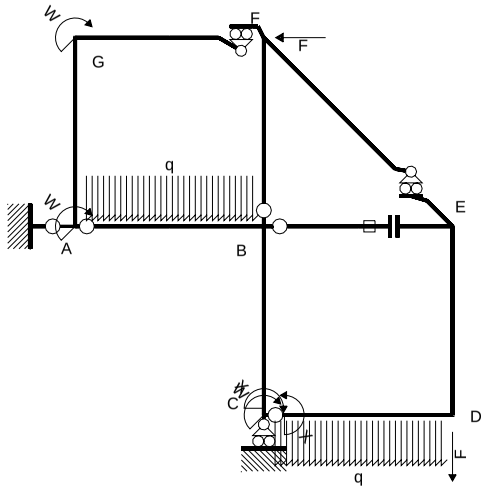

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-23/20
1
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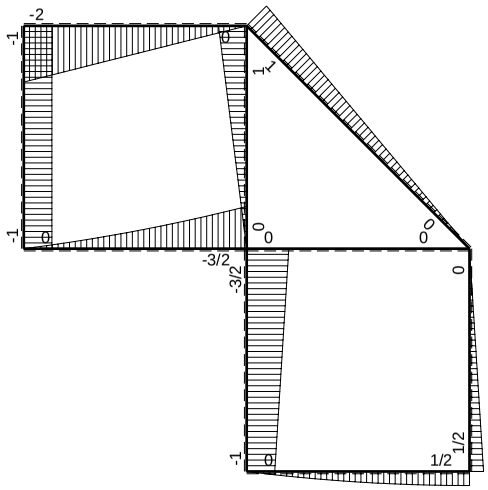
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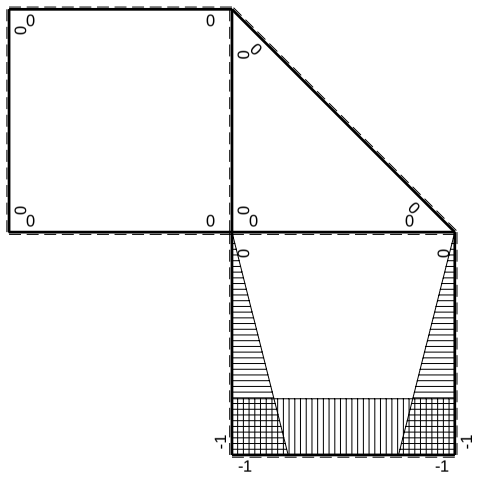

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-1
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0
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-3/2
0
-7/20
13/20
23/20
23/20

Fb





M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-Fx-1/2qx^2$	0	0	0	0
BA b	0	$3/2Fb-2Fx+1/2qx^2$	0	0		
BC b	-x/b	$-3/2Fb+1/2Fx$	$3/2Fx-1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	$Fb+1/2Fx$	$Fb-1/2Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	$Fx-1/2qx^2$	$-Fx+1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fb+1/2qx^2$	$-1/2Fb+1/2Fx^2/b$	1		
DE 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
ED b	x/b	$-1/2Fx$	$-1/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-2Fx$	0	0	0	0
GF b	0	$2Fb-2Fx$	0	0		
GA b	0	$-Fb$	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	$Fb-Fx$	0	0	0	0
BF b	0	$-Fx$	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$13/12Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-13/20Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2\ )\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/3\ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2 +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/2\ x +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

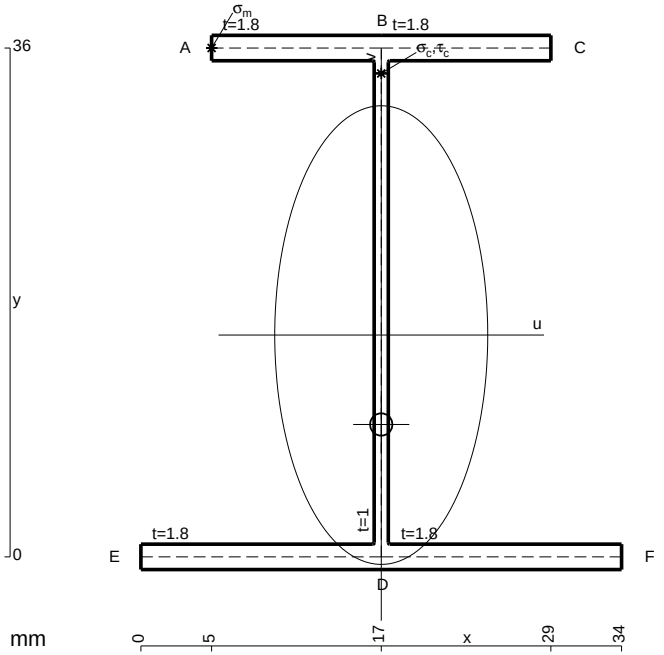
$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/3\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (-1/2 + x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/2\ x +1/2\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = -1/6\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (-1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

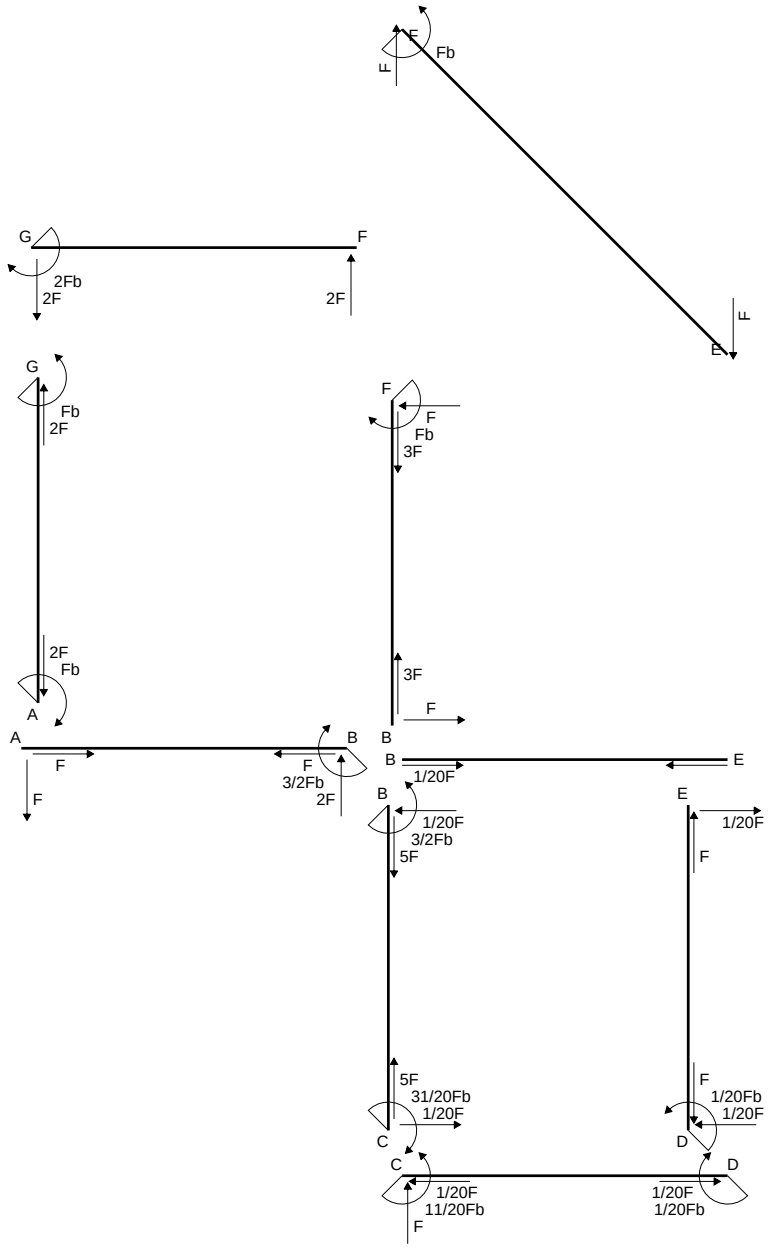
$= (-1/6\ b\ )\ Fb\ 1/EJ\ = -1/6\ Fb^2/EJ$

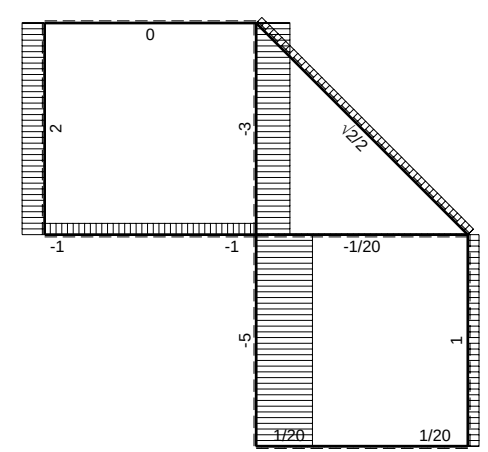


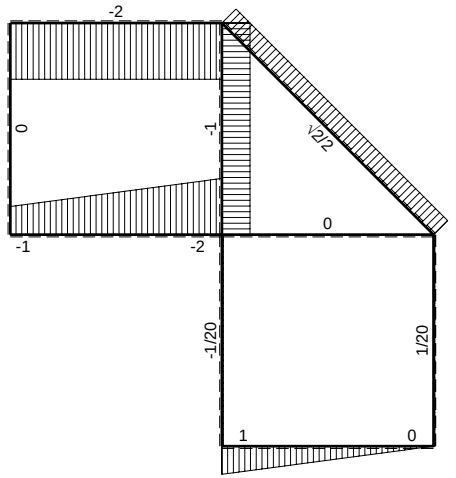
A = 140.4 mm^2
J_u = 36966. mm^4
J_v = 7969. mm^4
J_t = 124.8 mm^4
y_o = -6.325 mm
y_g = 15.69 mm
T_y = -700. N
M_x = -378000. Nmm
x_m = 5. mm
y_m = 36. mm
u_m = -12. mm
v_m = 20.31 mm
$\sigma_m = -Mv/J_u$ = 207.7 N/mm^2
x_c = 17. mm
y_c = 36. mm
v_c = 20.31 mm
$\sigma_c = -Mv/J_u$ = 207.7 N/mm^2
$\tau_c = TS^*/tJ_u$ = 16.61 N/mm^2
$\tau_g = TS^*/tJ_u$ = 16.61 N/mm^2
t_c = 350. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 209.6 N/mm^2

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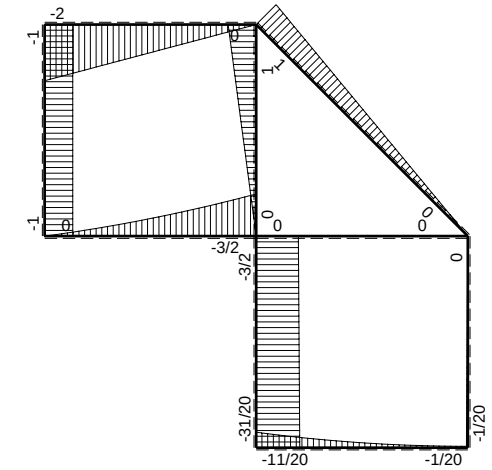

E
Fb
F
F
E
G
F
2Fb
2F
2F
G
Fb
2F
F
F
Fb
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Fb
A
3F
F
A
B
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F
F
B
E
3/2Fb
2F
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B
E
1/20F
1/20F
3/2Fb
5F
F
5F
31/20Fb
1/20F
F
1/20Fb
1/20F
C
D
C
D
1/20F
11/20Fb
1/20F
1/20Fb
F


0
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-1
-1/20
-5
1
1/20
1/20

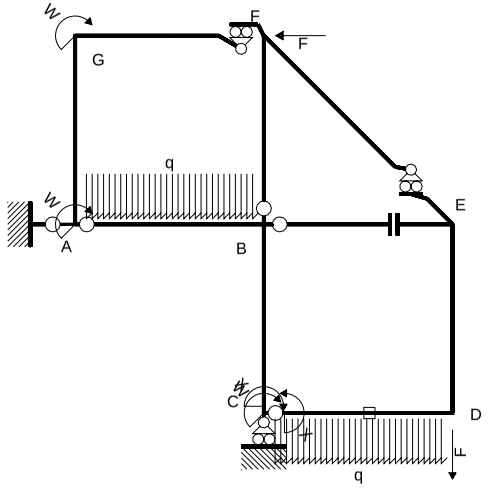

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0
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-2
0
-1/20
1/20
1
0

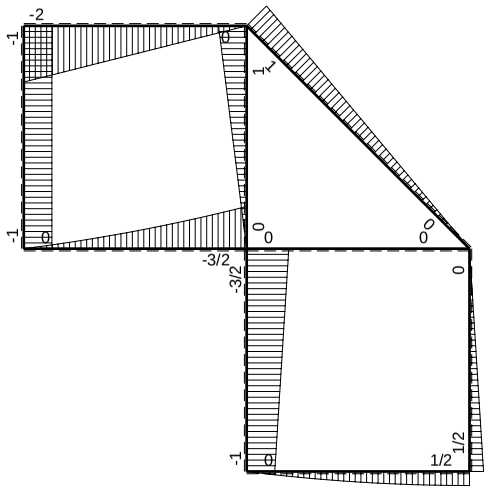
F

F

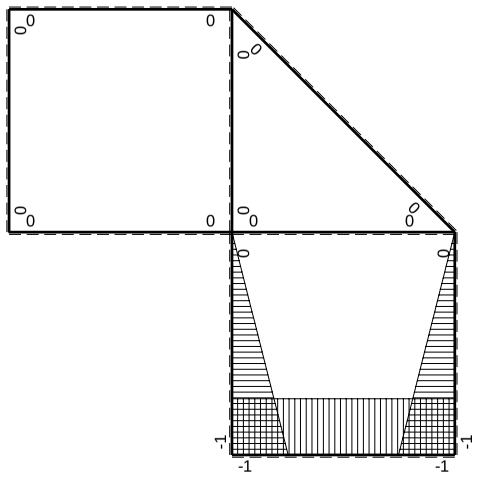

-2
-1
0
1
-1
0
0
0
0
-3/2
-3/2
0
-31/20
-1/20
-11/20
-1/20

Fb





M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-Fx-1/2qx^2$	0	0	0	0
BA b	0	$3/2Fb-2Fx+1/2qx^2$	0	0		
BC b	-x/b	$-3/2Fb+1/2Fx$	$3/2Fx-1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	$Fb+1/2Fx$	$Fb-1/2Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	$Fx-1/2qx^2$	$-Fx+1/2Fx^2/b$	1	$-1/3Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fb+1/2qx^2$	$-1/2Fb+1/2Fx^2/b$	1		
DE 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
ED b	x/b	$-1/2Fx$	$-1/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-11/12Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				11/20Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2\ )\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -4/3\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2 +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/2\ x +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (-1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -4/3\ \ Fb^2/EJ$

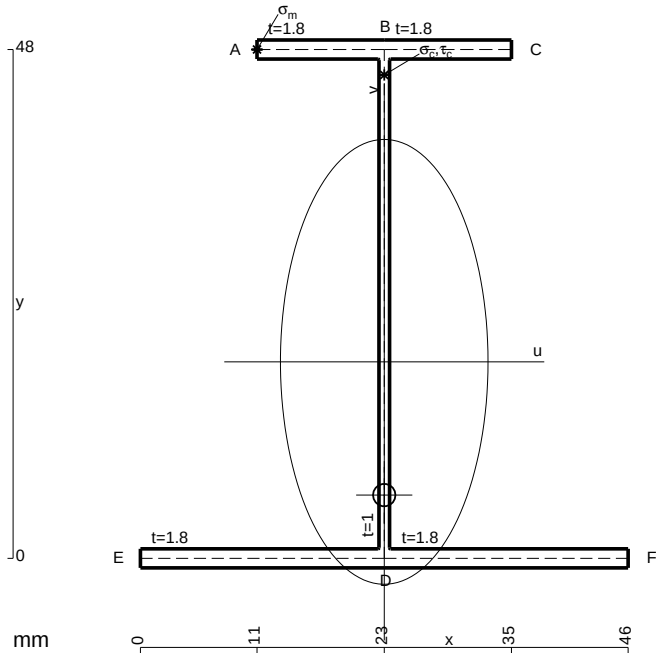
$L^{Xo}_{DE} = \int_o^b (-1/2 + x/b -1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/2\ x +1/2\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/2\ b +1/2\ b -1/6\ b\ )\ Fb\ 1/EJ\ = -1/6\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (-1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [-1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/6\ b\ )\ Fb\ 1/EJ\ = -1/6\ \ Fb^2/EJ$

PROCEDIMENTO E RISULTATI 267041 CI02.xxxx.167

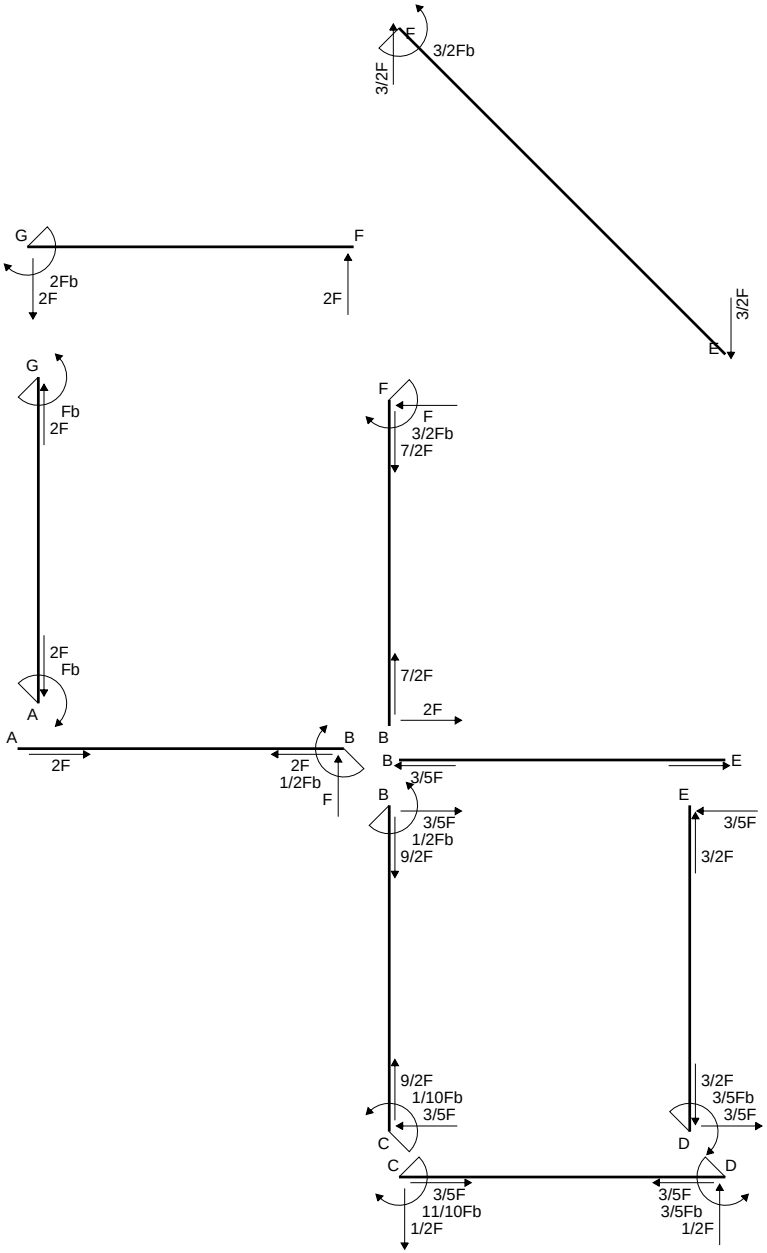


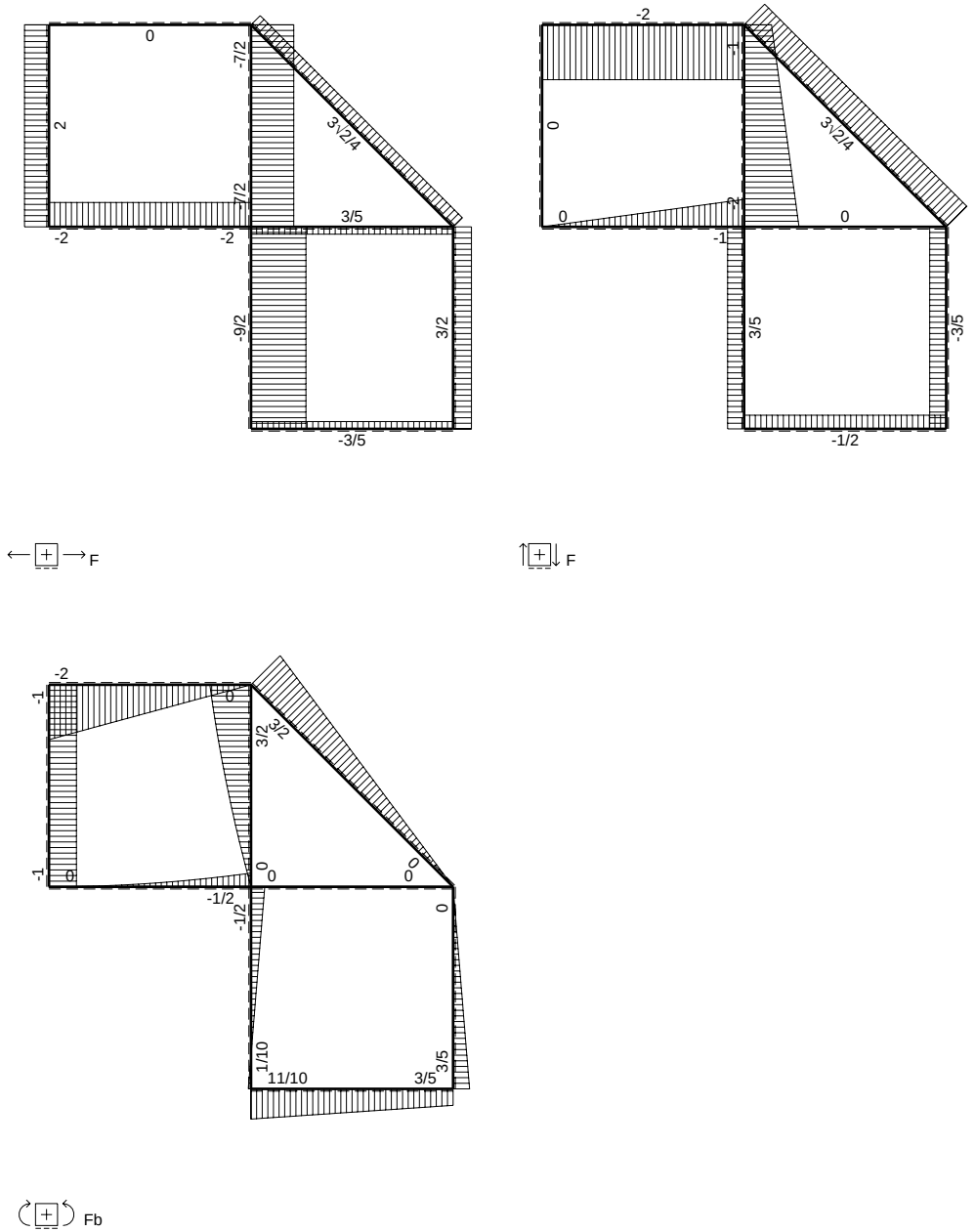
A = 174. mm^2
J_u = 76601. mm^4
J_v = 16674. mm^4
J_t = 152.1 mm^4
y_o = -12.57 mm
y_g = 18.54 mm
T_y = -740. N
M_x = -562400. Nmm
x_m = 11. mm
y_m = 48. mm
u_m = -12. mm
v_m = 29.46 mm
$\sigma_m = -Mv/J_u$ = 216.3 N/mm^2
x_c = 23. mm
y_c = 48. mm
v_c = 29.46 mm
$\sigma_c = -Mv/J_u$ = 216.3 N/mm^2
$\tau_c = TS^*/tJ_u$ = 12.3 N/mm^2
$\tau_g = TS^*/tJ_u$ = 12.3 N/mm^2
t_c = 370. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 217.4 N/mm^2

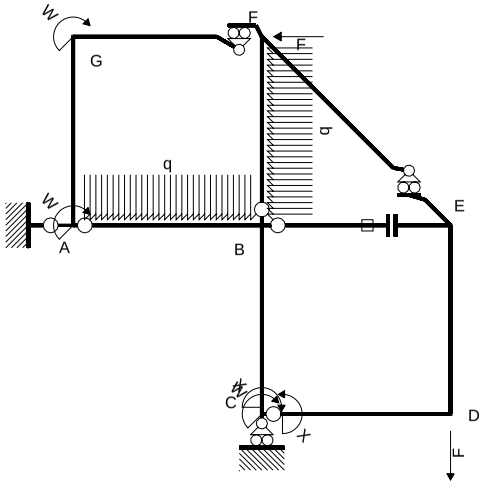
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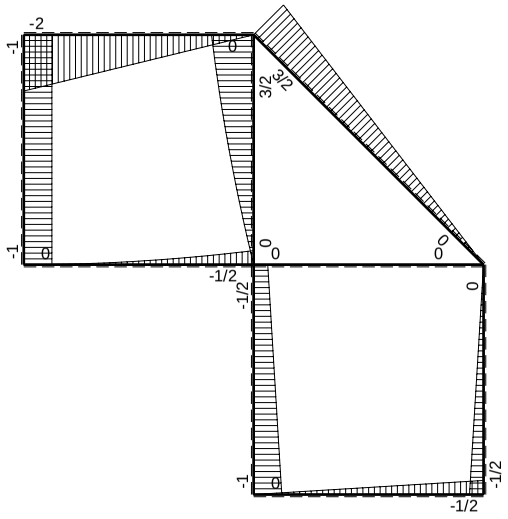
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E
3/2Fb
3/2F
G
F
2Fb
2F
2F
3/2F
E
G
Fb
2F
F
F
3/2Fb
7/2F
2F
Fb
A
7/2F
A
B
B
2F
2F
1/2Fb
F
B
E
3/5F
B
3/5F
1/2Fb
9/2F
E
3/5F
3/2F
9/2F
1/10Fb
3/5F
3/2F
3/5Fb
3/5F
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D
C
D
3/5F
11/10Fb
1/2F
3/5F
3/5Fb
1/2F

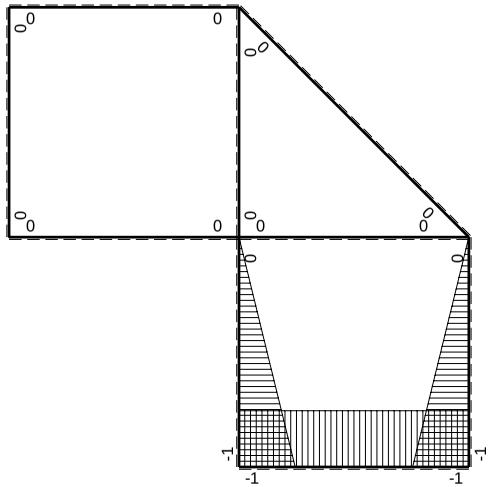

0
-7/2
2
3√2/4
7/2
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0
3√2/4
0
2
0
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3/5
-3/5
-1/2
F
-2
-1
0
3/2
3√2/2
-1
0
0
0
0
-1/2
-1/2
0
1/10
11/10
3/5
3/5
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-1/2qx^2$	0	0	0	0
BA b	0	$1/2Fb-Fx+1/2qx^2$	0	0		
BC b	-x/b	$-1/2Fb-1/2Fx$	$1/2Fx+1/2Fx^2/b$	x^2/b^2	$5/12Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	$Fb-1/2Fx$	$Fb-3/2Fx+1/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	$-1/2Fx$	$1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
DC b	1	$1/2Fb-1/2Fx$	$1/2Fb-1/2Fx$	1		
DE b	-1+x/b	$-1/2Fb+1/2Fx$	$1/2Fb-Fx+1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$1/2Fx$	$1/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	$3/2Fb-Fx-1/2qx^2$	0	0	0	0
BF b	0	$-2Fx+1/2qx^2$	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$11/6Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				-11/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2\ )\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (1/2\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b +1/6\ b\ )\ Fb\ 1/EJ\ = 5/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -3/2\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x -3/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -3/4\ b +1/6\ b\ )\ Fb\ 1/EJ\ = 5/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (1/2\ x/b\ )\ Fb\ 1/EJ\ dx = [1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b\ )\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (1/2 -1/2\ x/b\ )\ Fb\ 1/EJ\ dx = [1/2\ x -1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

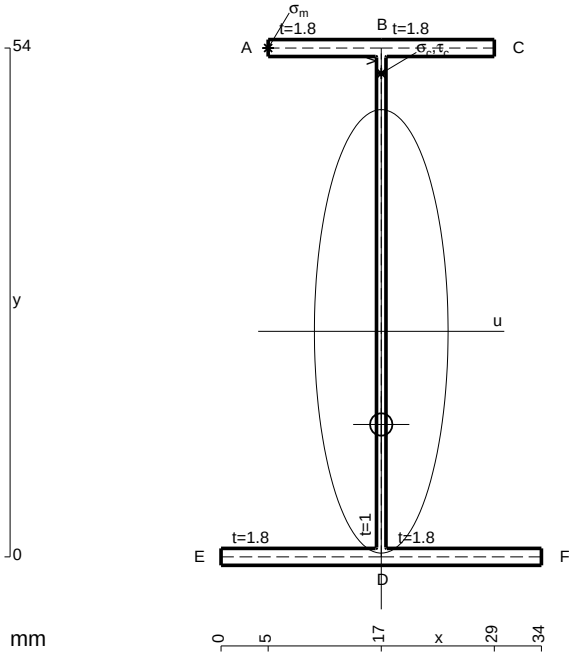
$= (1/2\ b -1/4\ b\ )\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2 - x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x -1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

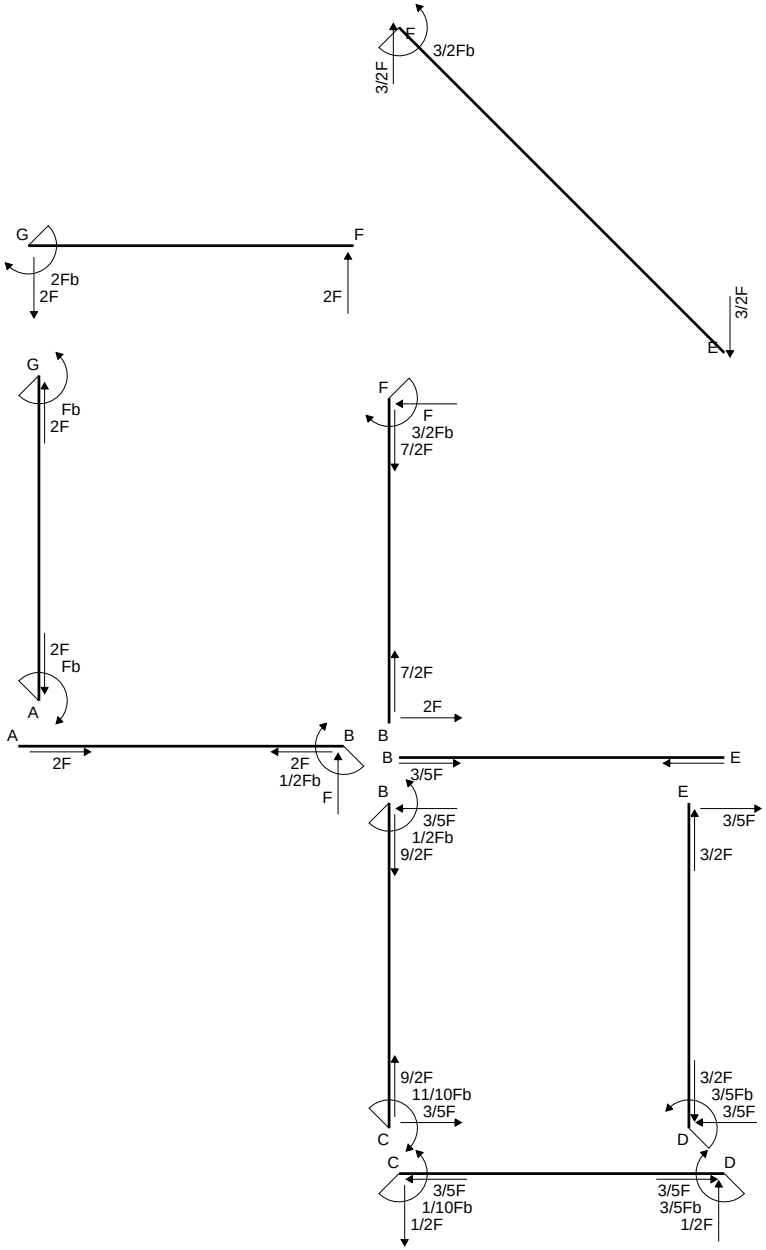
$= (1/6\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

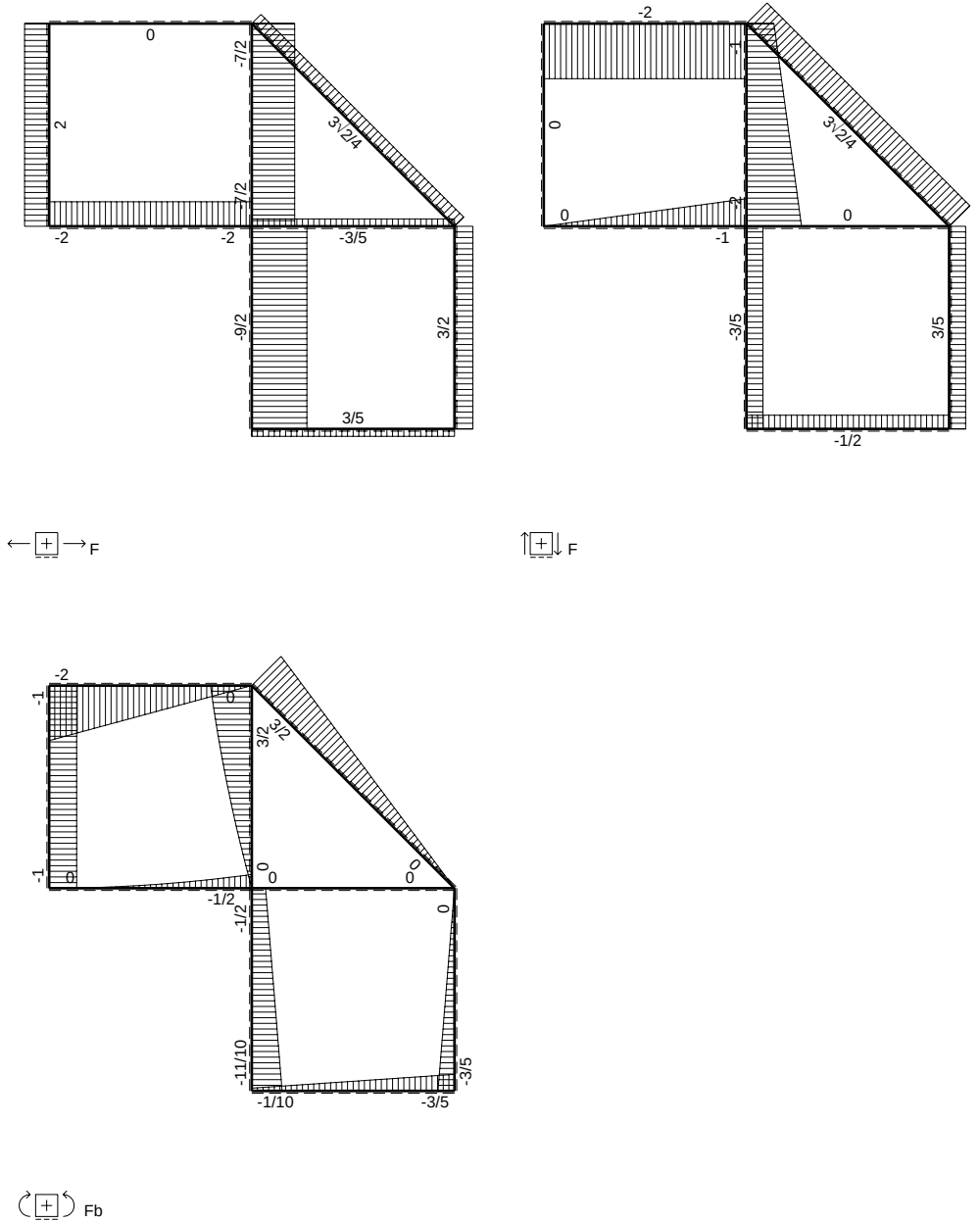


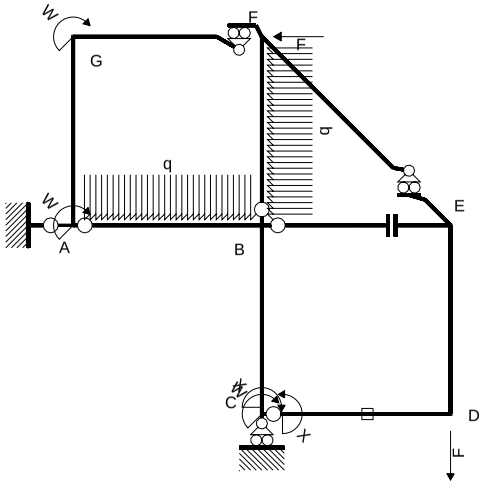
A = 158.4 mm^2
J_u = 87739. mm^4
J_v = 7969. mm^4
J_t = 130.8 mm^4
y_o = -9.881 mm
y_g = 23.93 mm
T_y = -720. N
M_x = -655200. Nmm
x_m = 5. mm
y_m = 54. mm
u_m = -12. mm
v_m = 30.07 mm
$\sigma_m = -Mv/J_u$ = 224.5 N/mm^2
x_c = 17. mm
y_c = 54. mm
v_c = 30.07 mm
$\sigma_c = -Mv/J_u$ = 224.5 N/mm^2
$\tau_c = TS^*/tJ_u$ = 10.66 N/mm^2
$\tau_g = TS^*/tJ_u$ = 10.66 N/mm^2
t_c = 360. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 225.3 N/mm^2

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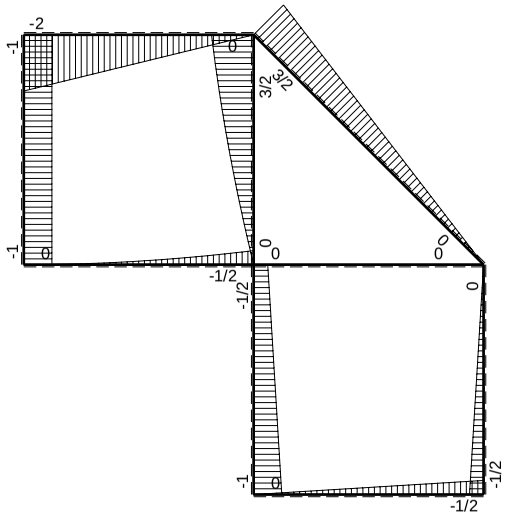
@ Adolfo Zavelani Rossi, Politecnico di Milano, vers.27.03.13 16.04.26


F
3/2Fb
3/2F
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2Fb
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7/2F
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Fb
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7/2F
2F
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B
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1/2Fb
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3/5F
B
E
3/5F
3/5F
1/2Fb
9/2F
3/2F
9/2F
11/10Fb
3/5F
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3/5Fb
1/2F

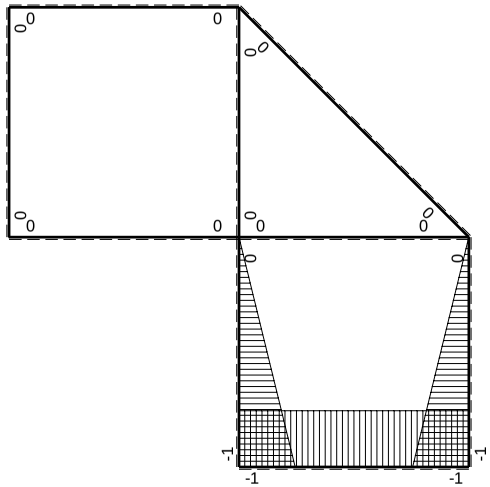

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3√2/4
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1
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3√2/4
0
2
0
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-3/5
3/5
-1/2
F
F
-2
-1
0
3/2
3√2/2
-1
0
0
0
0
-1/2
-1/2
0
-11/10
-3/5
-1/10
-3/5
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-1/2qx^2$	0	0	0	0
BA b	0	$1/2Fb-Fx+1/2qx^2$	0	0		
BC b	-x/b	-1/2Fb-1/2Fx	$1/2Fx+1/2Fx^2/b$	x^2/b^2	$5/12Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb-1/2Fx	$Fb-3/2Fx+1/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	-1/2Fx	1/2Fx	1	$1/4Fb^2/EJ$	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE 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
ED b	x/b	1/2Fx	$1/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	$3/2Fb-Fx-1/2qx^2$	0	0	0	0
BF b	0	$-2Fx+1/2qx^2$	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/6Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				1/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2\ )\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (1/2\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b +1/6\ b\ )\ Fb\ 1/EJ\ = 5/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -3/2\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x -3/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -3/4\ b +1/6\ b\ )\ Fb\ 1/EJ\ = 5/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (1/2\ x/b\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = [1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (1/4\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -3/4\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (1/2 -1/2\ x/b\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = [1/2\ x -1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/E$

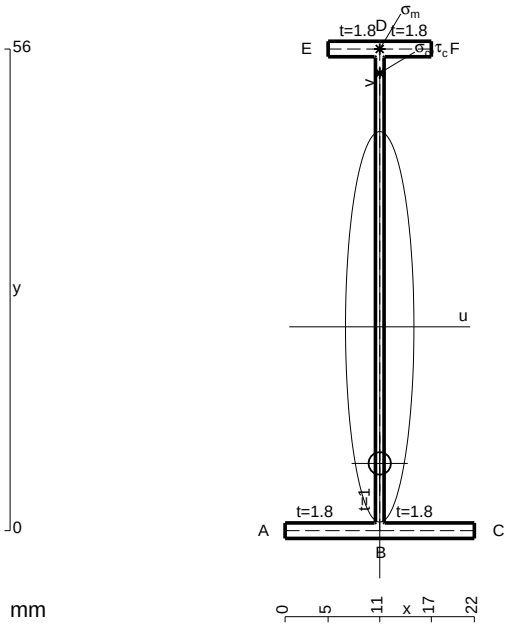
$= (1/2\ b -1/4\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -3/4\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2 - x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x -1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = 1/6\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

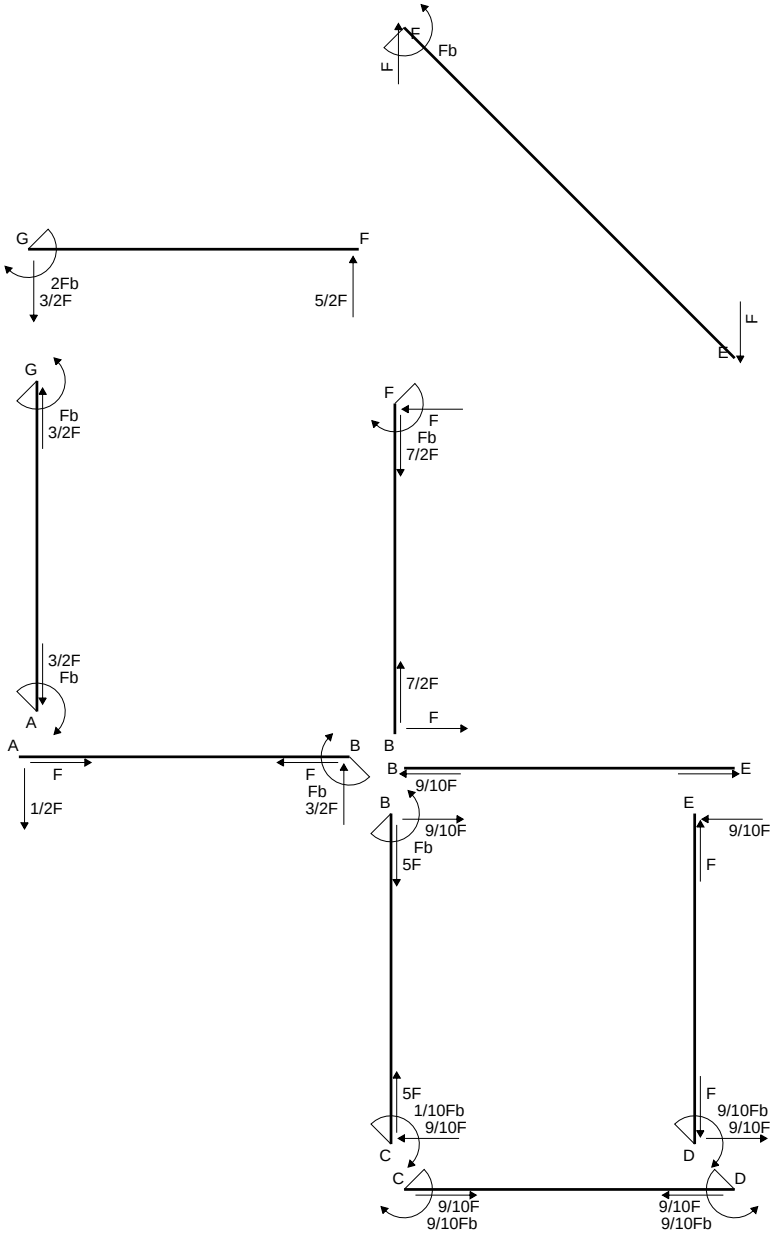
$= (1/6\ b\ )\ Fb\ 1/EJ\ = 1/6\ \ Fb^2/EJ$

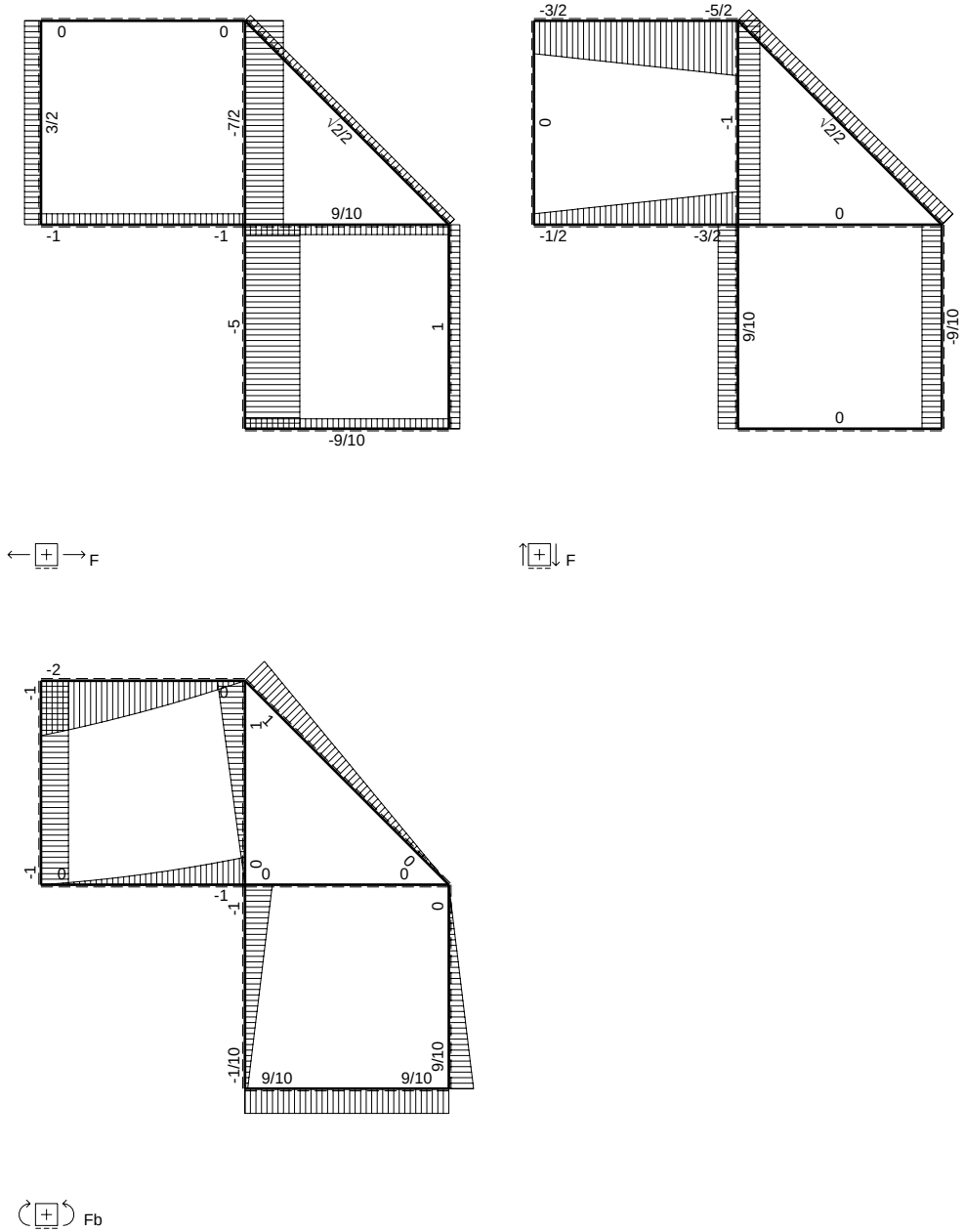


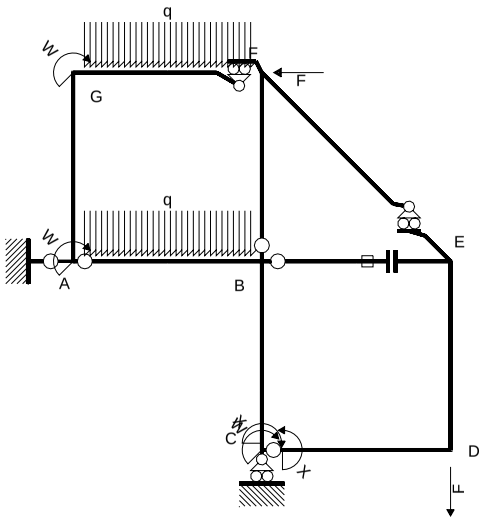
A = 117.2 mm^2
J_u = 60448. mm^4
J_v = 1856. mm^4
J_t = 84.76 mm^4
y_o = -15.88 mm
y_g = 23.7 mm
T_y = -440. N
M_x = -440000. Nmm
x_m = 11. mm
y_m = 56. mm
v_m = 32.3 mm
$\sigma_m = -Mv/J_u$ = 235.1 N/mm^2
y_c = 2. mm
u_c = -11. mm
v_c = -21.7 mm
$\sigma_c = -Mv/J_u$ = 235.1 N/mm^2
$\tau_c = TS^*/tJ_u$ = 5.078 N/mm^2
$\tau_g = TS^*/tJ_u$ = 5.078 N/mm^2
t_c = 220. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 235.3 N/mm^2

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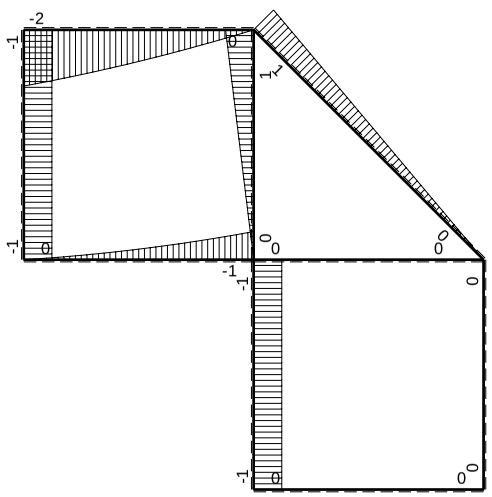
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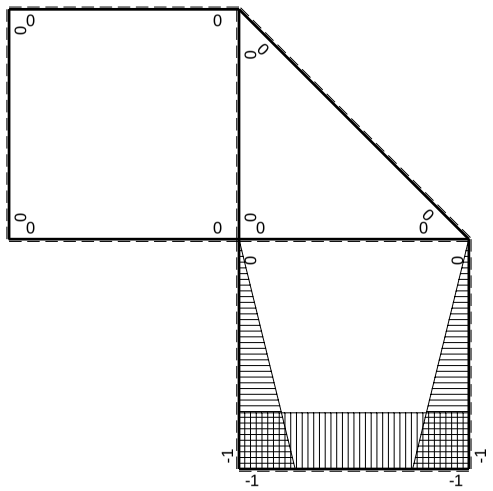

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-3/2
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9/10
-9/10
0
F
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0
1
1
-1
0
0
0
0
-1
-1
0
-1/10
9/10
9/10
9/10
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-1/2Fx-1/2qx^2$	0	0	0	0
BA b	0	$Fb-3/2Fx+1/2qx^2$	0	0		
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb	Fb-Fx	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	0	0	x^2/b^2		
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-5/2Fx+1/2qx^2$	0	0	0	0
GF b	0	$2Fb-3/2Fx-1/2qx^2$	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$3/2Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				-9/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

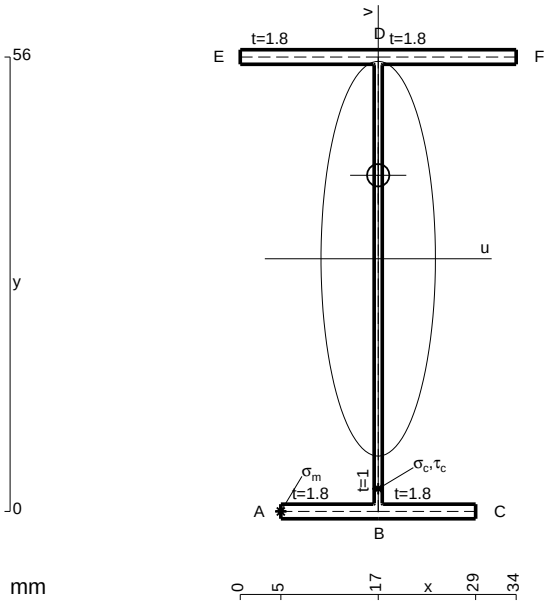
$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (x/b)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b)\ Fb\ 1/EJ\ = 1/2\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x/b)\ Fb\ 1/EJ\ dx = [\ x -1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

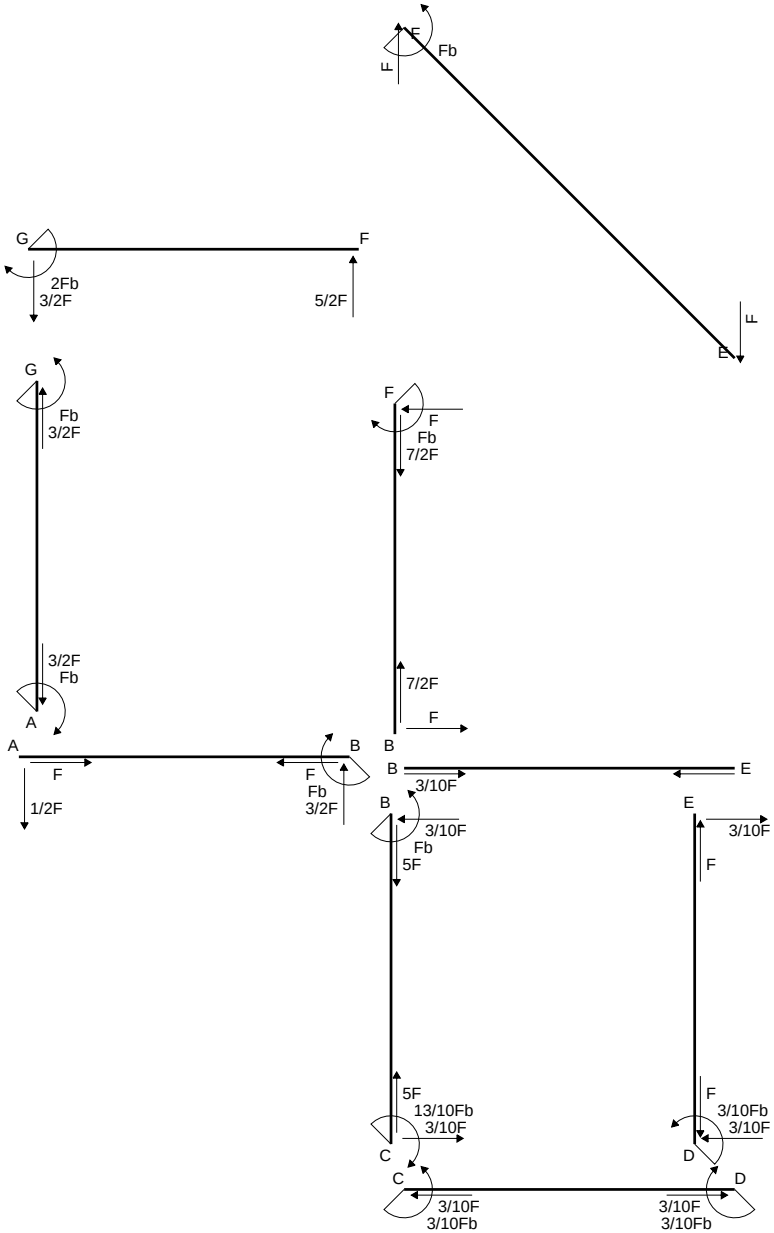
$= (\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 1/2\ \ Fb^2/EJ$

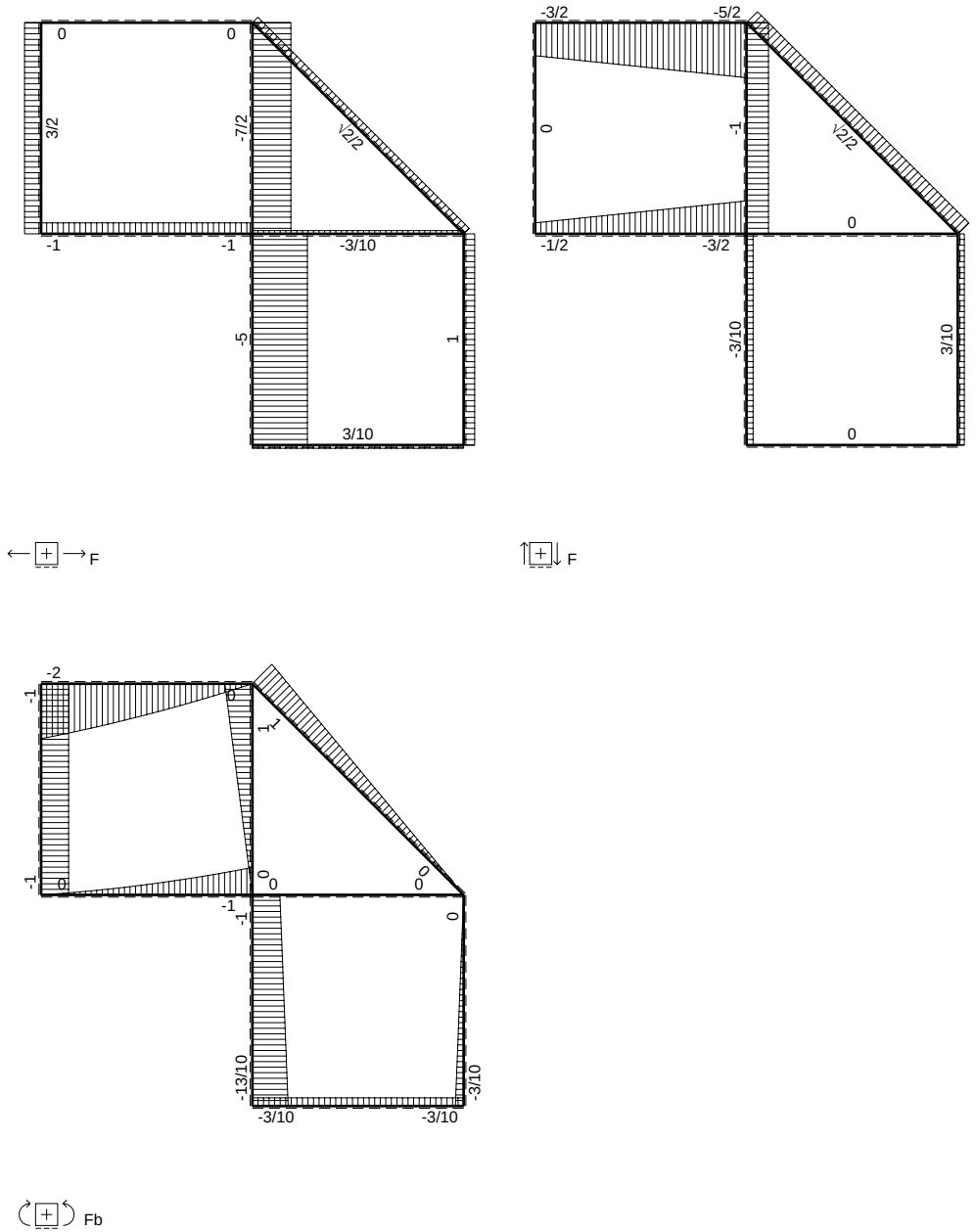


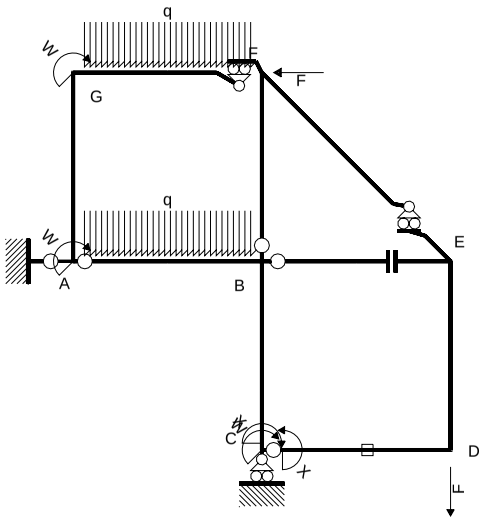
A = 160.4 mm^2
J_u = 94901. mm^4
J_v = 7969. mm^4
J_t = 131.4 mm^4
y_o = 10.29 mm
y_g = 31.14 mm
T_y = -855. N
M_x = -604200. Nmm
x_m = 5. mm
u_m = -12. mm
v_m = -31.14 mm
$\sigma_m = -Mv/J_u$ = -198.3 N/mm^2
x_c = 17. mm
v_c = -31.14 mm
$\sigma_c = -Mv/J_u$ = -198.3 N/mm^2
$\tau_c = TS^*/tJ_u$ = 12.12 N/mm^2
$\tau_g = TS^*/tJ_u$ = 12.12 N/mm^2
t_c = 570. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 199.4 N/mm^2

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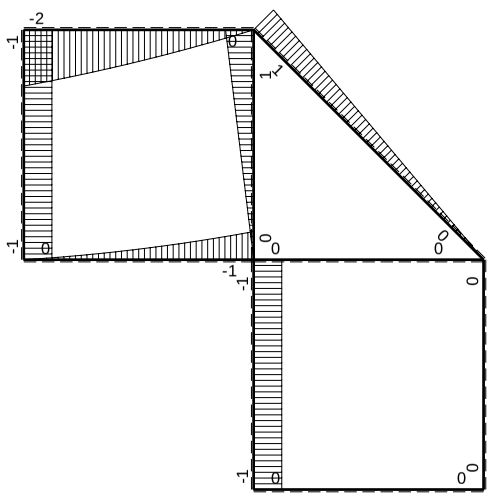
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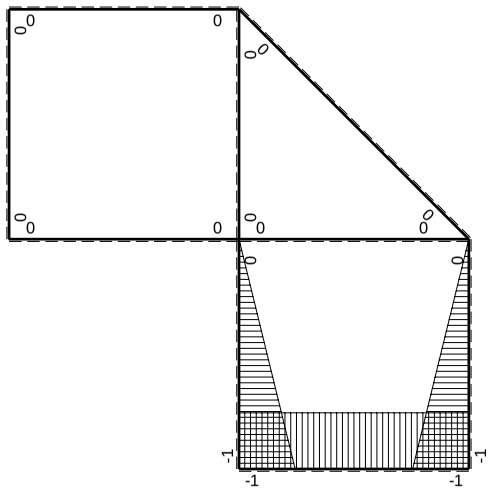

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Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-1/2Fx-1/2qx^2$	0	0	0	0
BA b	0	$Fb-3/2Fx+1/2qx^2$	0	0		
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb	Fb-Fx	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE b	-1+x/b	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	0	0	x^2/b^2		
EF $\sqrt{2}b$	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	$-5/2Fx+1/2qx^2$	0	0	0	0
GF b	0	$2Fb-3/2Fx-1/2qx^2$	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/2Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				3/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 - 2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b + 1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b + 1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 - 2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b + 1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b + 1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

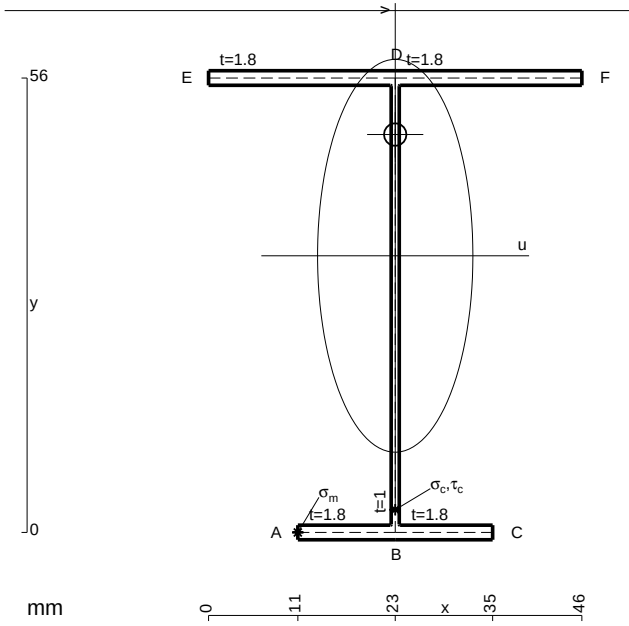
$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (x/b)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b)\ Fb\ 1/EJ\ = 1/2\ \ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x/b)\ Fb\ 1/EJ\ dx = [\ x - 1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

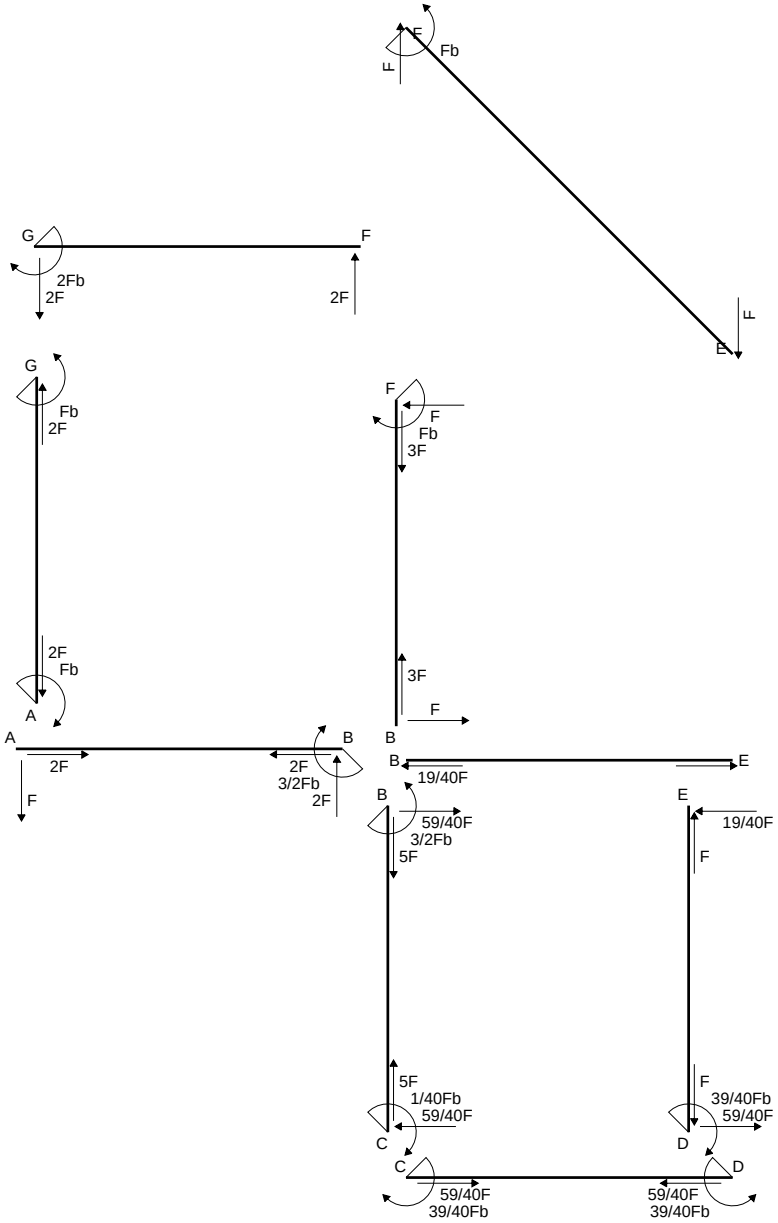
$= (\ b - 1/2\ b\ )\ Fb\ 1/EJ\ = 1/2\ \ Fb^2/EJ$

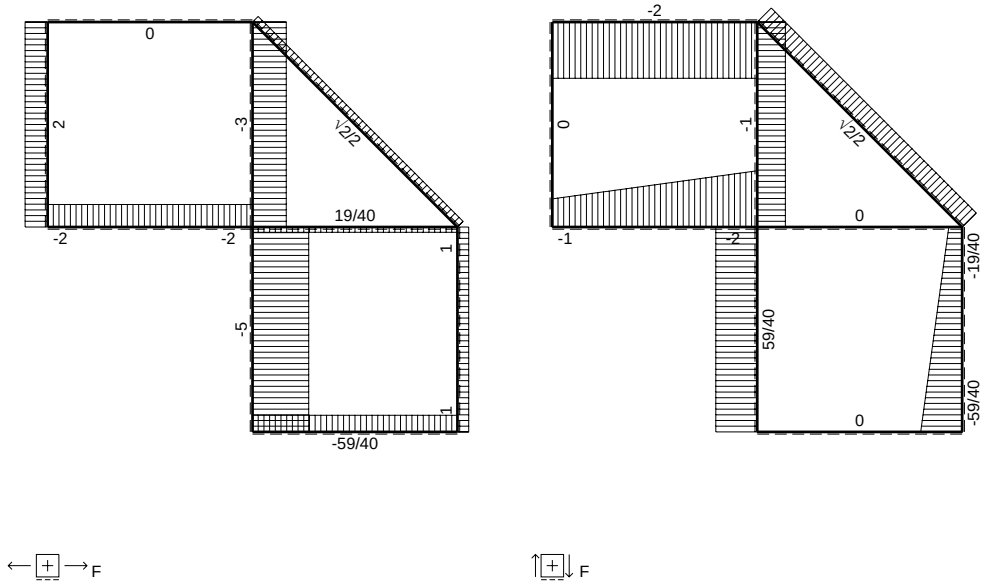


A = 182. mm^2
J_u = 106664. mm^4
J_v = 16674. mm^4
J_t = 154.7 mm^4
y_o = 14.94 mm
y_g = 34.09 mm
T_y = -840. N
M_x = -649600. Nmm
x_m = 11. mm
u_m = -12. mm
v_m = -34.09 mm
$\sigma_m = -Mv/J_u$ = -207.6 N/mm^2
x_c = 23. mm
v_c = -34.09 mm
$\sigma_c = -Mv/J_u$ = -207.6 N/mm^2
$\tau_c = TS^*/tJ_u$ = 11.6 N/mm^2
$\tau_g = TS^*/tJ_u$ = 11.6 N/mm^2
t_c = 560. mm
$\sigma_o = \sqrt{\sigma^2 + 3\tau^2}$ = 208.6 N/mm^2

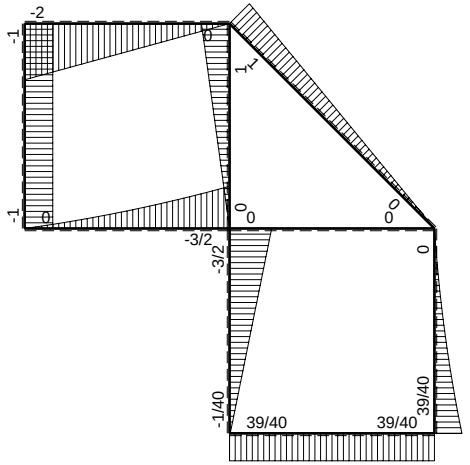
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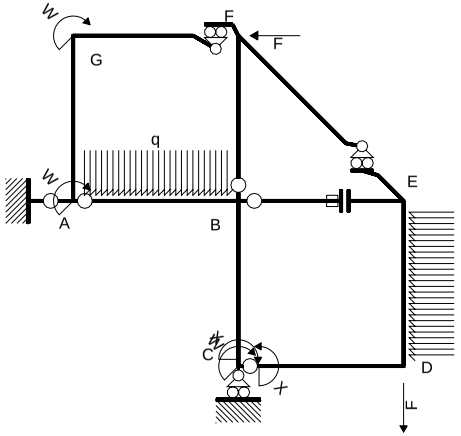

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3/2Fb
19/40F
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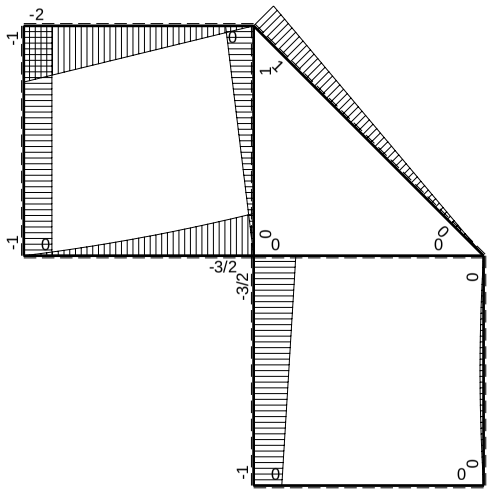
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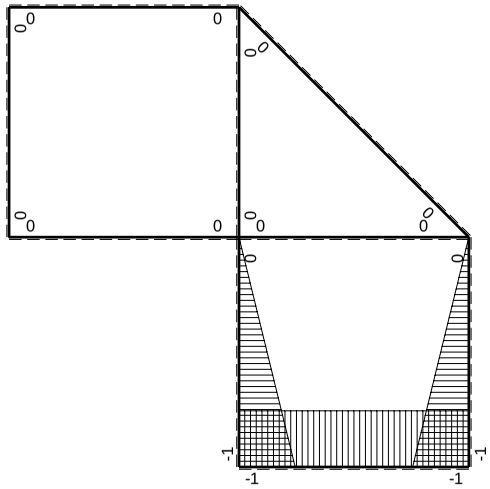
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-Fx-1/2qx^2$	0	0	0	0
BA b	0	$3/2Fb-2Fx+1/2qx^2$	0	0		
BC b	-x/b	$-3/2Fb+1/2Fx$	$3/2Fx-1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	$Fb+1/2Fx$	$Fb-1/2Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE 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
ED b	x/b	$1/2Fx-1/2qx^2$	$1/2Fx^2/b-1/2qx^3/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$13/8Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-39/40Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b)\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

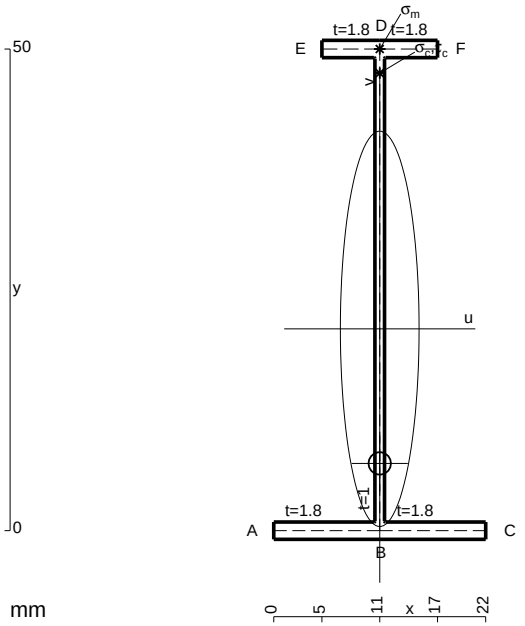
$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2\ x/b - x^2/b^2 +1/2\ x^3/b^3)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/3\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b -1/3\ b +1/8\ b)\ Fb\ 1/EJ\ = 1/24\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x^2/b^2 -1/2\ x^3/b^3)\ Fb\ 1/EJ\ dx = [1/6\ x^3/b^2 -1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

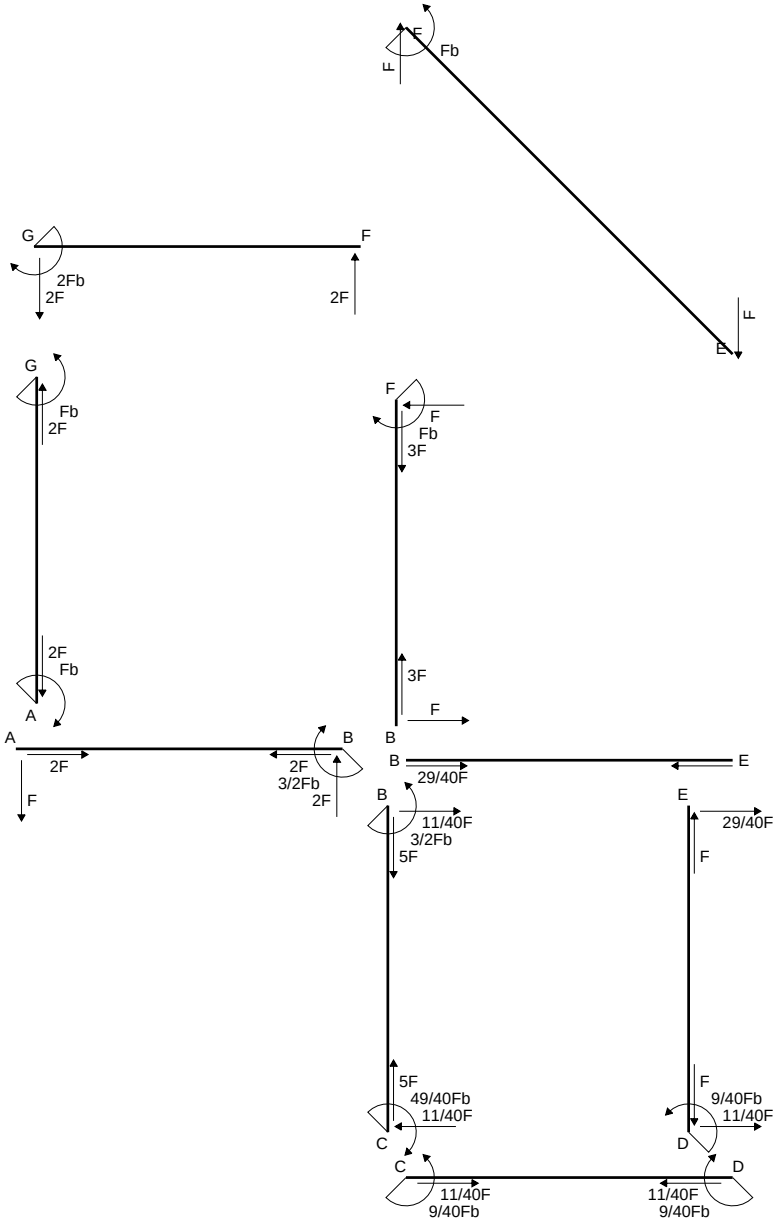
$= (1/6\ b -1/8\ b)\ Fb\ 1/EJ\ = 1/24\ Fb^2/EJ$

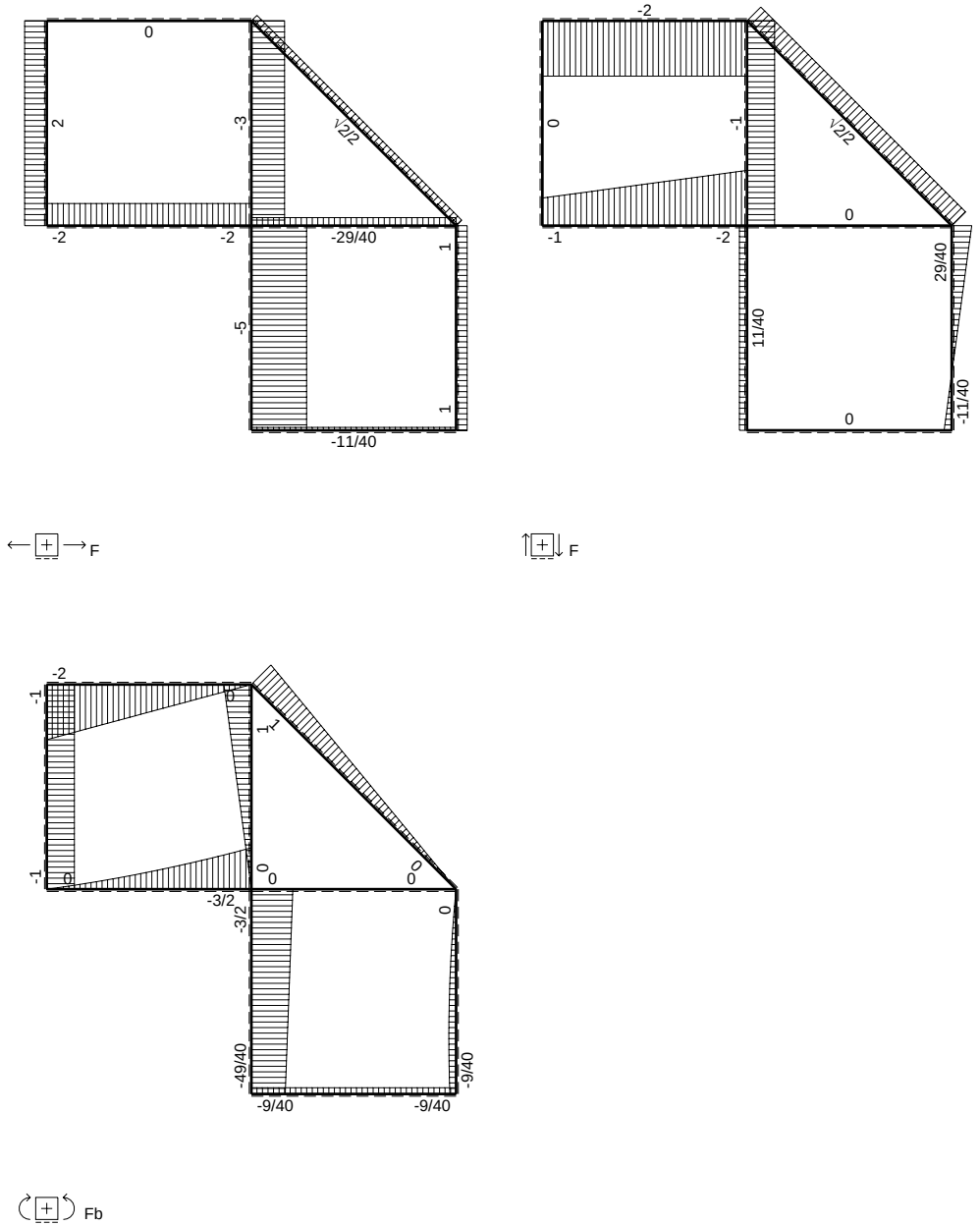


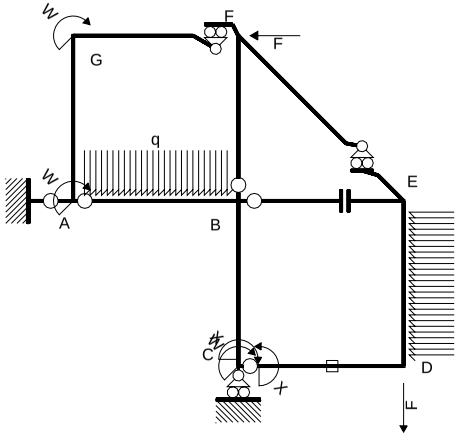
A = 111.2 mm^2
J_u = 46846. mm^4
J_v = 1856. mm^4
J_t = 82.76 mm^4
y_o = -13.97 mm
y_g = 20.95 mm
T_y = -620. N
M_x = -347200. Nmm
x_m = 11. mm
y_m = 50. mm
v_m = 29.05 mm
$\sigma_m = -Mv/J_u$ = 215.3 N/mm^2
y_c = 2. mm
u_c = -11. mm
v_c = -18.95 mm
$\sigma_c = -Mv/J_u$ = 215.3 N/mm^2
$\tau_c = TS^*/tJ_u$ = 8.304 N/mm^2
$\tau_g = TS^*/tJ_u$ = 8.304 N/mm^2
t_c = 310. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 215.8 N/mm^2

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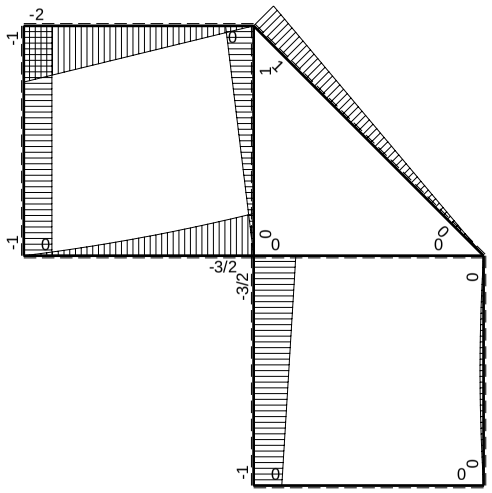
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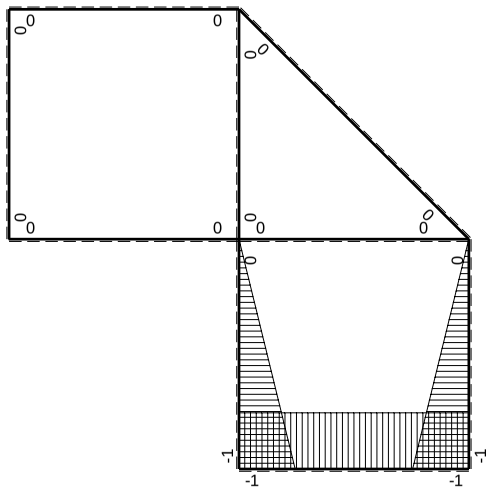

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-1
-2
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29/40
11/40
0
-11/40
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0
-49/40
-9/40
-9/40
-9/40
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_o(x)$	M_xM_o	M_xM_x	$\int M_xM_o/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-Fx-1/2qx^2$	0	0	0	0
BA b	0	$3/2Fb-2Fx+1/2qx^2$	0	0		
BC b	-x/b	$-3/2Fb+1/2Fx$	$3/2Fx-1/2Fx^2/b$	x^2/b^2	$7/12Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	$Fb+1/2Fx$	$Fb-1/2Fx-1/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	0	0	1	0	Xb/EJ
DC b	1	0	0	1		
DE 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
ED b	x/b	$1/2Fx-1/2qx^2$	$1/2Fx^2/b-1/2qx^3/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$\sqrt{2}/2Fx$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	Fb-Fx	0	0	0	0
BF b	0	-Fx	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-3/8Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				9/40Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [3/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (3/4\ b -1/6\ b)\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -1/2\ x/b -1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -1/4\ x^2/b -1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/4\ b -1/6\ b\ )\ Fb\ 1/EJ\ = 7/12\ Fb^2/EJ$

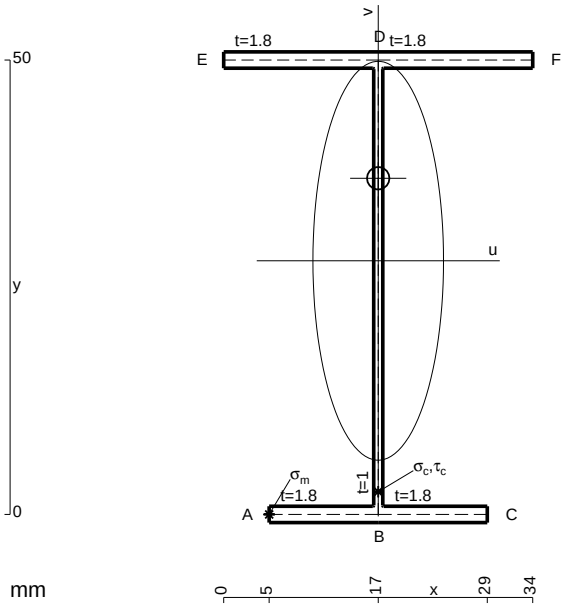
$L^{Xo}_{DE} = \int_o^b (1/2\ x/b - x^2/b^2 +1/2\ x^3/b^3)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b -1/3\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b -1/3\ b +1/8\ b\ )\ Fb\ 1/EJ\ = 1/24\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x^2/b^2 -1/2\ x^3/b^3)\ Fb\ 1/EJ\ dx = [1/6\ x^3/b^2 -1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (1/6\ b -1/8\ b\ )\ Fb\ 1/EJ\ = 1/24\ Fb^2/EJ$

PROCEDIMENTO E RISULTATI 275579 CI02.xxxx.173

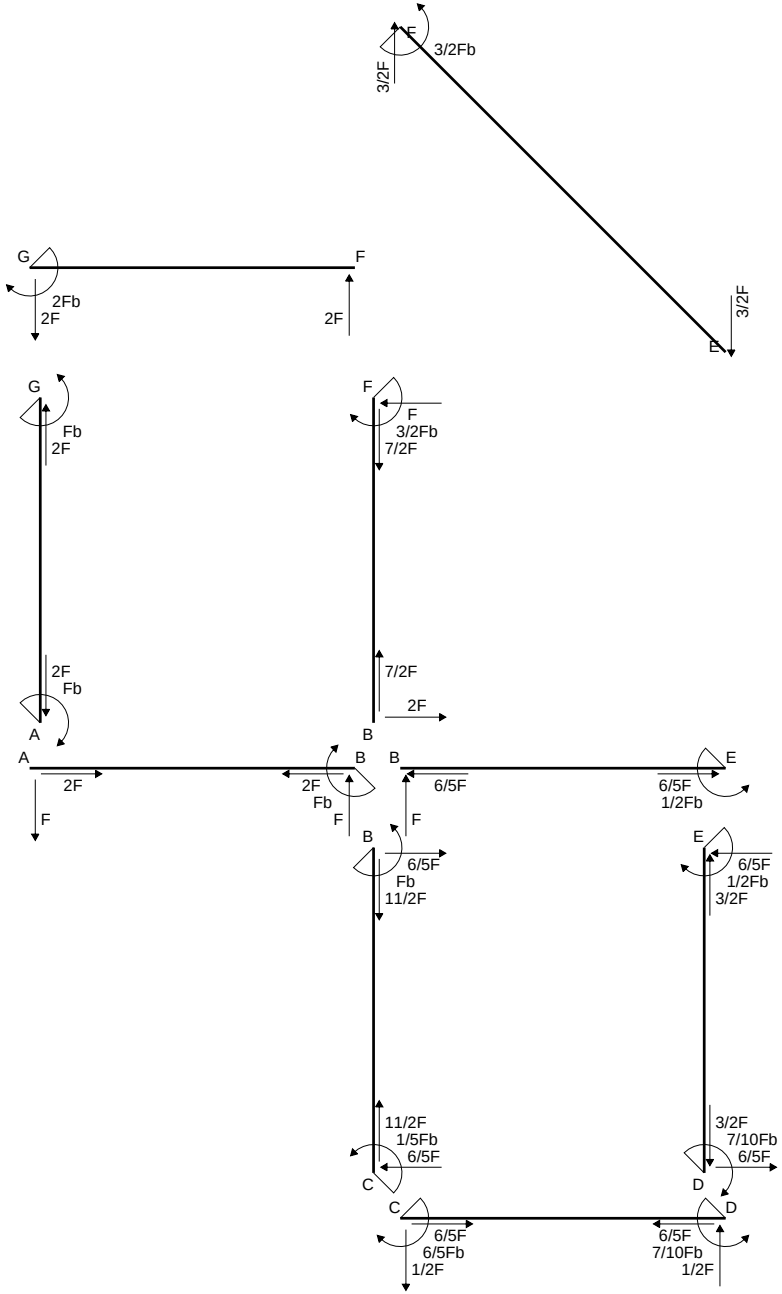


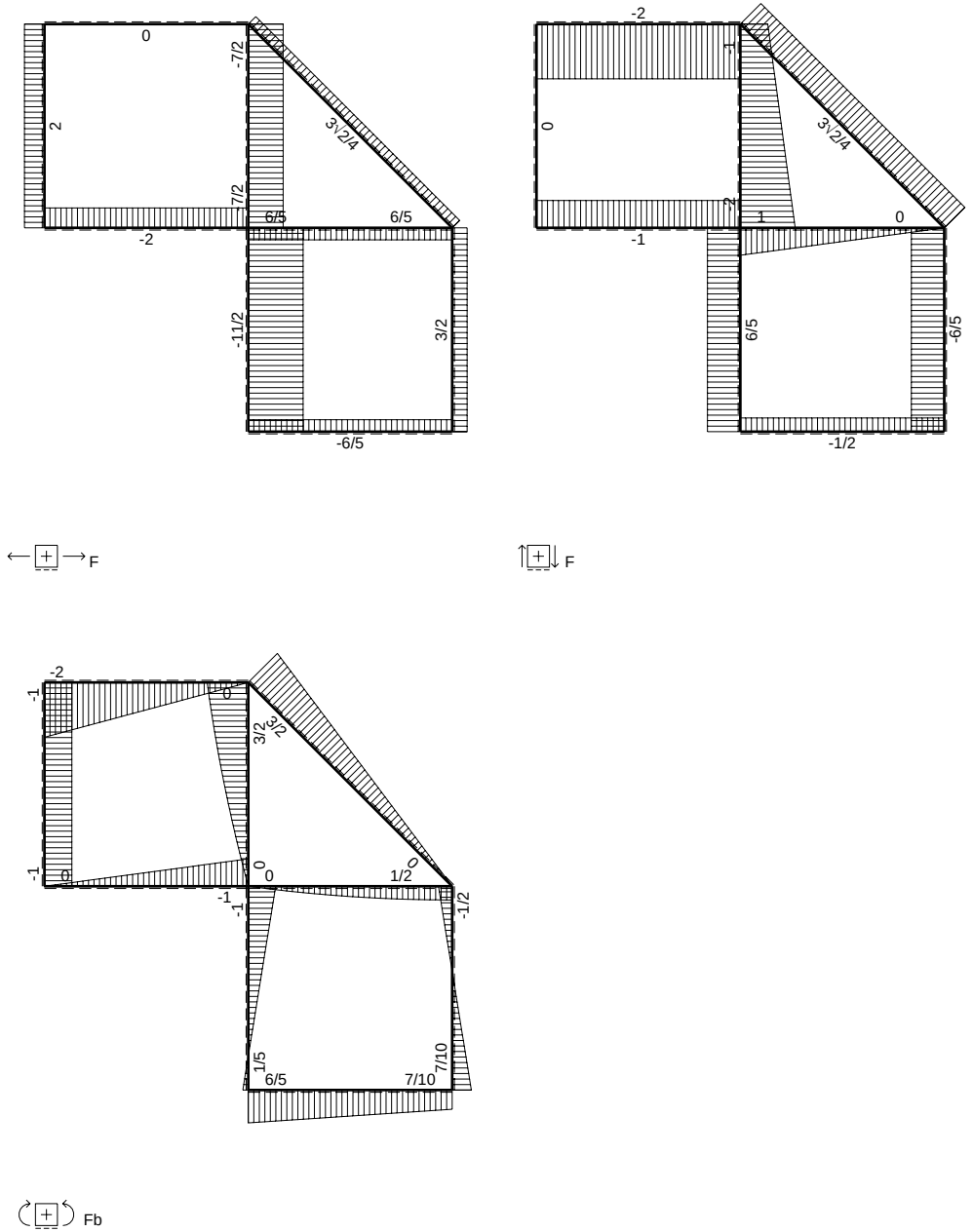
A = 154.4 mm^2
J_u = 74355. mm^4
J_v = 7969. mm^4
J_t = 129.4 mm^4
y_o = 9.075 mm
y_g = 27.91 mm
T_y = -1000. N
M_x = -610000. Nmm
x_m = 5. mm
u_m = -12. mm
v_m = -27.91 mm
$\sigma_m = -Mv/J_u$ = -229. N/mm^2
x_c = 17. mm
v_c = -27.91 mm
$\sigma_c = -Mv/J_u$ = -229. N/mm^2
$\tau_c = TS^*/tJ_u$ = 16.22 N/mm^2
$\tau_g = TS^*/tJ_u$ = 16.22 N/mm^2
t_c = 500. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 230.7 N/mm^2

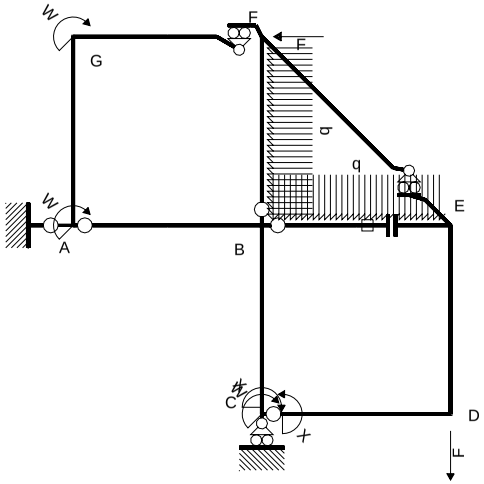
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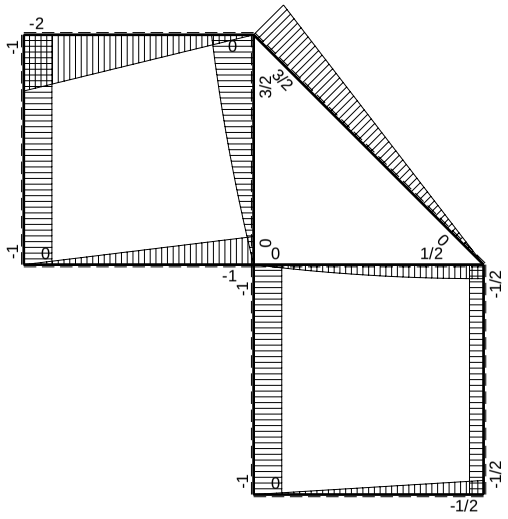
@ Adolfo Zavelani Rossi, Politecnico di Milano, vers.27.03.13 16.04.26


E
3/2Fb
3/2F
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2Fb
2F
2F
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7/2F
2F
Fb
7/2F
2F
A
B
A
B
B
E
2F
2F
Fb
6/5F
6/5F
1/2Fb
F
F
B
E
6/5F
Fb
11/2F
6/5F
1/2Fb
3/2F
11/2F
1/5Fb
6/5F
3/2F
7/10Fb
6/5F
C
D
C
D
6/5F
6/5Fb
1/2F
6/5F
7/10Fb
1/2F

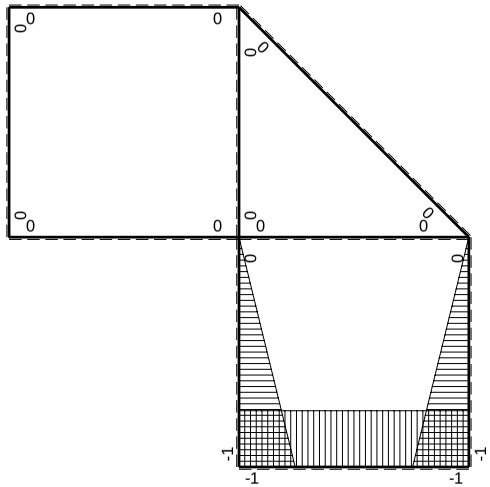

0
-7/2
2
3√2/4
7/2
6/5
6/5
-2
-11/2
3/2
-6/5
F
-2
1
0
3√2/4
2
1
0
-1
6/5
-6/5
-1/2
F
-2
-1
0
3/2
3√2/2
-1
0
0
1/2
0
-1
-1
-1/2
1/5
6/5
7/10
7/10
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-Fx	0	0	0	0
BA b	0	Fb-Fx	0	0		
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb	Fb-Fx	$1-2x/b+x^2/b^2$		
CD b	-1	-1/2Fx	1/2Fx	1	$1/4Fb^2/EJ$	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE b	-1+x/b	-1/2Fb	1/2Fb-1/2Fx	$1-2x/b+x^2/b^2$	$1/4Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	1/2Fb	1/2Fx	x^2/b^2		
EF $\sqrt{2}$b	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	$3/2Fb-Fx-1/2qx^2$	0	0	0	0
BF b	0	$-2Fx+1/2qx^2$	0	0		
BE b	0	$Fx-1/2qx^2$	0	0	0	0
EB b	0	$-1/2Fb+1/2qx^2$	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$2Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				-6/5Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (x/b)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b)\ Fb\ 1/EJ\ = 1/2\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x/b)\ Fb\ 1/EJ\ dx = [\ x -1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 1/2\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (1/2\ x/b)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b)\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (1/2 -1/2\ x/b)\ Fb\ 1/EJ\ dx = [1/2\ x -1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

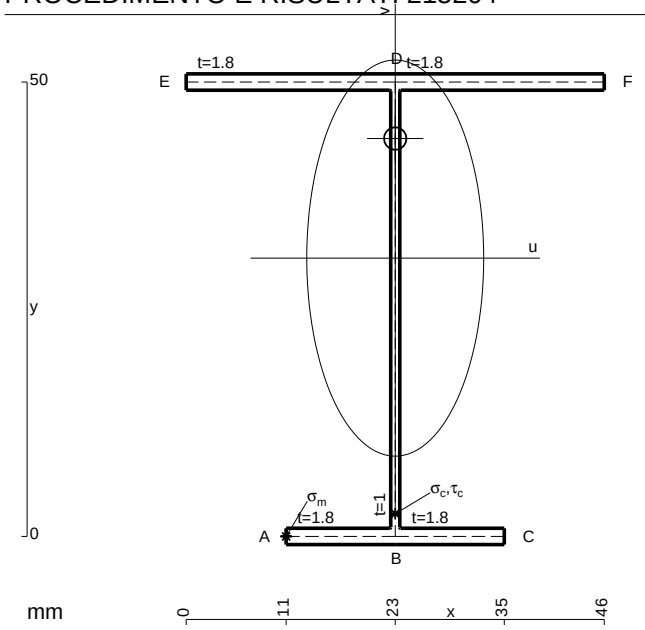
$= (1/2\ b -1/4\ b\ )\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2 -1/2\ x/b)\ Fb\ 1/EJ\ dx = [1/2\ x -1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/4\ b\ )\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x/b)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

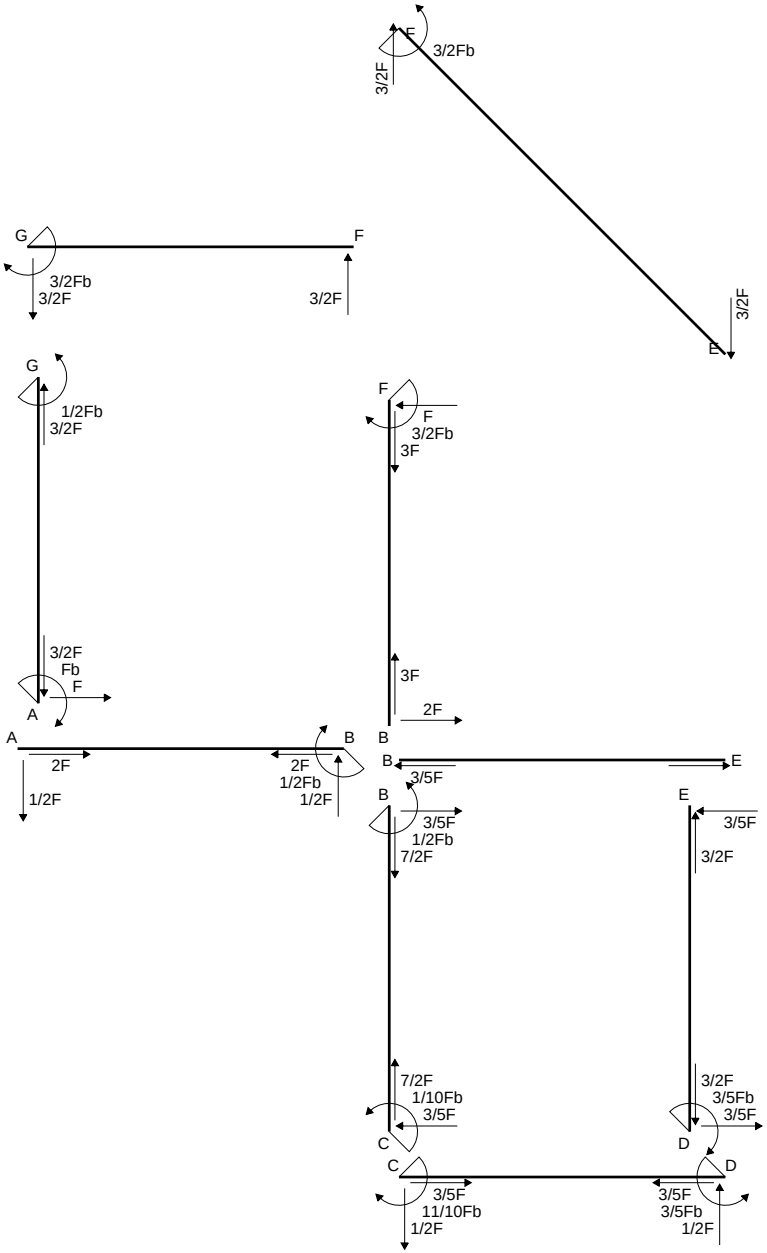
$= (1/4\ b)\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

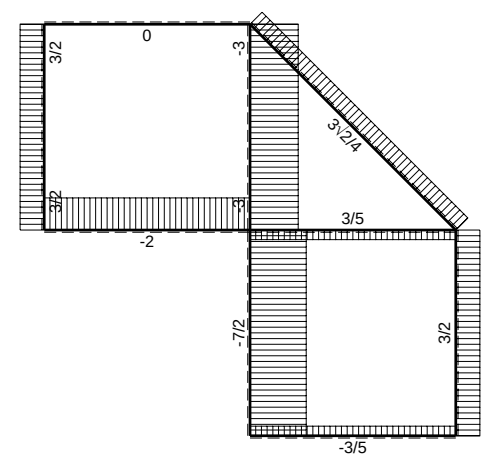


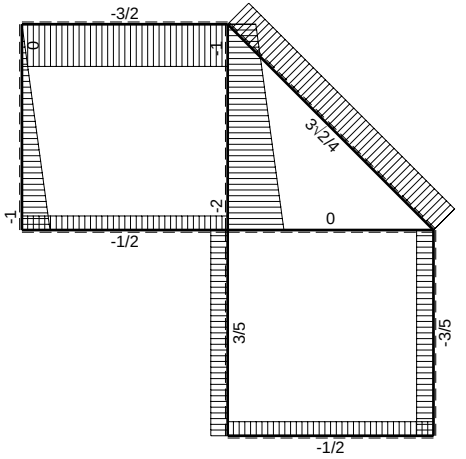
A = 176. mm^2
J_u = 83598. mm^4
J_v = 16674. mm^4
J_t = 152.7 mm^4
y_o = 13.16 mm
y_g = 30.63 mm
T_y = -1000. N
M_x = -650000. Nmm
x_m = 11. mm
u_m = -12. mm
v_m = -30.63 mm
$\sigma_m = -Mv/J_u$ = -238.1 N/mm^2
x_c = 23. mm
v_c = -30.63 mm
$\sigma_c = -Mv/J_u$ = -238.1 N/mm^2
$\tau_c = TS^*/tJ_u$ = 15.83 N/mm^2
$\tau_g = TS^*/tJ_u$ = 15.83 N/mm^2
t_c = 500. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 239.7 N/mm^2

CI02.xxxx.174

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E
3/2Fb
3/2F
G
F
3/2Fb
3/2F
3/2F
E
G
1/2Fb
3/2F
F
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3/2Fb
3F
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Fb
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1/2Fb
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3/2F
7/2F
1/10Fb
3/5F
3/2F
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D
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3/5Fb
1/2F

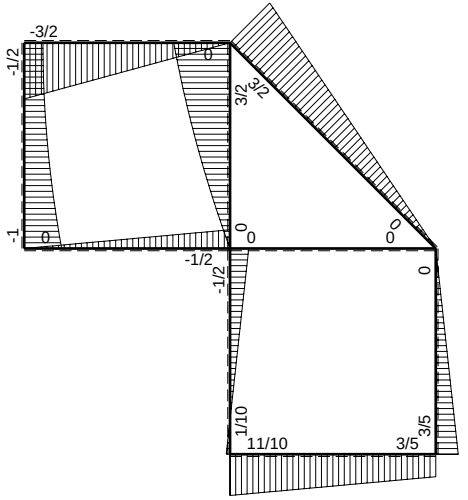

3/2
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3√2/4
3/2
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3/5
-7/2
3/2
-3/5


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-1
3√2/4
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-2
0
-1/2
3/5
-3/5
-1/2

F

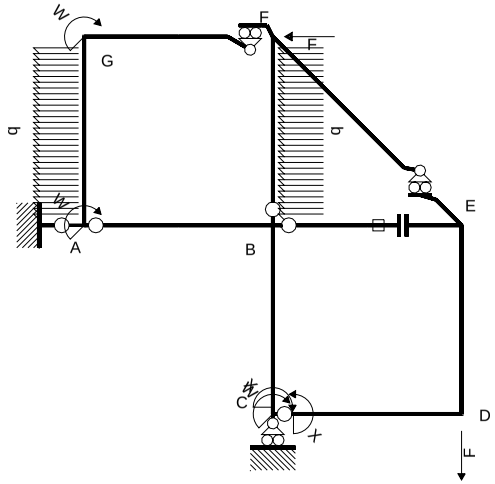


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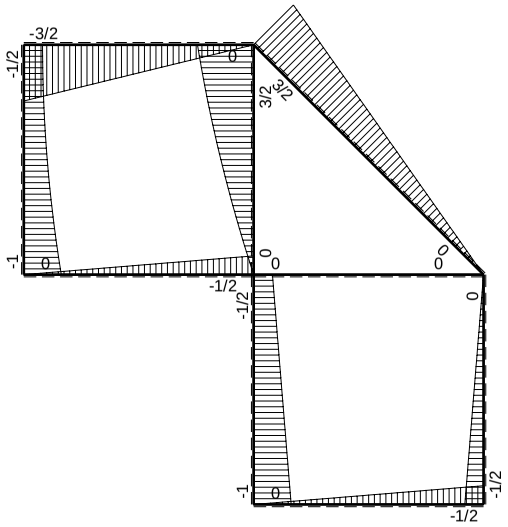

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0
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11/10
3/5
3/5



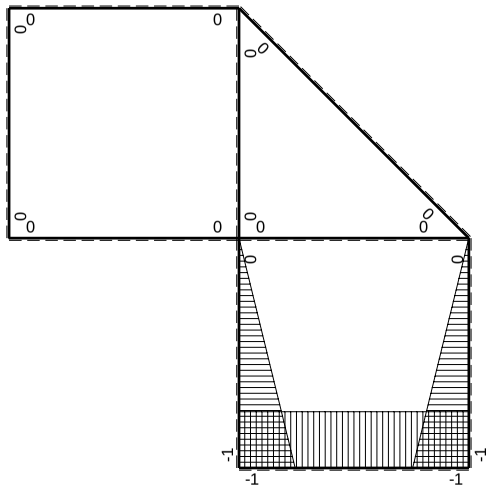
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-1/2Fx	0	0	0	0
BA b	0	1/2Fb-1/2Fx	0	0		
BC b	-x/b	-1/2Fb-1/2Fx	1/2Fx+1/2Fx^2/b	x^2/b^2	5/12Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb-1/2Fx	Fb-3/2Fx+1/2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb^2/EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE 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
ED b	x/b	1/2Fx	1/2Fx^2/b	x^2/b^2		
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-3/2Fx	0	0	0	0
GF b	0	3/2Fb-3/2Fx	0	0		
GA b	0	-1/2Fb-1/2qx^2	0	0	0	0
AG b	0	Fb-Fx+1/2qx^2	0	0		
FB b	0	3/2Fb-Fx-1/2qx^2	0	0	0	0
BF b	0	-2Fx+1/2qx^2	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				11/6Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-11/10Fb	

Sviluppi di calcolo iperstatica

PROCEDIMENTO E RISULTATI 265726 CI02.xxxx.175

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$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (1/2\ x/b +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b +1/6\ b)\ Fb\ 1/EJ\ = 5/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -3/2\ x/b +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -3/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -3/4\ b +1/6\ b)\ Fb\ 1/EJ\ = 5/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (1/2\ x/b)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b)\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (1/2 -1/2\ x/b)\ Fb\ 1/EJ\ dx = [1/2\ x -1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

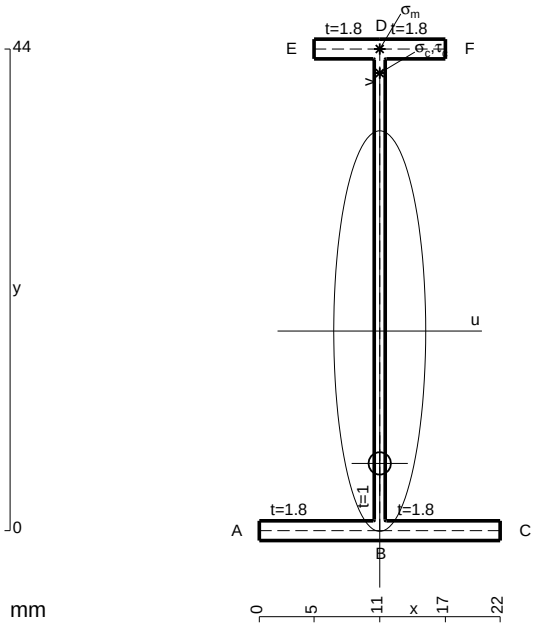
$= (1/2\ b -1/4\ b)\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2 - x/b +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/2\ x -1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/2\ b +1/6\ b)\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

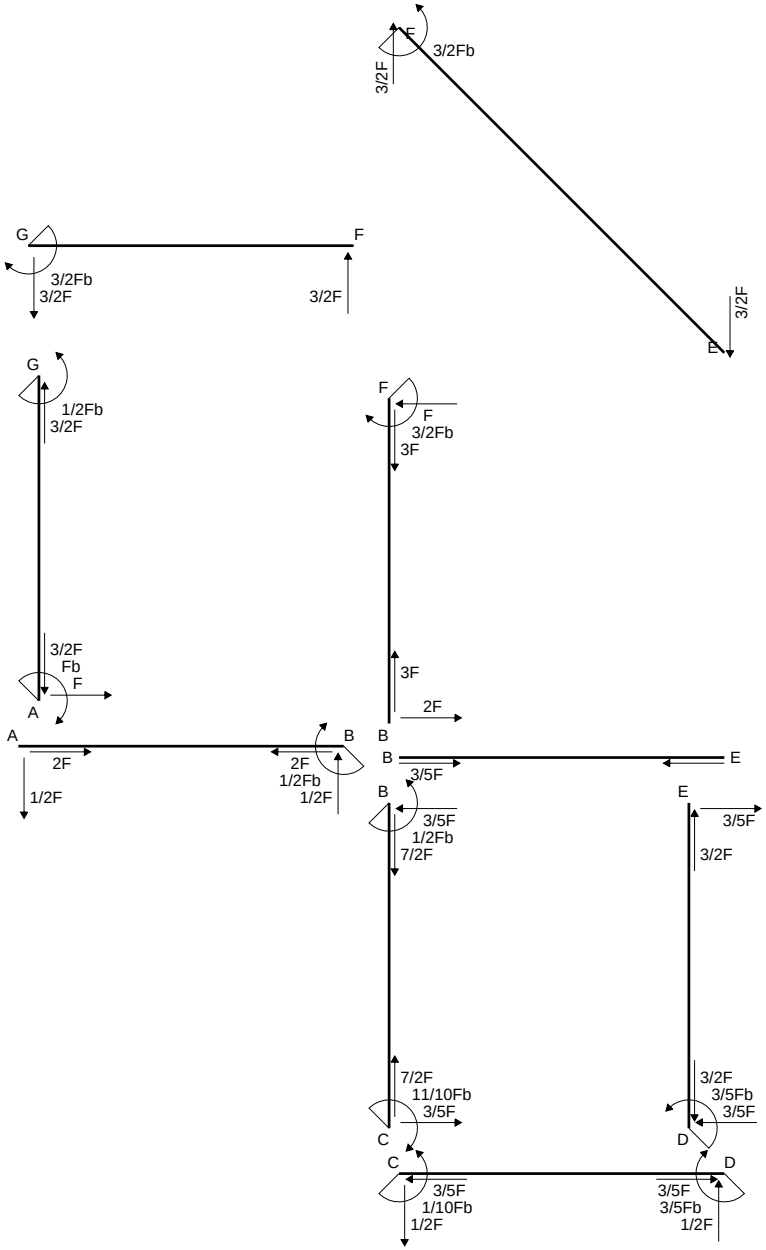
$= (1/6\ b)\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

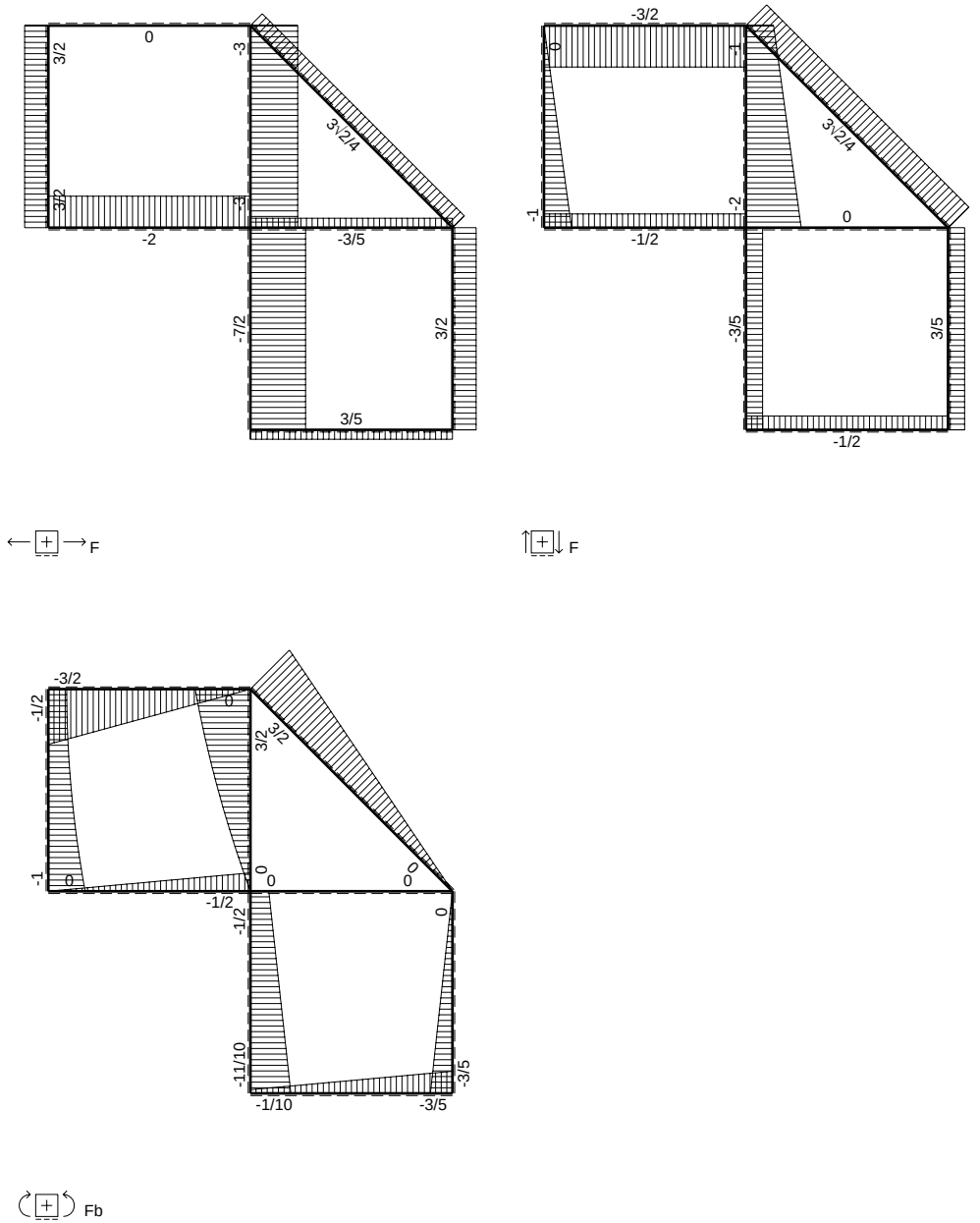


A = 105.2 mm^2
J_u = 35229. mm^4
J_v = 1856. mm^4
J_t = 80.76 mm^4
y_o = -12.09 mm
y_g = 18.24 mm
T_y = -420. N
M_x = -264600. Nmm
x_m = 11. mm
y_m = 44. mm
v_m = 25.76 mm
$\sigma_m = -Mv/J_u$ = 193.5 N/mm^2
y_c = 2. mm
u_c = -11. mm
v_c = -16.24 mm
$\sigma_c = -Mv/J_u$ = 193.5 N/mm^2
$\tau_c = TS^*/tJ_u$ = 6.635 N/mm^2
$\tau_g = TS^*/tJ_u$ = 6.635 N/mm^2
t_c = 280. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 193.9 N/mm^2

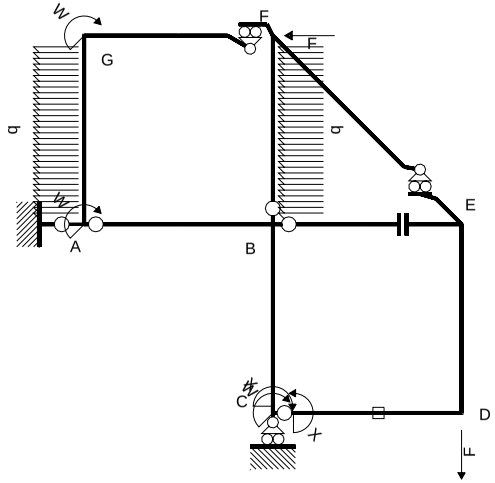
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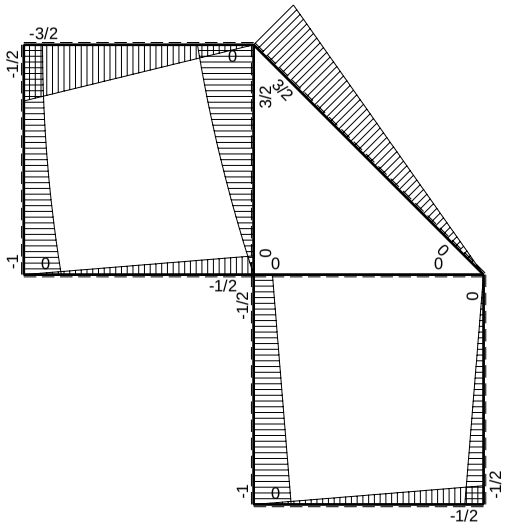




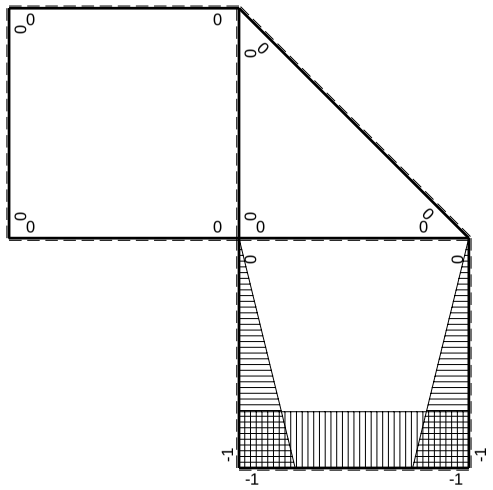
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Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

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Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-1/2Fx	0	0	0	0
BA b	0	1/2Fb-1/2Fx	0	0		
BC b	-x/b	-1/2Fb-1/2Fx	1/2Fx+1/2Fx^2/b	x^2/b^2	5/12Fb^2/EJ	1/3Xb/EJ
CB b	1-x/b	Fb-1/2Fx	Fb-3/2Fx+1/2Fx^2/b	1-2x/b+x^2/b^2		
CD b	-1	-1/2Fx	1/2Fx	1	1/4Fb^2/EJ	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE 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
ED b	x/b	1/2Fx	1/2Fx^2/b	x^2/b^2		
EF √2b	0	3√2/4Fx	0	0	0	0
FG b	0	-3/2Fx	0	0	0	0
GF b	0	3/2Fb-3/2Fx	0	0		
GA b	0	-1/2Fb-1/2qx^2	0	0	0	0
AG b	0	Fb-Fx+1/2qx^2	0	0		
FB b	0	3/2Fb-Fx-1/2qx^2	0	0	0	0
BF b	0	-2Fx+1/2qx^2	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				-Fb^2/EJ	
	totali				-1/6Fb^2/EJ	5/3Xb/EJ
	iperstatica $X=W_{CD}$				1/10Fb	

Sviluppi di calcolo iperstatica

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$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2\ )\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (1/2\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b +1/6\ b\ )\ Fb\ 1/EJ\ = 5/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -3/2\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x -3/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -3/4\ b +1/6\ b\ )\ Fb\ 1/EJ\ = 5/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (1/2\ x/b\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = [1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (1/4\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -3/4\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (1/2 -1/2\ x/b\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = [1/2\ x -1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/E$

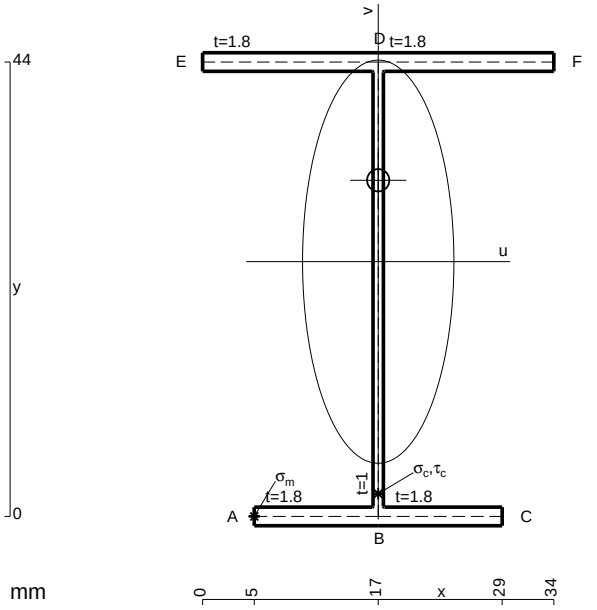
$= (1/2\ b -1/4\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -3/4\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2 - x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x -1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = 1/6\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

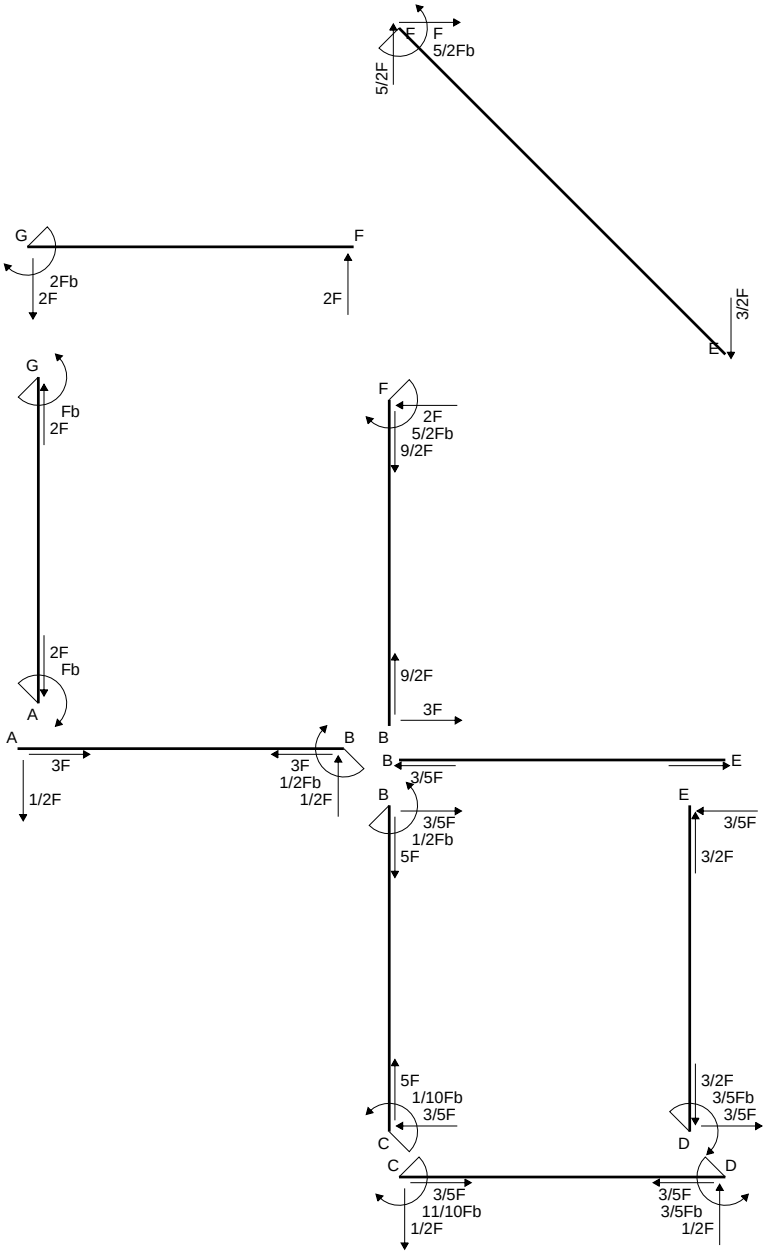
$= (1/6\ b\ )\ Fb\ 1/EJ\ = 1/6\ \ Fb^2/EJ$

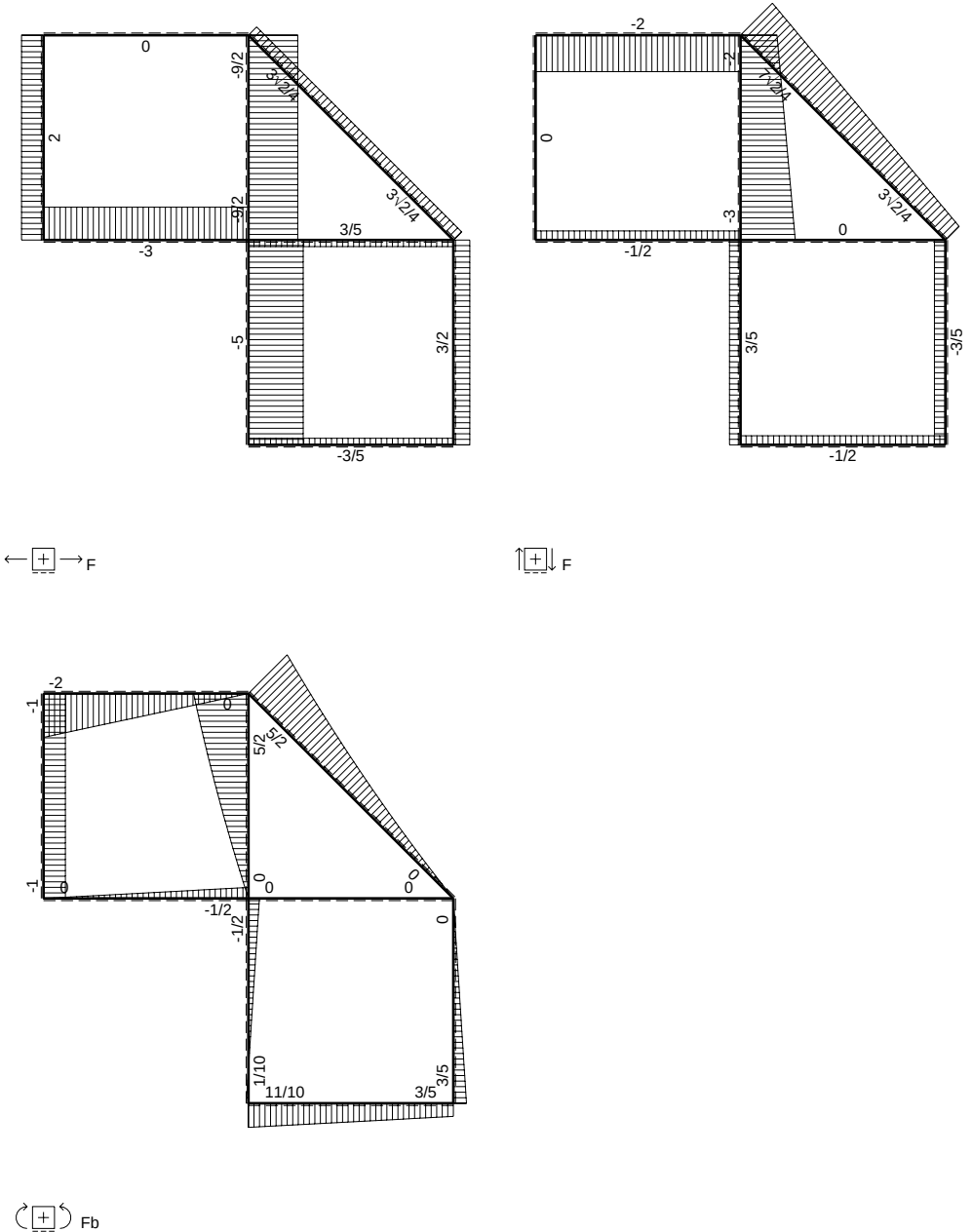


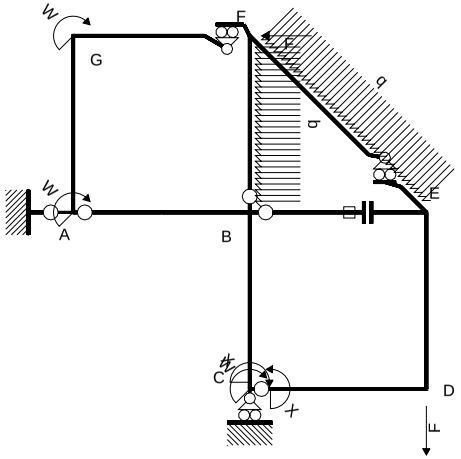
A = 148.4 mm^2
J_u = 56572. mm^4
J_v = 7969. mm^4
J_t = 127.4 mm^4
y_o = 7.883 mm
y_g = 24.67 mm
T_y = -705. N
M_x = -472350. Nmm
x_m = 5. mm
u_m = -12. mm
v_m = -24.67 mm
$\sigma_m = -Mv/J_u$ = -206. N/mm^2
x_c = 17. mm
v_c = -24.67 mm
$\sigma_c = -Mv/J_u$ = -206. N/mm^2
$\tau_c = TS^*/tJ_u$ = 13.28 N/mm^2
$\tau_g = TS^*/tJ_u$ = 13.28 N/mm^2
t_c = 470. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 207.3 N/mm^2

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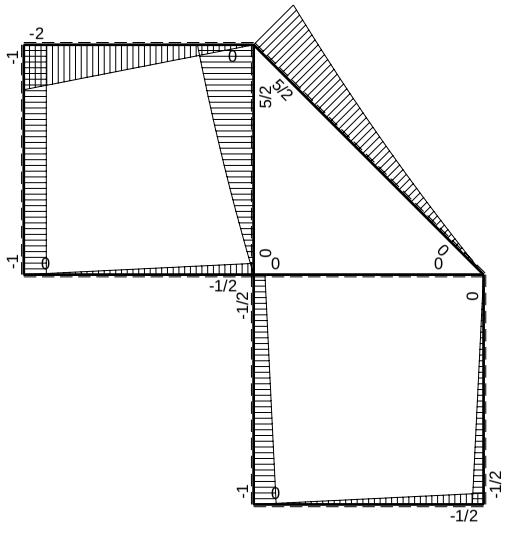
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F
F
5/2Fb
5/2F
G
F
2Fb
2F
2F
3/2F
E
G
Fb
2F
F
2F
5/2Fb
9/2F
2F
Fb
A
9/2F
3F
A
B
B
B
E
3F
3F
1/2Fb
1/2F
3F
1/2F
3/5F
B
E
3/5F
3/5F
1/2Fb
5F
3/2F
5F
1/10Fb
3/5F
3/2F
3/5Fb
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3/5F
3/5Fb
1/2F

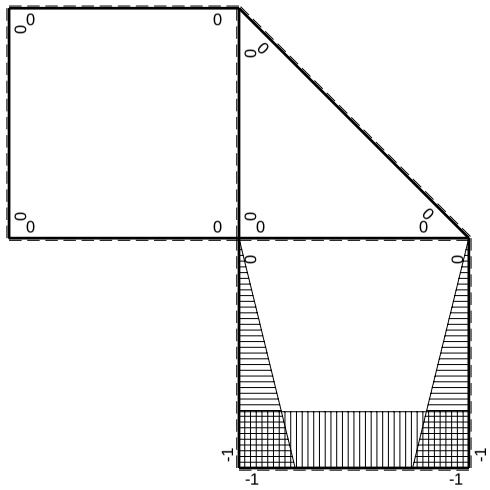

0
-9/2
3√2/4
2
-9/2
3√2/4
3/5
-3
-5
3/2
-3/5
F
-2
-2
1√2/4
0
3√2/4
-3
0
-1/2
3/5
-3/5
-1/2
F
-2
-1
0
5/2
5/2
-1
0
0
0
0
-1/2
-1/2
0
1/10
11/10
3/5
3/5
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-1/2Fx	0	0	0	0
BA b	0	1/2Fb-1/2Fx	0	0		
BC b	-x/b	-1/2Fb-1/2Fx	$1/2Fx+1/2Fx^2/b$	x^2/b^2	$5/12Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb-1/2Fx	$Fb-3/2Fx+1/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	-1/2Fx	1/2Fx	1	$1/4Fb^2/EJ$	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE b	-1+x/b	-1/2Fb+1/2Fx	$1/2Fb-Fx+1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	1/2Fx	$1/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$3\sqrt{2}/4Fx+1/2qx^2$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	$5/2Fb-2Fx-1/2qx^2$	0	0	0	0
BF b	0	$-3Fx+1/2qx^2$	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$11/6Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-11/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b)\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b)\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (1/2\ x/b +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b +1/6\ b)\ Fb\ 1/EJ\ = 5/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -3/2\ x/b +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -3/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -3/4\ b +1/6\ b)\ Fb\ 1/EJ\ = 5/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (1/2\ x/b)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b)\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (1/2 -1/2\ x/b)\ Fb\ 1/EJ\ dx = [1/2\ x -1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

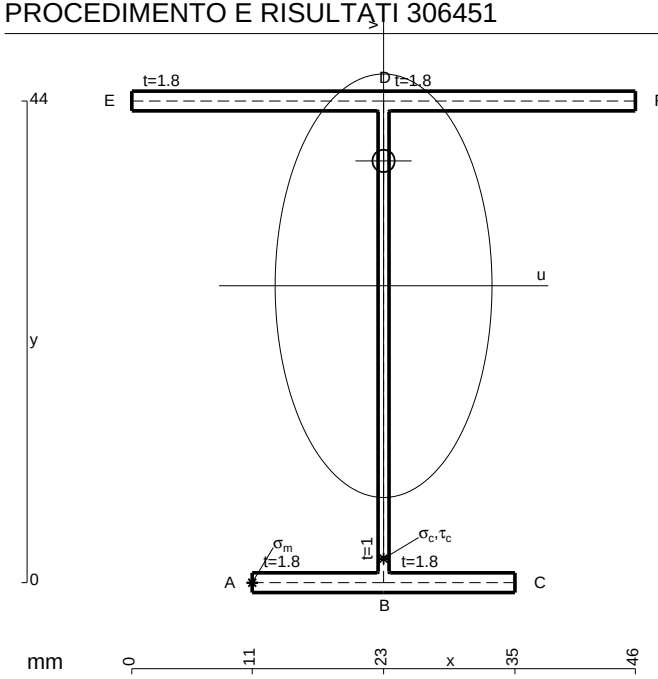
$= (1/2\ b -1/4\ b)\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2 - x/b +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/2\ x -1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/2\ b +1/6\ b)\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/6\ b)\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$



$A = 170.\ mm^2$

$J_u = 63618.\ mm^4$

$J_v = 16674.\ mm^4$

$J_t = 150.7\ mm^4$

$y_o = 11.4\ mm$

$y_g = 27.12\ mm$

$N = 297.\ N$

$T_y = 693.\ N$

$M_x = 497000.\ Nmm$

$x_m = 11.\ mm$

$u_m = -12.\ mm$

$v_m = -27.12\ mm$

$\sigma_m = N/A - Mv/J_u = 213.7\ N/mm^2$

$x_c = 23.\ mm$

$v_c = -27.12\ mm$

$\sigma_c = N/A - Mv/J_u = 213.7\ N/mm^2$

$\tau_c = TS^*/tJ_u = 12.76\ N/mm^2$

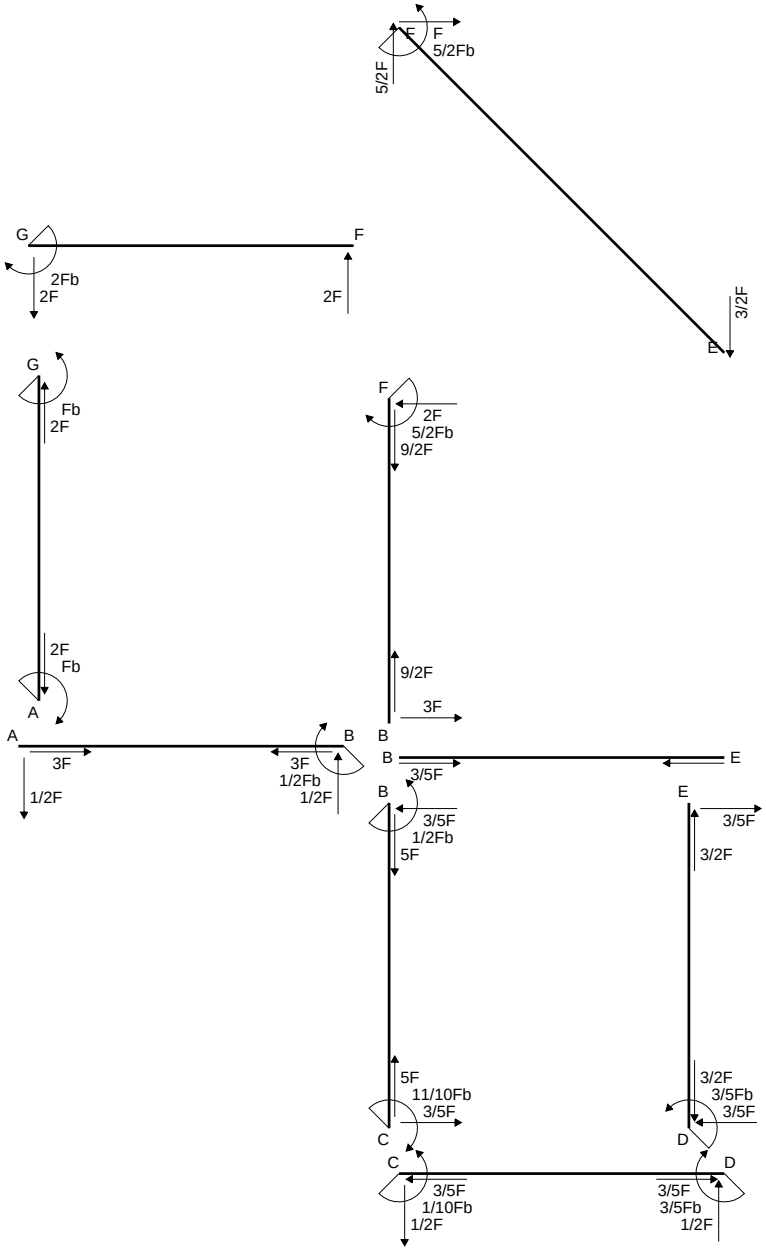
$\tau_g = TS^*/tJ_u = 12.76\ N/mm^2$

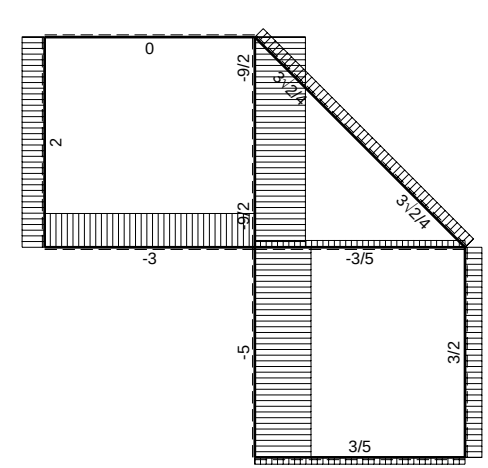
$t_c = 280.\ mm$

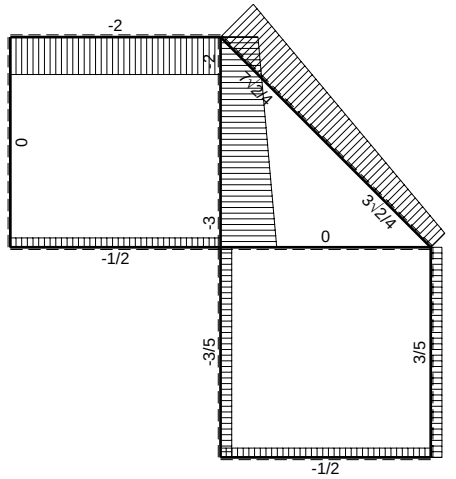
$\sigma_o = \sqrt{\sigma^2 + 3\tau^2} = 214.8\ N/mm^2$

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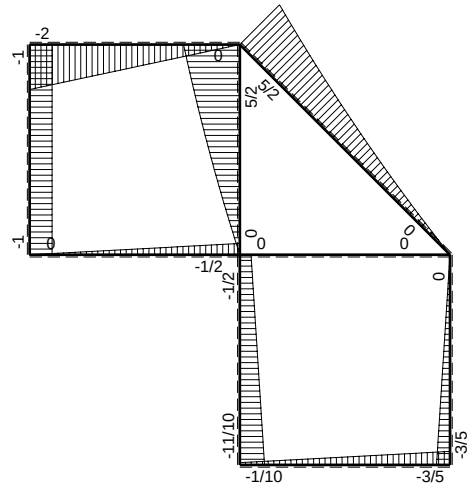

F
F
5/2Fb
5/2F
G
F
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2F
2F
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G
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F
2F
5/2Fb
9/2F
2F
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A
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3F
A
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E
3F
3F
1/2Fb
1/2F
1/2F
3/5F
B
E
3/5F
1/2Fb
3/2F
5F
5F
11/10Fb
3/5F
3/2F
3/5Fb
3/5F
C
D
C
D
3/5F
1/10Fb
1/2F
3/5F
3/5Fb
1/2F


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-3
-3/5
-5
3/2
3/5

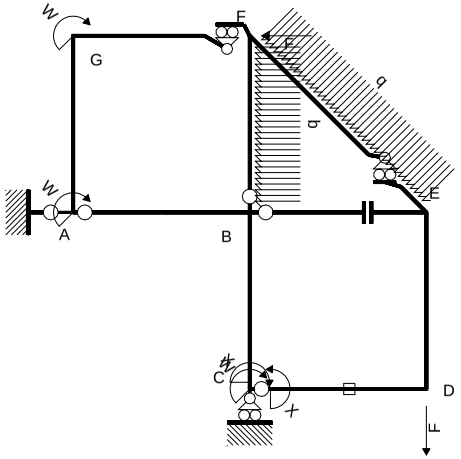

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-3
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-1/2
-3/5
3/5
-1/2

F

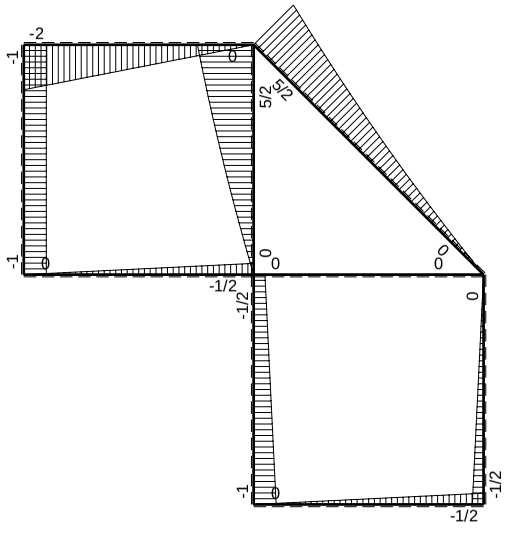
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-3/5
-1/10
-3/5

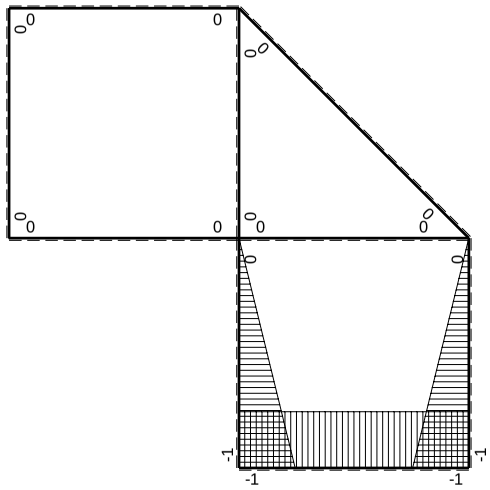
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-1/2Fx	0	0	0	0
BA b	0	1/2Fb-1/2Fx	0	0		
BC b	-x/b	-1/2Fb-1/2Fx	$1/2Fx+1/2Fx^2/b$	x^2/b^2	$5/12Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb-1/2Fx	$Fb-3/2Fx+1/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	-1/2Fx	1/2Fx	1	$1/4Fb^2/EJ$	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE 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
ED b	x/b	1/2Fx	$1/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$3\sqrt{2}/4Fx+1/2qx^2$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	$5/2Fb-2Fx-1/2qx^2$	0	0	0	0
BF b	0	$-3Fx+1/2qx^2$	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/6Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				1/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (1/2\ x/b +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b +1/6\ b)\ Fb\ 1/EJ\ = 5/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -3/2\ x/b +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -3/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -3/4\ b +1/6\ b\ )\ Fb\ 1/EJ\ = 5/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (1/2\ x/b\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = [1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (1/4\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -3/4\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (1/2 -1/2\ x/b\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = [1/2\ x -1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/E$

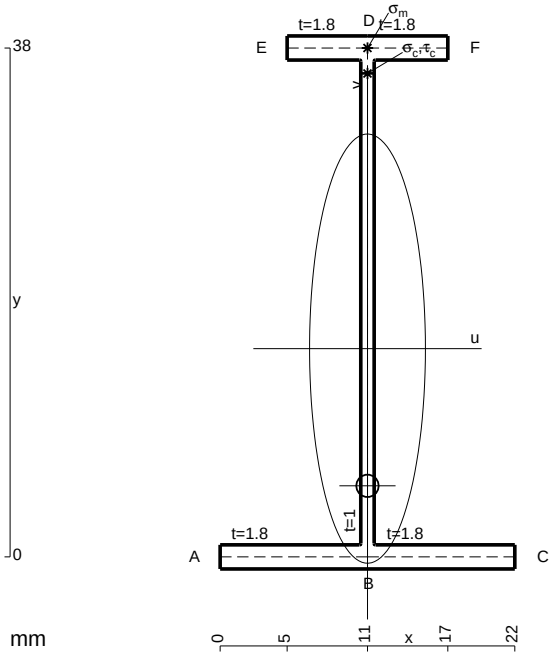
$= (1/2\ b -1/4\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -3/4\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2 - x/b +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/2\ x -1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = 1/6\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

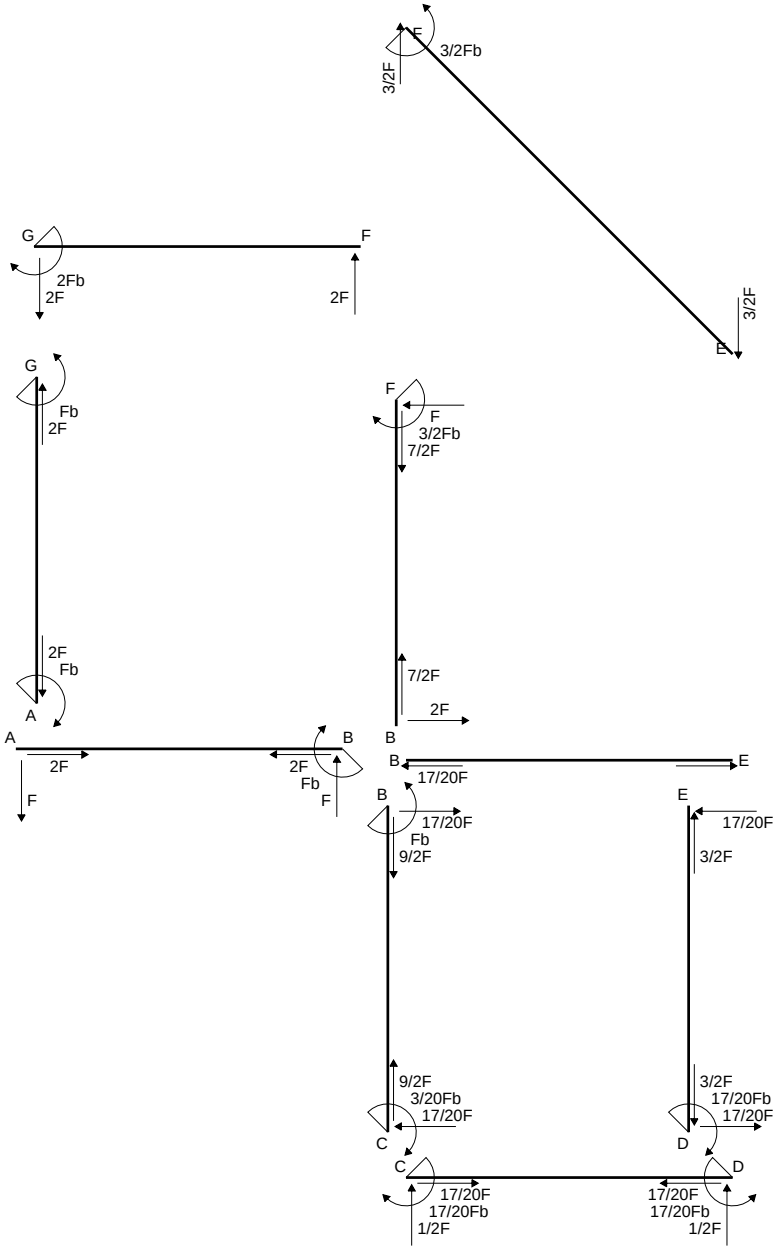
$= (1/6\ b\ )\ Fb\ 1/EJ\ = 1/6\ \ Fb^2/EJ$

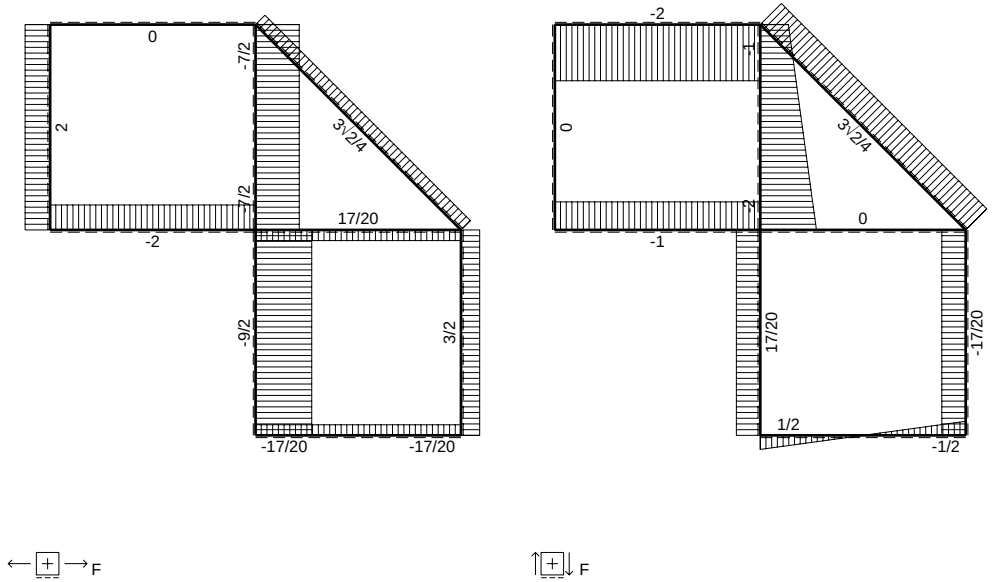


A = 99.2 mm^2
J_u = 25487. mm^4
J_v = 1856. mm^4
J_t = 78.76 mm^4
y_o = -10.25 mm
y_g = 15.55 mm
N = 169.7 N
T_y = 396. N
M_x = 256000. Nmm
x_m = 11. mm
y_m = 38. mm
v_m = 22.45 mm
$\sigma_m = N/A - Mv/J_u$ = -223.8 N/mm^2
y_c = 2. mm
u_c = -11. mm
v_c = -13.55 mm
$\sigma_c = N/A - Mv/J_u$ = -223.8 N/mm^2
$\tau_c = TS^*/tJ_u$ = 7.533 N/mm^2
$\tau_g = TS^*/tJ_u$ = 7.533 N/mm^2
t_c = 160. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 224.1 N/mm^2

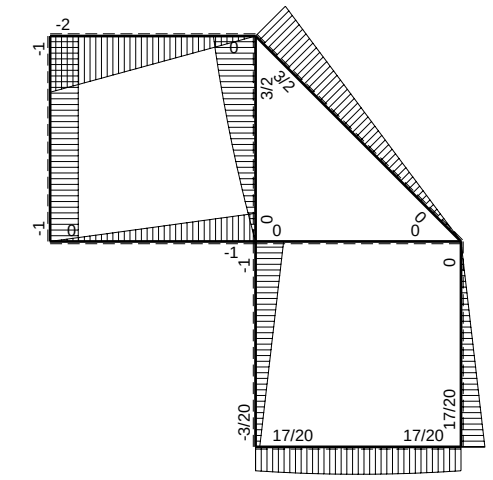
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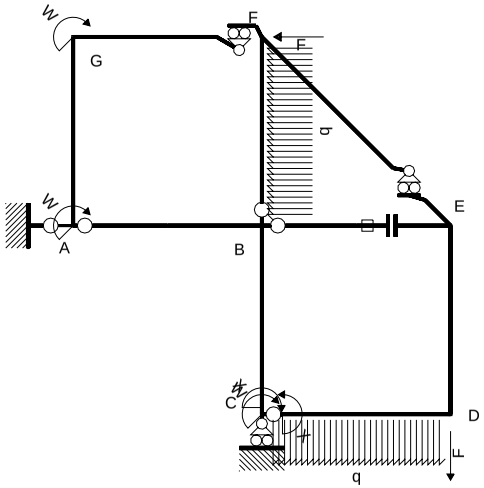

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17/20Fb
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3/2
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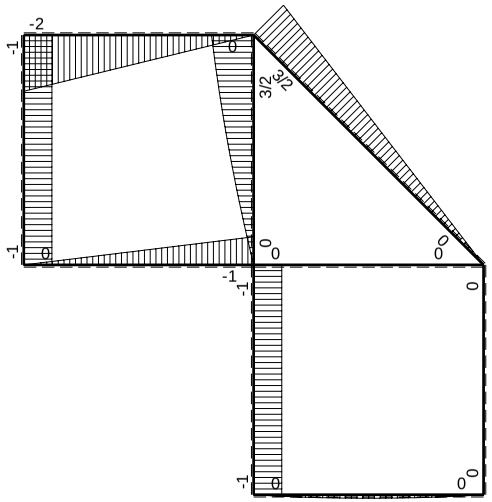
F F


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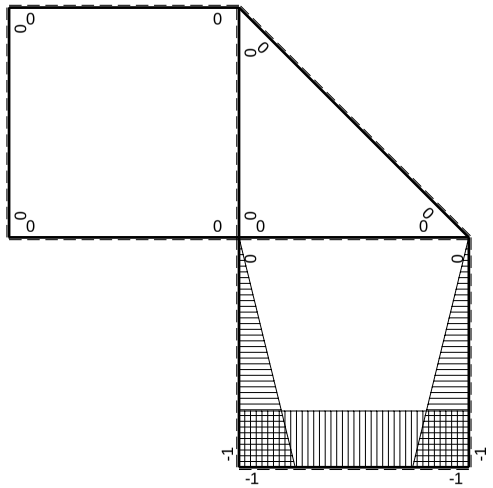
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-Fx	0	0	0	0
BA b	0	Fb-Fx	0	0		
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb	Fb-Fx	$1-2x/b+x^2/b^2$		
CD b	-1	$1/2Fx-1/2qx^2$	$-1/2Fx+1/2Fx^2/b$	1	$-1/12Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fx+1/2qx^2$	$-1/2Fx+1/2Fx^2/b$	1		
DE b	-1+x/b	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	0	0	x^2/b^2		
EF $\sqrt{2}b$	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	$3/2Fb-Fx-1/2qx^2$	0	0	0	0
BF b	0	$-2Fx+1/2qx^2$	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$17/12Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				$-17/20Fb$	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (x/b)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b)\ Fb\ 1/EJ\ = 1/2\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x/b)\ Fb\ 1/EJ\ dx = [\ x -1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 1/2\ Fb^2/EJ$

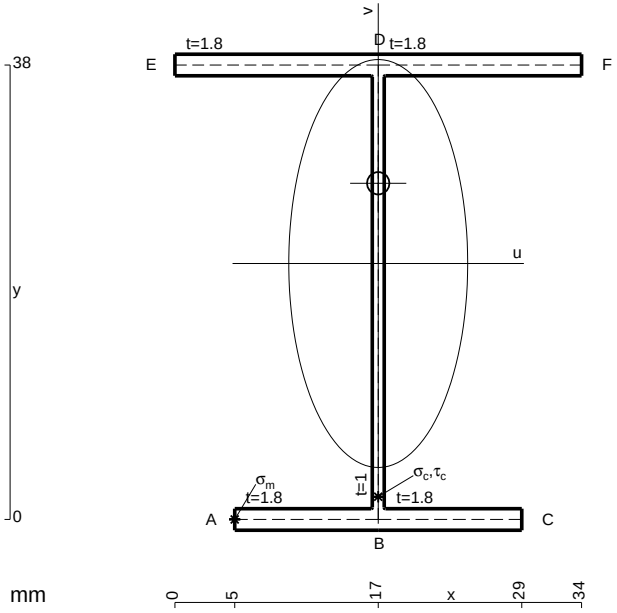
$L^{Xo}_{CD} = \int_o^b (-1/2\ x/b +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/4\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/12\ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2\ x/b +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [-1/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (-1/4\ b +1/6\ b\ )\ Fb\ 1/EJ\ = -1/12\ Fb^2/EJ$

PROCEDIMENTO E RISULTATI 267819 CI02.xxxx.179

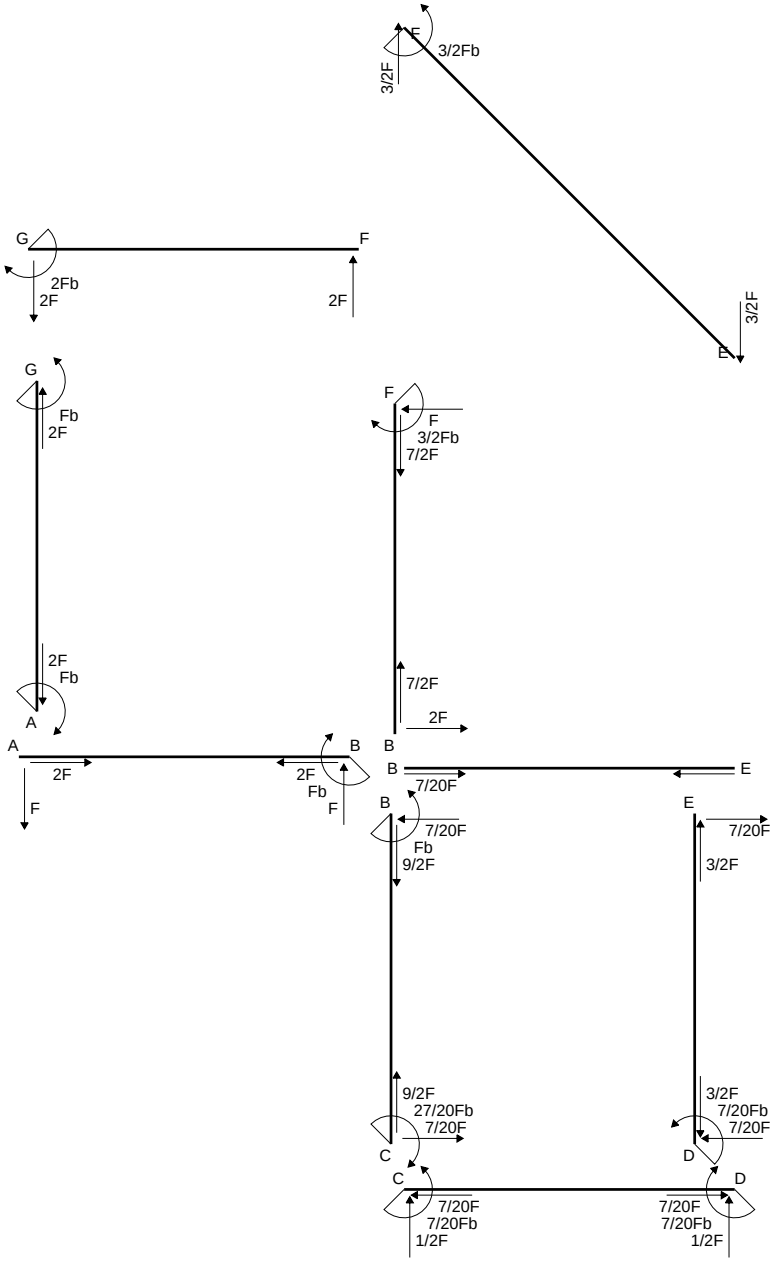


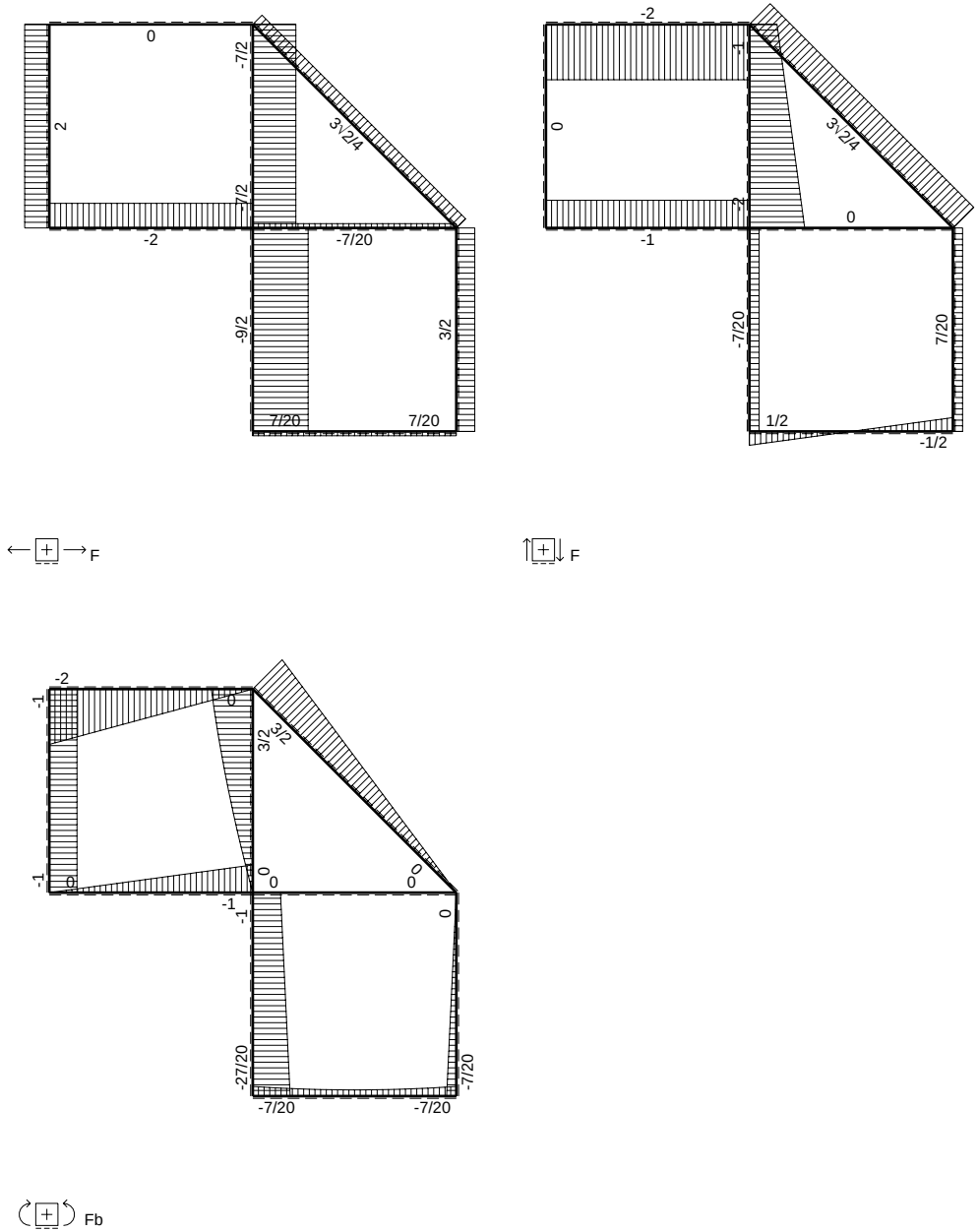
A = 142.4 mm^2
J_u = 41440. mm^4
J_v = 7969. mm^4
J_t = 125.4 mm^4
y_o = 6.711 mm
y_g = 21.4 mm
T_y = -680. N
M_x = -462400. Nmm
x_m = 5. mm
u_m = -12. mm
v_m = -21.4 mm
$\sigma_m = -Mv/J_u$ = -238.8 N/mm^2
x_c = 17. mm
v_c = -21.4 mm
$\sigma_c = -Mv/J_u$ = -238.8 N/mm^2
$\tau_c = TS^*/tJ_u$ = 15.17 N/mm^2
$\tau_g = TS^*/tJ_u$ = 15.17 N/mm^2
t_c = 340. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 240.3 N/mm^2

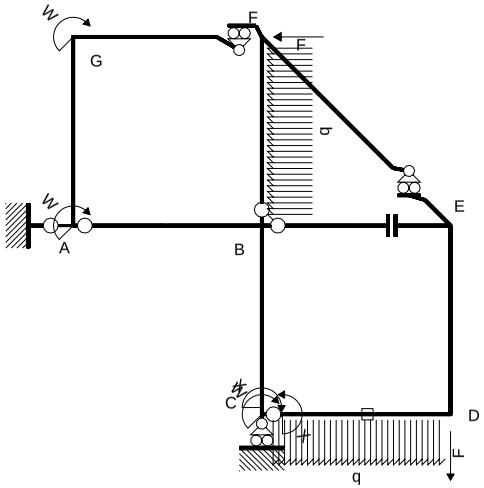
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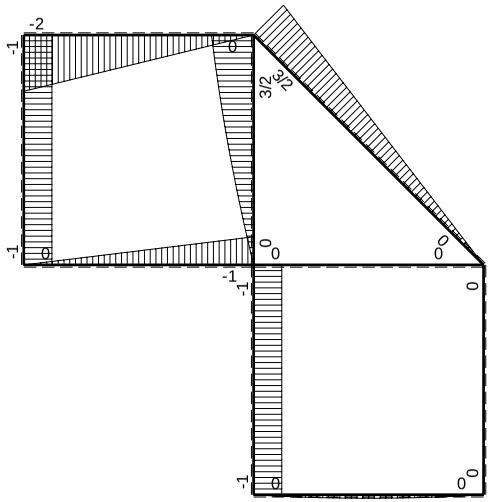
@ Adolfo Zavelani Rossi, Politecnico di Milano, vers.27.03.13 16.04.26


E
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2F
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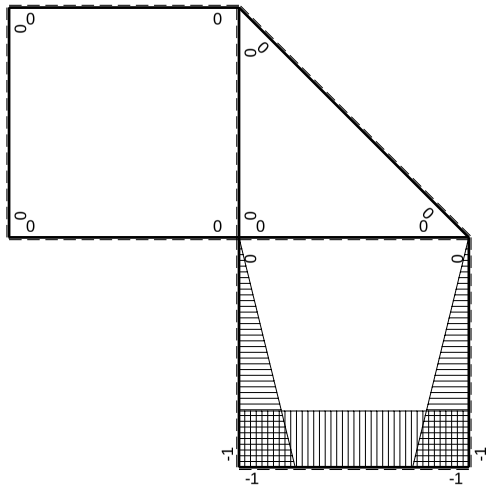

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3√2/4
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-1/2
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F
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√2
-1
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0
0
-1
-1
0
-27/20
-7/20
-7/20
-7/20
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-Fx	0	0	0	0
BA b	0	Fb-Fx	0	0		
BC b	-x/b	-Fb	Fx	x^2/b^2	$1/2Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	Fb	Fb-Fx	$1-2x/b+x^2/b^2$		
CD b	-1	$1/2Fx-1/2qx^2$	$-1/2Fx+1/2Fx^2/b$	1	$-1/12Fb^2/EJ$	Xb/EJ
DC b	1	$-1/2Fx+1/2qx^2$	$-1/2Fx+1/2Fx^2/b$	1		
DE b	-1+x/b	0	0	$1-2x/b+x^2/b^2$	0	$1/3Xb/EJ$
ED b	x/b	0	0	x^2/b^2		
EF $\sqrt{2}b$	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	$3/2Fb-Fx-1/2qx^2$	0	0	0	0
BF b	0	$-2Fx+1/2qx^2$	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-7/12Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				7/20Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (x/b)\ Fb\ 1/EJ\ dx = [1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b)\ Fb\ 1/EJ\ = 1/2\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 - x/b)\ Fb\ 1/EJ\ dx = [\ x -1/2\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -1/2\ b\ )\ Fb\ 1/EJ\ = 1/2\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (-1/2\ x/b +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

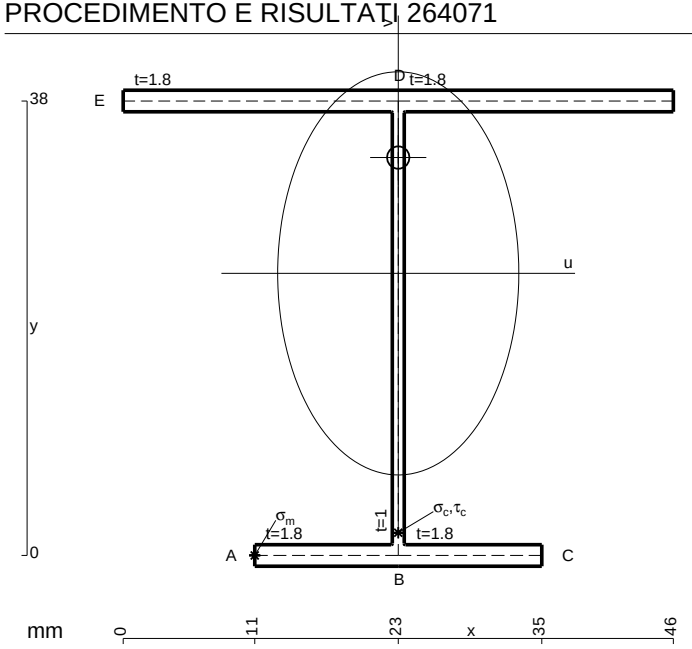
$= [-1/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (-1/4\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -13/12\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (-1/2\ x/b +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= [-1/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

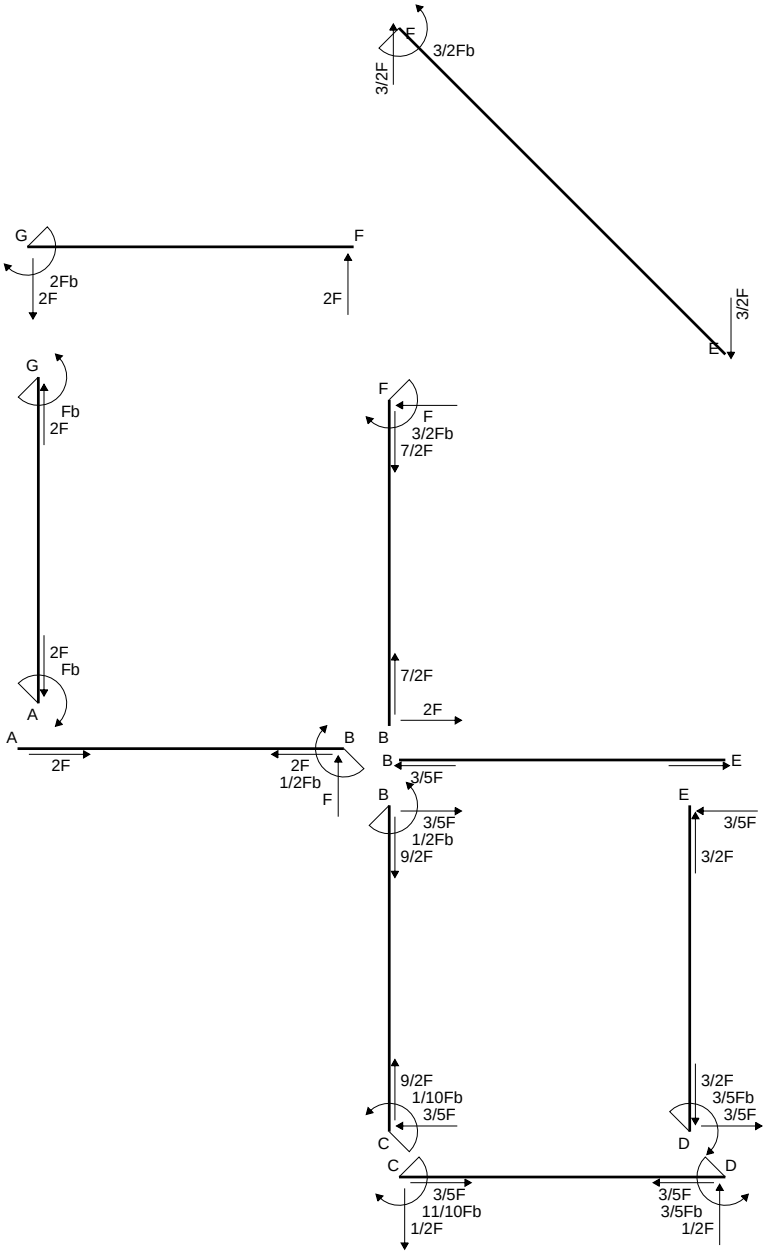
$= (-1/4\ b +1/6\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -13/12\ \ Fb^2/EJ$

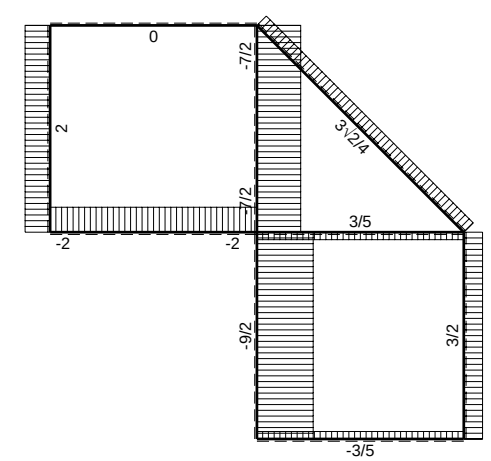


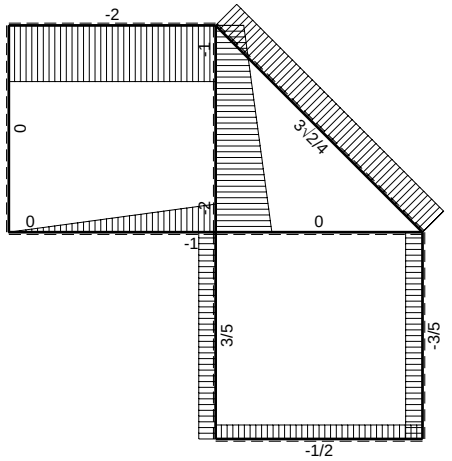
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J_u = 46607. mm^4
J_v = 16674. mm^4
J_t = 148.7 mm^4
y_o = 9.686 mm
y_g = 23.59 mm
T_y = -1080. N
M_x = -388800. Nmm
x_m = 11. mm
u_m = -12. mm
v_m = -23.59 mm
$\sigma_m = -Mv/J_u$ = -196.8 N/mm^2
x_c = 23. mm
v_c = -23.59 mm
$\sigma_c = -Mv/J_u$ = -196.8 N/mm^2
$\tau_c = TS^*/tJ_u$ = 23.61 N/mm^2
$\tau_g = TS^*/tJ_u$ = 23.61 N/mm^2
t_c = 540. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 201. N/mm^2

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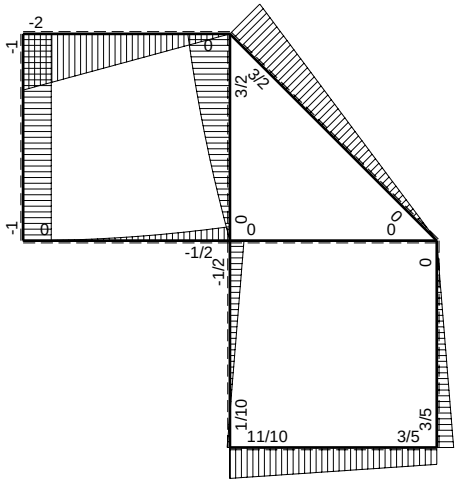

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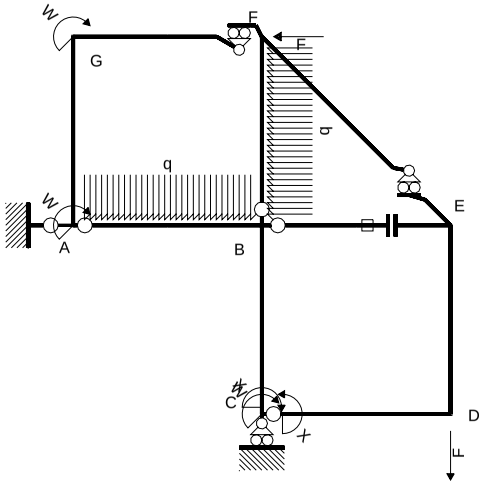

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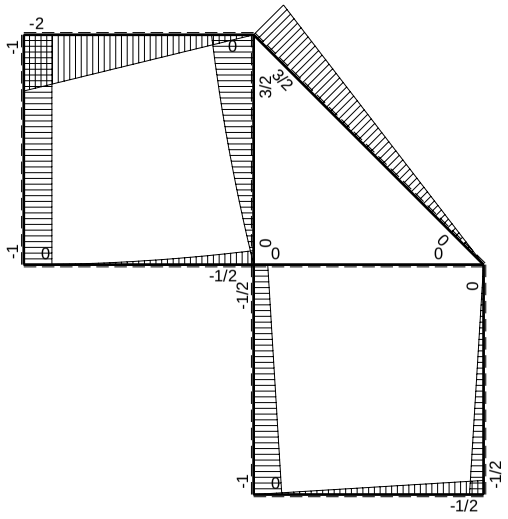
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3/5

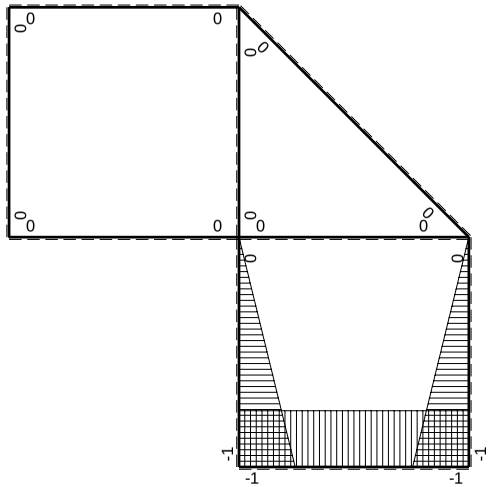
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-1/2qx^2$	0	0	0	0
BA b	0	$1/2Fb-Fx+1/2qx^2$	0	0		
BC b	-x/b	$-1/2Fb-1/2Fx$	$1/2Fx+1/2Fx^2/b$	x^2/b^2	$5/12Fb^2/EJ$	$1/3Xb/EJ$
CB b	1-x/b	$Fb-1/2Fx$	$Fb-3/2Fx+1/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	$-1/2Fx$	$1/2Fx$	1	$1/4Fb^2/EJ$	Xb/EJ
DC b	1	$1/2Fb-1/2Fx$	$1/2Fb-1/2Fx$	1		
DE b	-1+x/b	$-1/2Fb+1/2Fx$	$1/2Fb-Fx+1/2Fx^2/b$	$1-2x/b+x^2/b^2$	$1/6Fb^2/EJ$	$1/3Xb/EJ$
ED b	x/b	$1/2Fx$	$1/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	$3/2Fb-Fx-1/2qx^2$	0	0	0	0
BF b	0	$-2Fx+1/2qx^2$	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$11/6Fb^2/EJ$	$5/3Xb/EJ$
	iperstatica $X=W_{CD}$				-11/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1)\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2)\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b)\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (1/2\ x/b +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [1/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b +1/6\ b)\ Fb\ 1/EJ\ = 5/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -3/2\ x/b +1/2\ x^2/b^2)\ Fb\ 1/EJ\ dx = [\ x -3/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -3/4\ b +1/6\ b\ )\ Fb\ 1/EJ\ = 5/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (1/2\ x/b\ )\ Fb\ 1/EJ\ dx = [1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b\ )\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (1/2 -1/2\ x/b\ )\ Fb\ 1/EJ\ dx = [1/2\ x -1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

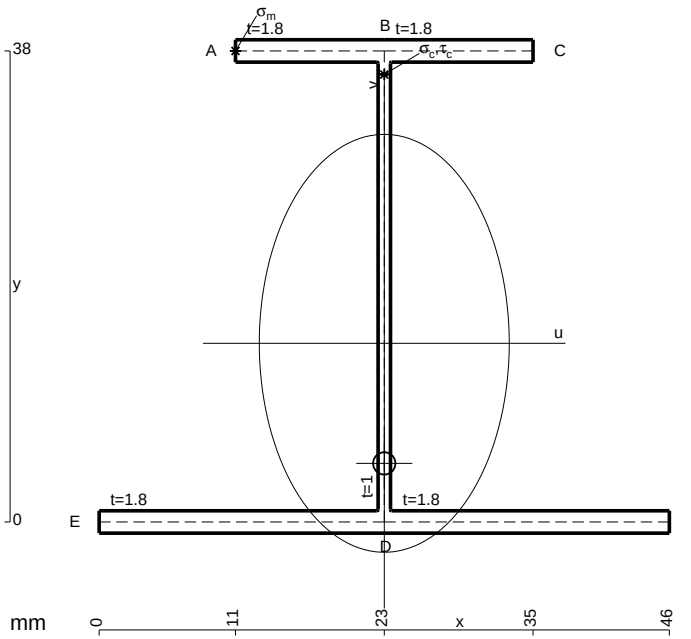
$= (1/2\ b -1/4\ b\ )\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2 - x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x -1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

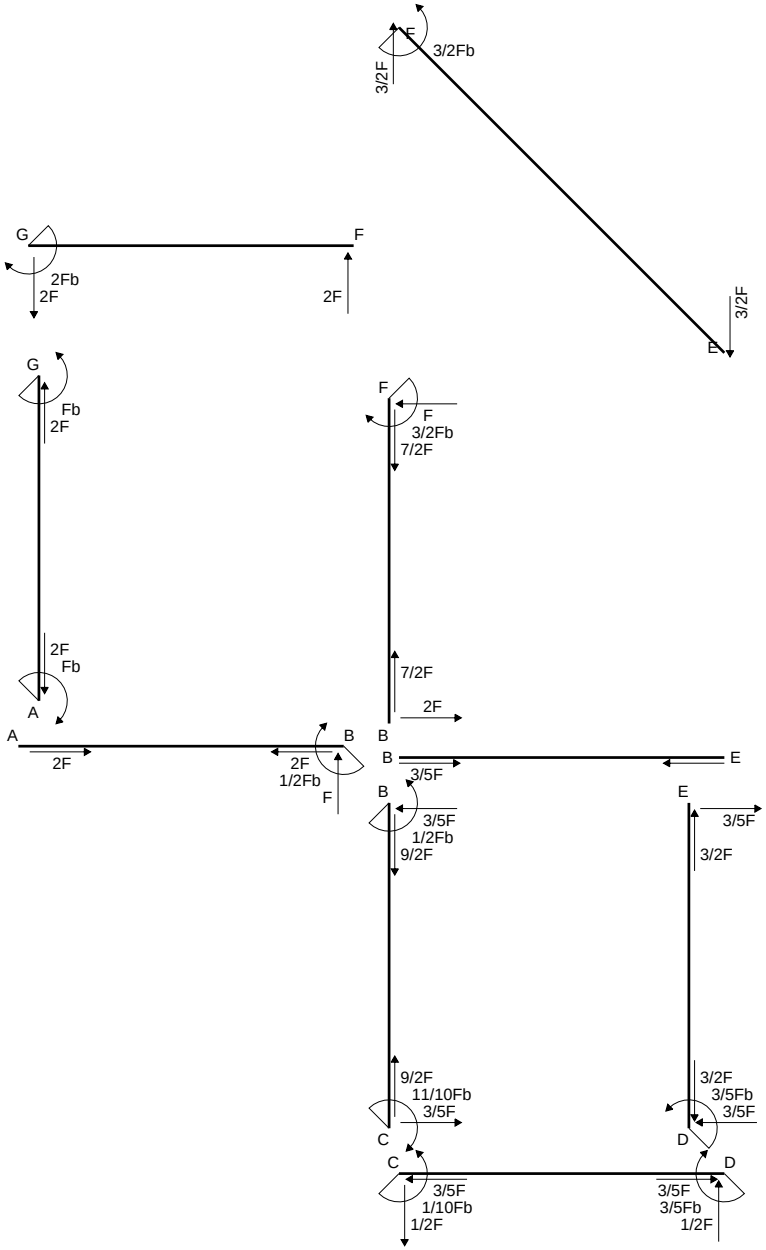
$= (1/6\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

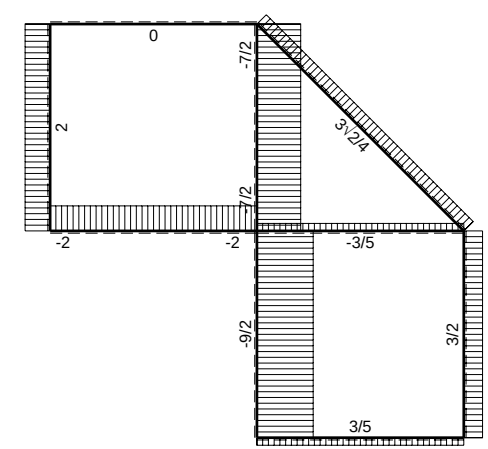


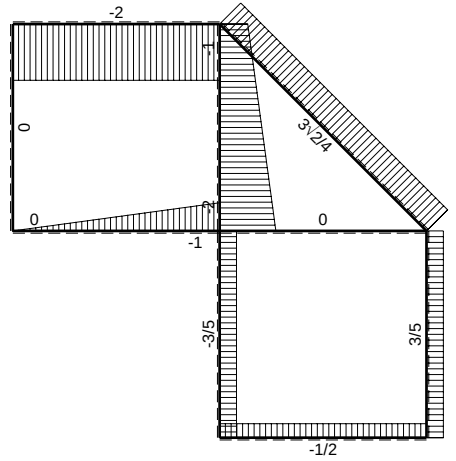
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J_u = 46607. mm^4
J_v = 16674. mm^4
J_t = 148.7 mm^4
y_o = -9.686 mm
y_g = 14.41 mm
T_y = -1060. N
M_x = -413400. Nmm
x_m = 11. mm
y_m = 38. mm
u_m = -12. mm
v_m = 23.59 mm
$\sigma_m = -Mv/J_u$ = 209.2 N/mm^2
x_c = 23. mm
y_c = 38. mm
v_c = 23.59 mm
$\sigma_c = -Mv/J_u$ = 209.2 N/mm^2
$\tau_c = TS^*/tJ_u$ = 23.18 N/mm^2
$\tau_g = TS^*/tJ_u$ = 23.18 N/mm^2
t_c = 530. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 213. N/mm^2

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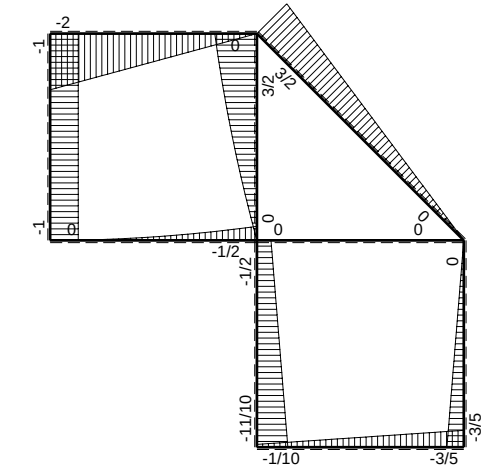

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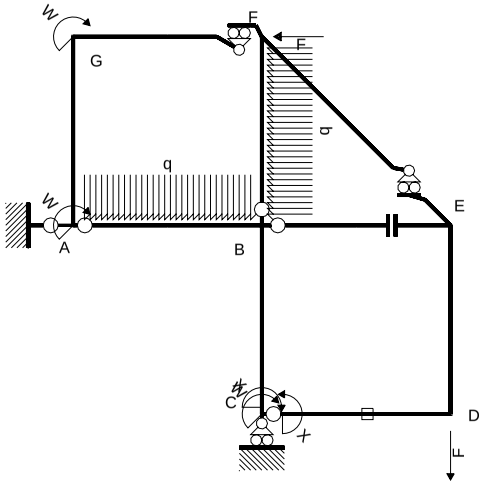

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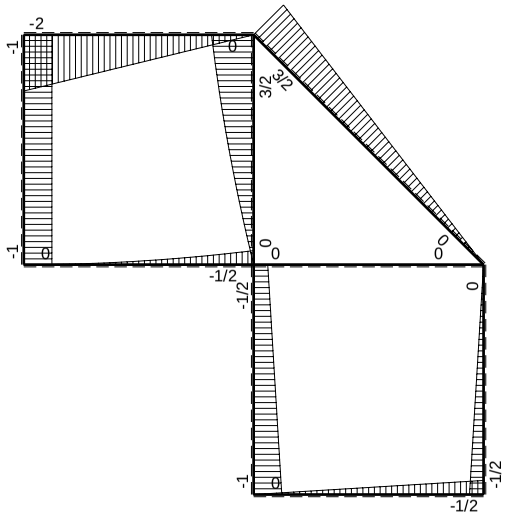
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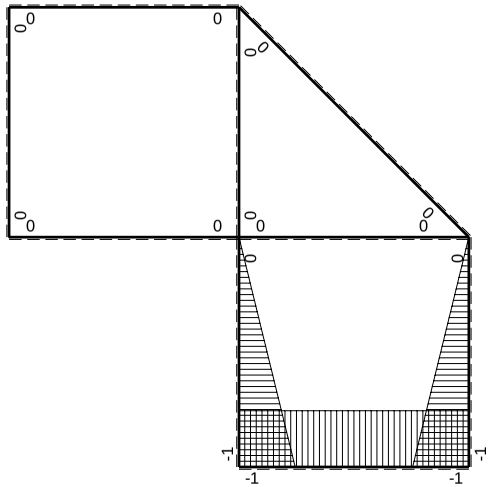
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	$-1/2qx^2$	0	0	0	0
BA b	0	$1/2Fb-Fx+1/2qx^2$	0	0		
BC b	-x/b	-1/2Fb-1/2Fx	$1/2Fx+1/2Fx^2/b$	x^2/b^2	$5/12Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb-1/2Fx	$Fb-3/2Fx+1/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	-1/2Fx	1/2Fx	1	$1/4Fb^2/EJ$	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE 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
ED b	x/b	1/2Fx	$1/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	-2Fx	0	0	0	0
GF b	0	2Fb-2Fx	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	$3/2Fb-Fx-1/2qx^2$	0	0	0	0
BF b	0	$-2Fx+1/2qx^2$	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/6Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				1/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2\ )\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (1/2\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b +1/6\ b\ )\ Fb\ 1/EJ\ = 5/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -3/2\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x -3/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -3/4\ b +1/6\ b\ )\ Fb\ 1/EJ\ = 5/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (1/2\ x/b\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = [1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (1/4\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -3/4\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (1/2 -1/2\ x/b\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = [1/2\ x -1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/E$

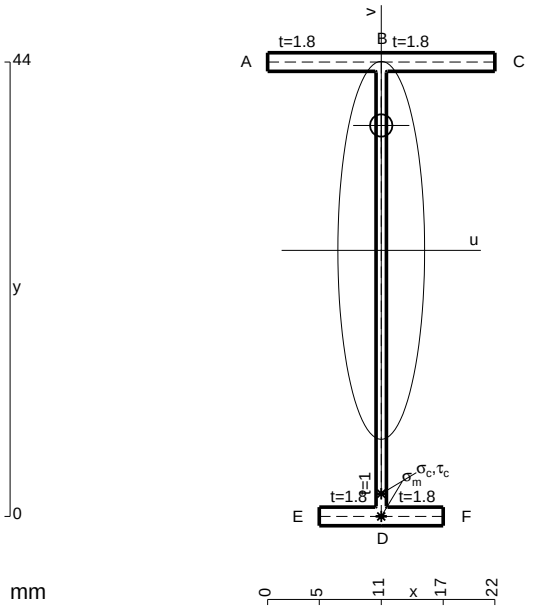
$= (1/2\ b -1/4\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -3/4\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2 - x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x -1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = 1/6\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

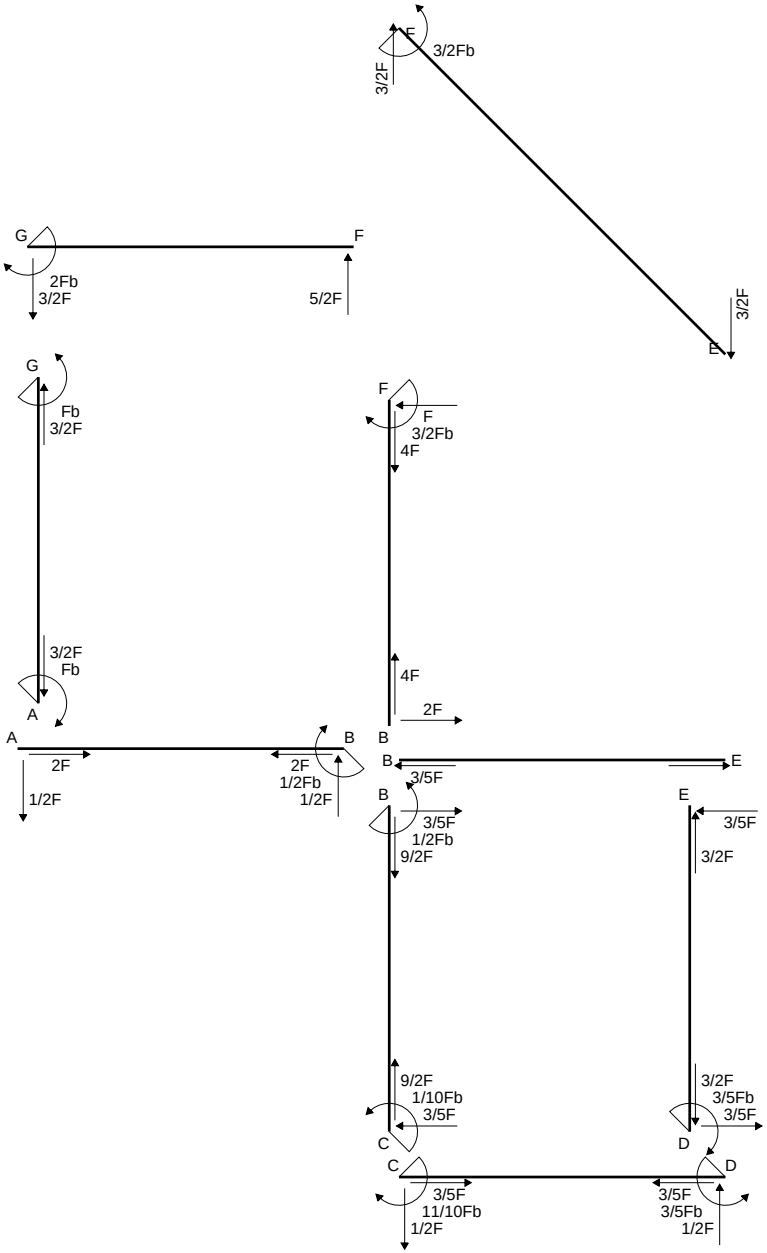
$= (1/6\ b\ )\ Fb\ 1/EJ\ = 1/6\ \ Fb^2/EJ$

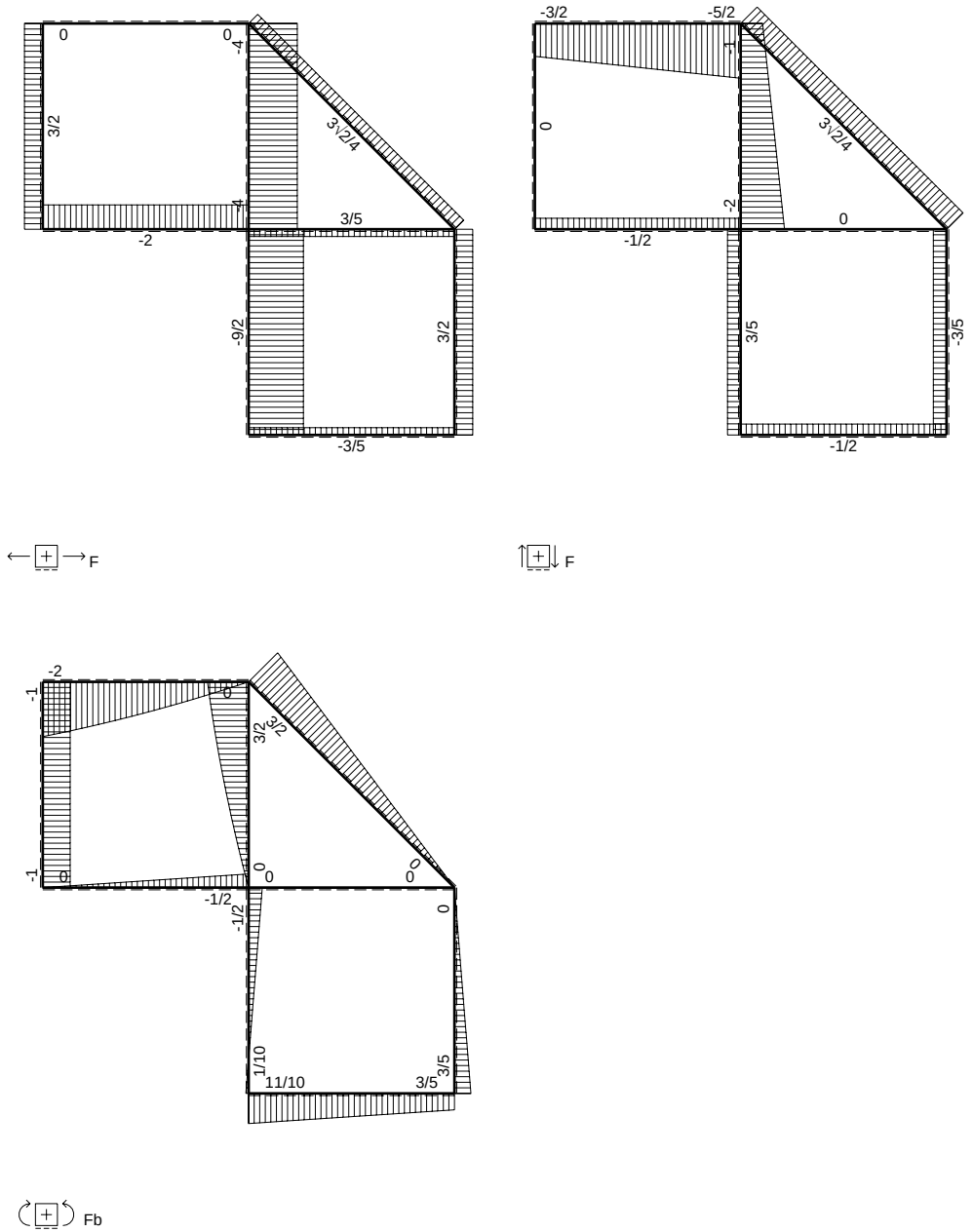


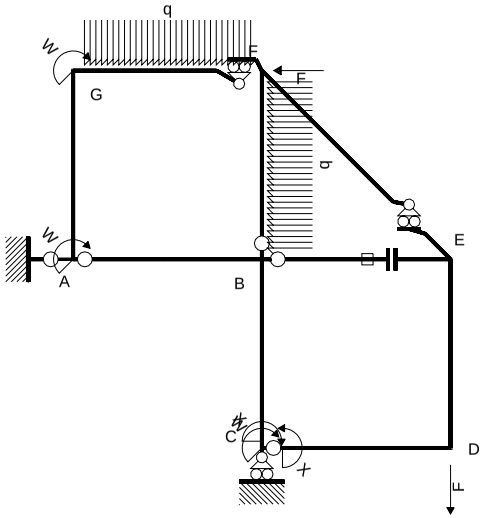
A = 105.2 mm^2
J_u = 35229. mm^4
J_v = 1856. mm^4
J_t = 80.76 mm^4
y_o = 12.09 mm
y_g = 25.76 mm
T_y = -600. N
M_x = -300000. Nmm
x_m = 11. mm
v_m = -25.76 mm
$\sigma_m = -Mv/J_u$ = -219.4 N/mm^2
y_c = 3. mm
u_c = -11. mm
v_c = -22.76 mm
$\sigma_c = -Mv/J_u$ = -219.4 N/mm^2
$\tau_c = TS^*/tJ_u$ = 9.478 N/mm^2
$\tau_g = TS^*/tJ_u$ = 9.478 N/mm^2
t_c = 300. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 220. N/mm^2

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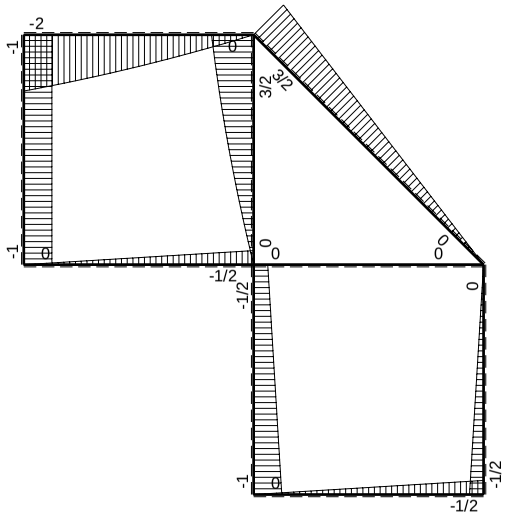
@ Adolfo Zavelani Rossi, Politecnico di Milano, vers.27.03.13 16.04.26


F
3/2Fb
3/2F
G
F
2Fb
3/2F
5/2F
E
3/2F
G
Fb
3/2F
F
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4F
2F
A
B
B
B
E
2F
2F
1/2Fb
1/2F
3/5F
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B
E
3/5F
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1/2F

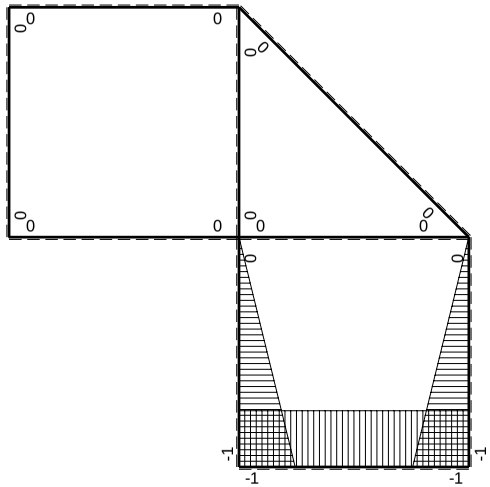

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3√2/4
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-1
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3√2/4
-2
0
-1/2
3/5
-3/5
-1/2
F
F
-2
-1
0
3/2
3√2/4
-1
0
0
0
0
-1/2
-1/2
0
1/10
11/10
3/5
3/5
Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-1/2Fx	0	0	0	0
BA b	0	1/2Fb-1/2Fx	0	0		
BC b	-x/b	-1/2Fb-1/2Fx	$1/2Fx+1/2Fx^2/b$	x^2/b^2	$5/12Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb-1/2Fx	$Fb-3/2Fx+1/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	-1/2Fx	1/2Fx	1	$1/4Fb^2/EJ$	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE 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
ED b	x/b	1/2Fx	$1/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	$-5/2Fx+1/2qx^2$	0	0	0	0
GF b	0	$2Fb-3/2Fx-1/2qx^2$	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	$3/2Fb-Fx-1/2qx^2$	0	0	0	0
BF b	0	$-2Fx+1/2qx^2$	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
BE	elongazione asta $N_{1BE}\varepsilon_{BE}L_{BE}$				Fb^2/EJ	
	totali				$11/6Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				-11/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2\ )\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (1/2\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b +1/6\ b\ )\ Fb\ 1/EJ\ = 5/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -3/2\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x -3/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -3/4\ b +1/6\ b\ )\ Fb\ 1/EJ\ = 5/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (1/2\ x/b\ )\ Fb\ 1/EJ\ dx = [1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b\ )\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (1/2 -1/2\ x/b\ )\ Fb\ 1/EJ\ dx = [1/2\ x -1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ$

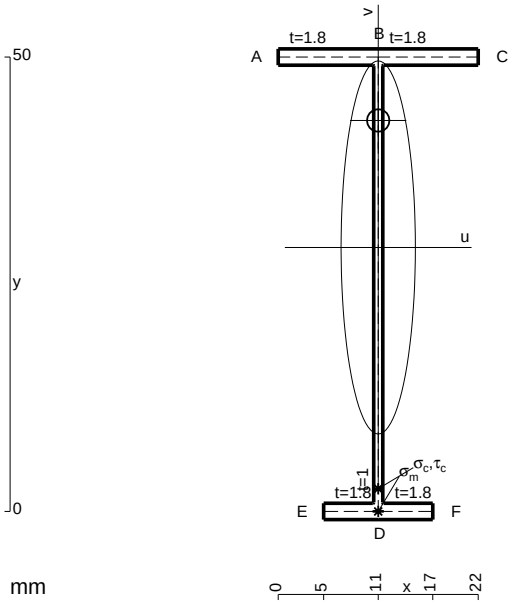
$= (1/2\ b -1/4\ b\ )\ Fb\ 1/EJ\ = 1/4\ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2 - x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x -1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

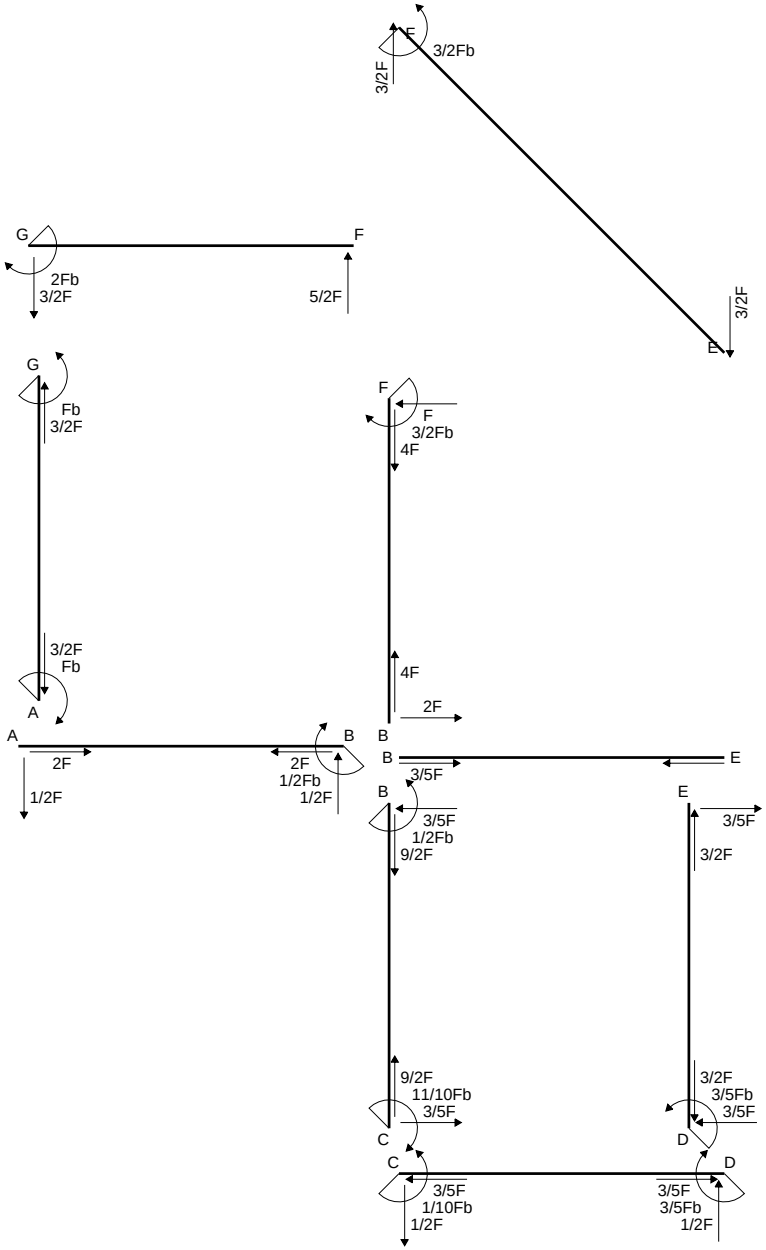
$= (1/6\ b\ )\ Fb\ 1/EJ\ = 1/6\ Fb^2/EJ$

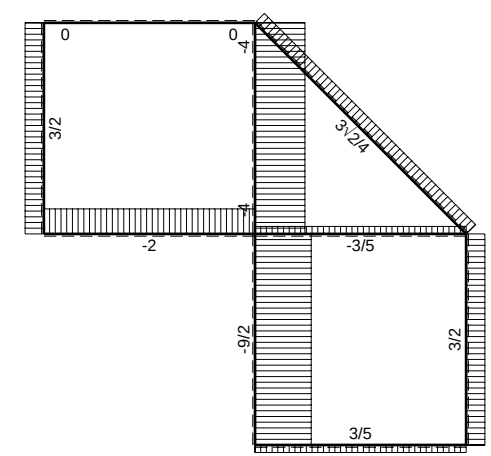


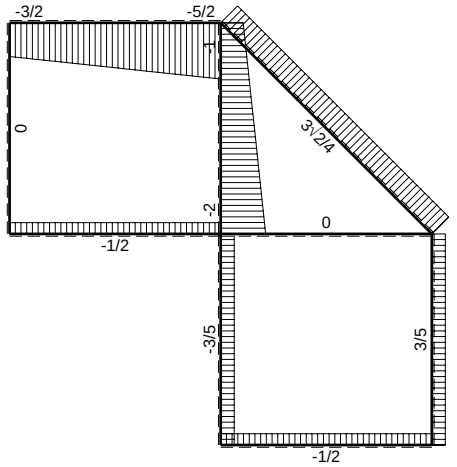
A = 111.2 mm^2
J_u = 46846. mm^4
J_v = 1856. mm^4
J_t = 82.76 mm^4
y_o = 13.97 mm
y_g = 29.05 mm
T_y = -450. N
M_x = -366000. Nmm
x_m = 11. mm
v_m = -29.05 mm
$\sigma_m = -Mv/J_u$ = -226.9 N/mm^2
y_c = 3. mm
u_c = -11. mm
v_c = -26.05 mm
$\sigma_c = -Mv/J_u$ = -226.9 N/mm^2
$\tau_c = TS^*/tJ_u$ = 6.027 N/mm^2
$\tau_g = TS^*/tJ_u$ = 6.027 N/mm^2
t_c = 300. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 227.2 N/mm^2

CI02.xxxx.183

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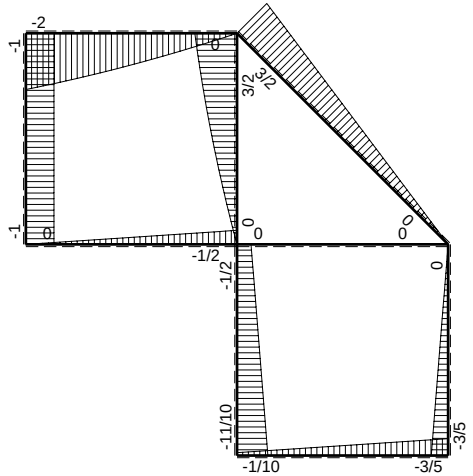

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3/5Fb
3/5F
D
C
D
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1/2F
3/5F
3/5Fb
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3/5

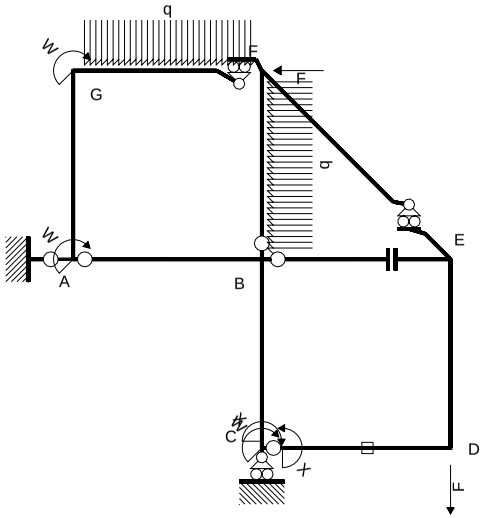

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0
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-2
0
-1/2
-3/5
3/5
-1/2

←□→ F

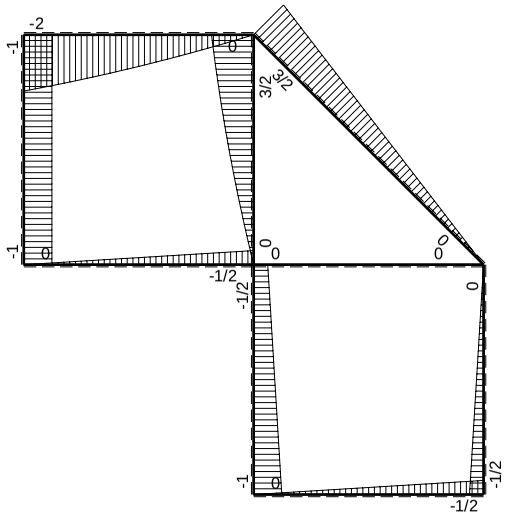
↑□↓ F


-2
-1
0
3/2
3√2/4
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0
-11/10
-3/5
-1/10
-3/5

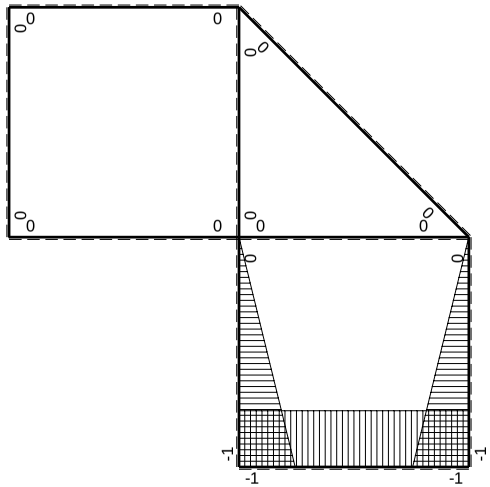
↻□↺ Fb



Schema di calcolo iperstatico



M_0 flessione da carichi assegnati



M_x flessione da iperstatica X=1

Quadro contributi PLV per iperstatica $X=W_{CD}$

→	$M_x(x)$	$M_0(x)$	M_xM_0	M_xM_x	$\int M_xM_0/EJdx$	$\int XM_xM_x/EJdx$
AB b	0	-1/2Fx	0	0	0	0
BA b	0	1/2Fb-1/2Fx	0	0		
BC b	-x/b	-1/2Fb-1/2Fx	$1/2Fx+1/2Fx^2/b$	x^2/b^2	$5/12Fb^2/EJ$	1/3Xb/EJ
CB b	1-x/b	Fb-1/2Fx	$Fb-3/2Fx+1/2Fx^2/b$	$1-2x/b+x^2/b^2$		
CD b	-1	-1/2Fx	1/2Fx	1	$1/4Fb^2/EJ$	Xb/EJ
DC b	1	1/2Fb-1/2Fx	1/2Fb-1/2Fx	1		
DE 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
ED b	x/b	1/2Fx	$1/2Fx^2/b$	x^2/b^2		
EF $\sqrt{2}$b	0	$3\sqrt{2}/4Fx$	0	0	0	0
FG b	0	$-5/2Fx+1/2qx^2$	0	0	0	0
GF b	0	$2Fb-3/2Fx-1/2qx^2$	0	0		
GA b	0	-Fb	0	0	0	0
AG b	0	Fb	0	0		
FB b	0	$3/2Fb-Fx-1/2qx^2$	0	0	0	0
BF b	0	$-2Fx+1/2qx^2$	0	0		
BE b	0	0	0	0	0	0
EB b	0	0	0	0		
CD	elongazione asta $N_{1CD}\varepsilon_{CD}L_{CD}$				$-Fb^2/EJ$	
	totali				$-1/6Fb^2/EJ$	5/3Xb/EJ
	iperstatica $X=W_{CD}$				1/10Fb	

Sviluppi di calcolo iperstatica

$L^{XX}_{BC} = \int_o^b (x^2/b^2)\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CB} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{CD} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DC} = \int_o^b (1\ )\ 1/EJ\ dx = [\ x\ ]_o^b\ 1/EJ$

$= (\ b\ )\ 1/EJ\ =\ b/EJ$

$L^{XX}_{DE} = \int_o^b (1 -2\ x/b + x^2/b^2\ )\ 1/EJ\ dx = [\ x - x^2/b +1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (\ b - b +1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{XX}_{ED} = \int_o^b (x^2/b^2\ )\ 1/EJ\ dx = [1/3\ x^3/b^2\ ]_o^b\ 1/EJ$

$= (1/3\ b\ )\ 1/EJ\ = 1/3\ b/EJ$

$L^{Xo}_{BC} = \int_o^b (1/2\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/4\ b +1/6\ b\ )\ Fb\ 1/EJ\ = 5/12\ Fb^2/EJ$

$L^{Xo}_{CB} = \int_o^b (1 -3/2\ x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [\ x -3/4\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (\ b -3/4\ b +1/6\ b\ )\ Fb\ 1/EJ\ = 5/12\ Fb^2/EJ$

$L^{Xo}_{CD} = \int_o^b (1/2\ x/b\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = [1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ$

$= (1/4\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -3/4\ \ Fb^2/EJ$

$L^{Xo}_{DC} = \int_o^b (1/2 -1/2\ x/b\ )\ Fb\ 1/EJ\ dx + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = [1/2\ x -1/4\ x^2/b\ ]_o^b\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/E$

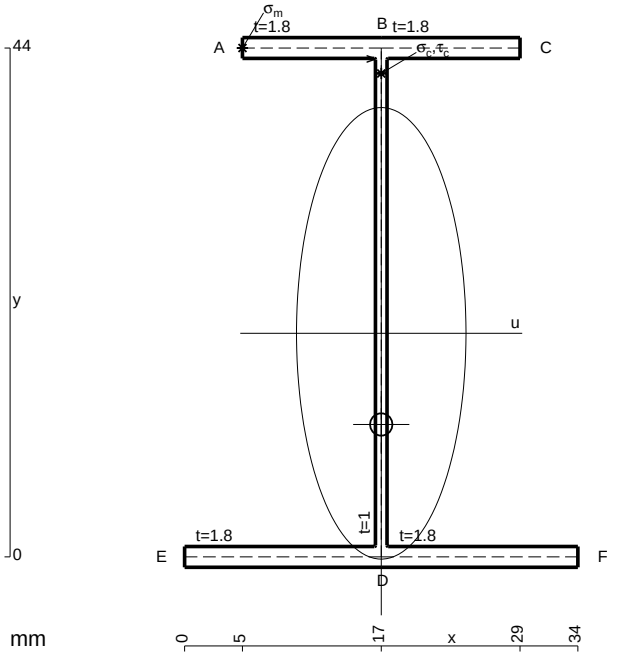
$= (1/2\ b -1/4\ b\ )\ Fb\ 1/EJ\ + 1\ \ (-1)\ \ 1\ \ Fb^2/EJ = -3/4\ \ Fb^2/EJ$

$L^{Xo}_{DE} = \int_o^b (1/2 - x/b +1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/2\ x -1/2\ x^2/b +1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/2\ b -1/2\ b +1/6\ b\ )\ Fb\ 1/EJ\ = 1/6\ \ Fb^2/EJ$

$L^{Xo}_{ED} = \int_o^b (1/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx = [1/6\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ$

$= (1/6\ b\ )\ Fb\ 1/EJ\ = 1/6\ \ Fb^2/EJ$



A = 148.4 mm^2
J_u = 56572. mm^4
J_v = 7969. mm^4
J_t = 127.4 mm^4
y_o = -7.883 mm
y_g = 19.33 mm
T_y = -705. N
M_x = -545200. Nmm
x_m = 5. mm
y_m = 44. mm
u_m = -12. mm
v_m = 24.67 mm
$\sigma_m = -Mv/J_u$ = 237.7 N/mm^2
x_c = 17. mm
y_c = 44. mm
v_c = 24.67 mm
$\sigma_c = -Mv/J_u$ = 237.7 N/mm^2
$\tau_c = TS^*/tJ_u$ = 13.28 N/mm^2
$\tau_g = TS^*/tJ_u$ = 13.28 N/mm^2
t_c = 470. mm
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 238.8 N/mm^2

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