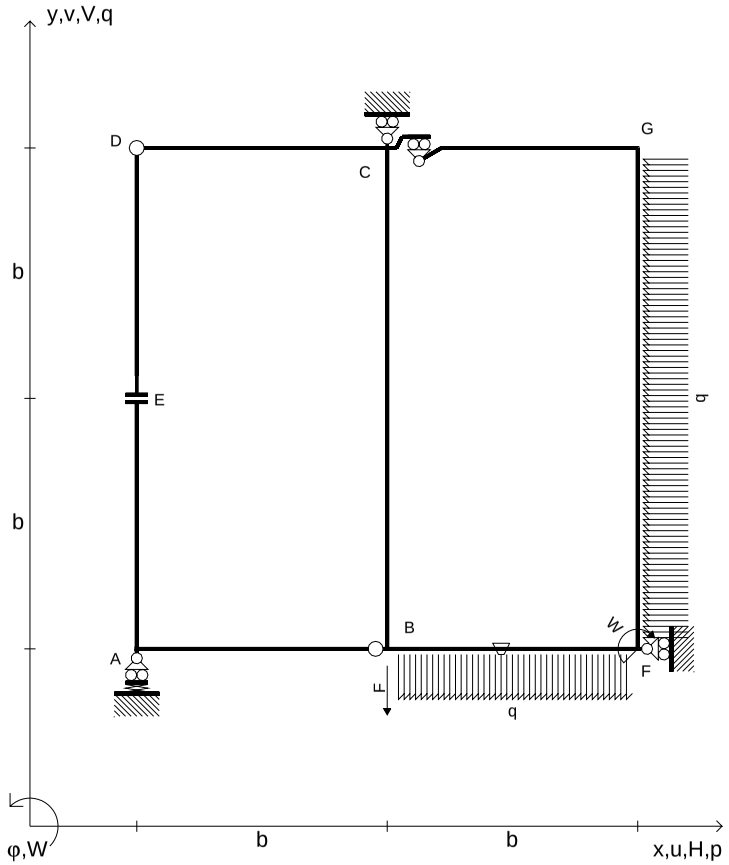
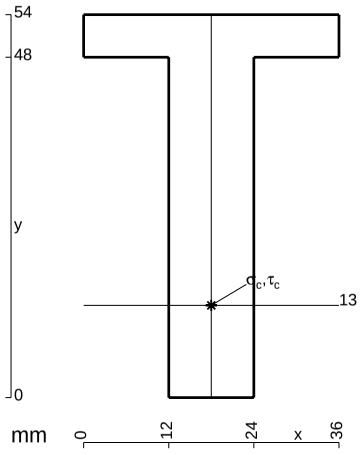
$V_B = -F$
$W_F = -W = -Fb$
$q_{BF} = -q = -F/b$
$p_{FG} = -q = -F/b$
$\theta_{BF} = -\theta = -\alpha T/b = -bF/EJ$
$k_A = 4EJ/b^3$
$EJ_{AB} = EJ$
$EJ_{CD} = EJ$
$EJ_{DE} = EJ$
$EJ_{EA} = EJ$
$EJ_{BF} = EJ$
$EJ_{GC} = EJ$
$EJ_{FG} = EJ$
$EJ_{CB} = EJ$

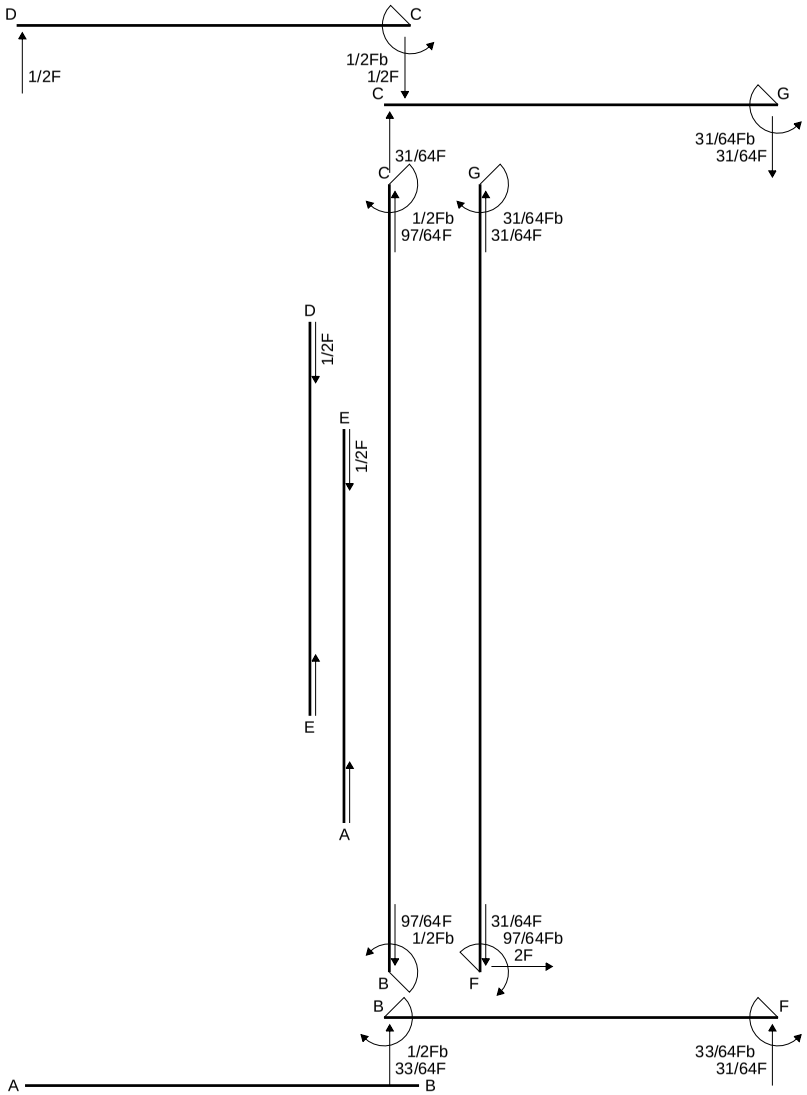


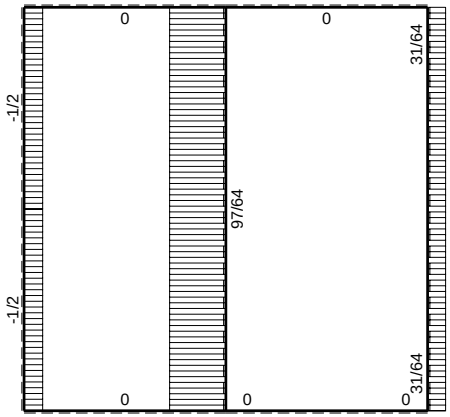




Reazioni iperstatiche in soluzione: $X=W_{GF}$
Carichi e deformazioni date hanno verso efficace in disegno.
Calcolare reazioni vincolari della struttura e delle aste.
Tracciare i diagrammi quotati delle azioni interne nelle aste.
$J_{YZ}$ - $x_{YZ}$ - $\theta_{YZ}$ riferimento locale asta YZ con origine in Y.
La trave CD ha la sezione riportata e dimensioni in mm, con:
b = 730 mm, F = 4330 N
Calcolare sulla sezione C la massima tensione normale $\sigma_m$.
Calcolare in * le tensioni $\sigma_c$,$\tau_c$ e la tensione di von Mises.
Lembo inferiore sezione su tratteggio trave, a destra da C a D
Curvatura θ asta BF positiva se convessa a destra con inizio B.

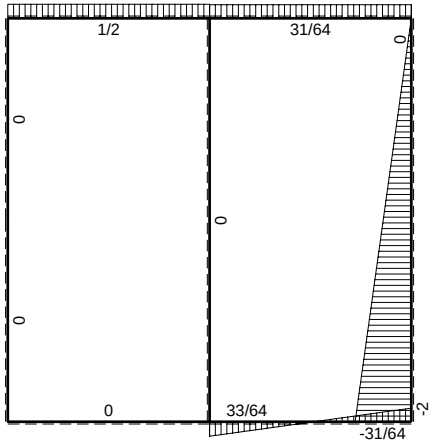




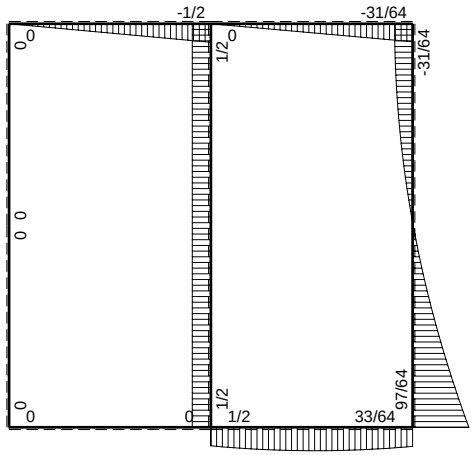






←⊞→ F



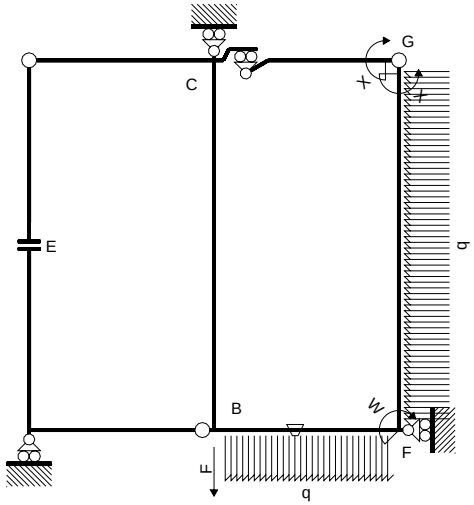

↑⊞↓ F

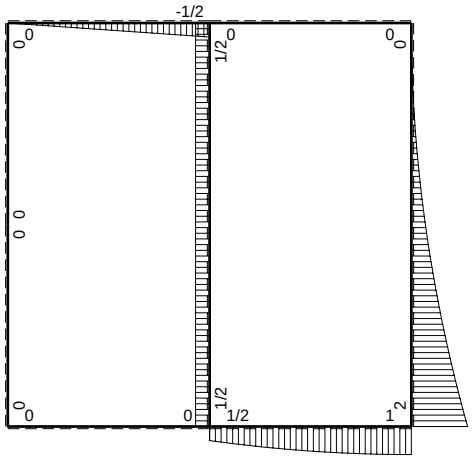



↻⊞↺ Fb

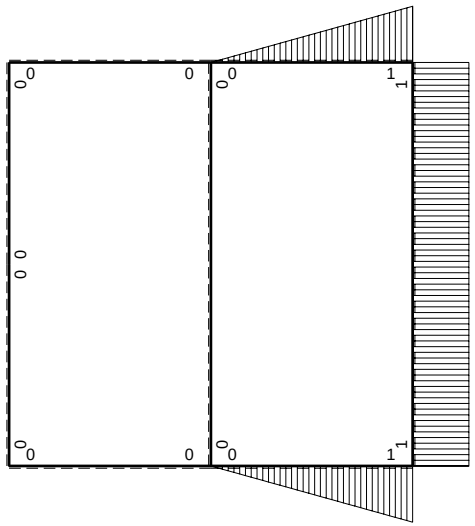







↻⊞↺ $M_o$ flessione da carichi assegnati




↻⊞↺ $M_x$ flessione da iperstatica X=1

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

| → | $M_x(x)$ | $M_o(x)$ | θ | $M_xM_o$ | $M_x\theta$ | $M_xM_x$ | $\int M_x(M_o/EJ+\theta)dx$ | $\int XM_xM_x/EJdx$ |
|---|---|---|---|---|---|---|---|---|
| AB b | 0 | 0 | 0 | 0 | 0 | 0 | 0+0 | 0 |
| BA b | 0 | 0 | 0 | 0 | 0 | 0 | | |
| CD b | 0 | -1/2Fb+1/2Fx | 0 | 0 | 0 | 0 | 0+0 | 0 |
| DC b | 0 | 1/2Fx | 0 | 0 | 0 | 0 | | |
| DE b | 0 | 0 | 0 | 0 | 0 | 0 | 0+0 | 0 |
| ED b | 0 | 0 | 0 | 0 | 0 | 0 | | |
| EA b | 0 | 0 | 0 | 0 | 0 | 0 | 0+0 | 0 |
| AE b | 0 | 0 | 0 | 0 | 0 | 0 | | |
| BF b | x/b | 1/2Fb+Fx-1/2qx$^2$ | -Fb/EJ | 1/2Fx+Fx$^2$/b-1/2qx$^3$/b | -Fx/EJ | x$^2$/b$^2$ | (11/24-1/2)Fb$^2$/EJ | 1/3Xb/EJ |
| FB b | -1+x/b | -Fb+1/2qx$^2$ | Fb/EJ | Fb-Fx-1/2Fx$^2$/b+1/2qx$^3$/b | -Fb/EJ+Fx/EJ | 1-2x/b+x$^2$/b$^2$ | | |
| GC b | 1-x/b | 0 | 0 | 0 | 0 | 1-2x/b+x$^2$/b$^2$ | 0+0 | 1/3Xb/EJ |
| CG b | -x/b | 0 | 0 | 0 | 0 | x$^2$/b$^2$ | | |
| FG 2b | 1 | 2Fb-2Fx+1/2qx$^2$ | 0 | 2Fb-2Fx+1/2Fx$^2$/b | 0 | 1 | (4/3+0)Fb$^2$/EJ | 2Xb/EJ |
| GF 2b | -1 | -1/2qx$^2$ | 0 | 1/2Fx$^2$/b | 0 | 1 | | |
| CB 2b | 0 | 1/2Fb | 0 | 0 | 0 | 0 | 0+0 | 0 |
| BC 2b | 0 | -1/2Fb | 0 | 0 | 0 | 0 | | |
| | totali | | | | | | 31/24Fb$^2$/EJ | 8/3Xb/EJ |
| | iperstatica X=$W_{GF}$ | | | | | | -31/64Fb | |

Sviluppi di calcolo iperstatica





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

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

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

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

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

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

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

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

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

$= (2\ b )\ 1/EJ\ = 2\ b/EJ$

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

$= (2\ b )\ 1/EJ\ = 2\ b/EJ$

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

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

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

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

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

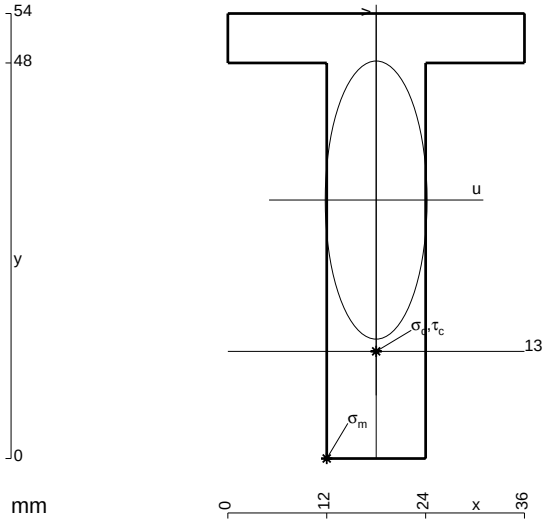
$= (\ b -1/2\ b -1/6\ b +1/8\ b )\ Fb\ 1/EJ\ + (\ b -1/2\ b )\ \theta\ = -1/24\ Fb^2/EJ$

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

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

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

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




A = 792. $mm^2$
$J_u$ = 225759. $mm^4$
$J_v$ = 30240. $mm^4$
$y_g$ = 31.36 mm
$T_y$ = 2165. N
$M_x$ = -1580450. Nmm
$x_m$ = 12. mm
$u_m$ = -6. mm
$v_m$ = -31.36 mm
$\sigma_m = -Mv/J_u$ = -219.6 $N/mm^2$
$x_c$ = 18. mm
$y_c$ = 13. mm
$v_c$ = -18.36 mm
$\sigma_c = -Mv/J_u$ = -128.6 $N/mm^2$
$\tau_c$ = 3.1 $N/mm^2$
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 128.7 $N/mm^2$
$S^*$ = 3879. $mm^3$



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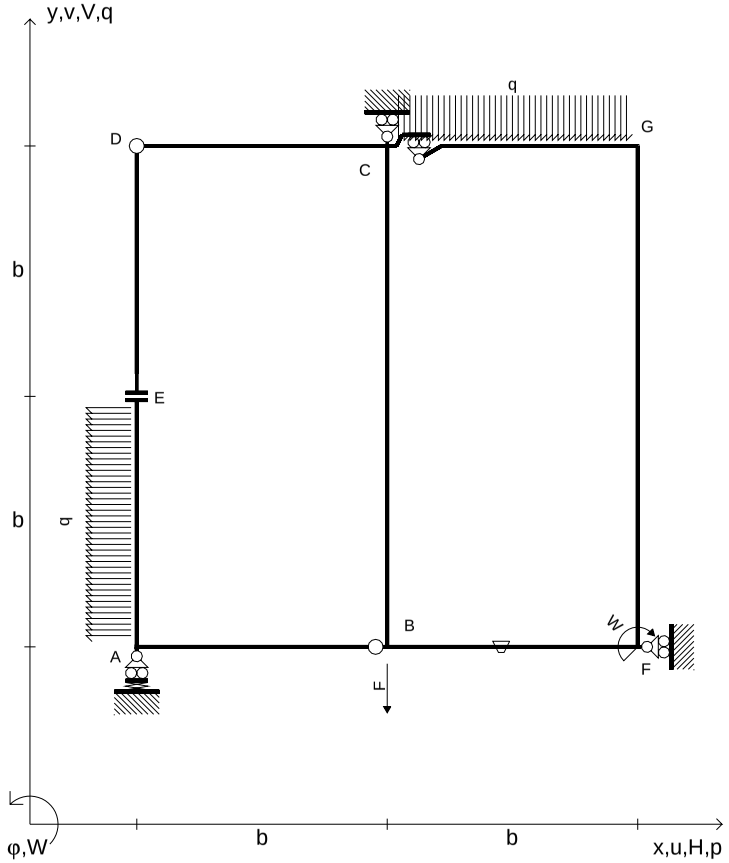
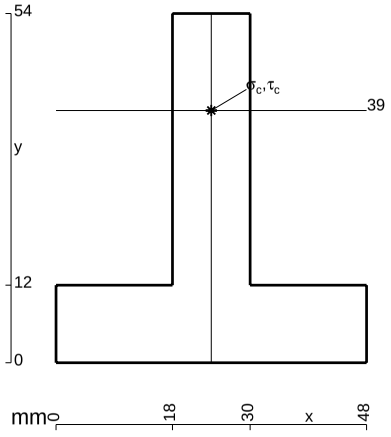
$V_B = -F$
$W_F = -W = -Fb$
$p_{EA} = -q = -F/b$
$q_{GC} = -q = -F/b$
$\theta_{BF} = -\theta = -\alpha T/b = -bF/EJ$
$k_A = 4EJ/b^3$
$EJ_{AB} = EJ$
$EJ_{CD} = EJ$
$EJ_{DE} = EJ$
$EJ_{EA} = EJ$
$EJ_{BF} = EJ$
$EJ_{GC} = EJ$
$EJ_{FG} = EJ$
$EJ_{CB} = EJ$

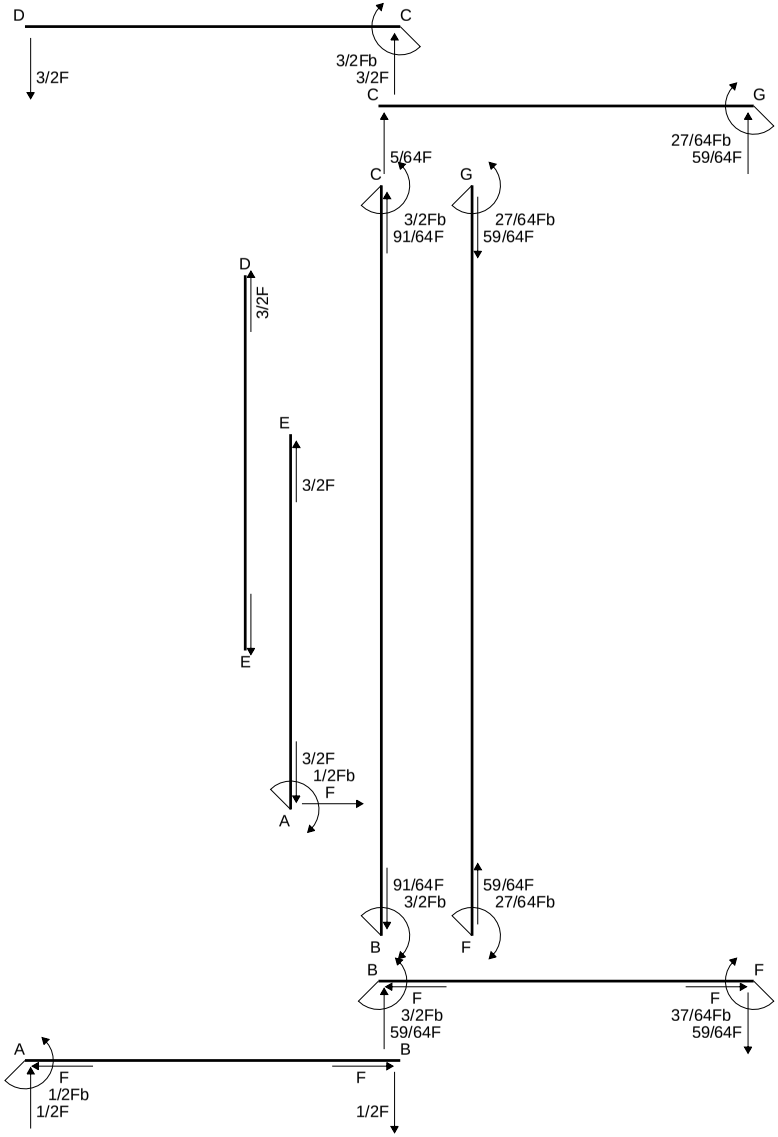


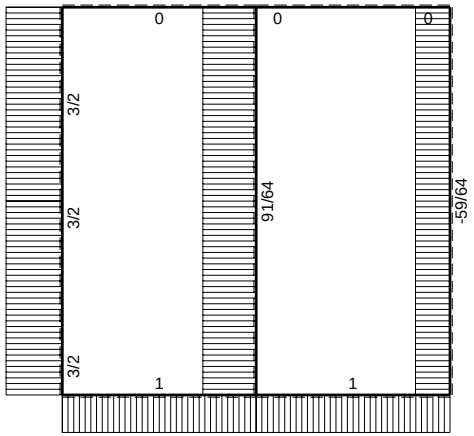




Reazioni iperstatiche in soluzione: $X=W_{GF}$
Carichi e deformazioni date hanno verso efficace in disegno.
Calcolare reazioni vincolari della struttura e delle aste.
Tracciare i diagrammi quotati delle azioni interne nelle aste.
$J_{YZ}$ - $x_{YZ}$ - $\theta_{YZ}$ riferimento locale asta YZ con origine in Y.
La trave CD ha la sezione riportata e dimensioni in mm, con:
b = 640 mm, F = 1620 N
Calcolare sulla sezione C la massima tensione normale $\sigma_m$.
Calcolare in * le tensioni $\sigma_c,\tau_c$ e la tensione di von Mises.
Lembo inferiore sezione su tratteggio trave, a destra da C a D
Curvatura θ asta BF positiva se convessa a destra con inizio B.

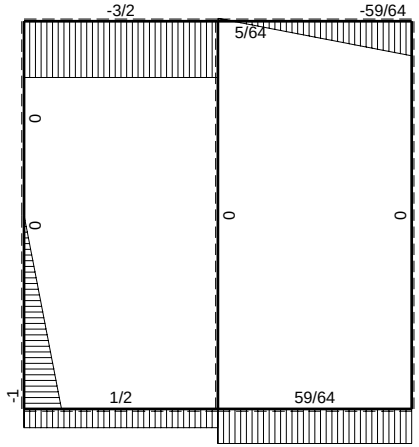




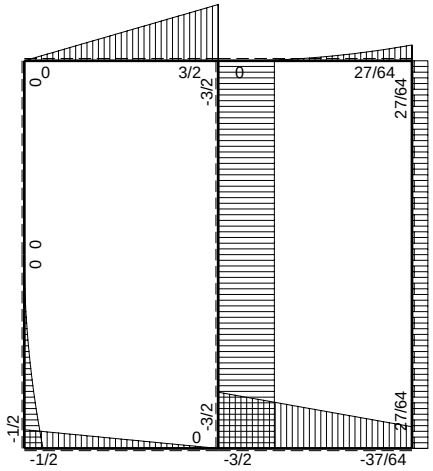





←F→



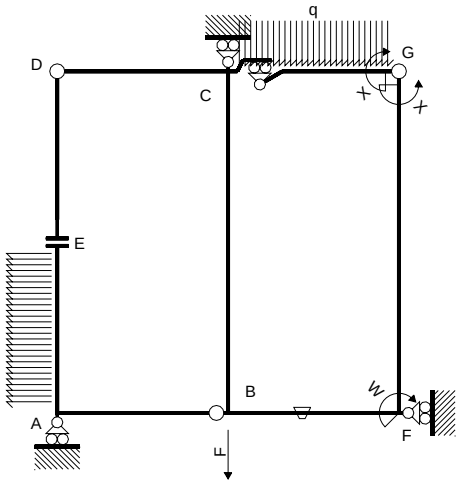

↑F↓

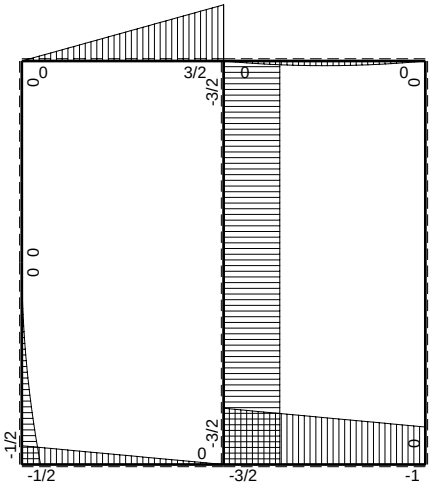



Fb

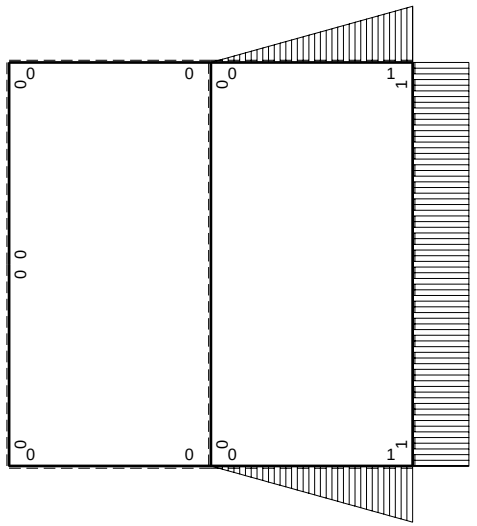







$M_o$ flessione da carichi assegnati




$M_x$ flessione da iperstatica X=1

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

| → | $M_x(x)$ | $M_o(x)$ | θ | $M_xM_o$ | $M_x\theta$ | $M_xM_x$ | $\int M_x(M_o/EJ+\theta)dx$ | $\int XM_xM_x/EJdx$ |
|---|---|---|---|---|---|---|---|---|
| AB b | 0 | -1/2Fb+1/2Fx | 0 | 0 | 0 | 0 | 0+0 | 0 |
| BA b | 0 | 1/2Fx | 0 | 0 | 0 | 0 | | |
| CD b | 0 | 3/2Fb-3/2Fx | 0 | 0 | 0 | 0 | 0+0 | 0 |
| DC b | 0 | -3/2Fx | 0 | 0 | 0 | 0 | | |
| DE b | 0 | 0 | 0 | 0 | 0 | 0 | 0+0 | 0 |
| ED b | 0 | 0 | 0 | 0 | 0 | 0 | | |
| EA b | 0 | $-1/2qx^2$ | 0 | 0 | 0 | 0 | 0+0 | 0 |
| AE b | 0 | $1/2Fb-Fx+1/2qx^2$ | 0 | 0 | 0 | 0 | | |
| BF b | x/b | -3/2Fb+1/2Fx | -Fb/EJ | $-3/2Fx+1/2Fx^2/b$ | -Fx/EJ | $x^2/b^2$ | $(-7/12-1/2)Fb^2/EJ$ | 1/3Xb/EJ |
| FB b | -1+x/b | Fb+1/2Fx | Fb/EJ | $-Fb+1/2Fx+1/2Fx^2/b$ | -Fb/EJ+Fx/EJ | $1-2x/b+x^2/b^2$ | | |
| GC b | 1-x/b | $-1/2Fx+1/2qx^2$ | 0 | $-1/2Fx+Fx^2/b-1/2qx^3/b$ | 0 | $1-2x/b+x^2/b^2$ | $(-1/24+0)Fb^2/EJ$ | 1/3Xb/EJ |
| CG b | -x/b | $1/2Fx-1/2qx^2$ | 0 | $-1/2Fx^2/b+1/2qx^3/b$ | 0 | $x^2/b^2$ | | |
| FG 2b | 1 | 0 | 0 | 0 | 0 | 1 | 0+0 | 2Xb/EJ |
| GF 2b | -1 | 0 | 0 | 0 | 0 | 1 | | |
| CB 2b | 0 | -3/2Fb | 0 | 0 | 0 | 0 | 0+0 | 0 |
| BC 2b | 0 | 3/2Fb | 0 | 0 | 0 | 0 | | |
| | | totali | | | | | $-9/8Fb^2/EJ$ | 8/3Xb/EJ |
| | | iperstatica $X=W_{GF}$ | | | | | 27/64Fb | |

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

$= (2\ b )\ 1/EJ = 2\ b/EJ$

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

$= (2\ b )\ 1/EJ = 2\ b/EJ$

$L_{BF}^{Xo} = \int_o^b (-3/2\ x/b +1/2\ x^2/b^2 )\ Fb\ 1/EJ\ dx + \int_o^b (- x/b )\ \theta\ dx$

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

$= (-3/4\ b +1/6\ b )\ Fb\ 1/EJ + (-1/2\ b )\ \theta = -13/12\ Fb^2/EJ$

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

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

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

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

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

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

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



PROCEDIMENTO E RISULTATI 995596 ESΣ08.xxxx.015

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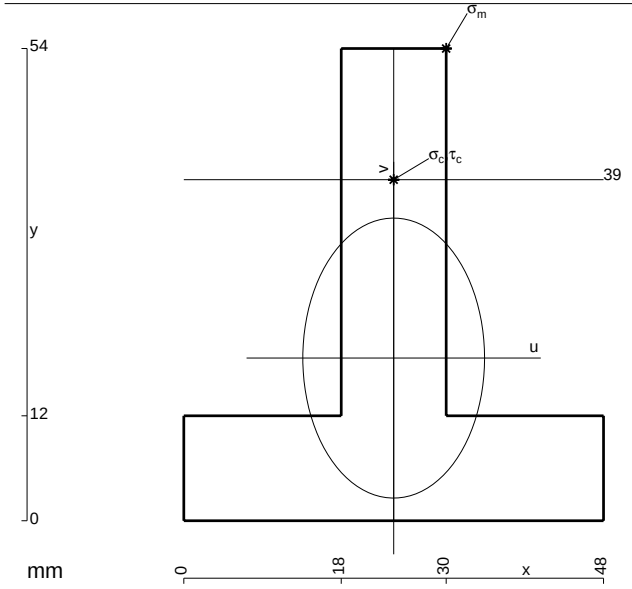


A = 1080. $mm^2$
$J_u$ = 276955. $mm^4$
$J_v$ = 116640. $mm^4$
$y_g$ = 18.6 mm
$T_y$ = -2430. N
$M_x$ = 1555200. Nmm
$x_m$ = 30. mm
$y_m$ = 54. mm
$u_m$ = 6. mm
$v_m$ = 35.4 mm
$\sigma_m = -Mv/J_u$ = -198.8 $N/mm^2$
$x_c$ = 24. mm
$y_c$ = 39. mm
$v_c$ = 20.4 mm
$\sigma_c = -Mv/J_u$ = -114.6 $N/mm^2$
$\tau_c$ = 3.672 $N/mm^2$
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 114.7 $N/mm^2$
$S^*$ = 5022. $mm^3$



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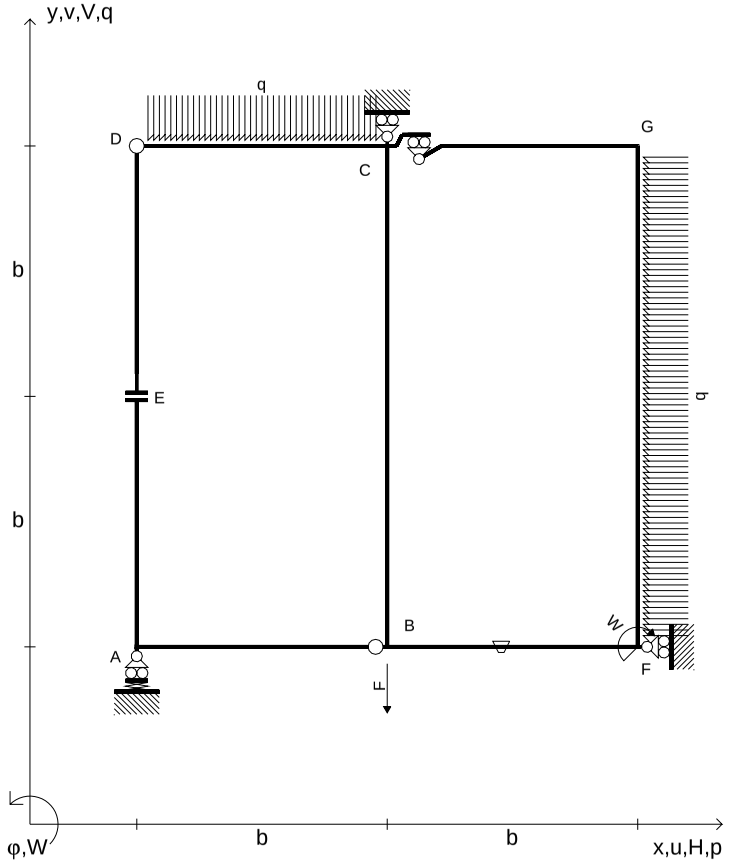
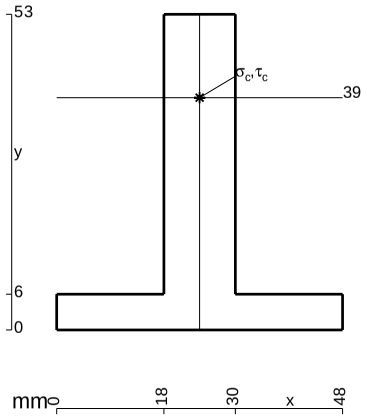
$V_B = -F$
$W_F = -W = -Fb$
$q_{CD} = -q = -F/b$
$p_{FG} = -q = -F/b$
$\theta_{BF} = -\theta = -\alpha T/b = -bF/EJ$
$k_A = 4EJ/b^3$
$EJ_{AB} = EJ$
$EJ_{CD} = EJ$
$EJ_{DE} = EJ$
$EJ_{EA} = EJ$
$EJ_{BF} = EJ$
$EJ_{GC} = EJ$
$EJ_{FG} = EJ$
$EJ_{CB} = EJ$

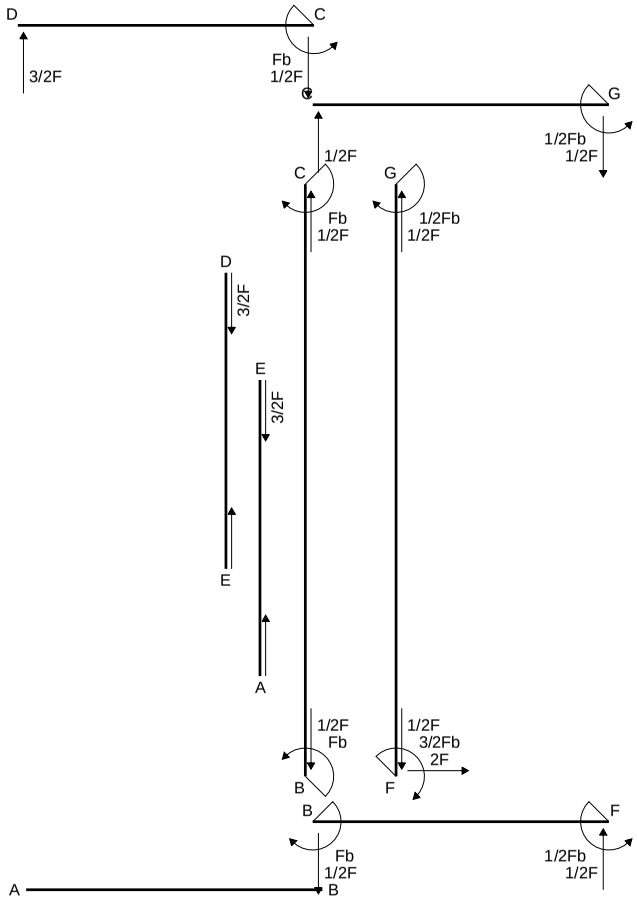



Reazioni iperstatiche in soluzione: $X=W_{GF}$
Carichi e deformazioni date hanno verso efficace in disegno.
Calcolare reazioni vincolari della struttura e delle aste.
Tracciare i diagrammi quotati delle azioni interne nelle aste.
$J_{YZ}$ - $x_{YZ}$ - $\theta_{YZ}$ riferimento locale asta YZ con origine in Y.
La trave CD ha la sezione riportata e dimensioni in mm, con:
b = 710 mm, F = 3640 N
Calcolare sulla sezione mediana la massima tensione normale $\sigma_m$
Calcolare in * le tensioni $\sigma_c,\tau_c$ e la tensione di von Mises.
Lembo inferiore sezione su tratteggio trave, a destra da C a D
Curvatura θ asta BF positiva se convessa a destra con inizio B.



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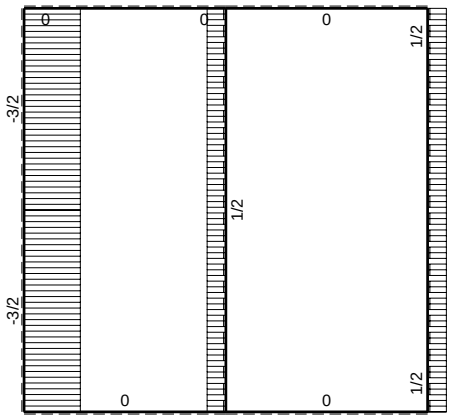
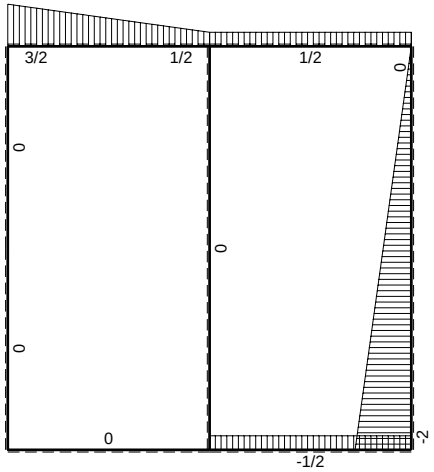
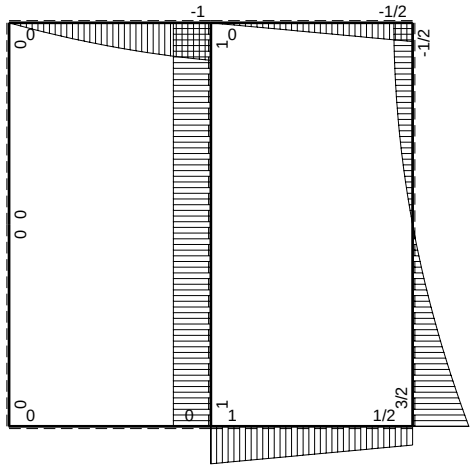



←□→ F

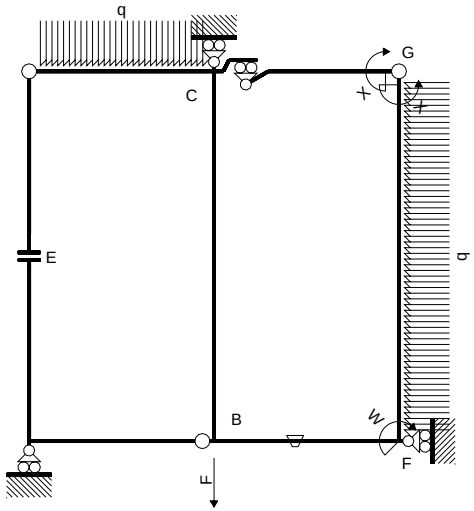


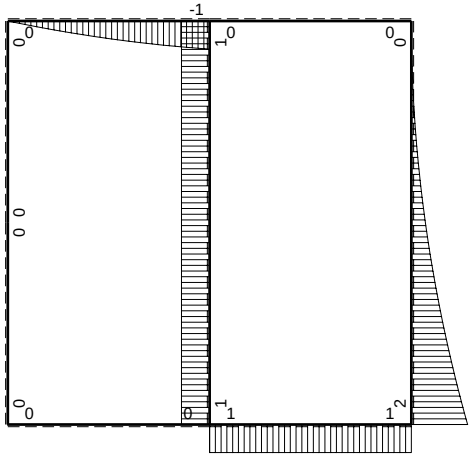

↑□↓ F



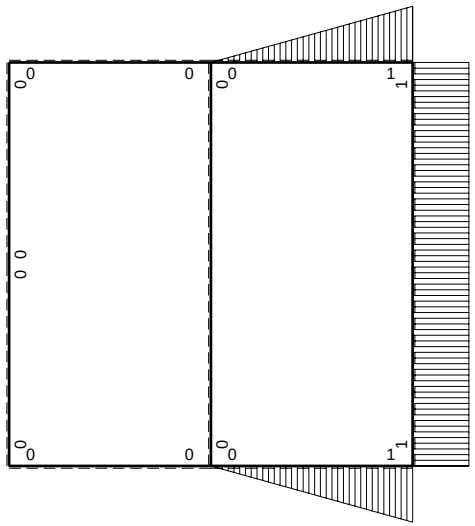

□ Fb






□ $M_o$ flessione da carichi assegnati




□ $M_x$ flessione da iperstatica X=1



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

| → | $M_x(x)$ | $M_o(x)$ | $\theta$ | $M_xM_o$ | $M_x\theta$ | $M_xM_x$ | $\int M_x(M_o/EJ+\theta)dx$ | $\int XM_xM_x/EJdx$ |
|---|---|---|---|---|---|---|---|---|
| AB b | 0 | 0 | 0 | 0 | 0 | 0 | 0+0 | 0 |
| BA b | 0 | 0 | 0 | 0 | 0 | 0 | | |
| CD b | 0 | $-Fb+1/2Fx+1/2qx^2$ | 0 | 0 | 0 | 0 | 0+0 | 0 |
| DC b | 0 | $3/2Fx-1/2qx^2$ | 0 | 0 | 0 | 0 | | |
| DE b | 0 | 0 | 0 | 0 | 0 | 0 | 0+0 | 0 |
| ED b | 0 | 0 | 0 | 0 | 0 | 0 | | |
| EA b | 0 | 0 | 0 | 0 | 0 | 0 | 0+0 | 0 |
| AE b | 0 | 0 | 0 | 0 | 0 | 0 | | |
| BF b | x/b | Fb | -Fb/EJ | Fx | -Fx/EJ | $x^2/b^2$ | $(1/2-1/2)Fb^2/EJ$ | 1/3Xb/EJ |
| FB b | -1+x/b | -Fb | Fb/EJ | Fb-Fx | -Fb/EJ+Fx/EJ | $1-2x/b+x^2/b^2$ | | |
| GC b | 1-x/b | 0 | 0 | 0 | 0 | $1-2x/b+x^2/b^2$ | 0+0 | 1/3Xb/EJ |
| CG b | -x/b | 0 | 0 | 0 | 0 | $x^2/b^2$ | | |
| FG 2b | 1 | $2Fb-2Fx+1/2qx^2$ | 0 | $2Fb-2Fx+1/2Fx^2/b$ | 0 | 1 | $(4/3+0)Fb^2/EJ$ | 2Xb/EJ |
| GF 2b | -1 | $-1/2qx^2$ | 0 | $1/2Fx^2/b$ | 0 | 1 | | |
| CB 2b | 0 | Fb | 0 | 0 | 0 | 0 | 0+0 | 0 |
| BC 2b | 0 | -Fb | 0 | 0 | 0 | 0 | | |
| | totali | | | | | | $4/3Fb^2/EJ$ | 8/3Xb/EJ |
| | iperstatica $X=W_{GF}$ | | | | | | -1/2Fb | |

Sviluppi di calcolo iperstatica



PROCEDIMENTO E RISULTATI 238395 ESΣ08.xxxx.027

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

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

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

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

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

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

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

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

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

$= (2\ b)\ 1/EJ\ = 2\ b/EJ$

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

$= (2\ b)\ 1/EJ\ = 2\ b/EJ$

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

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

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

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

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

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

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

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

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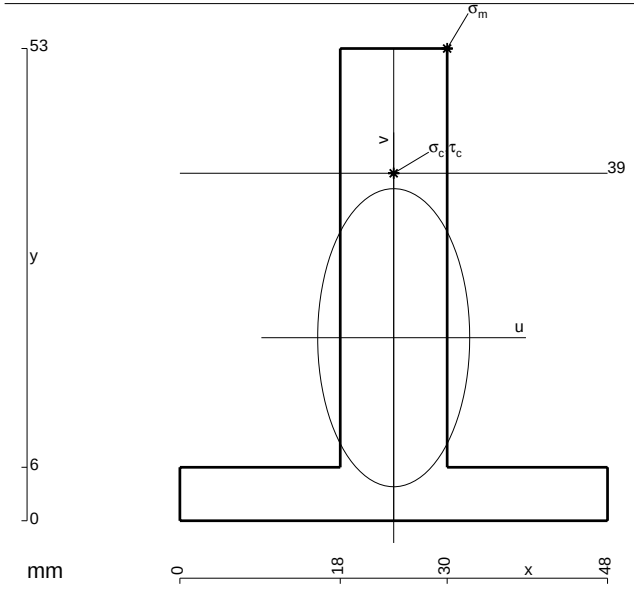


A = 852. $mm^2$
$J_u$ = 238569. $mm^4$
$J_v$ = 62064. $mm^4$
$y_g$ = 20.54 mm
$T_y$ = 3640. N
$M_x$ = -1615250. Nmm
$x_m$ = 30. mm
$y_m$ = 53. mm
$u_m$ = 6. mm
$v_m$ = 32.46 mm
$\sigma_m = -Mv/J_u$ = 219.8 $N/mm^2$
$x_c$ = 24. mm
$y_c$ = 39. mm
$v_c$ = 18.46 mm
$\sigma_c = -Mv/J_u$ = 125. $N/mm^2$
$\tau_c$ = 5.438 $N/mm^2$
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 125.3 $N/mm^2$
$S^*$ = 4277. $mm^3$



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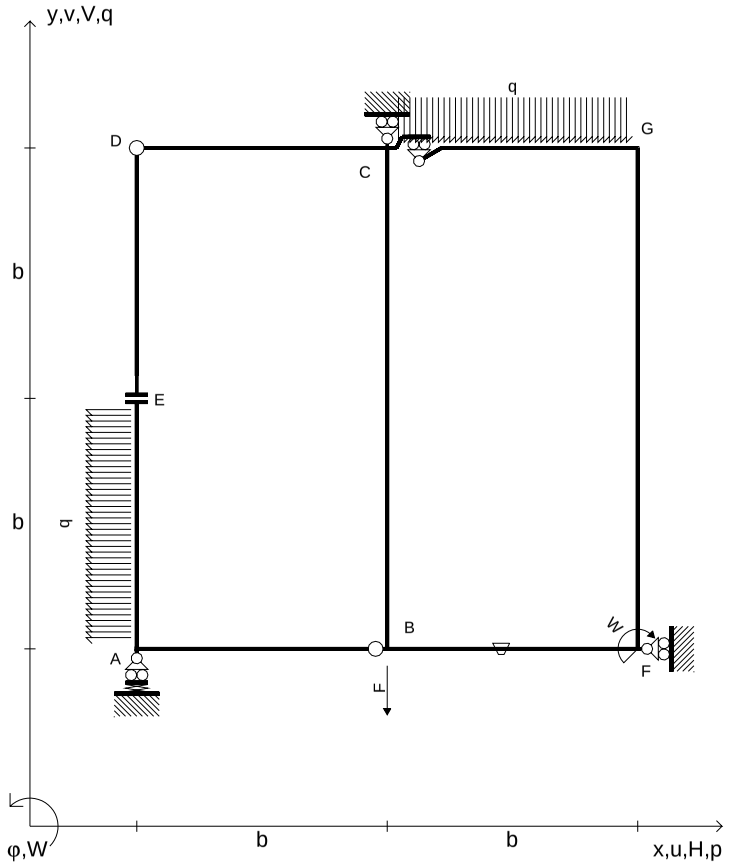
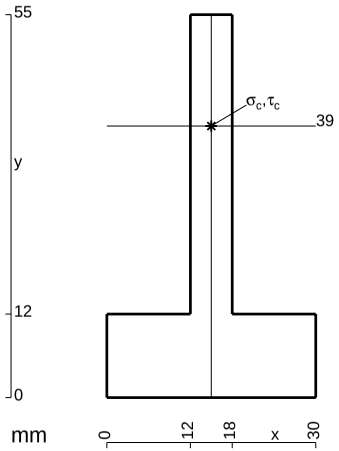
$V_B = -F$
$W_F = -W = -Fb$
$p_{EA} = -q = -F/b$
$q_{GC} = -q = -F/b$
$\theta_{BF} = -\theta = -\alpha T/b = -bF/EJ$
$k_A = 3EJ/b^3$
$EJ_{AB} = EJ$
$EJ_{CD} = EJ$
$EJ_{DE} = EJ$
$EJ_{EA} = EJ$
$EJ_{BF} = EJ$
$EJ_{GC} = EJ$
$EJ_{FG} = EJ$
$EJ_{CB} = EJ$

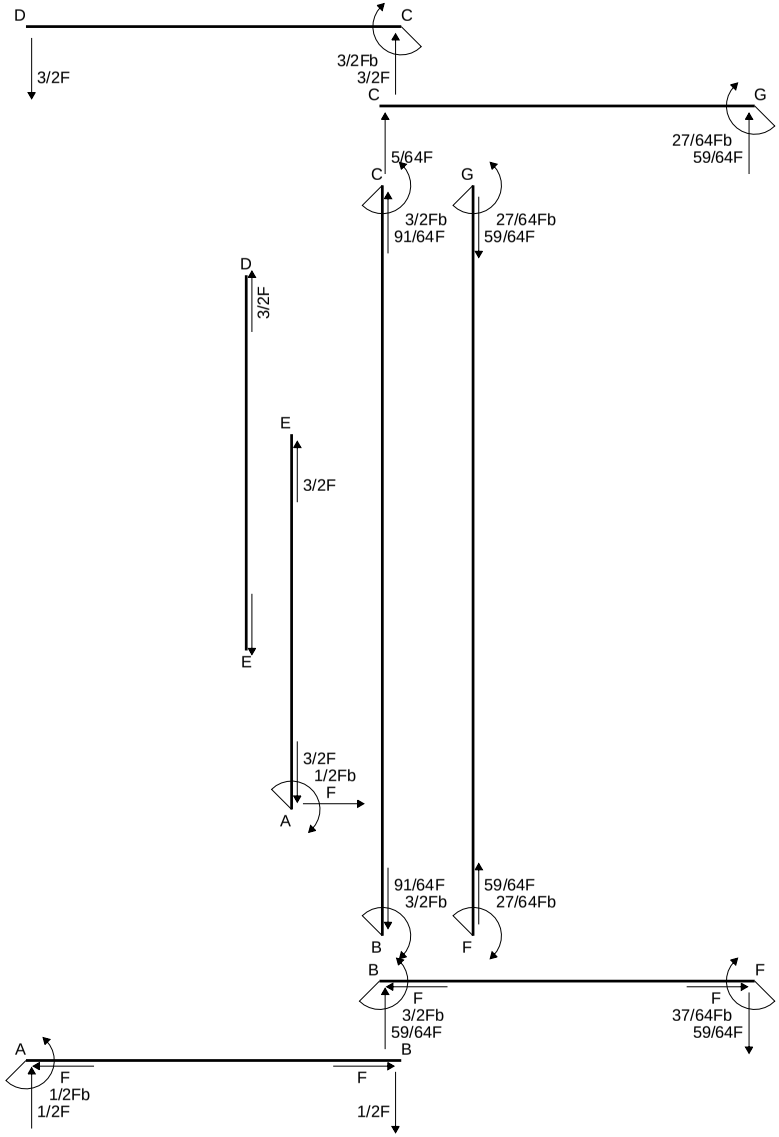


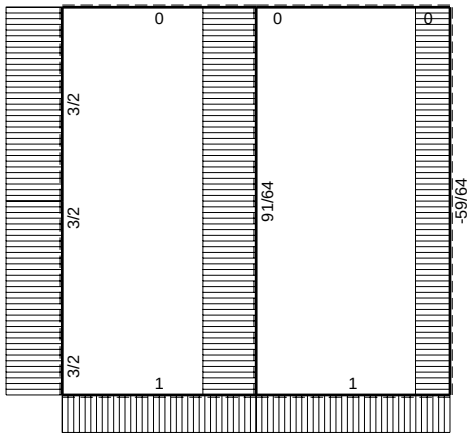




Reazioni iperstatiche in soluzione: $X=W_{GC}$
Carichi e deformazioni date hanno verso efficace in disegno.
Calcolare reazioni vincolari della struttura e delle aste.
Tracciare i diagrammi quotati delle azioni interne nelle aste.
$J_{YZ}$ - $x_{YZ}$ - $\theta_{YZ}$ riferimento locale asta YZ con origine in Y.
La trave CD ha la sezione riportata e dimensioni in mm, con:
b = 610 mm, F = 1100 N
Calcolare sulla sezione C la massima tensione normale $\sigma_m$.
Calcolare in * le tensioni $\sigma_c$,$\tau_c$ e la tensione di von Mises.
Lembo inferiore sezione su tratteggio trave, a destra da C a D
Curvatura θ asta BF positiva se convessa a destra con inizio B.

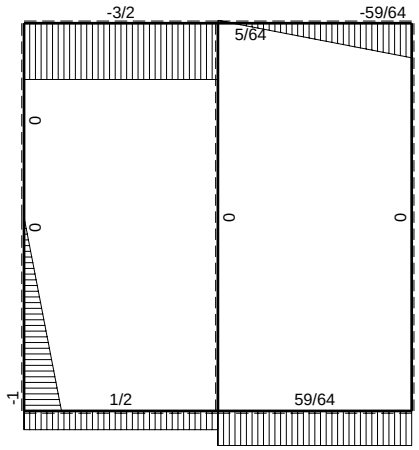




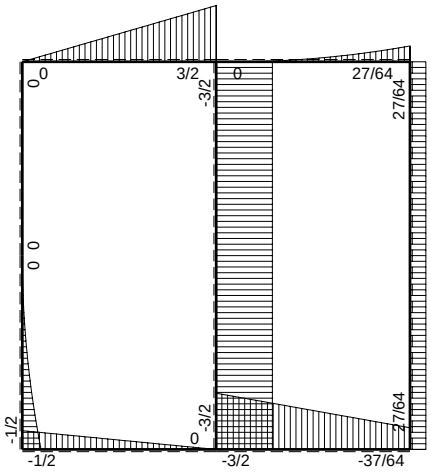






$\leftarrow \boxplus \rightarrow F$



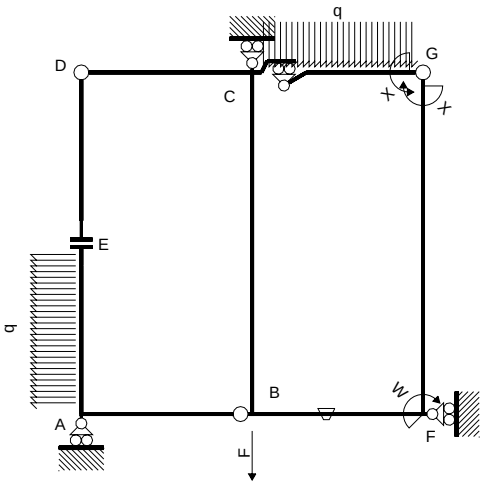

$\uparrow \boxplus \downarrow F$



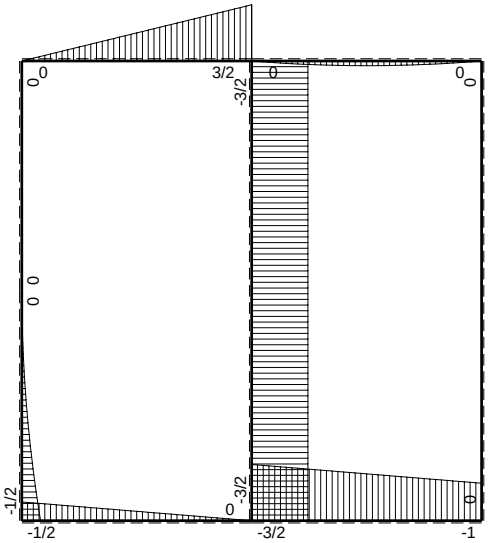

$\circlearrowleft \boxplus \circlearrowright$ Fb



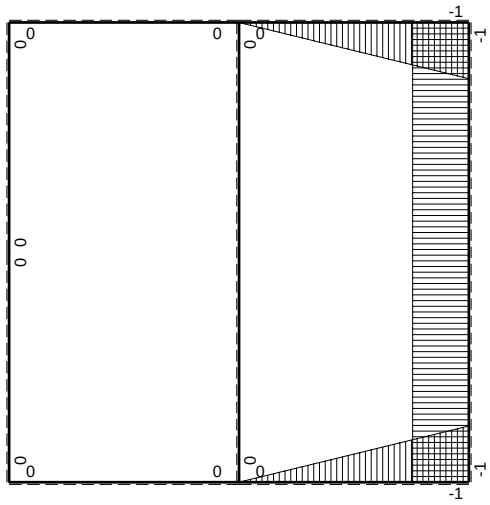





Schema di calcolo iperstatico




$\circlearrowleft \boxplus \circlearrowright$ $M_o$ flessione da carichi assegnati




$\circlearrowleft \boxplus \circlearrowright$ $M_x$ flessione da iperstatica X=1

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

| → | $M_x(x)$ | $M_o(x)$ | θ | $M_xM_o$ | $M_x\theta$ | $M_xM_x$ | $\int M_x(M_o/EJ+\theta)dx$ | $\int XM_xM_x/EJdx$ |
|---|---|---|---|---|---|---|---|---|
| AB b | 0 | -1/2Fb+1/2Fx | 0 | 0 | 0 | 0 | 0+0 | 0 |
| BA b | 0 | 1/2Fx | 0 | 0 | 0 | 0 | | |
| CD b | 0 | 3/2Fb-3/2Fx | 0 | 0 | 0 | 0 | 0+0 | 0 |
| DC b | 0 | -3/2Fx | 0 | 0 | 0 | 0 | | |
| DE b | 0 | 0 | 0 | 0 | 0 | 0 | 0+0 | 0 |
| ED b | 0 | 0 | 0 | 0 | 0 | 0 | | |
| EA b | 0 | $-1/2qx^2$ | 0 | 0 | 0 | 0 | 0+0 | 0 |
| AE b | 0 | $1/2Fb-Fx+1/2qx^2$ | 0 | 0 | 0 | 0 | | |
| BF b | -x/b | -3/2Fb+1/2Fx | -Fb/EJ | $3/2Fx-1/2Fx^2/b$ | Fx/EJ | $x^2/b^2$ | $(7/12+1/2)Fb^2/EJ$ | 1/3Xb/EJ |
| FB b | 1-x/b | Fb+1/2Fx | Fb/EJ | $Fb-1/2Fx-1/2Fx^2/b$ | Fb/EJ-Fx/EJ | $1-2x/b+x^2/b^2$ | | |
| GC b | -1+x/b | $-1/2Fx+1/2qx^2$ | 0 | $1/2Fx-Fx^2/b+1/2qx^3/b$ | 0 | $1-2x/b+x^2/b^2$ | $(1/24+0)Fb^2/EJ$ | 1/3Xb/EJ |
| CG b | x/b | $1/2Fx-1/2qx^2$ | 0 | $1/2Fx^2/b-1/2qx^3/b$ | 0 | $x^2/b^2$ | | |
| FG 2b | -1 | 0 | 0 | 0 | 0 | 1 | 0+0 | 2Xb/EJ |
| GF 2b | 1 | 0 | 0 | 0 | 0 | 1 | | |
| CB 2b | 0 | -3/2Fb | 0 | 0 | 0 | 0 | 0+0 | 0 |
| BC 2b | 0 | 3/2Fb | 0 | 0 | 0 | 0 | | |
| | totali | | | | | | $9/8Fb^2/EJ$ | 8/3Xb/EJ |
| | iperstatica X=$W_{GC}$ | | | | | | -27/64Fb | |

Sviluppi di calcolo iperstatica



PROCEDIMENTO E RISULTATI 236422 ESΣ08.xxxx.044

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

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

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

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

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

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

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

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

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

$= (2\ b )\ 1/EJ = 2\ b/EJ$

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

$= (2\ b )\ 1/EJ = 2\ b/EJ$

$L_{BF}^{Xo} = \int_o^b (3/2\ x/b -1/2\ x^2/b^2 )\ Fb\ 1/EJ\ dx + \int_o^b ( x/b )\ \theta\ dx$

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

$= (3/4\ b -1/6\ b )\ Fb\ 1/EJ + (1/2\ b )\ \theta = 13/12\ Fb^2/EJ$

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

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

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

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

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

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

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

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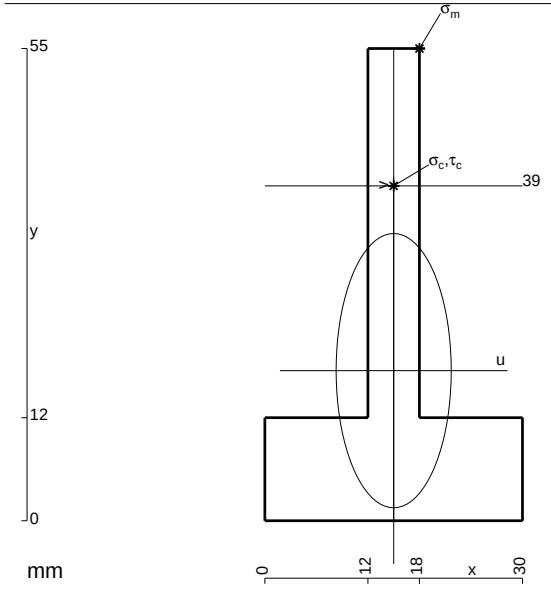


$A = 618.\ mm^2$
$J_u = 157731.\ mm^4$
$J_v = 27774.\ mm^4$
$y_g = 17.48\ mm$
$T_y = -1650.\ N$
$M_x = 1006500.\ Nmm$
$x_m = 18.\ mm$
$y_m = 55.\ mm$
$u_m = 3.\ mm$
$v_m = 37.52\ mm$
$\sigma_m = -Mv/J_u = -239.4\ N/mm^2$
$x_c = 15.\ mm$
$y_c = 39.\ mm$
$v_c = 21.52\ mm$
$\sigma_c = -Mv/J_u = -137.3\ N/mm^2$
$\tau_c = 4.941\ N/mm^2$
$\sigma_o = \sqrt{\sigma^2+3\tau^2} = 137.6\ N/mm^2$
$S^* = 2834.\ mm^3$



ESΣ08.xxxx.044

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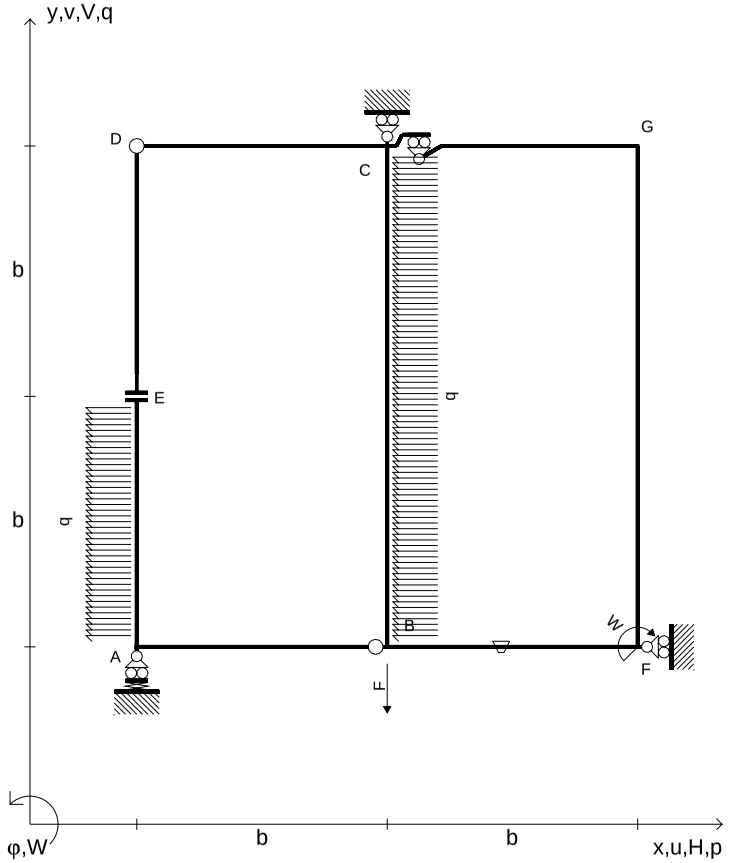
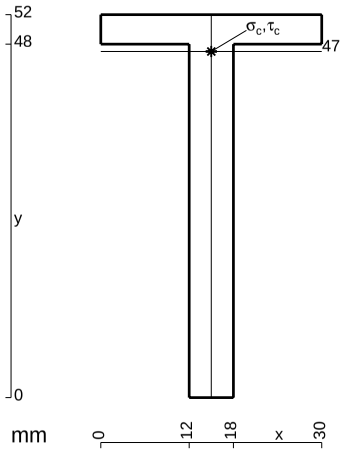
$V_B = -F$
$W_F = -W = -Fb$
$p_{EA} = -q = -F/b$
$p_{CB} = -q = -F/b$
$\theta_{BF} = -\theta = -\alpha T/b = -bF/EJ$
$k_A = 3EJ/b^3$
$EJ_{AB} = EJ$
$EJ_{CD} = EJ$
$EJ_{DE} = EJ$
$EJ_{EA} = EJ$
$EJ_{BF} = EJ$
$EJ_{GC} = EJ$
$EJ_{FG} = EJ$
$EJ_{CB} = EJ$

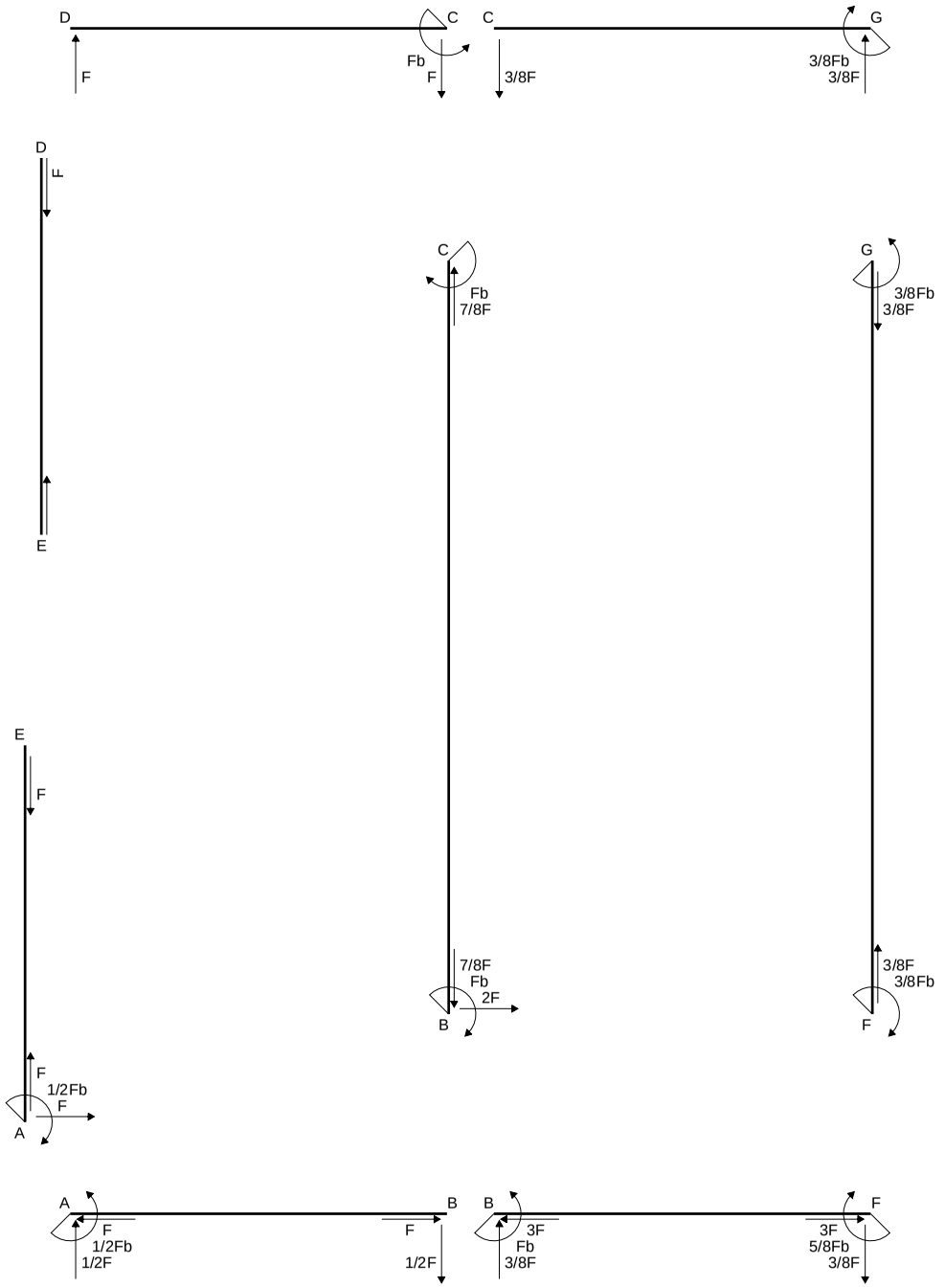


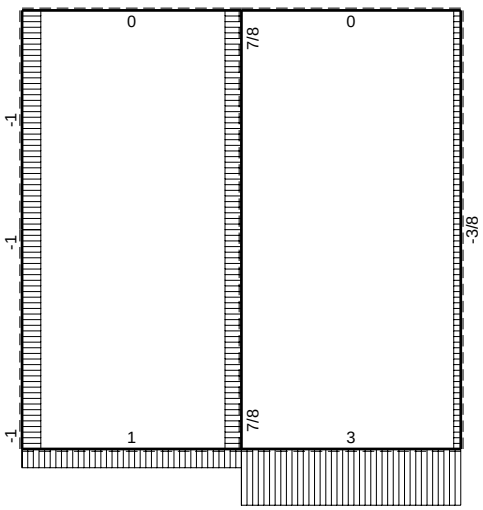




Reazioni iperstatiche in soluzione: $X=W_{GF}$
Carichi e deformazioni date hanno verso efficace in disegno.
Calcolare reazioni vincolari della struttura e delle aste.
Tracciare i diagrammi quotati delle azioni interne nelle aste.
$J_{YZ}$ - $x_{YZ}$ - $\theta_{YZ}$ riferimento locale asta YZ con origine in Y.
La trave CB ha la sezione riportata e dimensioni in mm, con:
b = 530 mm, F = 1560 N
Calcolare sulla sezione B la massima tensione normale $\sigma_m$.
Calcolare in * le tensioni $\sigma_c$,$\tau_c$ e la tensione di von Mises.
Lembo inferiore sezione su tratteggio trave, a destra da C a B
Curvatura θ asta BF positiva se convessa a destra con inizio B.

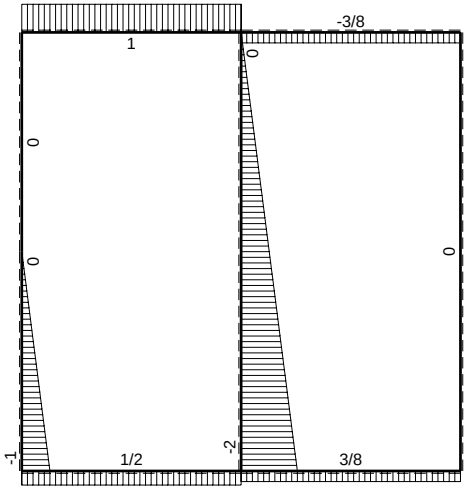




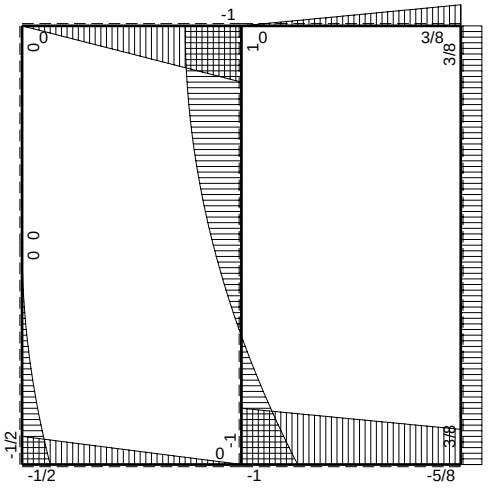






←□→ F



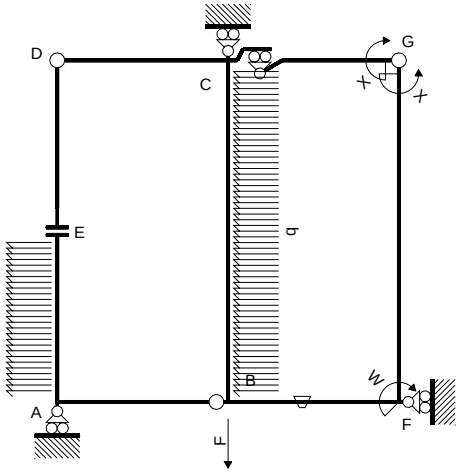

↑□↓ F

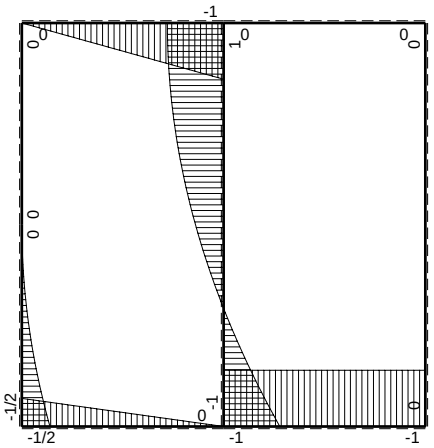



↺□↻ Fb

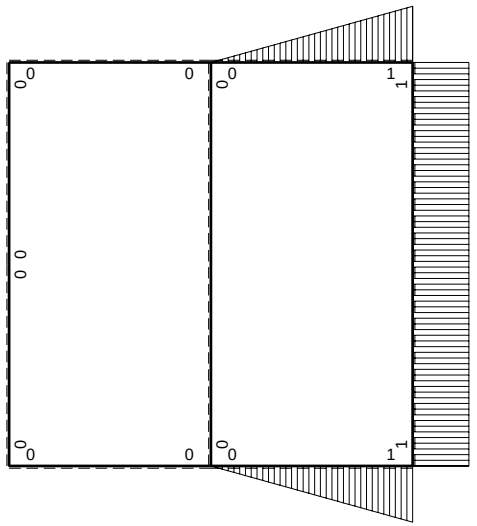







↺□↻ $M_o$ flessione da carichi assegnati




↺□↻ $M_x$ flessione da iperstatica X=1

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

| → | $M_x(x)$ | $M_o(x)$ | $\theta$ | $M_xM_o$ | $M_x\theta$ | $M_xM_x$ | $\int M_x(M_o/EJ+\theta)dx$ | $\int XM_xM_x/EJdx$ |
|---|---|---|---|---|---|---|---|---|
| AB b | 0 | -1/2Fb+1/2Fx | 0 | 0 | 0 | 0 | 0+0 | 0 |
| BA b | 0 | 1/2Fx | 0 | 0 | 0 | 0 | | |
| CD b | 0 | -Fb+Fx | 0 | 0 | 0 | 0 | 0+0 | 0 |
| DC b | 0 | Fx | 0 | 0 | 0 | 0 | | |
| DE b | 0 | 0 | 0 | 0 | 0 | 0 | 0+0 | 0 |
| ED b | 0 | 0 | 0 | 0 | 0 | 0 | | |
| EA b | 0 | $-1/2qx^2$ | 0 | 0 | 0 | 0 | 0+0 | 0 |
| AE b | 0 | $1/2Fb-Fx+1/2qx^2$ | 0 | 0 | 0 | 0 | | |
| BF b | x/b | -Fb | -Fb/EJ | -Fx | -Fx/EJ | $x^2/b^2$ | $(-1/2-1/2)Fb^2/EJ$ | 1/3Xb/EJ |
| FB b | -1+x/b | Fb | Fb/EJ | -Fb+Fx | -Fb/EJ+Fx/EJ | $1-2x/b+x^2/b^2$ | | |
| GC b | 1-x/b | 0 | 0 | 0 | 0 | $1-2x/b+x^2/b^2$ | 0+0 | 1/3Xb/EJ |
| CG b | -x/b | 0 | 0 | 0 | 0 | $x^2/b^2$ | | |
| FG 2b | 1 | 0 | 0 | 0 | 0 | 1 | 0+0 | 2Xb/EJ |
| GF 2b | -1 | 0 | 0 | 0 | 0 | 1 | | |
| CB 2b | 0 | $Fb-1/2qx^2$ | 0 | 0 | 0 | 0 | 0+0 | 0 |
| BC 2b | 0 | $Fb-2Fx+1/2qx^2$ | 0 | 0 | 0 | 0 | | |
| | | totali | | | | | $-Fb^2/EJ$ | 8/3Xb/EJ |
| | | iperstatica $X=W_{GF}$ | | | | | 3/8Fb | |

Sviluppi di calcolo iperstatica





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

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

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

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

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

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

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

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

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

$= (2\ b\ )\ 1/EJ\ = 2\ b/EJ$

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

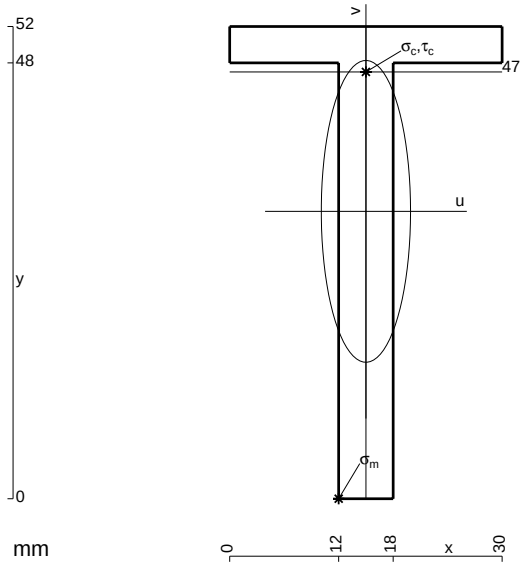
$= (2\ b\ )\ 1/EJ\ = 2\ b/EJ$

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

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

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

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




A = 408. $mm^2$
$J_u$ = 112717. $mm^4$
$J_v$ = 9864. $mm^4$
$y_g$ = 31.65 mm
N = 1365. N
$T_y$ = -3120. N
$M_x$ = -826800. Nmm
$x_m$ = 12. mm
$u_m$ = -3. mm
$v_m$ = -31.65 mm
$\sigma_m = N/A - Mv/J_u$ = -228.8 $N/mm^2$
$x_c$ = 15. mm
$y_c$ = 47. mm
$v_c$ = 15.35 mm
$\sigma_c = N/A - Mv/J_u$ = 116. $N/mm^2$
$\tau_c$ = 10.6 $N/mm^2$
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 117.4 $N/mm^2$
$S^*$ = 2297. $mm^3$



ESΣ08.xxxx.053

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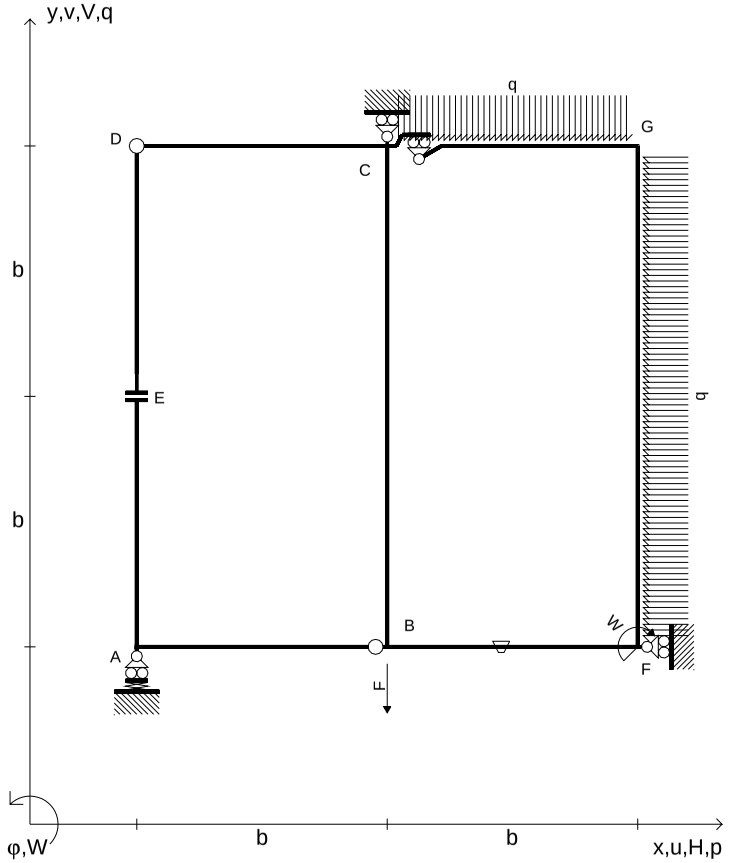
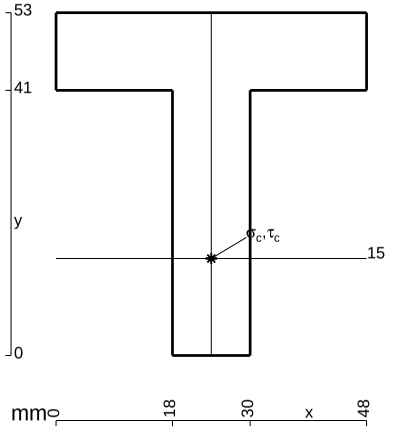
$V_B = -F$
$W_F = -W = -Fb$
$q_{GC} = -q = -F/b$
$p_{FG} = -q = -F/b$
$\theta_{BF} = -\theta = -\alpha T/b = -bF/EJ$
$k_A = EJ/b^3$
$EJ_{AB} = EJ$
$EJ_{CD} = EJ$
$EJ_{DE} = EJ$
$EJ_{EA} = EJ$
$EJ_{BF} = EJ$
$EJ_{GC} = EJ$
$EJ_{FG} = EJ$
$EJ_{CB} = EJ$

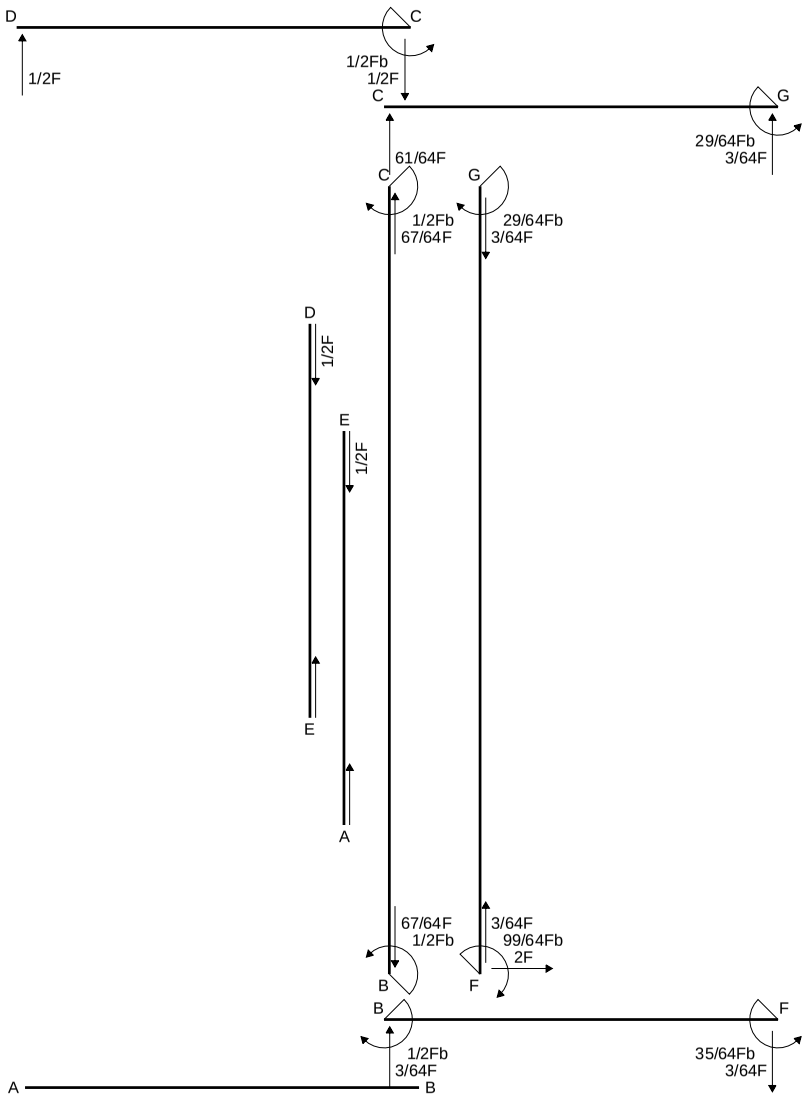


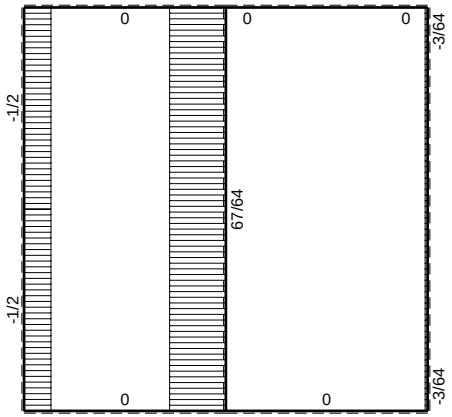



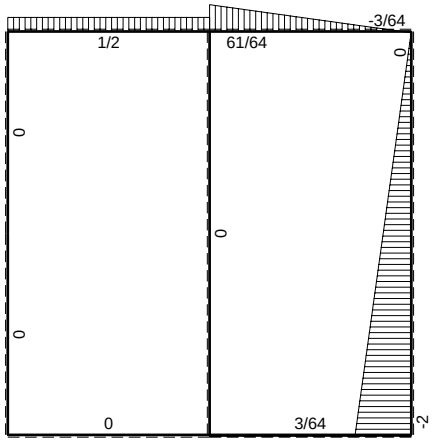

Reazioni iperstatiche in soluzione: $X=W_{FG}$
Carichi e deformazioni date hanno verso efficace in disegno.
Calcolare reazioni vincolari della struttura e delle aste.
Tracciare i diagrammi quotati delle azioni interne nelle aste.
$J_{YZ}$ - $x_{YZ}$ - $\theta_{YZ}$ riferimento locale asta YZ con origine in Y.
La trave CD ha la sezione riportata e dimensioni in mm, con:
b = 420 mm, F = 7170 N
Calcolare sulla sezione C la massima tensione normale $\sigma_m$.
Calcolare in * le tensioni $\sigma_c,\tau_c$ e la tensione di von Mises.
Lembo inferiore sezione su tratteggio trave, a destra da C a D
Curvatura θ asta BF positiva se convessa a destra con inizio B.





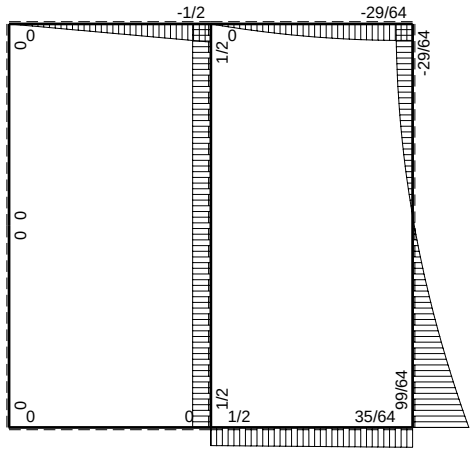





←□→ F

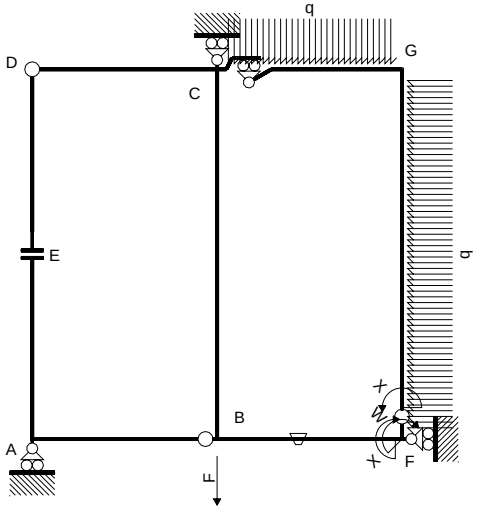
↑□↓ F



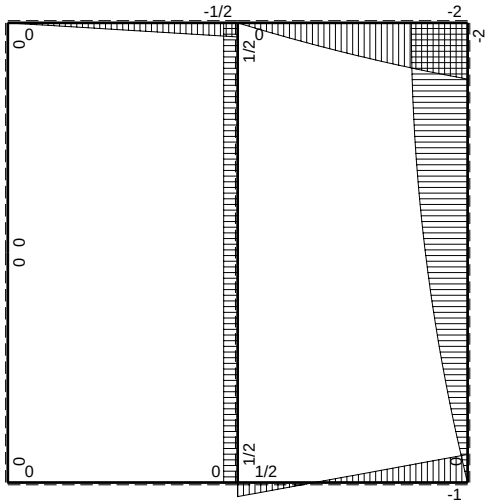

Fb



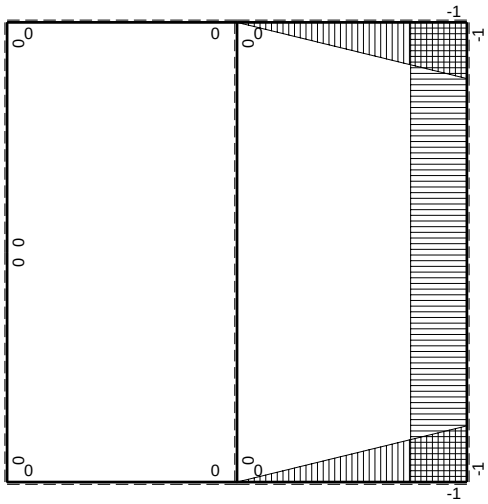





Schema di calcolo iperstatico




$M_o$ flessione da carichi assegnati




$M_x$ flessione da iperstatica X=1

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

| → | $M_x(x)$ | $M_o(x)$ | θ | $M_xM_o$ | $M_x\theta$ | $M_xM_x$ | $\int M_x(M_o/EJ+\theta)dx$ | $\int XM_xM_x/EJdx$ |
|---|---|---|---|---|---|---|---|---|
| AB b | 0 | 0 | 0 | 0 | 0 | 0 | 0+0 | 0 |
| BA b | 0 | 0 | 0 | 0 | 0 | 0 | | |
| CD b | 0 | -1/2Fb+1/2Fx | 0 | 0 | 0 | 0 | 0+0 | 0 |
| DC b | 0 | 1/2Fx | 0 | 0 | 0 | 0 | | |
| DE b | 0 | 0 | 0 | 0 | 0 | 0 | 0+0 | 0 |
| ED b | 0 | 0 | 0 | 0 | 0 | 0 | | |
| EA b | 0 | 0 | 0 | 0 | 0 | 0 | 0+0 | 0 |
| AE b | 0 | 0 | 0 | 0 | 0 | 0 | | |
| BF b | -x/b | 1/2Fb-3/2Fx | -Fb/EJ | -1/2Fx+3/2Fx$^2$/b | Fx/EJ | x$^2$/b$^2$ | (1/4+1/2)Fb$^2$/EJ | 1/3Xb/EJ |
| FB b | 1-x/b | Fb-3/2Fx | Fb/EJ | Fb-5/2Fx+3/2Fx$^2$/b | Fb/EJ-Fx/EJ | 1-2x/b+x$^2$/b$^2$ | | |
| GC b | -1+x/b | -2Fb+3/2Fx+1/2qx$^2$ | 0 | 2Fb-7/2Fx+Fx$^2$/b+1/2qx$^3$/b | 0 | 1-2x/b+x$^2$/b$^2$ | (17/24+0)Fb$^2$/EJ | 1/3Xb/EJ |
| CG b | x/b | 5/2Fx-1/2qx$^2$ | 0 | 5/2Fx$^2$/b-1/2qx$^3$/b | 0 | x$^2$/b$^2$ | | |
| FG 2b | -1 | -2Fx+1/2qx$^2$ | 0 | 2Fx-1/2Fx$^2$/b | 0 | 1 | (8/3+0)Fb$^2$/EJ | 2Xb/EJ |
| GF 2b | 1 | 2Fb-1/2qx$^2$ | 0 | 2Fb-1/2Fx$^2$/b | 0 | 1 | | |
| CB 2b | 0 | 1/2Fb | 0 | 0 | 0 | 0 | 0+0 | 0 |
| BC 2b | 0 | -1/2Fb | 0 | 0 | 0 | 0 | | |
| | | | | totali | | | 33/8Fb$^2$/EJ | 8/3Xb/EJ |
| | | | | iperstatica X=$W_{FG}$ | | | -99/64Fb | |

Sviluppi di calcolo iperstatica

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

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

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

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

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

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

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

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

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

$= (2\ b)\ 1/EJ\ = 2\ b/EJ$

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

$= (2\ b)\ 1/EJ\ = 2\ b/EJ$

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

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

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

$L^{Xo}_{FB} = \int_o^b (1 -5/2\ x/b +3/2\ x^2/b^2\ )\ Fb\ 1/EJ\ dx + \int_o^b (-1 + x/b\ )\ \theta\ dx$

$= [\ x -5/4\ x^2/b +1/2\ x^3/b^2\ ]_o^b\ Fb\ 1/EJ\ + [- x +1/2\ x^2/b\ ]_o^b\ \theta$

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

$L^{Xo}_{GC} = \int_o^b (2 -7/2\ x/b + x^2/b^2 +1/2\ x^3/b^3\ )\ Fb\ 1/EJ\ dx = [2\ x -7/4\ x^2/b +1/3\ x^3/b^2 +1/8\ x^4/b^3\ ]_o^b\ Fb\ 1/EJ$

$= (2\ b -7/4\ b +1/3\ b +1/8\ b\ )\ Fb\ 1/EJ\ = 17/24\ Fb^2/EJ$

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

$= (5/6\ b -1/8\ b\ )\ Fb\ 1/EJ\ = 17/24\ Fb^2/EJ$

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

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

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

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



PROCEDIMENTO E RISULTATI 982088 ESΣ08.xxxx.100

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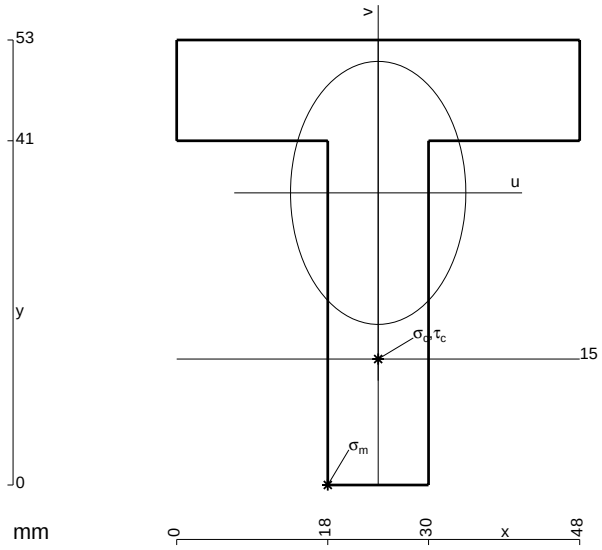


A = 1068. $mm^2$
$J_u$ = 262174. $mm^4$
$J_v$ = 116496. $mm^4$
$y_g$ = 34.79 mm
$T_y$ = 3585. N
$M_x$ = -1505700. Nmm
$x_m$ = 18. mm
$u_m$ = -6. mm
$v_m$ = -34.79 mm
$\sigma_m = -Mv/J_u$ = -199.8 $N/mm^2$
$x_c$ = 24. mm
$y_c$ = 15. mm
$v_c$ = -19.79 mm
$\sigma_c = -Mv/J_u$ = -113.7 $N/mm^2$
$\tau_c$ = 5.598 $N/mm^2$
$\sigma_0 = \sqrt{\sigma^2+3\tau^2}$ = 114.1 $N/mm^2$
$S^*$ = 4913. $mm^3$



ESΣ08.xxxx.100

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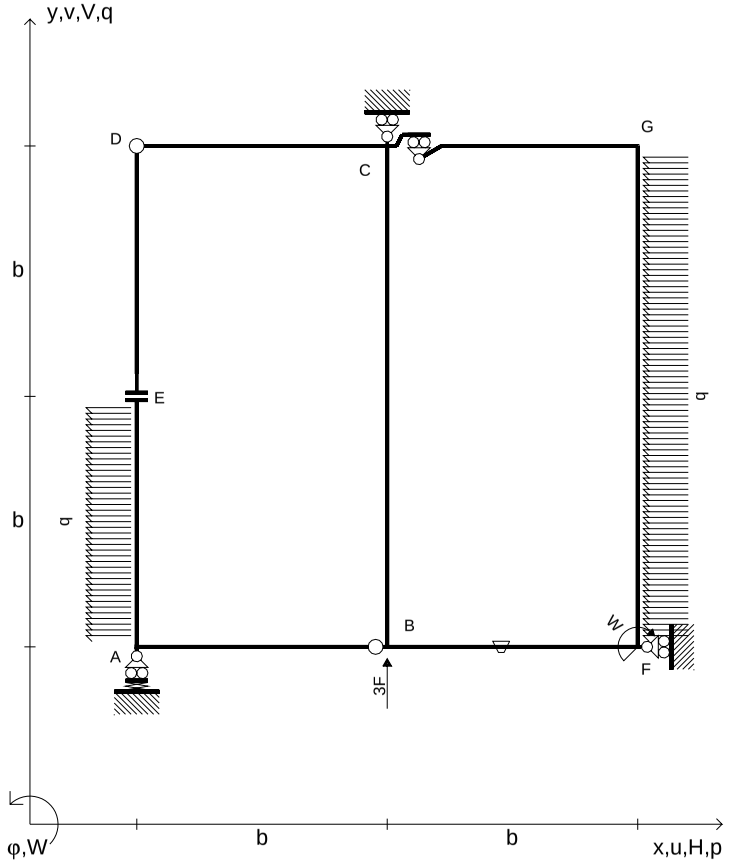
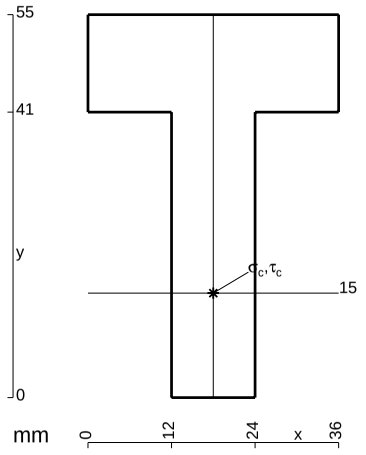
$V_B = 3F$
$W_F = -W = -Fb$
$p_{EA} = -q = -F/b$
$p_{FG} = -q = -F/b$
$\theta_{BF} = -\theta = -\alpha T/b = -bF/EJ$
$k_A = 4EJ/b^3$
$EJ_{AB} = EJ$
$EJ_{CD} = EJ$
$EJ_{DE} = EJ$
$EJ_{EA} = EJ$
$EJ_{BF} = EJ$
$EJ_{GC} = EJ$
$EJ_{FG} = EJ$
$EJ_{CB} = EJ$

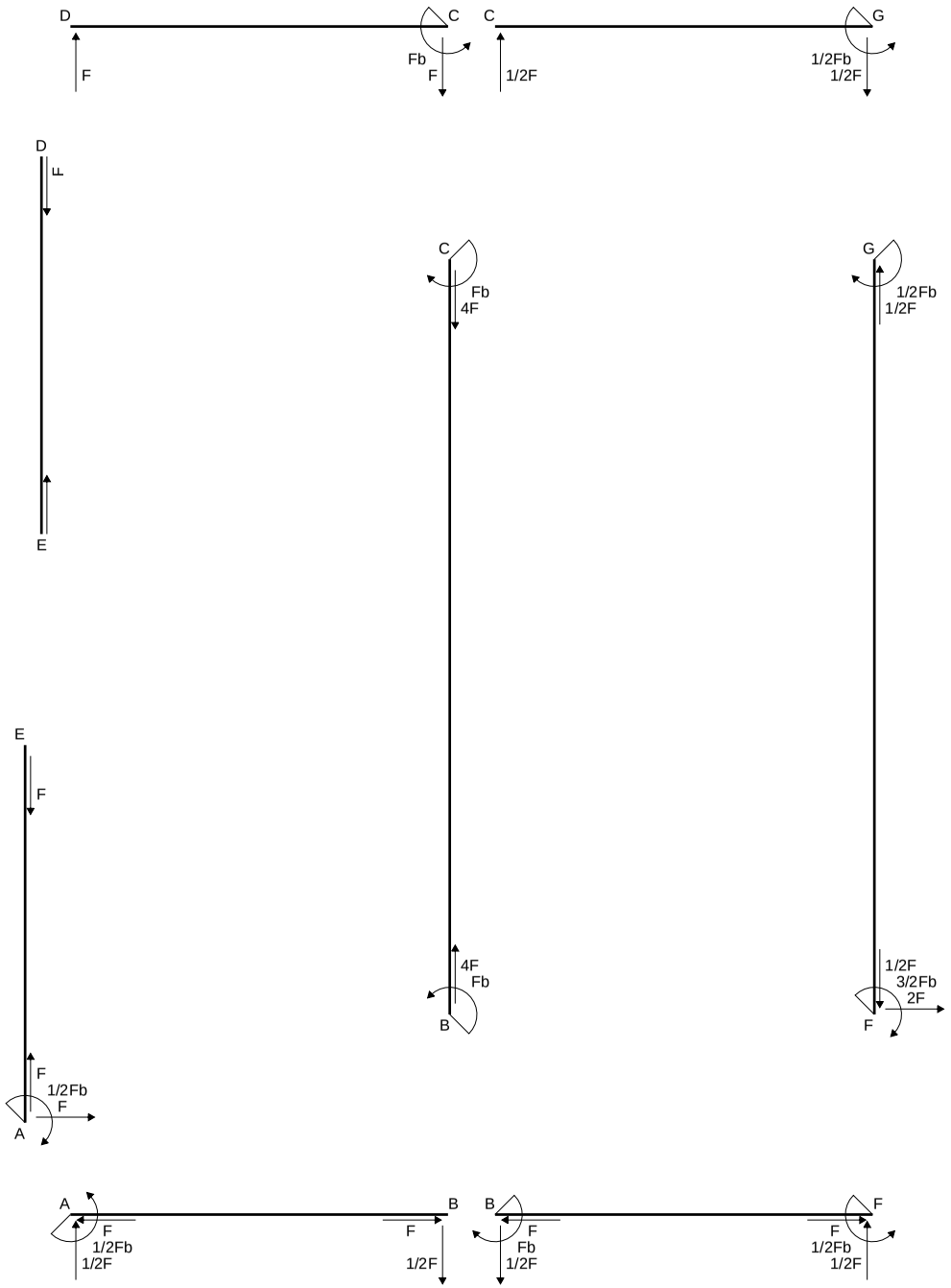


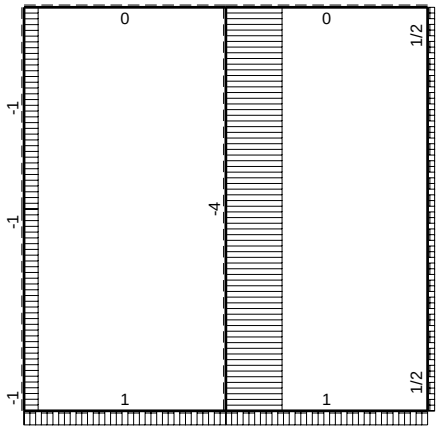



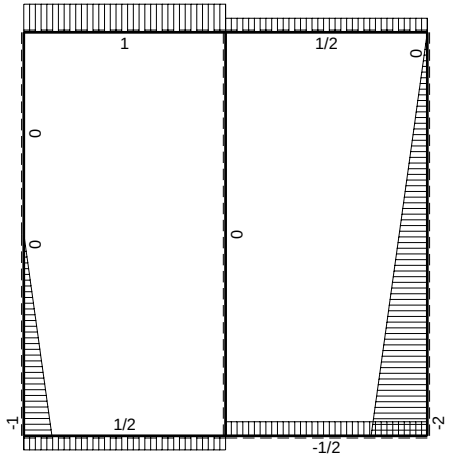

Reazioni iperstatiche in soluzione: $X=W_{FG}$
Carichi e deformazioni date hanno verso efficace in disegno.
Calcolare reazioni vincolari della struttura e delle aste.
Tracciare i diagrammi quotati delle azioni interne nelle aste.
$J_{YZ}$ - $x_{YZ}$ - $\theta_{YZ}$ riferimento locale asta YZ con origine in Y.
La trave CD ha la sezione riportata e dimensioni in mm, con:
b = 440 mm, F = 3500 N
Calcolare sulla sezione C la massima tensione normale $\sigma_m$.
Calcolare in * le tensioni $\sigma_c$,$\tau_c$ e la tensione di von Mises.
Lembo inferiore sezione su tratteggio trave, a destra da C a D
Curvatura θ asta BF positiva se convessa a destra con inizio B.





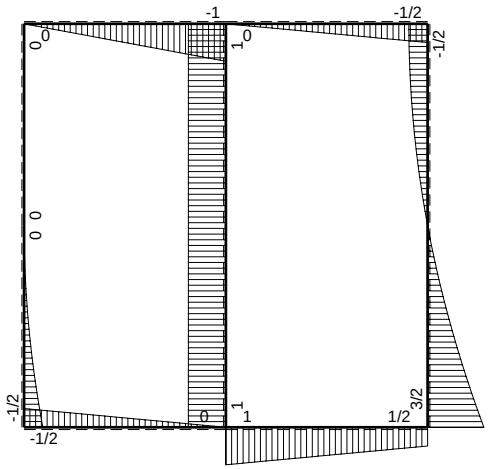






←□→ F

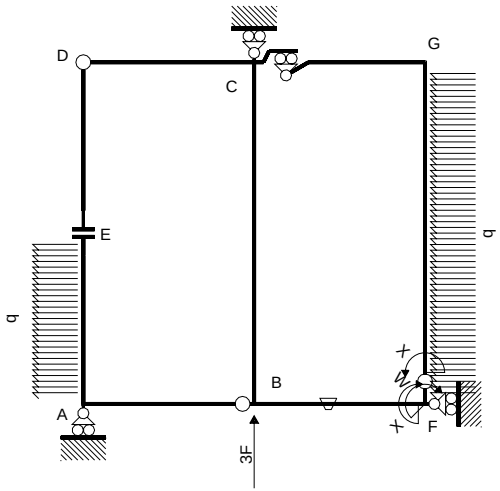
↑□↓ F



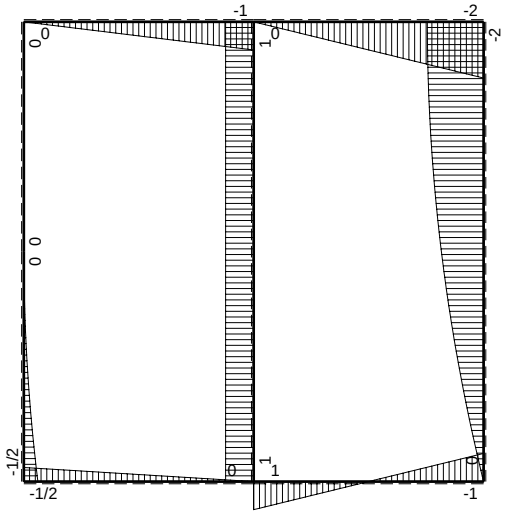

↻□↺ Fb



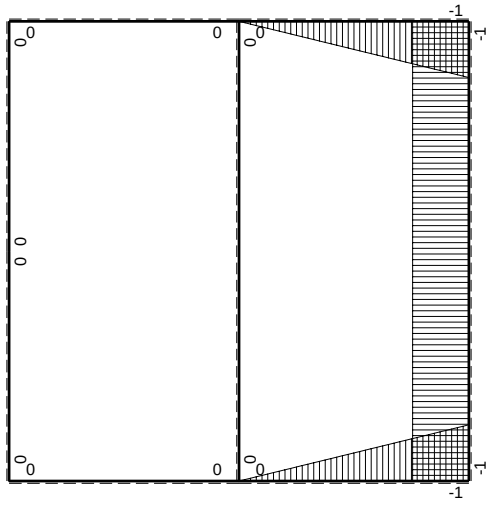





Schema di calcolo iperstatico




↻□↺ $M_o$ flessione da carichi assegnati




↻□↺ $M_x$ flessione da iperstatica X=1

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

| → | $M_x(x)$ | $M_o(x)$ | $\theta$ | $M_xM_o$ | $M_x\theta$ | $M_xM_x$ | $\int M_x(M_o/EJ+\theta)dx$ | $\int XM_xM_x/EJdx$ |
|---|---|---|---|---|---|---|---|---|
| AB b | 0 | -1/2Fb+1/2Fx | 0 | 0 | 0 | 0 | 0+0 | 0 |
| BA b | 0 | 1/2Fx | 0 | 0 | 0 | 0 | | |
| CD b | 0 | -Fb+Fx | 0 | 0 | 0 | 0 | 0+0 | 0 |
| DC b | 0 | Fx | 0 | 0 | 0 | 0 | | |
| DE b | 0 | 0 | 0 | 0 | 0 | 0 | 0+0 | 0 |
| ED b | 0 | 0 | 0 | 0 | 0 | 0 | | |
| EA b | 0 | $-1/2qx^2$ | 0 | 0 | 0 | 0 | 0+0 | 0 |
| AE b | 0 | $1/2Fb-Fx+1/2qx^2$ | 0 | 0 | 0 | 0 | | |
| BF b | -x/b | Fb-2Fx | -Fb/EJ | $-Fx+2Fx^2/b$ | Fx/EJ | $x^2/b^2$ | $(1/6+1/2)Fb^2/EJ$ | 1/3Xb/EJ |
| FB b | 1-x/b | Fb-2Fx | Fb/EJ | $Fb-3Fx+2Fx^2/b$ | Fb/EJ-Fx/EJ | $1-2x/b+x^2/b^2$ | | |
| GC b | -1+x/b | -2Fb+2Fx | 0 | $2Fb-4Fx+2Fx^2/b$ | 0 | $1-2x/b+x^2/b^2$ | $(2/3+0)Fb^2/EJ$ | 1/3Xb/EJ |
| CG b | x/b | 2Fx | 0 | $2Fx^2/b$ | 0 | $x^2/b^2$ | | |
| FG 2b | -1 | $-2Fx+1/2qx^2$ | 0 | $2Fx-1/2Fx^2/b$ | 0 | 1 | $(8/3+0)Fb^2/EJ$ | 2Xb/EJ |
| GF 2b | 1 | $2Fb-1/2qx^2$ | 0 | $2Fb-1/2Fx^2/b$ | 0 | 1 | | |
| CB 2b | 0 | Fb | 0 | 0 | 0 | 0 | 0+0 | 0 |
| BC 2b | 0 | -Fb | 0 | 0 | 0 | 0 | | |
| | totali | | | | | | $4Fb^2/EJ$ | 8/3Xb/EJ |
| | iperstatica $X=W_{FG}$ | | | | | | -3/2Fb | |

Sviluppi di calcolo iperstatica





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

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

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

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

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

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

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

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

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

$= (2\ b)\ 1/EJ\ = 2\ b/EJ$

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

$= (2\ b)\ 1/EJ\ = 2\ b/EJ$

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

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

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

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

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

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

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

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

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

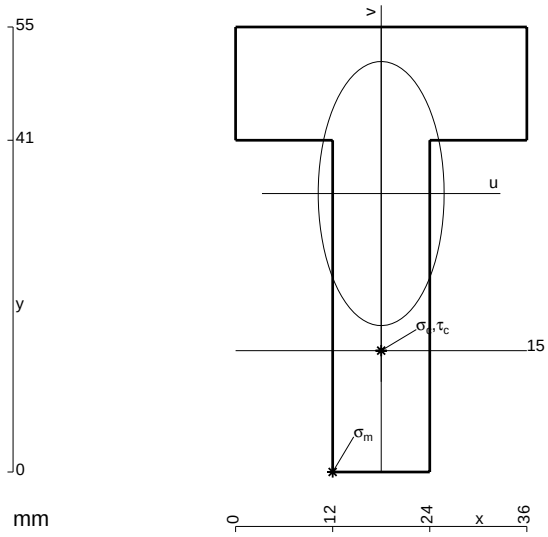
$= (2/3\ b)\ Fb\ 1/EJ\ = 2/3\ Fb^2/EJ$

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

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

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

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




A = 996. $mm^2$
$J_u$ = 265432. $mm^4$
$J_v$ = 60336. $mm^4$
$y_g$ = 34.42 mm
$T_y$ = 3500. N
$M_x$ = -1540000. Nmm
$x_m$ = 12. mm
$u_m$ = -6. mm
$v_m$ = -34.42 mm
$\sigma_m = -Mv/J_u$ = -199.7 $N/mm^2$
$x_c$ = 18. mm
$y_c$ = 15. mm
$v_c$ = -19.42 mm
$\sigma_c = -Mv/J_u$ = -112.6 $N/mm^2$
$\tau_c$ = 5.324 $N/mm^2$
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 113. $N/mm^2$
$S^*$ = 4845. $mm^3$



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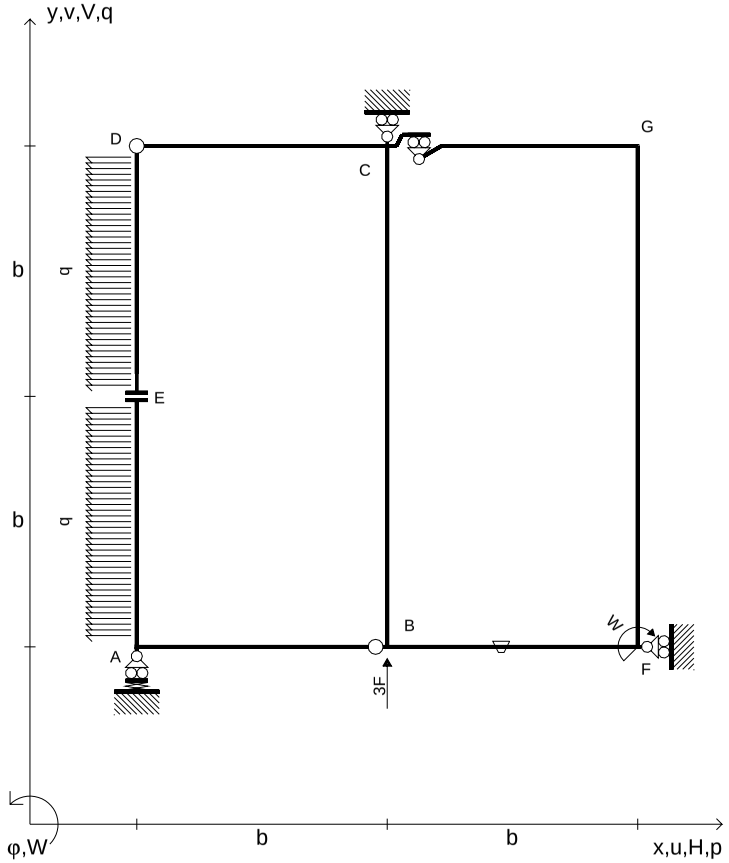
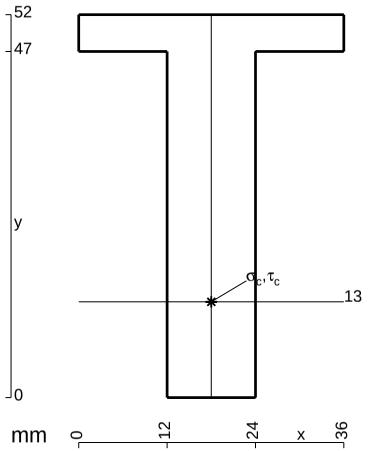
$V_B = 3F$
$W_F = -W = -Fb$
$p_{DE} = -q = -F/b$
$p_{EA} = -q = -F/b$
$\theta_{BF} = -\theta = -\alpha T/b = -bF/EJ$
$k_A = 4EJ/b^3$
$EJ_{AB} = EJ$
$EJ_{CD} = EJ$
$EJ_{DE} = EJ$
$EJ_{EA} = EJ$
$EJ_{BF} = EJ$
$EJ_{GC} = EJ$
$EJ_{FG} = EJ$
$EJ_{CB} = EJ$

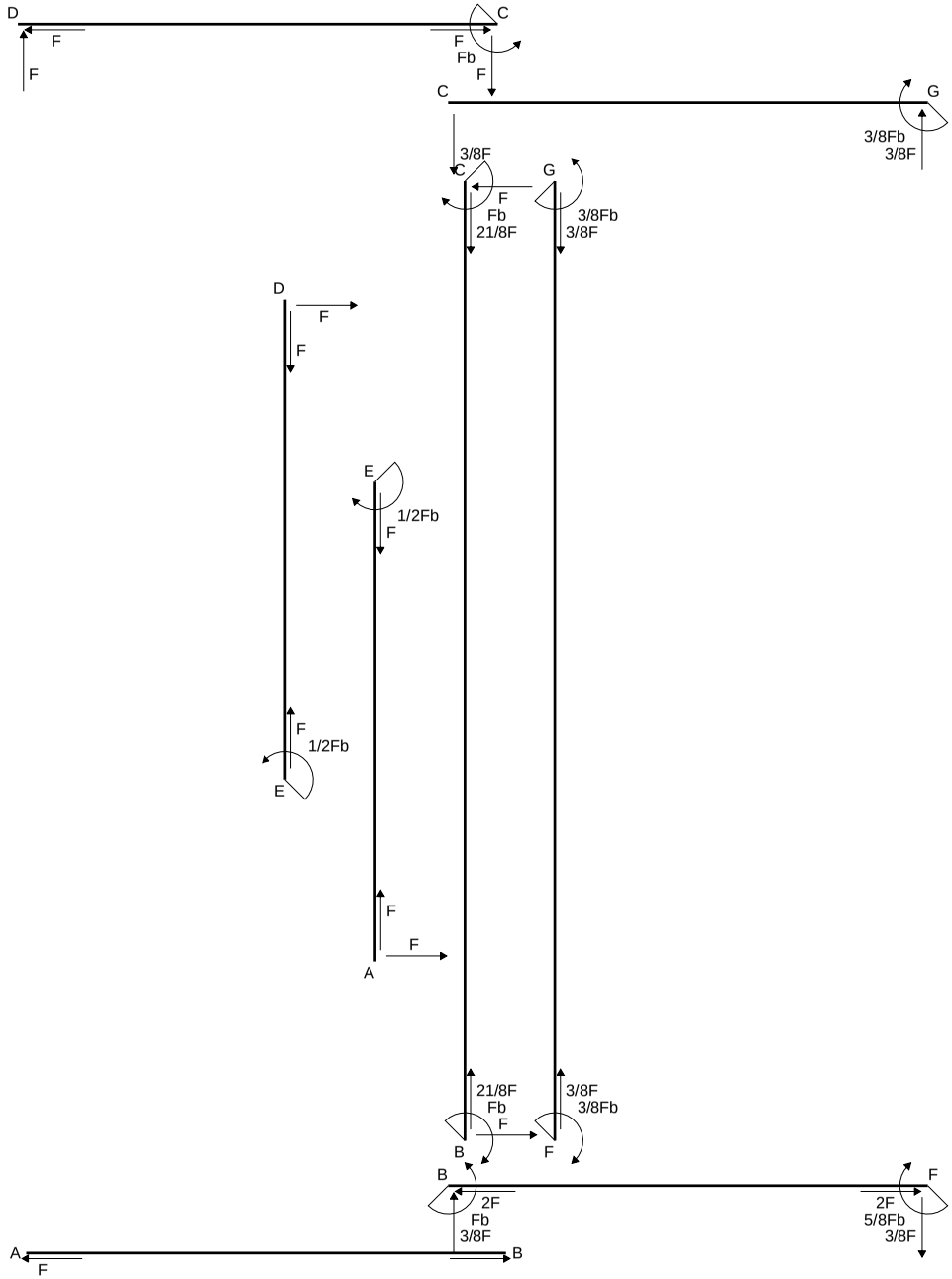


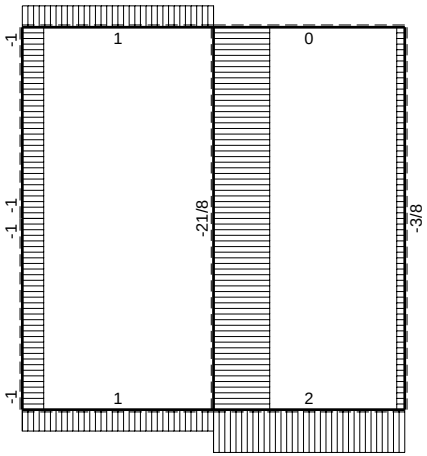



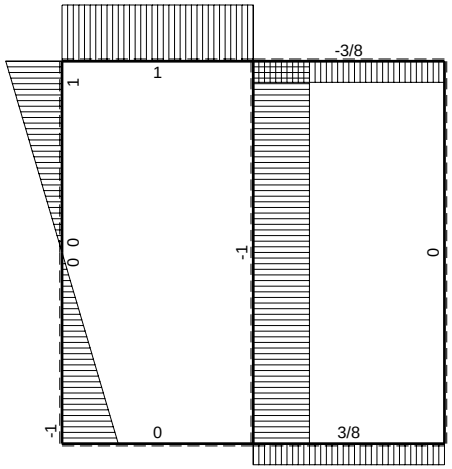

Reazioni iperstatiche in soluzione: $X=V_{CG}$
Carichi e deformazioni date hanno verso efficace in disegno.
Calcolare reazioni vincolari della struttura e delle aste.
Tracciare i diagrammi quotati delle azioni interne nelle aste.
$J_{YZ}$ - $x_{YZ}$ - $\theta_{YZ}$ riferimento locale asta YZ con origine in Y.
La trave CB ha la sezione riportata e dimensioni in mm, con:
b = 610 mm, F = 2080 N
Calcolare sulla sezione B la massima tensione normale $\sigma_m$.
Calcolare in * le tensioni $\sigma_c$,$\tau_c$ e la tensione di von Mises.
Lembo inferiore sezione su tratteggio trave, a destra da C a B
Curvatura θ asta BF positiva se convessa a destra con inizio B.





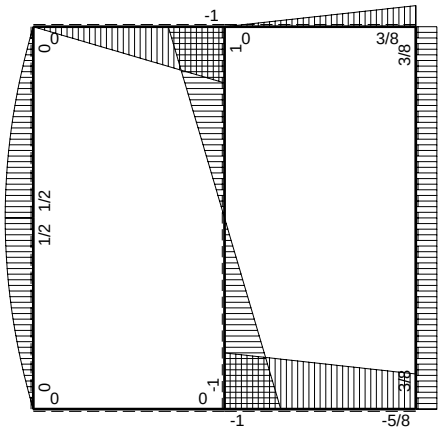





←□→ F

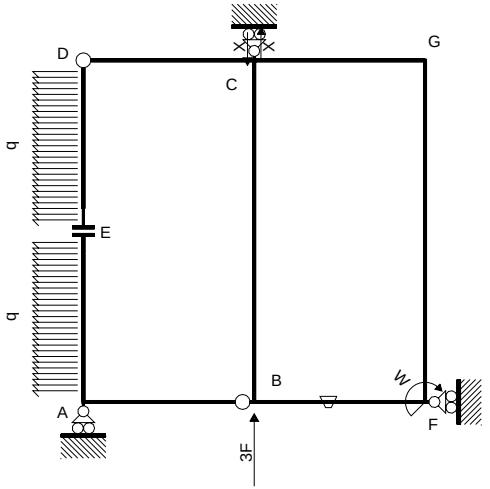
↑□↓ F



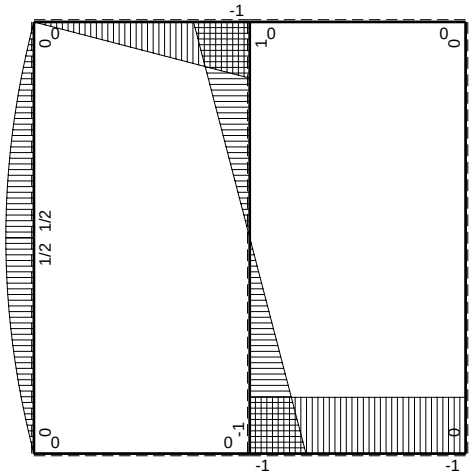

(□) Fb



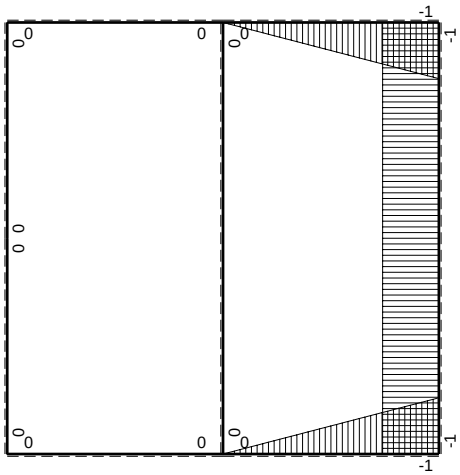





Schema di calcolo iperstatico




(□) $M_o$ flessione da carichi assegnati




(□) $M_x$ flessione da iperstatica X=1

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

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

Sviluppi di calcolo iperstatica



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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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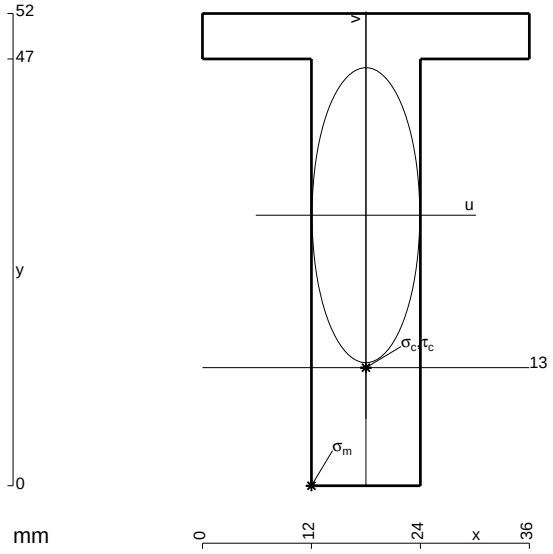


A = 744. $mm^2$
$J_u$ = 196439. $mm^4$
$J_v$ = 26208. $mm^4$
$y_g$ = 29.79 mm
N = -5460. N
$T_y$ = -2080. N
$M_x$ = -1268800. Nmm
$x_m$ = 12. mm
$u_m$ = -6. mm
$v_m$ = -29.79 mm
$\sigma_m = N/A - Mv/J_u$ = -199.8 $N/mm^2$
$x_c$ = 18. mm
$y_c$ = 13. mm
$v_c$ = -16.79 mm
$\sigma_c = N/A - Mv/J_u$ = -115.8 $N/mm^2$
$\tau_c$ = 3.206 $N/mm^2$
$\sigma_o = \sqrt{\sigma^2+3\tau^2}$ = 115.9 $N/mm^2$
$S^*$ = 3633. $mm^3$



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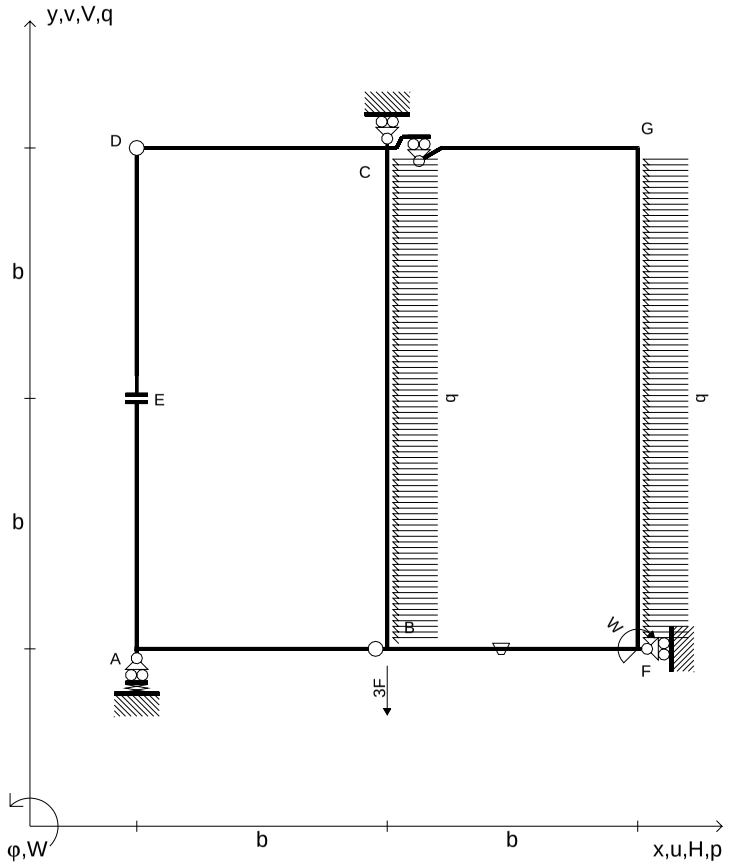
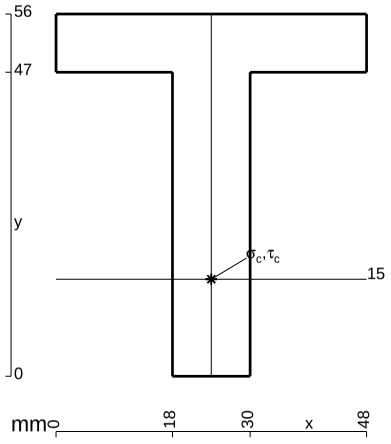
$V_B = -3F$
$W_F = -W = -Fb$
$p_{CB} = -q = -F/b$
$p_{FG} = -q = -F/b$
$\theta_{BF} = -\theta = -\alpha T/b = -bF/EJ$
$k_A = 4EJ/b^3$
$EJ_{AB} = EJ$
$EJ_{CD} = EJ$
$EJ_{DE} = EJ$
$EJ_{EA} = EJ$
$EJ_{BF} = EJ$
$EJ_{GC} = EJ$
$EJ_{FG} = EJ$
$EJ_{CB} = EJ$

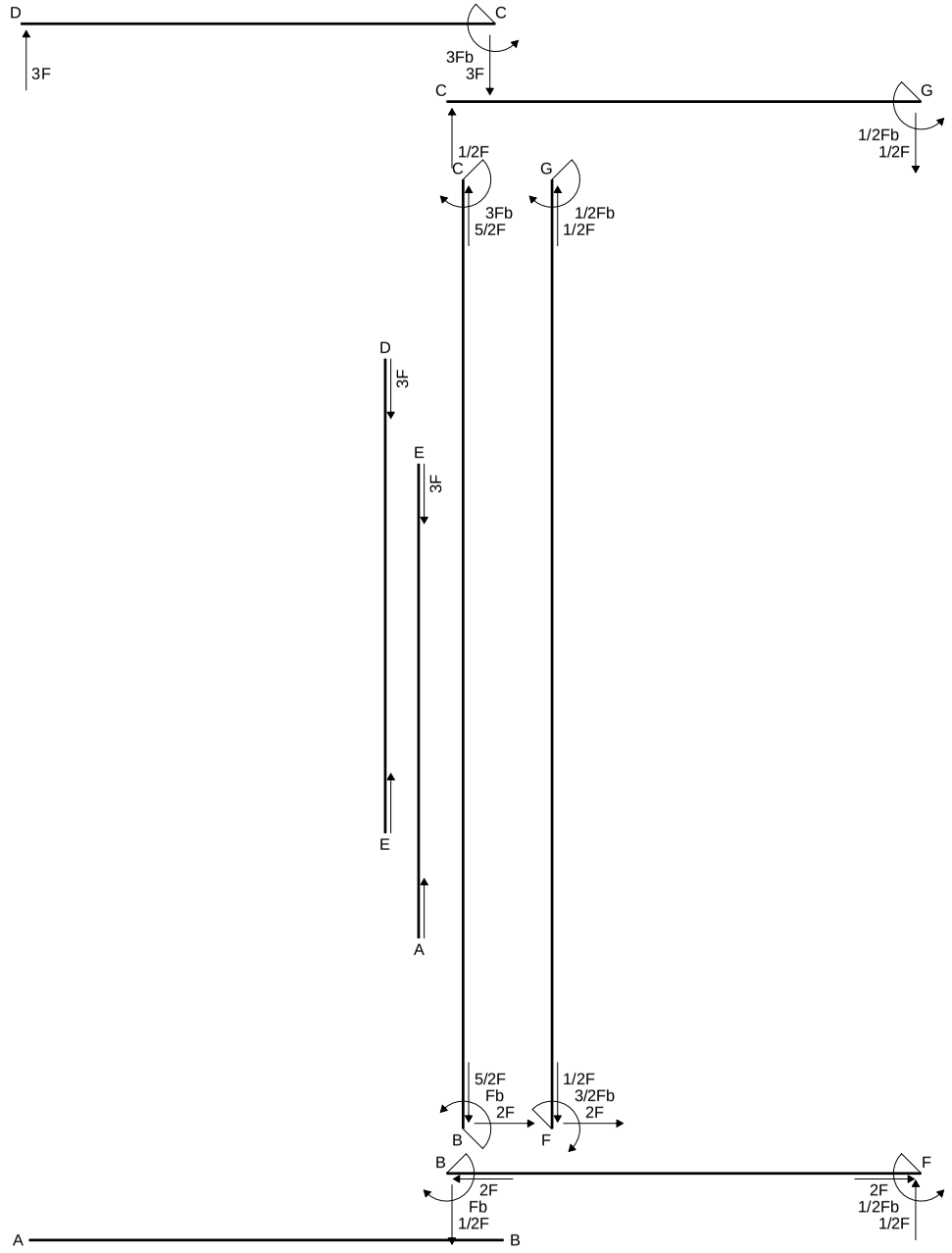


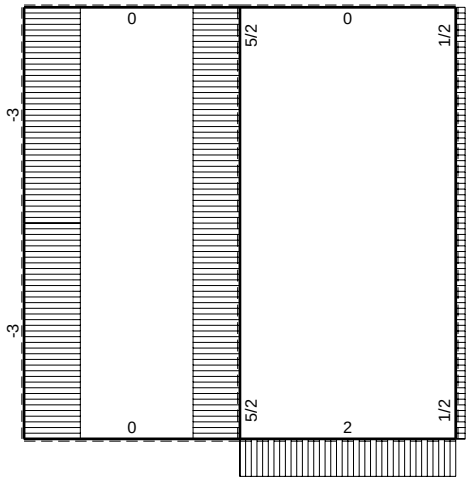




Reazioni iperstatiche in soluzione: $X=V_{CG}$
Carichi e deformazioni date hanno verso efficace in disegno.
Calcolare reazioni vincolari della struttura e delle aste.
Tracciare i diagrammi quotati delle azioni interne nelle aste.
$J_{YZ}$ - $x_{YZ}$ - $\theta_{YZ}$ riferimento locale asta YZ con origine in Y.
La trave CD ha la sezione riportata e dimensioni in mm, con:
b = 740 mm, F = 820 N
Calcolare sulla sezione C la massima tensione normale $\sigma_m$.
Calcolare in * le tensioni $\sigma_c,\tau_c$ e la tensione di von Mises.
Lembo inferiore sezione su tratteggio trave, a destra da C a D
Curvatura θ asta BF positiva se convessa a destra con inizio B.

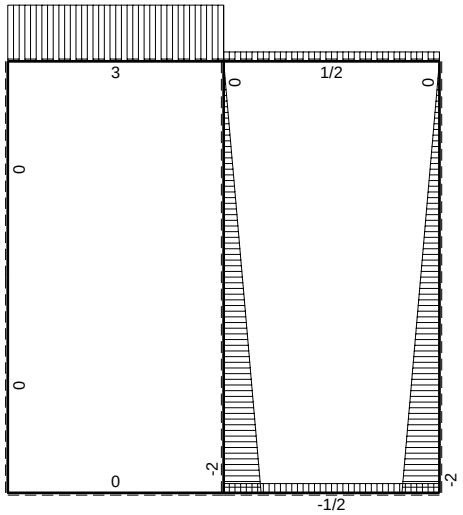




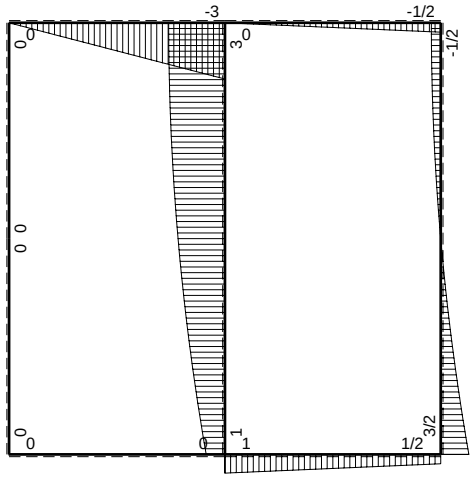






←□→ F



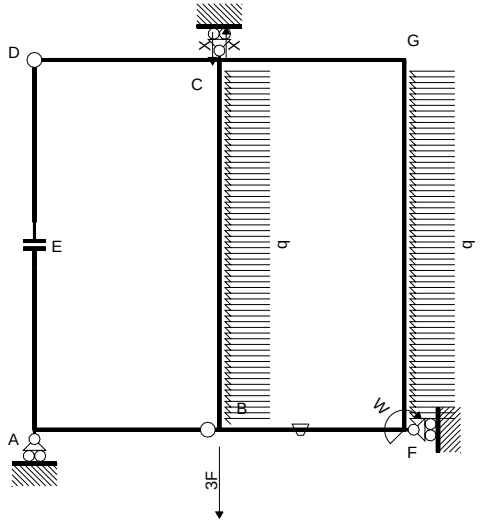

↑□↓ F

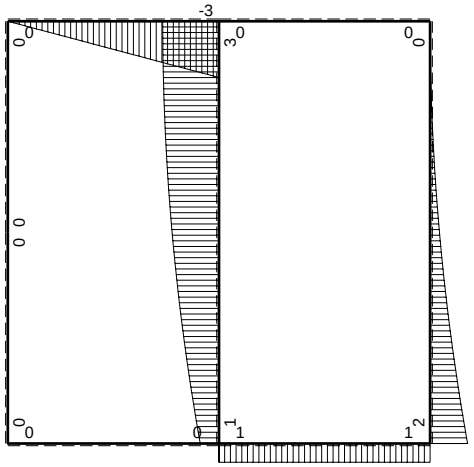



□ Fb

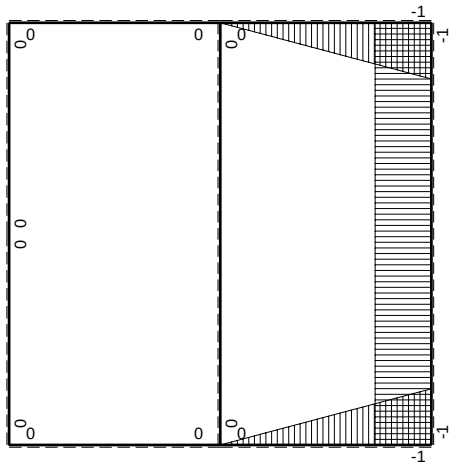







□ $M_o$ flessione da carichi assegnati




□ $M_x$ flessione da iperstatica X=1

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

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

Sviluppi di calcolo iperstatica



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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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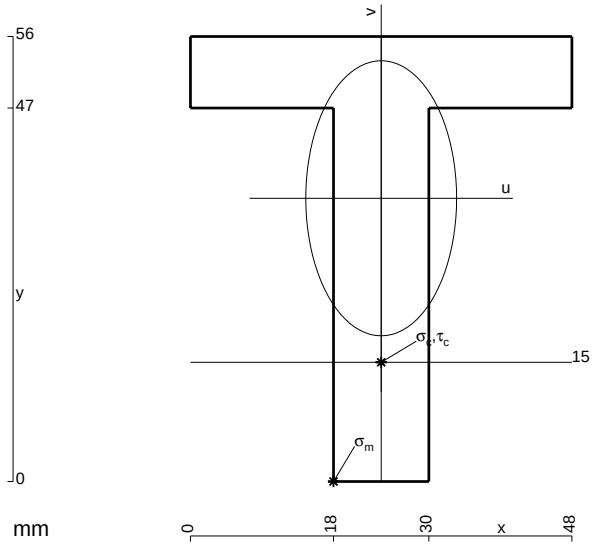


$A = 996.\ mm^2$
$J_u = 298526.\ mm^4$
$J_v = 89712.\ mm^4$
$y_g = 35.64\ mm$
$T_y = 2460.\ N$
$M_x = -1820400.\ Nmm$
$x_m = 18.\ mm$
$u_m = -6.\ mm$
$v_m = -35.64\ mm$
$\sigma_m = -Mv/J_u = -217.4\ N/mm^2$
$x_c = 24.\ mm$
$y_c = 15.\ mm$
$v_c = -20.64\ mm$
$\sigma_c = -Mv/J_u = -125.9\ N/mm^2$
$\tau_c = 3.479\ N/mm^2$
$\sigma_o = \sqrt{\sigma^2+3\tau^2} = 126.\ N/mm^2$
$S^* = 5066.\ mm^3$



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