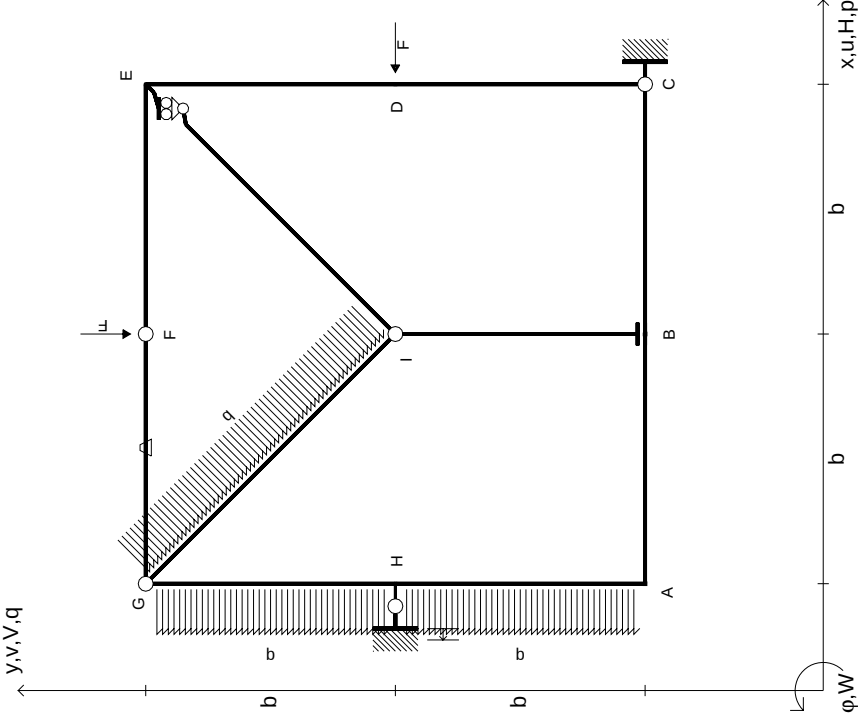
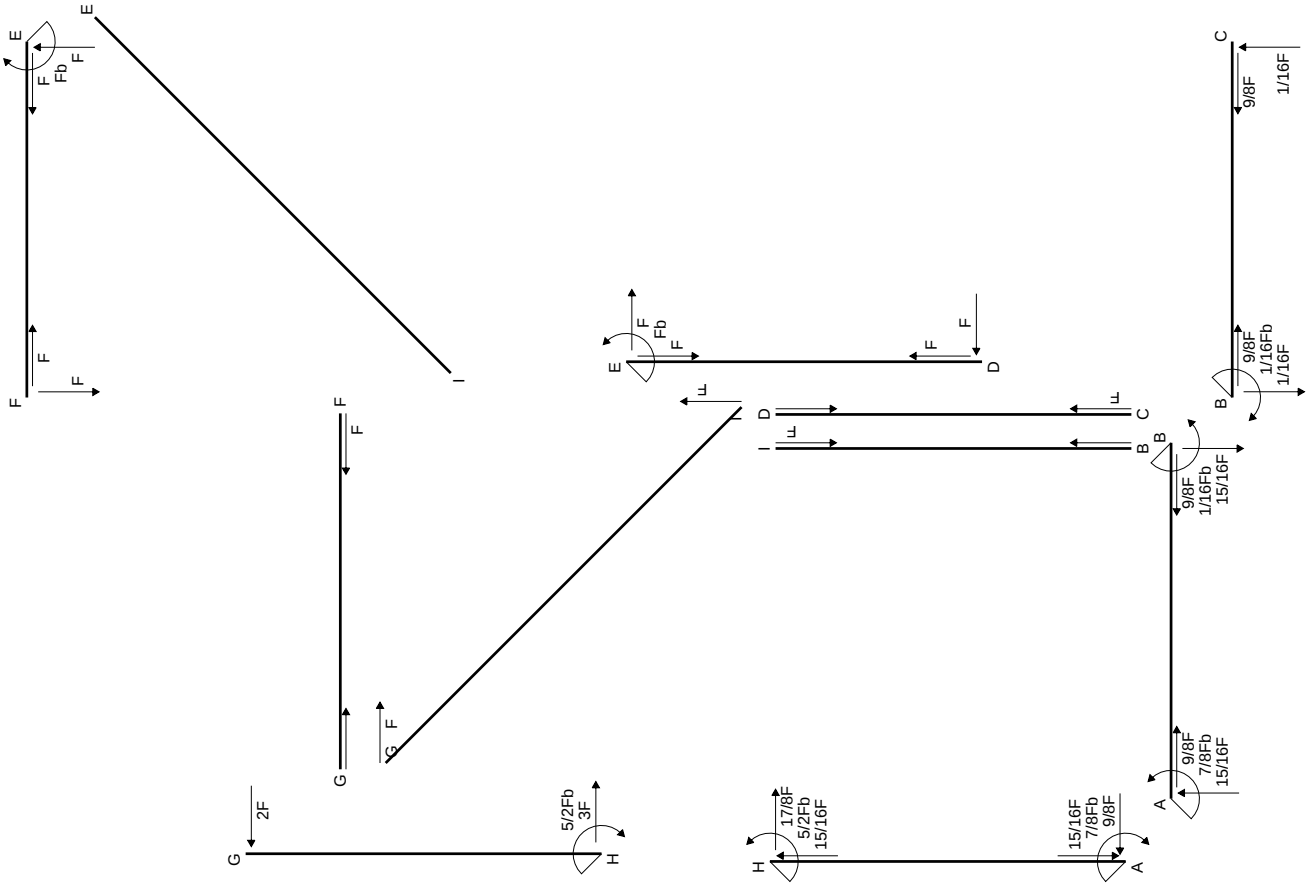


$V_F = -F$
 $H_D = -F$
 $P_{HA} = -q = -F/b$
 $P_{GH} = -q = -F/b$
 $q_{GI} = -q = -F/b$
 $q_{GI} = -q = -F/b$
 $\theta_{FG} = -\theta = -\alpha T/b = -bF/EJ$
 $u_H = -\delta = -b^3F/EJ$

$EJ_{AB} = EJ$
 $EJ_{BC} = EJ$
 $EJ_{CD} = EJ$
 $EJ_{DE} = EJ$
 $EJ_{EF} = EJ$
 $EJ_{FG} = EJ$
 $EJ_{GH} = EJ$
 $EJ_{GI} = EJ$
 $EJ_{IB} = EJ$
 $EJ_{IE} = EJ$
 $EJ_{HA} = EJ$



Reazioni iperstatiche in soluzione: $X=H_H$
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.
Carichi di aste misurati in proiezione sugli assi x,y.
Diagrammi di carico con valori riferiti ad asse della trave.
Componenti di carico distribuito riferiti ad assi ortogonali.
 $J_{yz} - X_{yz} - \theta_{yz}$ riferimento locale asta YZ con origine in Y.
La trave GH ha la sezione riportata e dimensioni in mm, con:
 $b = 680 \text{ mm}$, $F = 950 \text{ N}$
Calcolare sulla sezione H la massima tensione normale σ_m
Calcolare in * le tensioni σ_c, τ_c e la tensione di von Mises.
Lembo inferiore sezione su tratteggio trave, a destra da G a H
Curvatura θ asta FG positiva se convessa a destra con inizio F.
Spostamento orizzontale assoluto u imposto al nodo H.



Quadro contributi PLV per iperstatica $X=H_H$

→	$M_x(x)$	$M_o(x)$	θ	$M_x M_o$	$M_x \theta$	$M_x M_x$	$\int M_x(M_o/EJ+\theta)dx$	$\int X M_x M_x/EJ dx$
AB b	$b-1/2x$	$-6Fb+7/2Fx$	0	$-6Fb^2+13/2Fbx-7/4Fx^2$	0	$b^2-bx+1/4x^2$	$(-10/3+0)Fb^3/EJ$	$7/12Xb^3/EJ$
BA b	$-1/2b-1/2x$	$5/2Fb+7/2Fx$	0	$-5/4Fb^2-3Fbx-7/4Fx^2$	0	$1/4b^2+1/2bx+1/4x^2$		
BC b	$1/2b-1/2x$	$-5/2Fb+5/2Fx$	0	$-5/4Fb^2+5/2Fbx-5/4Fx^2$	0	$1/4b^2-1/2bx+1/4x^2$	$(-5/12+0)Fb^3/EJ$	$1/12Xb^3/EJ$
CB b	$-1/2x$	$5/2Fx$	0	$-5/4Fx^2$	0	$1/4x^2$		
CD b	0	0	0	0	0	0	0+0	0
DC b	0	0	0	0	0	0		
DE b	0	Fx	0	0	0	0	0+0	0
ED b	0	-Fb+Fx	0	0	0	0		
EF b	0	Fb-Fx	0	0	0	0	0+0	0
FE b	0	-Fx	0	0	0	0		
FG b	0	0	-Fb/EJ	0	0	0	0+0	0
GF b	0	0	Fb/EJ	0	0	0		
GH b	0	$-2Fx-1/2qx^2$	0	0	0	0	0+0	0
HG b	0	$5/2Fb-3Fx+1/2qx^2$	0	0	0	0		
GI $\sqrt{2}b$	0	$\sqrt{2}/2Fx-1/2qx^2$	0	0	0	0	0	0
IB b	0	0	0	0	0	0	0+0	0
BI b	0	0	0	0	0	0		
IE $\sqrt{2}b$	0	0	0	0	0	0	0	0
HA b	x	$-5/2Fb-3Fx-1/2qx^2$	0	$-5/2Fbx-3Fx^2-1/2qx^3$	0	x^2	$(-19/8+0)Fb^3/EJ$	$1/3Xb^3/EJ$
AH b	-b+x	$6Fb-4Fx+1/2qx^2$	0	$-6Fb^2+10Fbx-9/2Fx^2+1/2qx^3$	0	$b^2-2bx+x^2$		
H	cedimento nodo $-H_{1H}u_H$						Fb^3/EJ	
	totali						$-41/8Fb^3/EJ$	Xb^3/EJ
	iperstatica $X=H_H$						41/8F	

Sviluppi di calcolo iperstatica

$$L_{AB}^{xx} = \int_0^b (1 - x/b + 1/4 x^2/b^2) b^2 1/EJ dx = \left[x - 1/2 x^2/b + 1/12 x^3/b^2 \right]_0^b b^2 1/EJ$$

$$= (b - 1/2 b + 1/12 b) b^2 1/EJ = 7/12 b^3/EJ$$

$$L_{BA}^{xx} = \int_0^b (1/4 + 1/2 x/b + 1/4 x^2/b^2) b^2 1/EJ dx = \left[1/4 x + 1/4 x^2/b + 1/12 x^3/b^2 \right]_0^b b^2 1/EJ$$

$$= (1/4 b + 1/4 b + 1/12 b) b^2 1/EJ = 7/12 b^3/EJ$$

$$L_{BC}^{xx} = \int_0^b (1/4 - 1/2 x/b + 1/4 x^2/b^2) b^2 1/EJ dx = \left[1/4 x - 1/4 x^2/b + 1/12 x^3/b^2 \right]_0^b b^2 1/EJ$$

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

$$L_{CB}^{xx} = \int_0^b (1/4 x^2/b^2) b^2 1/EJ dx = \left[1/12 x^3/b^2 \right]_0^b b^2 1/EJ$$

$$= (1/12 b) b^2 1/EJ = 1/12 b^3/EJ$$

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

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

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

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

$$L_{AB}^{x_0} = \int_0^b (-6 + 13/2 x/b - 7/4 x^2/b^2) Fb^2 1/EJ dx = \left[-6 x + 13/4 x^2/b - 7/12 x^3/b^2 \right]_0^b Fb^2 1/EJ$$

$$= (-6 b + 13/4 b - 7/12 b) Fb^2 1/EJ = -10/3 Fb^3/EJ$$

$$L_{BA}^{x_0} = \int_0^b (-5/4 - 3 x/b - 7/4 x^2/b^2) Fb^2 1/EJ dx = \left[-5/4 x - 3/2 x^2/b - 7/12 x^3/b^2 \right]_0^b Fb^2 1/EJ$$

$$= (-5/4 b - 3/2 b - 7/12 b) Fb^2 1/EJ = -10/3 Fb^3/EJ$$

$$L_{BC}^{x_0} = \int_0^b (-5/4 + 5/2 x/b - 5/4 x^2/b^2) Fb^2 1/EJ dx = \left[-5/4 x + 5/4 x^2/b - 5/12 x^3/b^2 \right]_0^b Fb^2 1/EJ$$

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

$$L_{CB}^{x_0} = \int_0^b (-5/4 x^2/b^2) Fb^2 1/EJ dx = \left[-5/12 x^3/b^2 \right]_0^b Fb^2 1/EJ$$

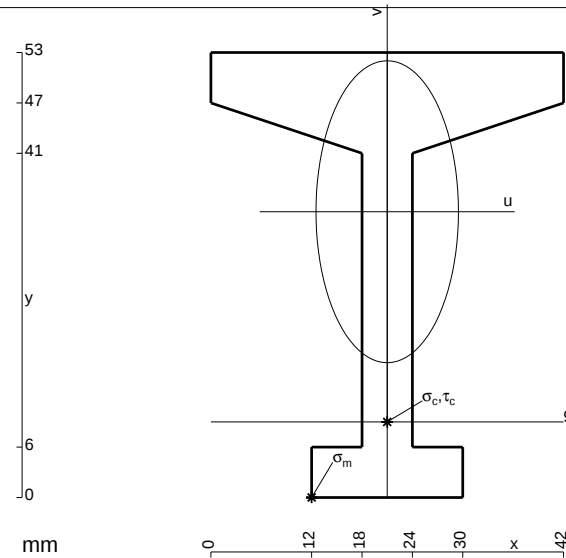
$$= (-5/12 b) Fb^2 1/EJ = -5/12 Fb^3/EJ$$

$$L_{HA}^{x_0} = \int_0^b (-5/2 x/b - 3 x^2/b^2 - 1/2 x^3/b^3) Fb^2 1/EJ dx = \left[-5/4 x^2/b - x^3/b^2 - 1/8 x^4/b^3 \right]_0^b Fb^2 1/EJ$$

$$= (-5/4 b - b - 1/8 b) Fb^2 1/EJ = -19/8 Fb^3/EJ$$

$$L_{AH}^{x_0} = \int_0^b (-6 + 10 x/b - 9/2 x^2/b^2 + 1/2 x^3/b^3) Fb^2 1/EJ dx = \left[-6 x + 5 x^2/b - 3/2 x^3/b^2 + 1/8 x^4/b^3 \right]_0^b Fb^2 1/EJ$$

$$= (-6 b + 5 b - 3/2 b + 1/8 b) Fb^2 1/EJ = -19/8 Fb^3/EJ$$



$$A = 714. \text{ mm}^2$$

$$J_u = 230961. \text{ mm}^4$$

$$J_v = 51390. \text{ mm}^4$$

$$y_g = 34.04 \text{ mm}$$

$$T_y = -2850. \text{ N}$$

$$M_x = -1615000. \text{ Nmm}$$

$$x_m = 12. \text{ mm}$$

$$u_m = -9. \text{ mm}$$

$$v_m = -34.04 \text{ mm}$$

$$\sigma_m = -Mv/J_u = -238. \text{ N/mm}^2$$

$$x_c = 21. \text{ mm}$$

$$y_c = 9. \text{ mm}$$

$$v_c = -25.04 \text{ mm}$$

$$\sigma_c = -Mv/J_u = -175.1 \text{ N/mm}^2$$

$$\tau_c = 7.876 \text{ N/mm}^2$$

$$\sigma_0 = \sqrt{\sigma^2 + 3\tau^2} = 175.6 \text{ N/mm}^2$$

$$S = 3830. \text{ mm}^3$$