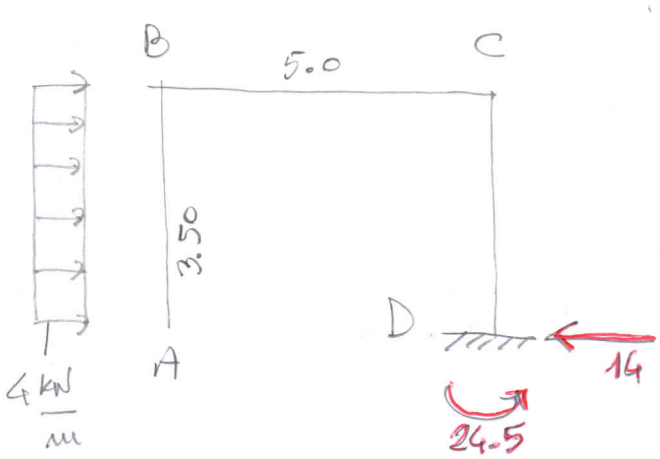
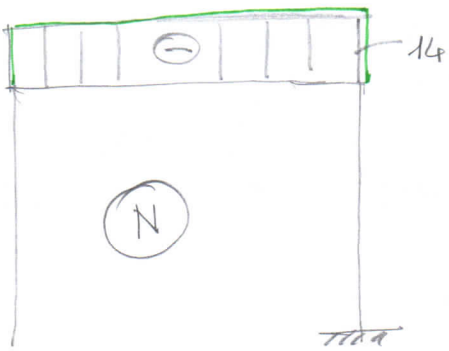
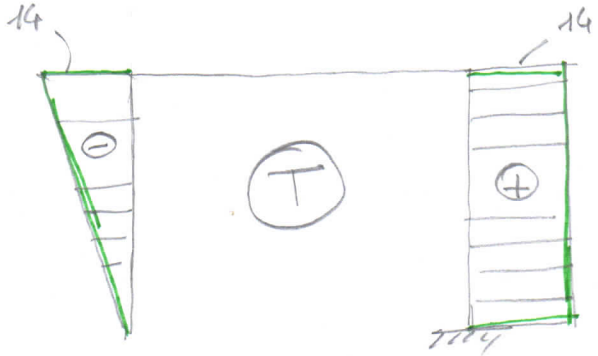
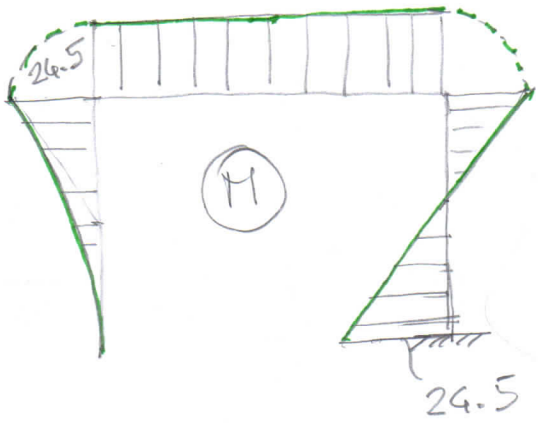


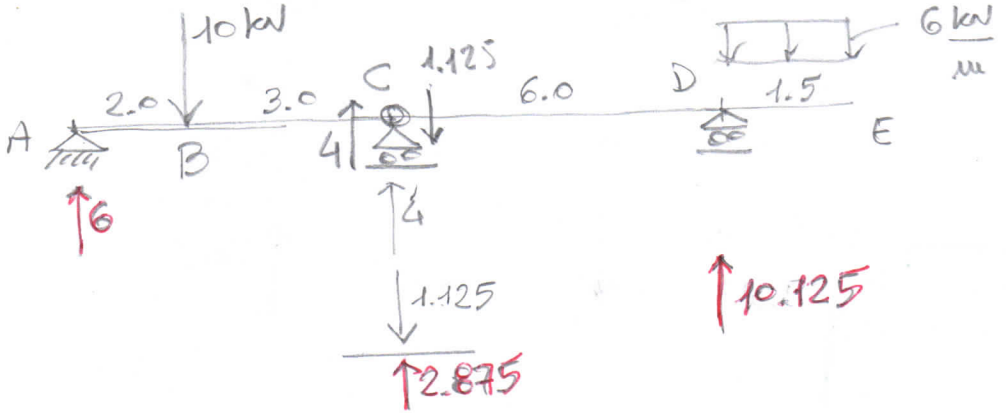


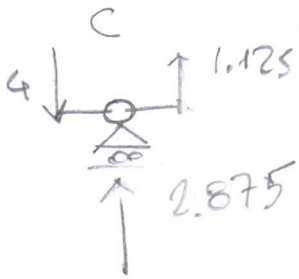
ES.1

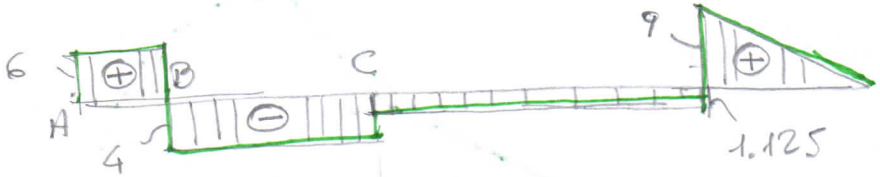




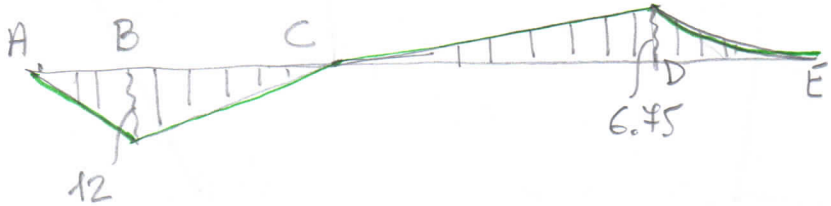
$AB_{c=A}) \quad M(z) = -4\frac{z^2}{2} = -2z^2$



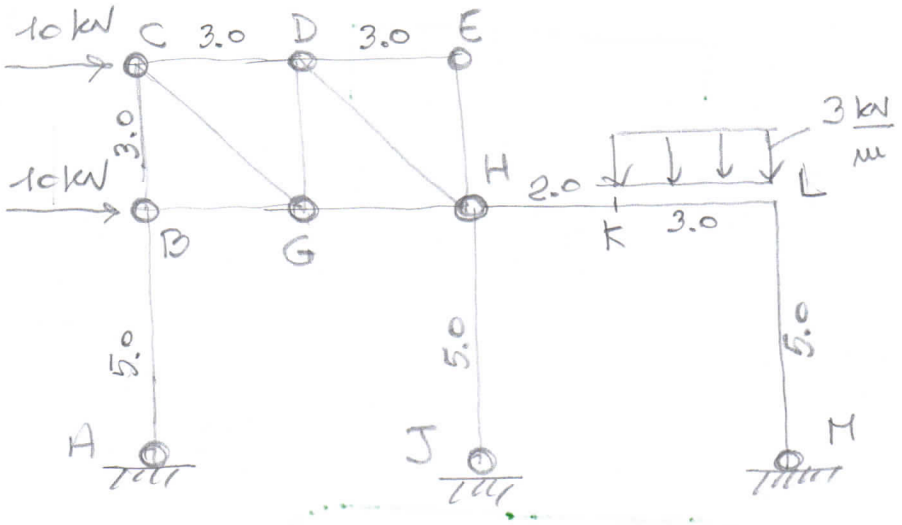




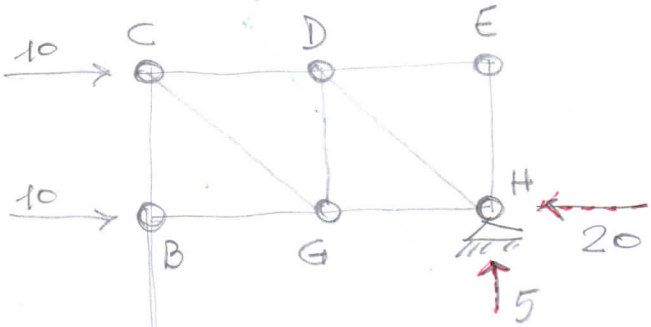
T(z)

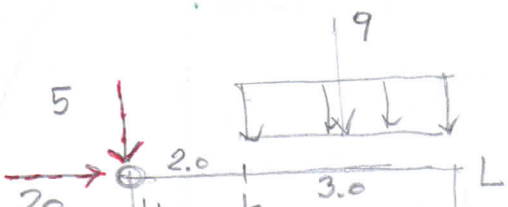


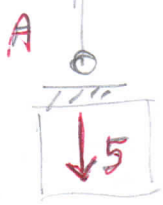
M(z)

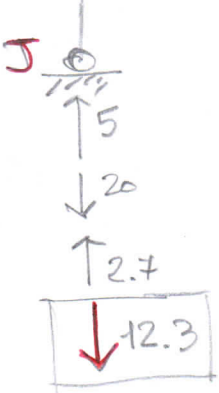

10 kN
10 kN
C
D
E
3.0
3.0
3.0
3.0
B
G
H
K
L
2.0
3 kN/m
5.0
5.0
5.0
A
J
M

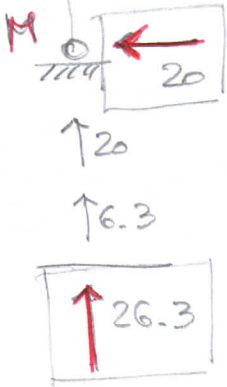
ES.2

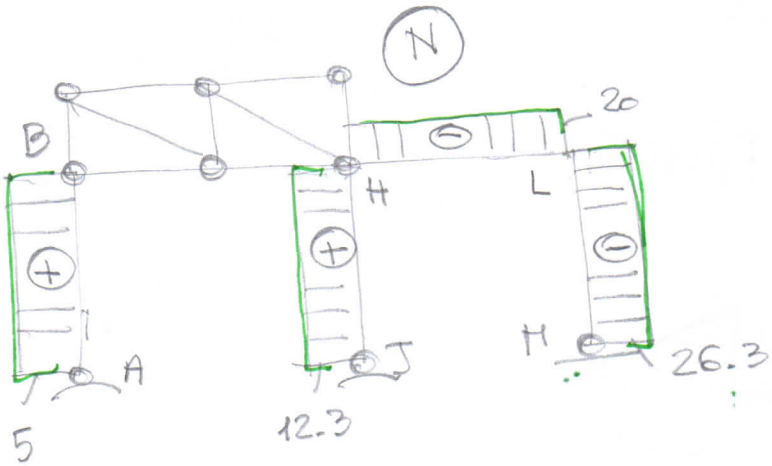

10
10
C
D
E
B
G
H
20
5

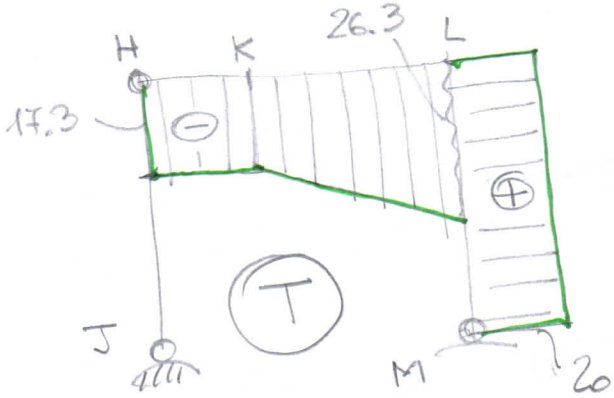

9
5
2.0
3.0
20
H
K
L

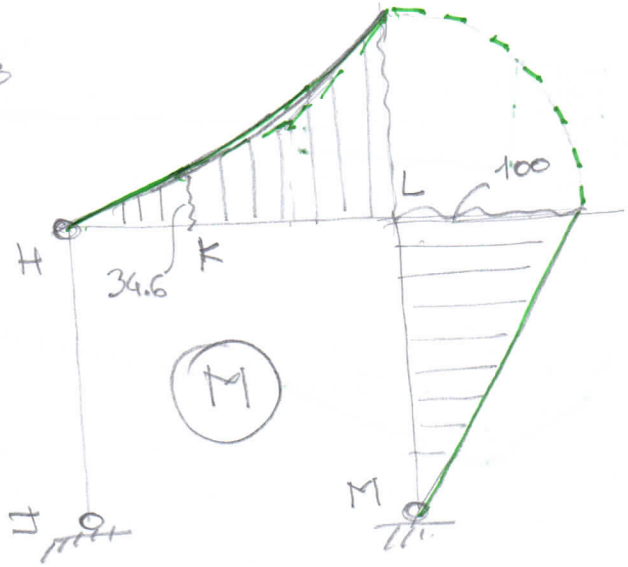

A
5

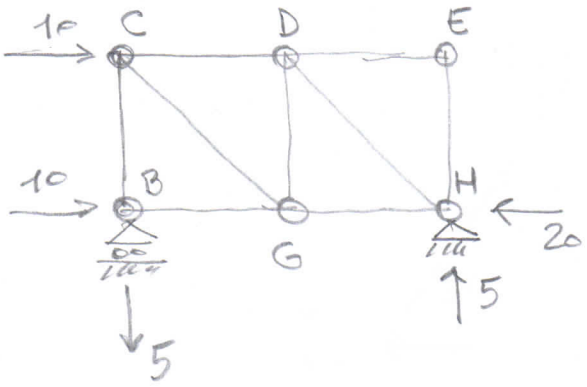

J
5
20
2.7
12.3


M
20
20
6.3
26.3

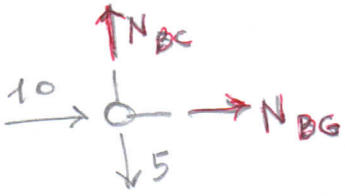

N
B
H
L
20
A
J
M
26.3
5
12.3


H
K
26.3
L
17.3
T
J
M
20


H
K
L
100
34.6
M
M



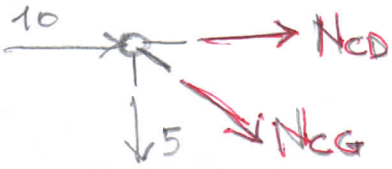
Nodo B



$N_{BC} = 5$

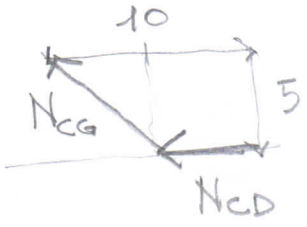
$N_{BG} = -10$

Nodo C

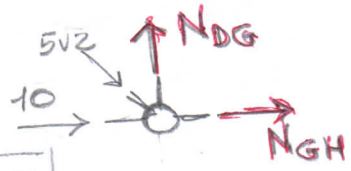


$$N_{CD} + 10 + N_{CG}\frac{\sqrt{2}}{2} = 0 \qquad N_{CD} = 5 - 10 = -5$$

$$5 + N_{CG}\frac{\sqrt{2}}{2} = 0 \qquad N_{CG} = -5\sqrt{2} = -7.07$$

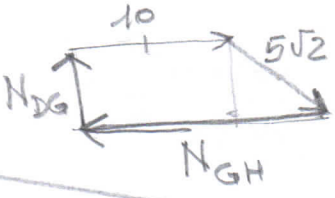


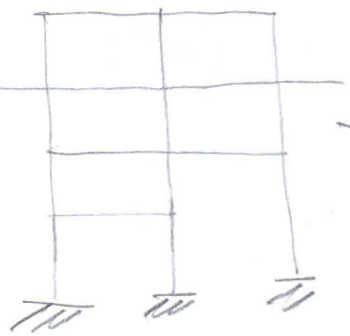
Nodo G



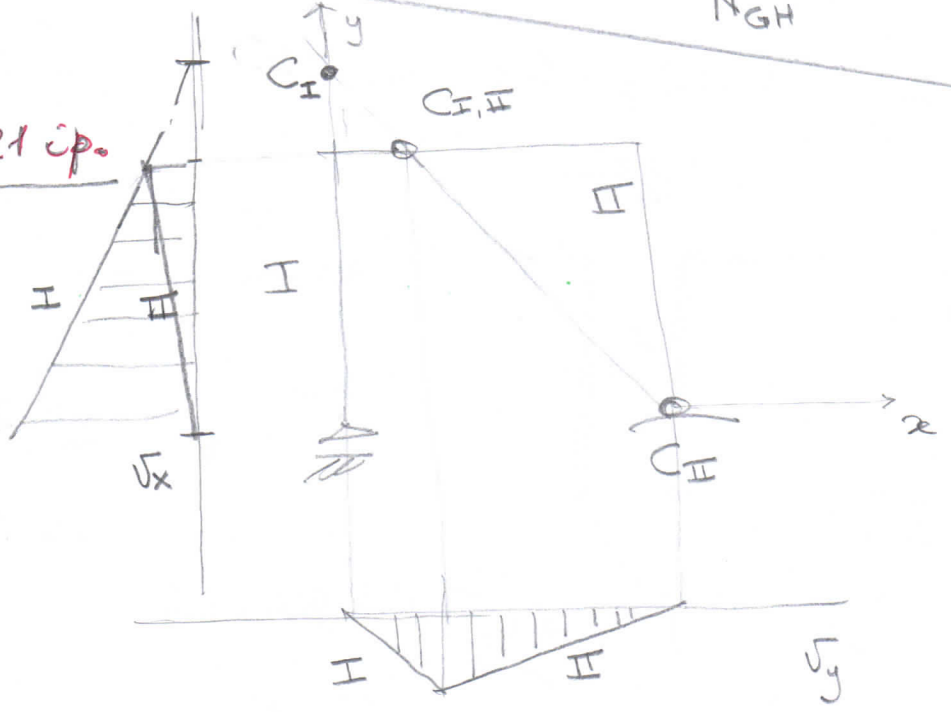
$$10 + 5 + N_{GH} = 0 \Rightarrow N_{GH} = -15$$

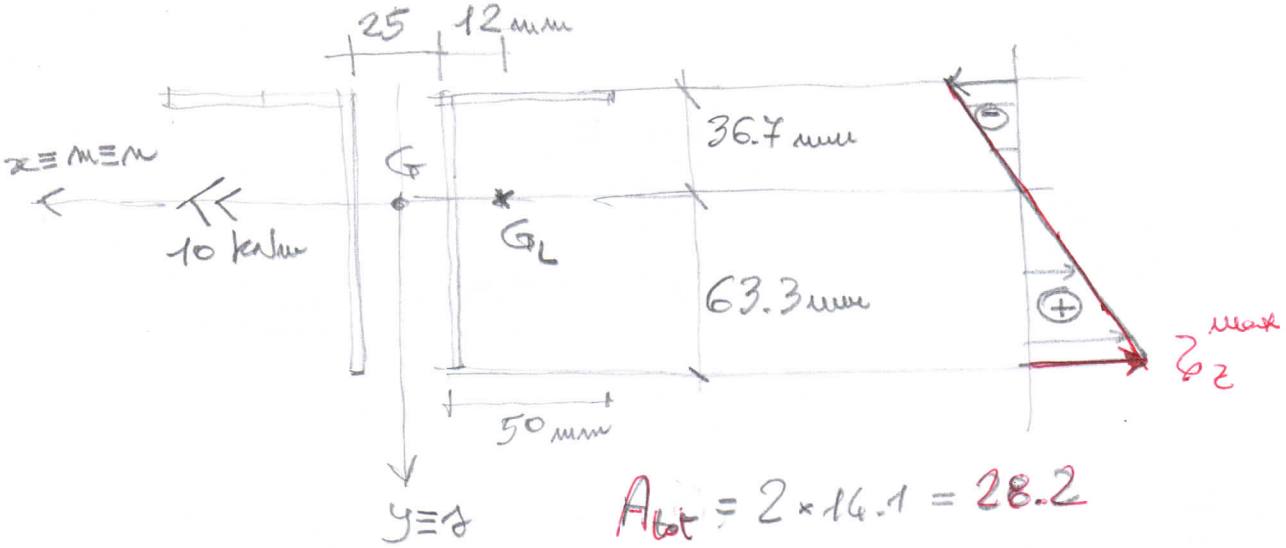
$$-5 + N_{DG} = 0 \Rightarrow N_{DG} = 5$$





= 21 cp.





$A_{tot} = 2 \times 14.1 = 28.2$

$$I_{x_{tot}} = 2\,I_x = 282\ cm^4$$

$$I_{y_{tot}} = 2\left[23.4 + 14.1 \times \left(1.2 + \frac{2.5}{2}\right)^2\right] = 216.07\ cm^4$$

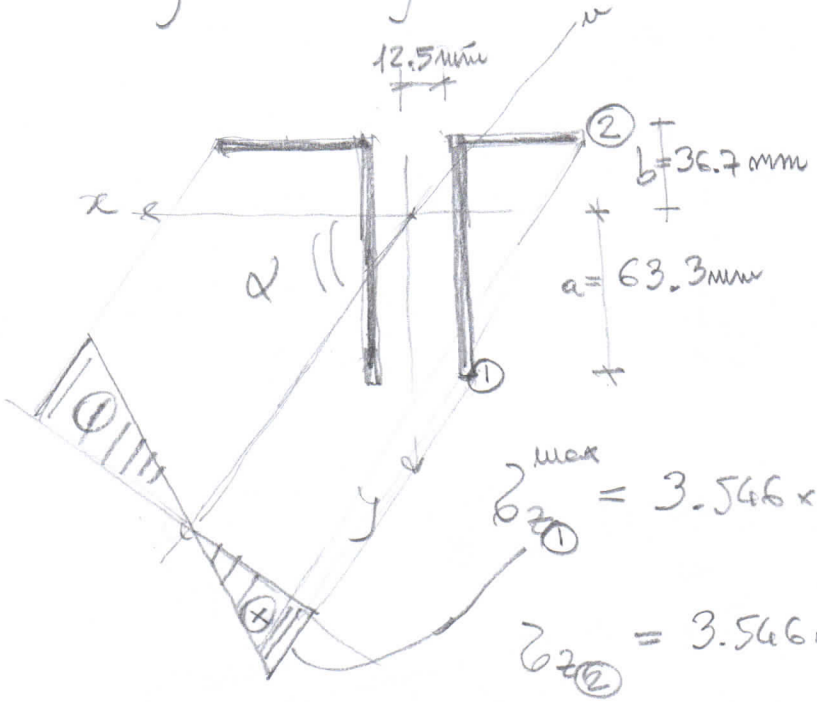
$$\sigma_z^{max} = \frac{10 \times 10^6}{282 \times 10^4} * 63.3 = 225\ \frac{N}{mm^2}$$

3.546

$M_x + M_y$

$$\sigma_z = \frac{10 \times 10^6}{282 \times 10^4}\,y - \frac{10 \times 10^6}{216.07 \times 10^4}\,x = 3.546\,y - 4.628\,x$$

m-m) $\quad 3.546\,y - 4.628\,x = 0 \qquad \frac{y}{x} = 1.305 \qquad \varphi \approx 53°$



$- 4.628 \cdot (-12.5) = 282\ N/mm^2$

$$\sigma_{z①}^{max} = 3.546 \times 63.3 - 4.628 \times (-12.5 - 10) = 329\ \frac{N}{mm^2}$$

$$\sigma_{z②} = 3.546 \times (-36.7) - 4.628 \times (-12.5 - 50) = 159\ \frac{N}{mm^2}$$