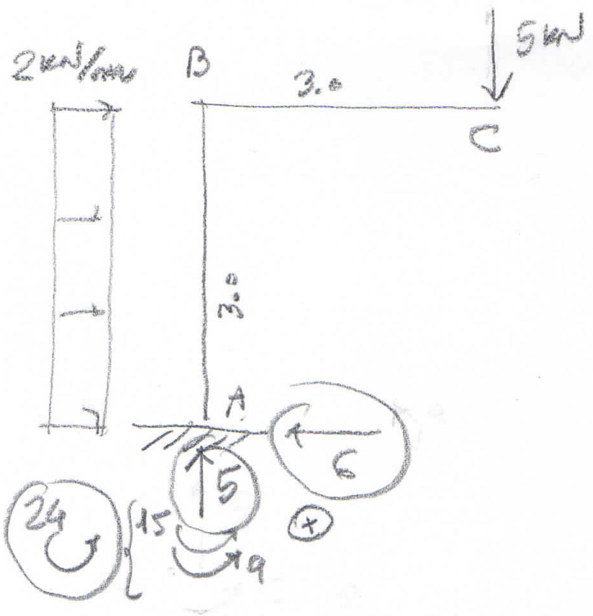
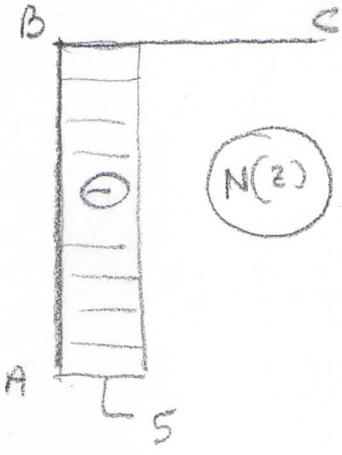
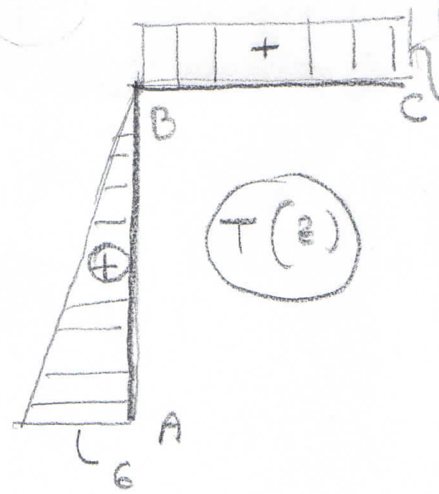
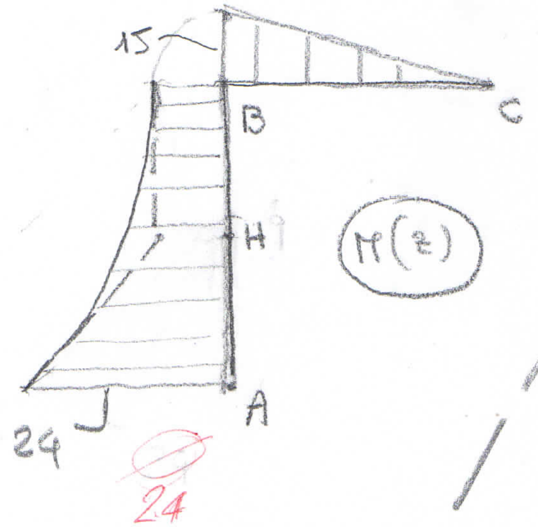
P1

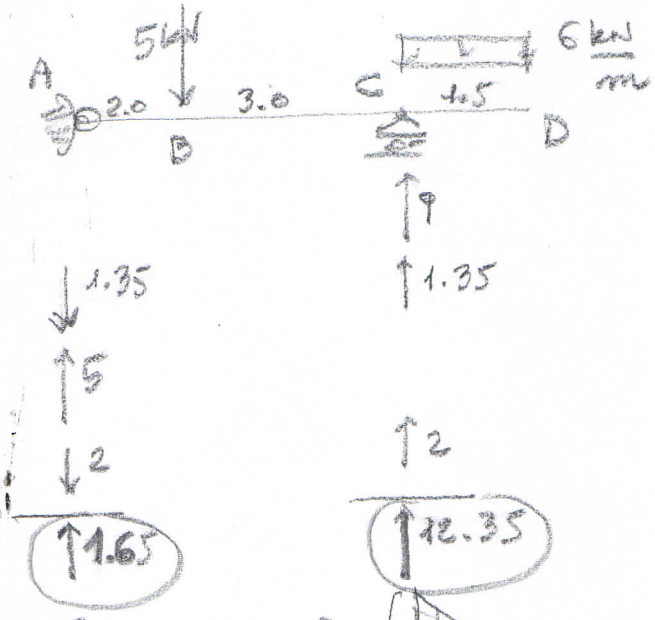

2 kN/m
B
3.0
5 kN
C
3.0
A
6
5
24
15
9
+

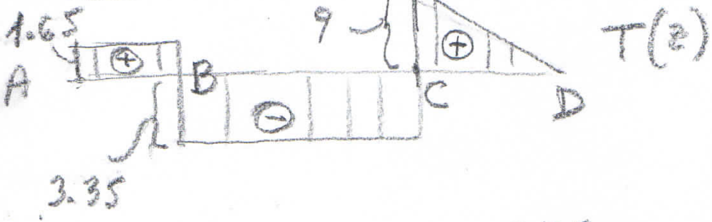

B
C
N(z)
A
5

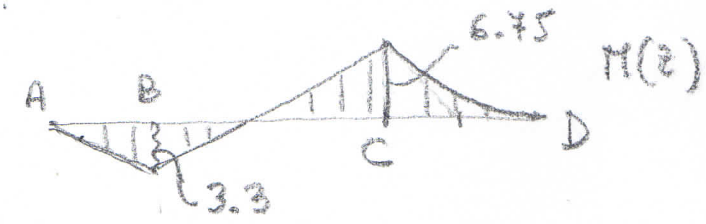

+
B
C
5
T(z)
A
6

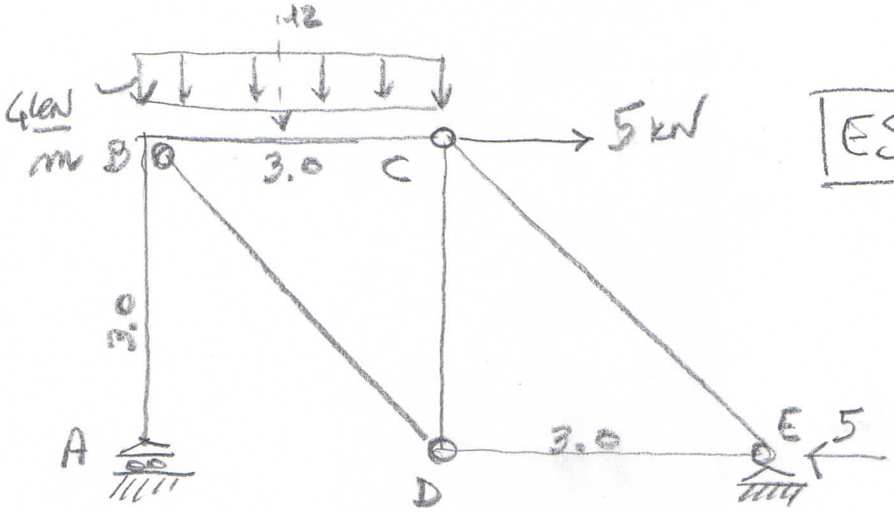
ES. 1


15
B
C
H
M(z)
A
24
24


5 kN
6 kN/m
A
2.0
3.0
C
1.5
B
D
9
1.35
1.35
5
2
2
1.65
12.35


1.65
9
T(z)
A
B
C
D
3.35


6.75
M(z)
A
B
C
D
3.3

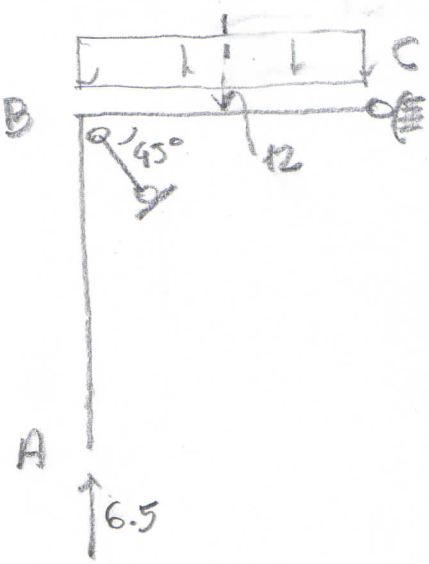


ES. 2

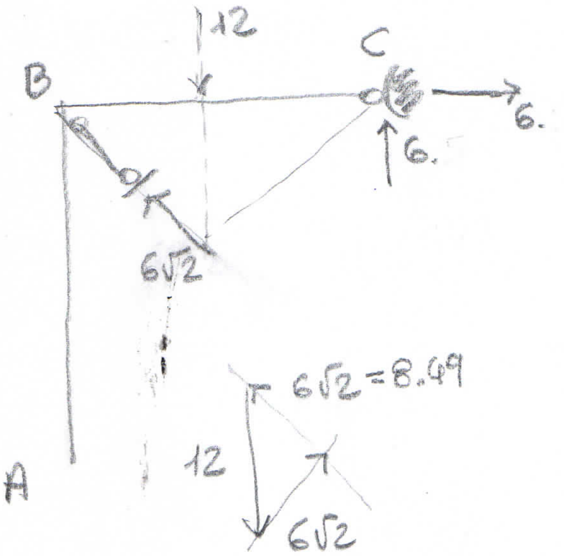
È internamente isostatica quindi si possono determinare le R.V. ext considerando tutto come unico tratto.

$6.5\uparrow \left\{ \begin{array}{l} \uparrow 12 \\ \downarrow 3 \quad \downarrow 2.5 \end{array} \right.$

$5.5\uparrow \left\{ \uparrow 3 \quad \uparrow 2.5 \right.$

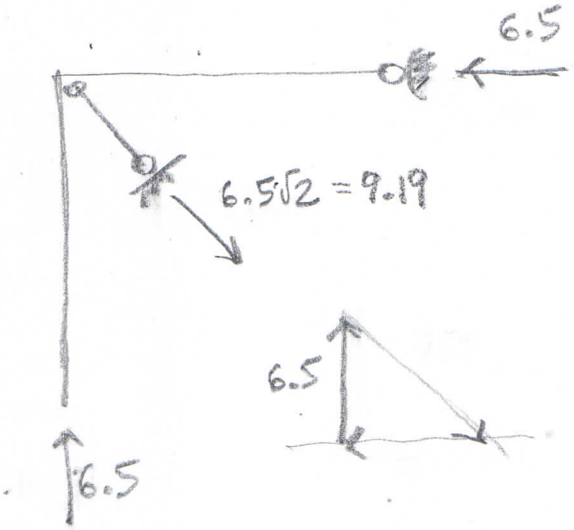


=

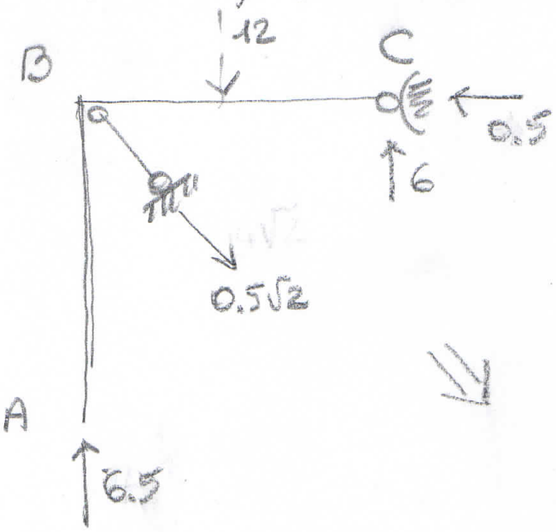


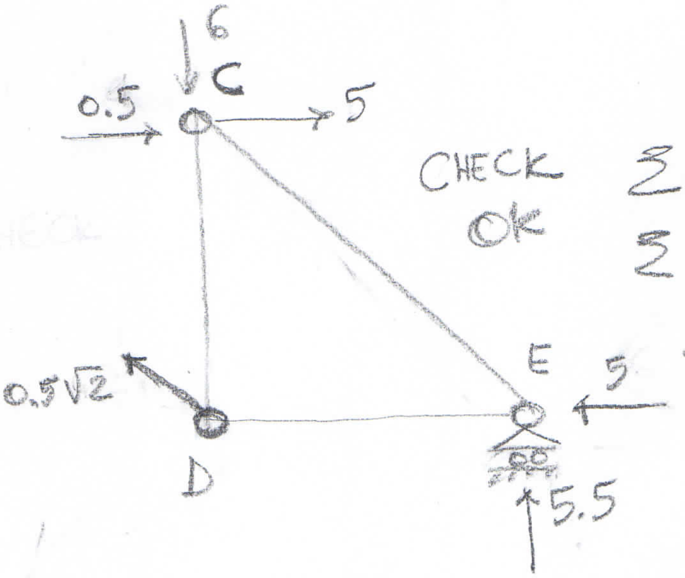
+

+



Quindi, sommando i contributi si ha:





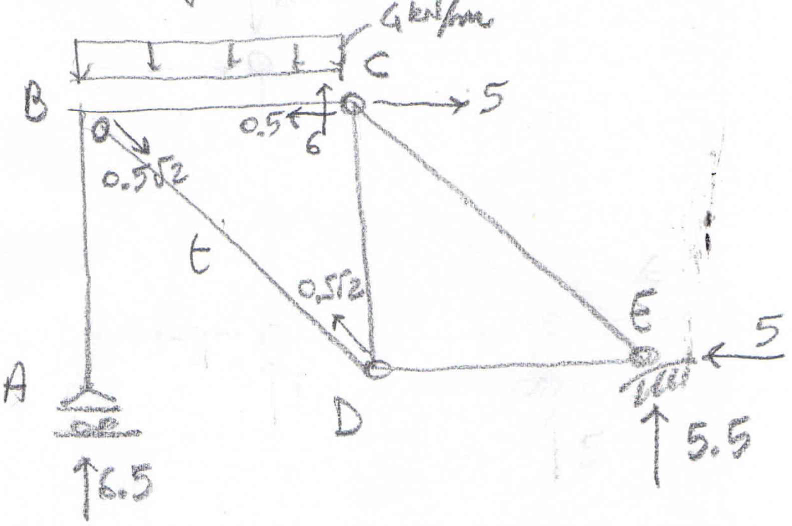
CHECK OK

$\sum F_{i_x}=0$

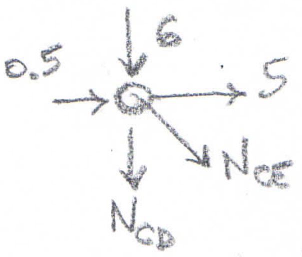
$\sum F_{i_y}=0$

$\sum M_{i_E}=0$

In definitiva:



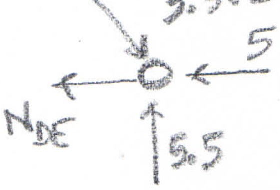
Nodo C



$$\begin{cases} N_{CE}\dfrac{\sqrt{2}}{2}+5.5=0 \\ N_{CD}+N_{CE}\dfrac{\sqrt{2}}{2}+6=0 \end{cases}$$

$$\boxed{\begin{aligned} N_{CE}&=-\frac{11}{\sqrt{2}}=-5.5\sqrt{2} \\ N_{CD}&=-6+5.5\sqrt{2}\,\frac{\sqrt{2}}{2}=-0.5 \end{aligned}}$$

Nodo E



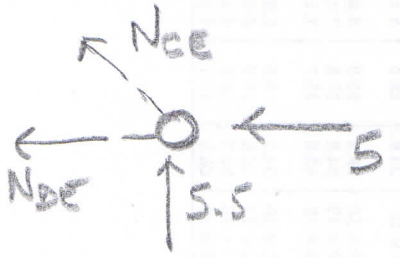
$$-N_{DE}-5+5.5=0$$

$$\Downarrow$$

$$\boxed{N_{DE}=0.5}$$

In alternativa, determinate le reazioni esterne, si può procedere con equilibrio nodo E e poi equilibrio nodo C:

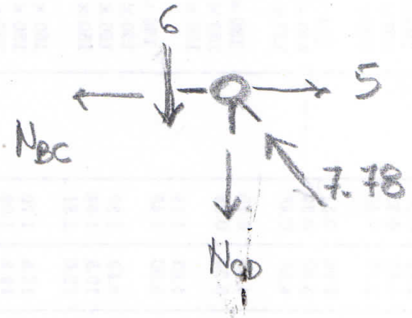
nodo E



$$N_{CE}\frac{\sqrt{2}}{2}+5.5=0 \Rightarrow N_{CE}=-\frac{11}{\sqrt{2}}=-5.5\sqrt{2}=-7.78$$

$$N_{DE}+5+N_{CE}\frac{\sqrt{2}}{2}=0 \Rightarrow N_{DE}=0.5$$

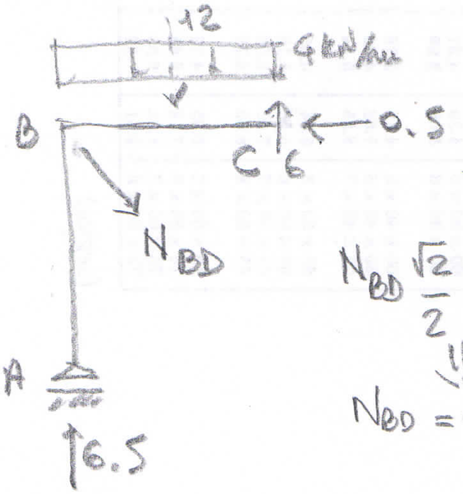
nodo C



$$-N_{BC}+5-5.5\cancel{\sqrt{2}}\frac{\cancel{\sqrt{2}}}{\cancel{2}}=0 \Rightarrow N_{BC}=-0.5$$

$$-6-N_{CD}+5.5\cancel{\sqrt{2}}\frac{\cancel{\sqrt{2}}}{\cancel{2}}=0 \Rightarrow N_{CD}=-0.5$$

Quindi:

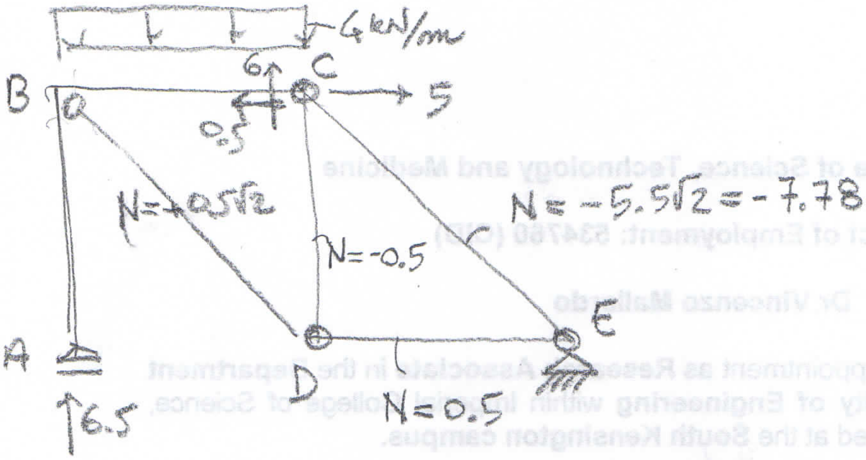


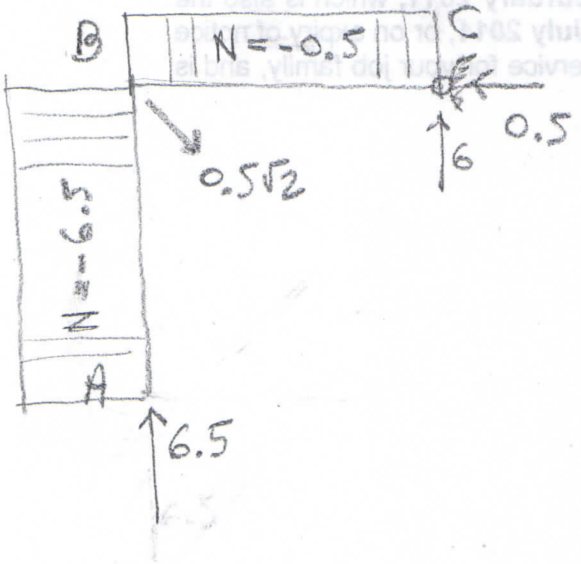
$$N_{BD}\frac{\sqrt{2}}{2}-0.5=0$$

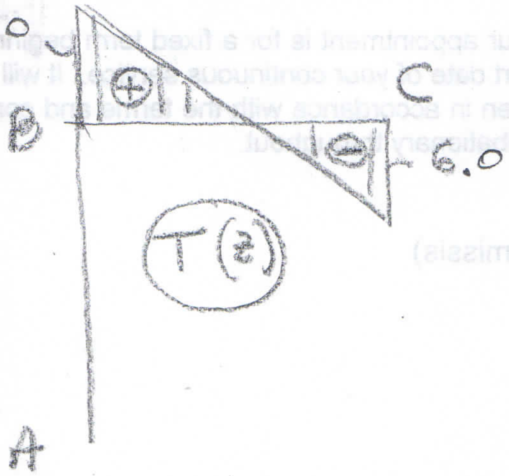
$$\Downarrow$$

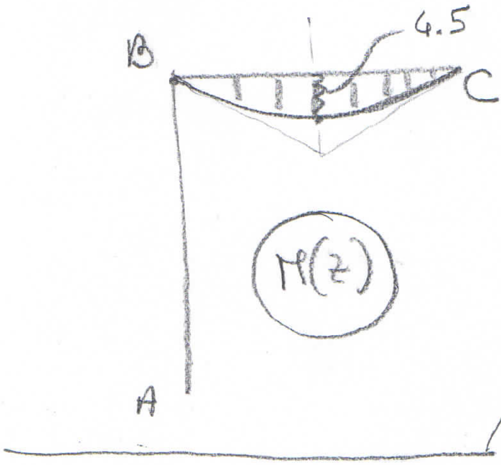
$$N_{BD}=\frac{1}{\sqrt{2}}=0.5\sqrt{2}$$

N.B. È possibile utilizzare l'equilibrio del nodo C (ossia max 2 incognite) in quanto è noto a priori che $M_B=0$ e quindi il carico distribuito si ripartisce in parti uguali su B e C





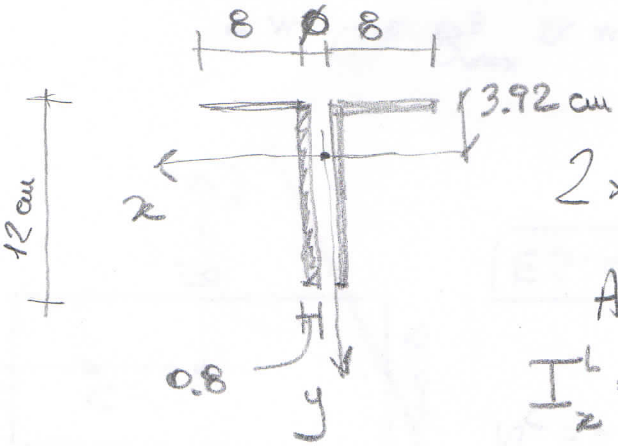




ES. 3

$$Y_G = \frac{50\times 10\times 55 + 35\times 50\times 25}{50\times 10 + 35\times 50} = \frac{71250}{2250} = 31.7\,\text{cm}$$

$$X_G = \frac{50\times 10\times 25 + 35\times 50\times\left(\frac{35}{2} + 15\right)}{2250} = \frac{69375}{2250} = 30.8\,\text{cm}$$

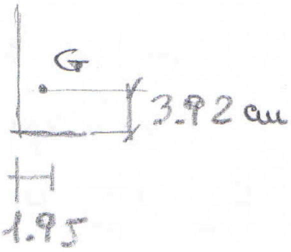


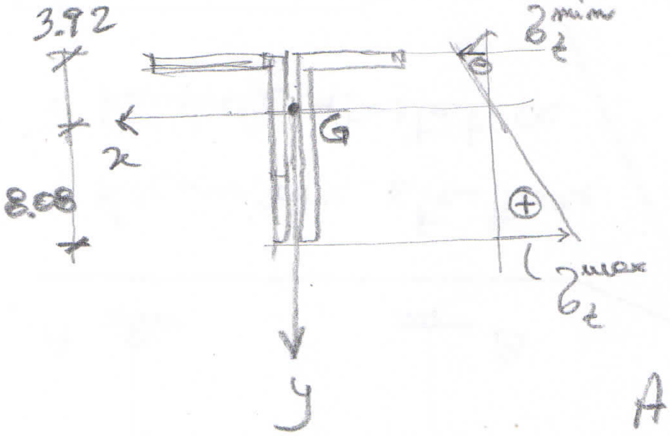
$$2 \times L\,120 \times 80 \times 10$$

$$A^{L} = 19.1\ cm^2$$

$$I_x^{L} = 276\ cm^4$$

$$I_y^{L} = 98.1\ cm^4$$





$$\sigma_z^{min}$$

$$\sigma_z^{max}$$

$$M_x = 25\ kNm$$

$$A_{tot} = 2 \times 19.1 = 38.2\ cm^2$$

$$I_x^{tot} = 2 \times 276 = 552\ cm^4$$

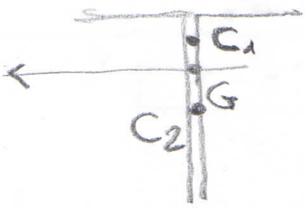
$$I_y^{tot} = 2\left(98.1 + 19.1 \times 1.95^2\right) = 341.6555\ cm^4$$

$$\left[\frac{N}{mm^2}\right] \sigma_z = \frac{25 \times 10^6}{552 \times 10^4} \cdot y = 4.529\, y \quad \text{in } N/mm^2$$

$$\sigma_z^{max} = 4.529 \times (\underbrace{120 - 39.2}_{80.8}) = 366\ \frac{N}{mm^2}$$

$$\sigma_z^{min} = 4.529 \times (-39.2) = -178\ N/mm^2$$

$$GC_1 \times (120 - 39.2) = \rho_x^2 \Rightarrow GC_1 = \frac{552 \times 10^4}{38.2 \times 10^2} \cdot \frac{1}{80.8} = 18\ mm$$



$$GC_2 = \frac{552 \times 10^4}{38.2 \times 10^2} \cdot \frac{1}{39.2} = 37\ mm$$