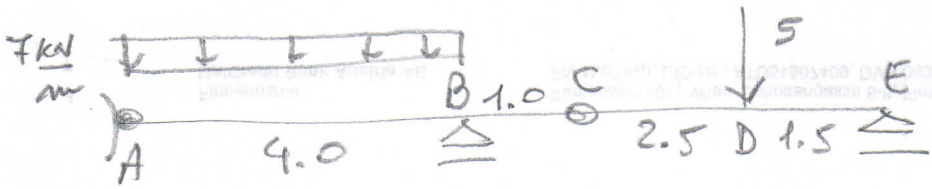
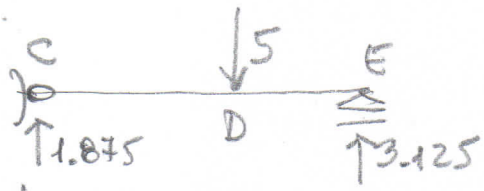
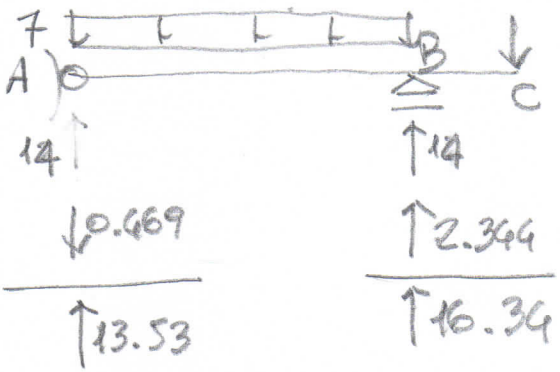
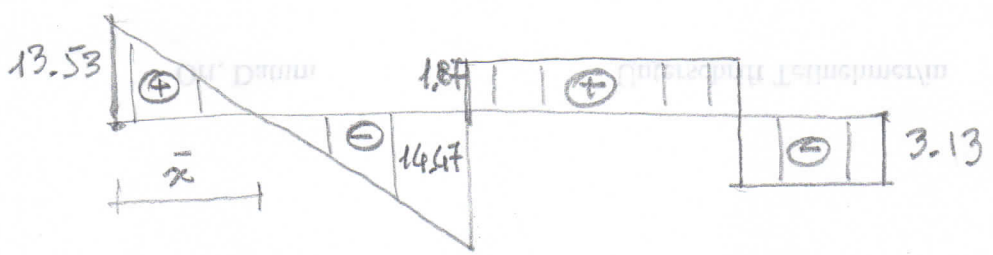
Es. 1

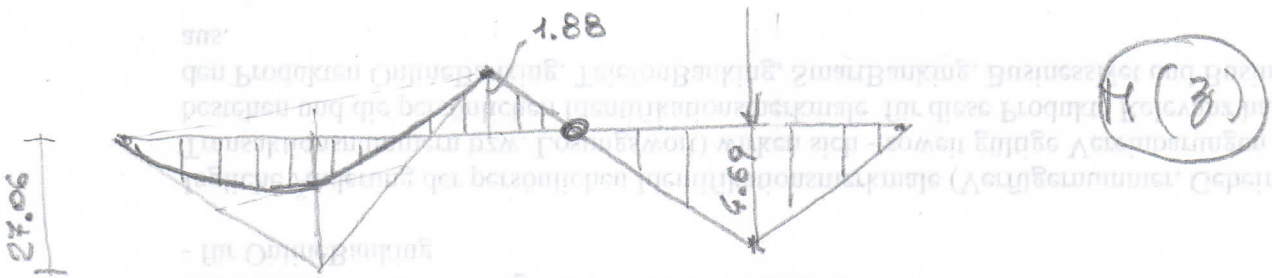








T(z)

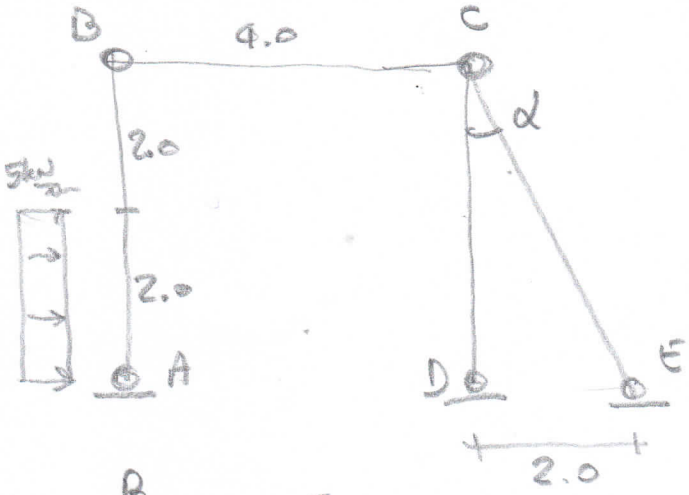


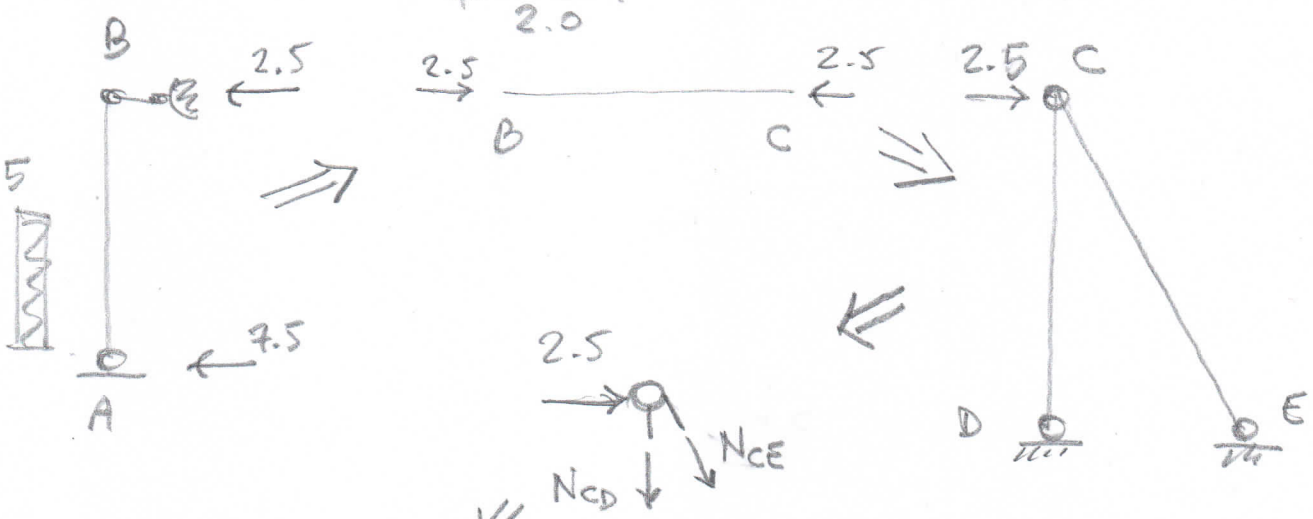
M(z)

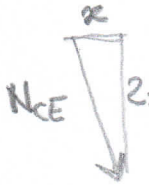
Non richiesto:

$$\frac{\bar{x}}{13.53} = \frac{4}{13.53+14.47} \Rightarrow \bar{x} = \frac{4}{28} \times 13.53 = 1.93$$

$$M_{max} = M(\bar{x}) = 13.53 \times \frac{1.93}{2} = 13.06 \text{ kNm}$$





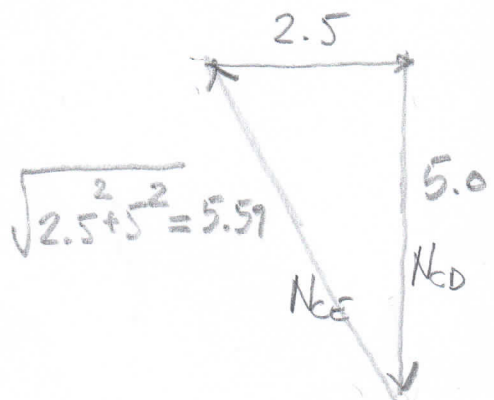


$$\sqrt{x^2+4x^2} = N_{CE} \Rightarrow x = \frac{N_{CE}}{\sqrt{5}} = \frac{\sqrt{5}}{5} N_{CE}$$

oppure $\quad tg\alpha = \frac{2}{4} = 0.5 \Rightarrow \alpha = \text{arctg}\, 0.5 = 26^\circ 33' = 0.464\,\text{rad}$

equazioni equilibrio nodo

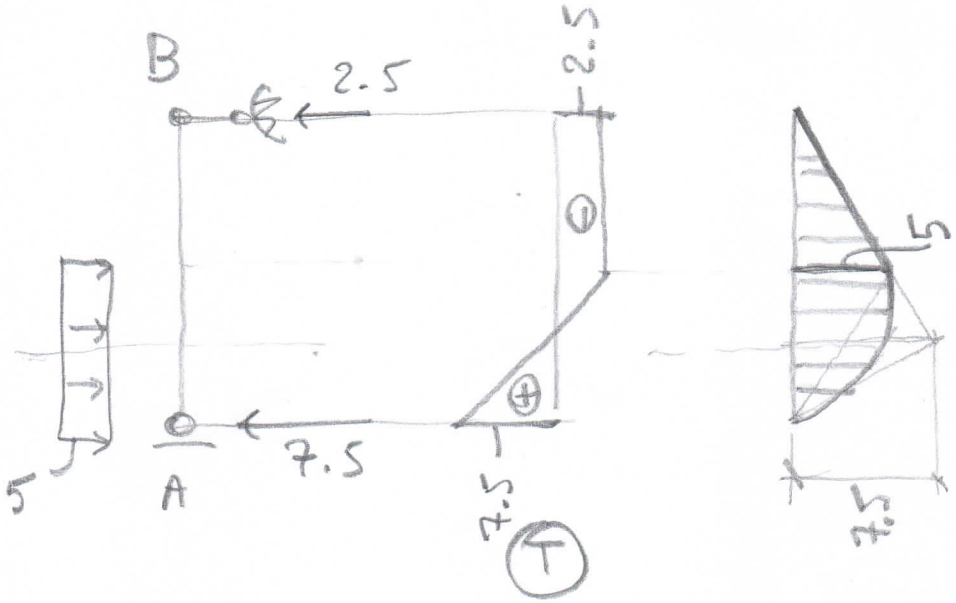
$$\begin{cases} 2.5 + N_{CE} \cdot \text{sen}\alpha = 0 \Rightarrow 2.5 + N_{CE} \cdot 0.447 = 0 \Rightarrow N_{CE} = -5.59 \\ N_{CD} + N_{CE} \cos\alpha = 0 \Rightarrow N_{CD} = 5.59 \cos\alpha = 5.0 \end{cases}$$



equilibrio grafico

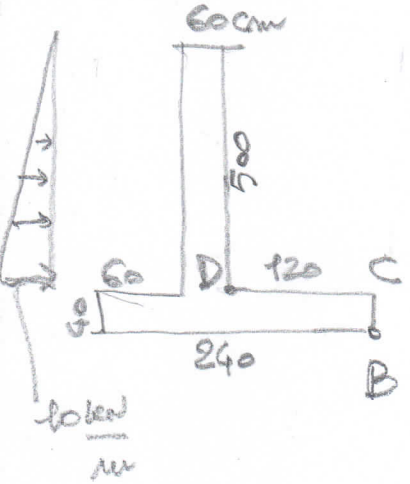
Sommario:

$N_{BC} = -2.5 \quad N_{CD} = +5 \quad N_{CE} = -5.59$



$$\Delta l_{CE} = \frac{N_{CE}\, l_{CE}}{E\, A} = \frac{5.59 \cdot 1000\,N \times \sqrt{4000^2 + 2000^2}\,mm}{8000 \frac{N}{mm^2} \cdot 100 \times 100\,mm^2} = 0.31\,mm$$

Es. 3



$$P = P_1 + P_2 = 5 \times 0.6 \times 18 + 2.4 \times 0.4 \times 18 =$$

$$= 54\,kN + 17.28\,kN = 71.28\,kN$$

$$M_B^{pesi} = 54 \times (1.2 + 0.3) + 17.28 \times \frac{2.4}{2} = 101.74\,kNm \;\curvearrowright$$

$$M_B^{forze} = -10 \times \frac{5}{2} \times \left(\overbrace{\frac{1}{3} \times 5}^{1.67} + 0.4\right) = -51.67\,kNm \;\curvearrowleft$$

$P_1 = 54\,kN \qquad P_2 = (0.6 + 0.6 + x) \times 0.4 \times 18 = 8.64 + 7.2x$

$$54 \times (x + 0.3) + (8.64 + 7.2x) \times \frac{x + 1.2}{2} = 51.67$$

$$\Downarrow$$

$$54x + 16.2 + 4.32x + 5.184 + 3.6x^2 + 4.32x = 51.67$$

$$\Downarrow$$

$$3.6x^2 + 62.64x - 30.29 = 0 \Rightarrow x = \begin{cases} 0.47\,m \\ -17.87\,m \end{cases}$$

$$CD_{min} = 0.43\,m$$

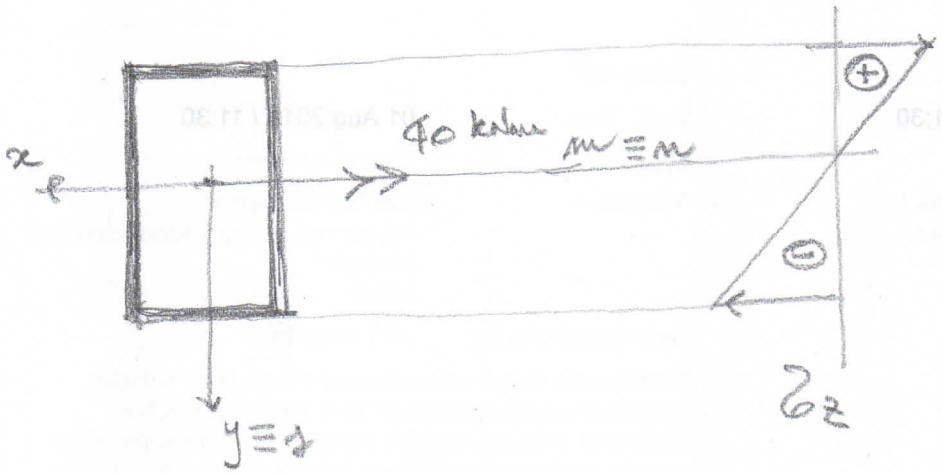
Es. 4

$$A = 30 \times 50 - 29 \times 49 = 79\ cm^2$$

$$I_x = 30 \times \frac{50^3}{12} - 29 \times \frac{49^3}{12} = 28182\ cm^4$$

$$I_y = 50 \times \frac{30^3}{12} - 49 \times \frac{29^3}{12} = 12912\ cm^4$$

$$M_b = 10 \times 4 = 40\ kNm$$



$$\sigma_z^{max} = \frac{40 \times 10^3 \times 10^3\ N \cdot mm}{28182 \times 10^4\ mm^4} \cdot 250\ mm = 35\ \frac{N}{mm^2}$$