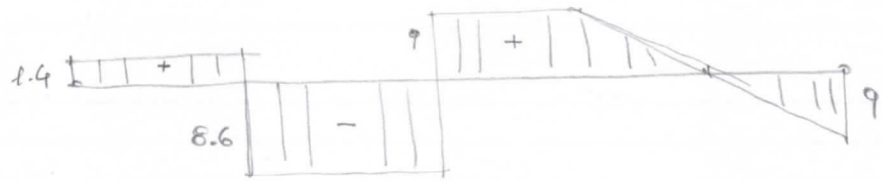
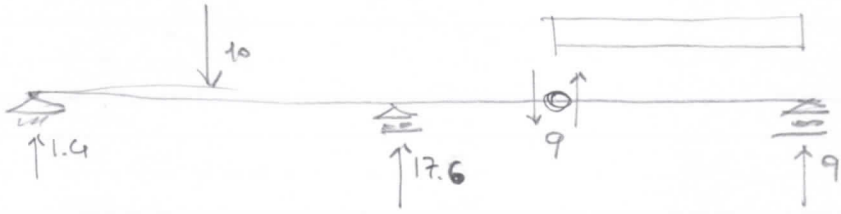
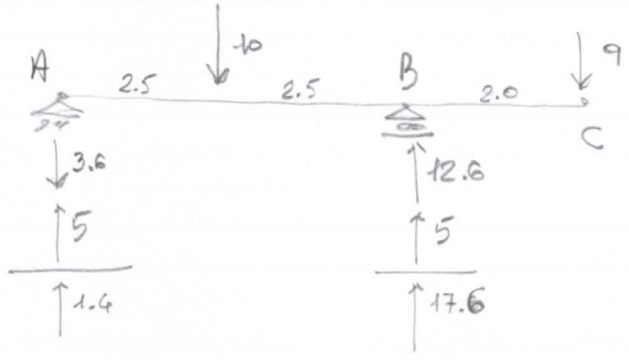
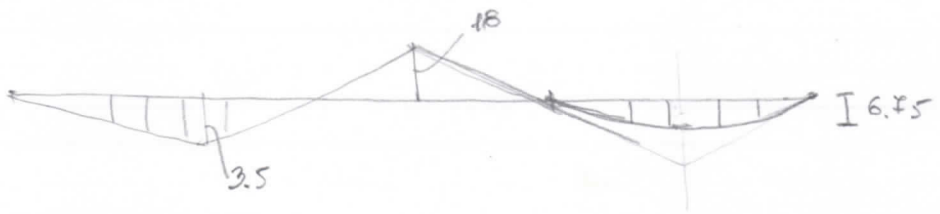


ES. 1

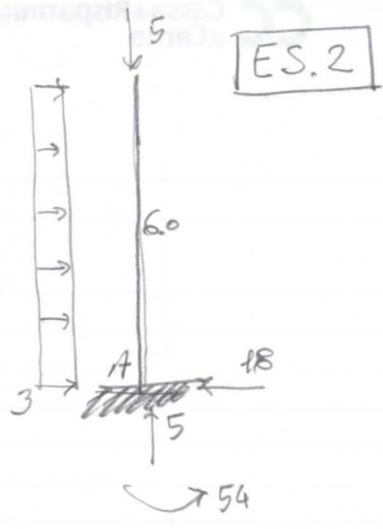
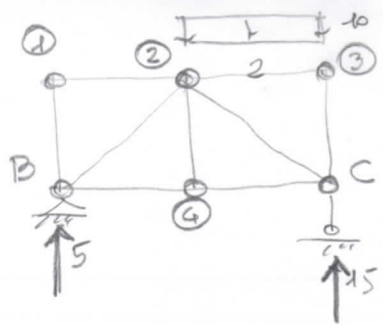
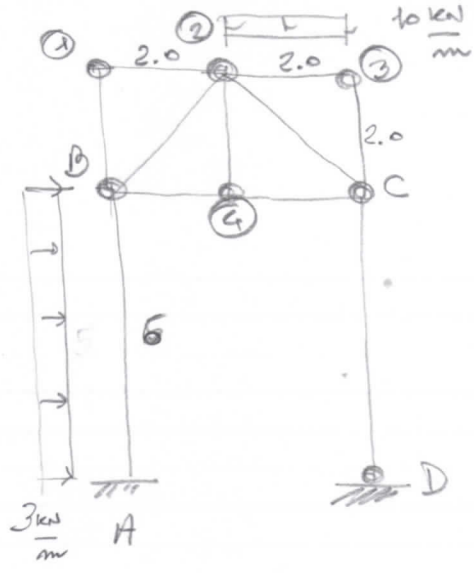


(T)



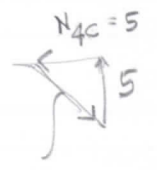
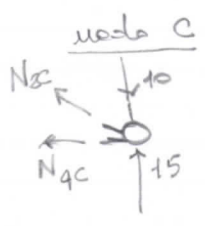
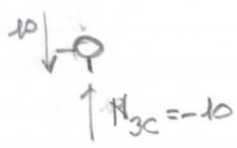
(H)

①) $V(z) = 9z - \frac{3}{2}z^2 = 9z - 1.5z^2$

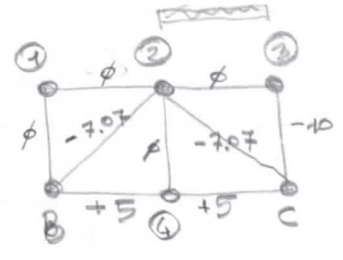


ES.2

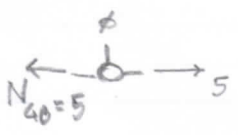
modo ③



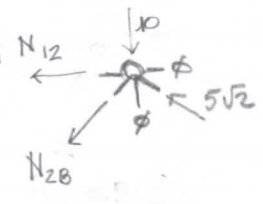
$N_{2c} = -5\sqrt{2} = -7.07$



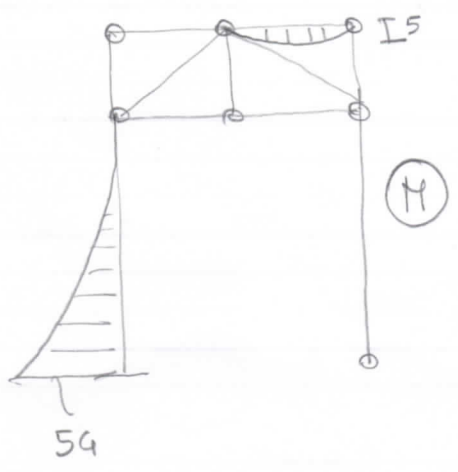
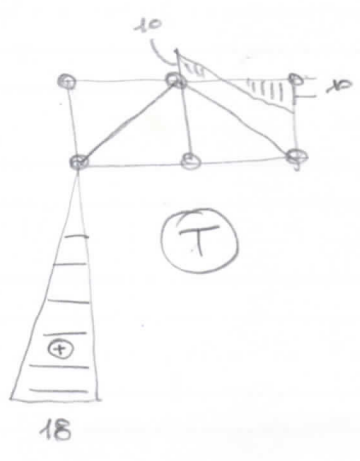
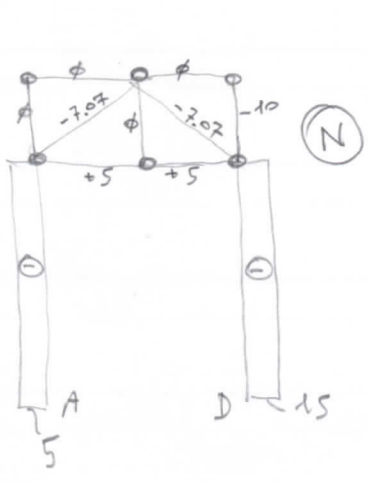
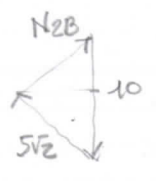
modo ④



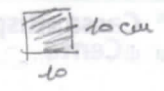
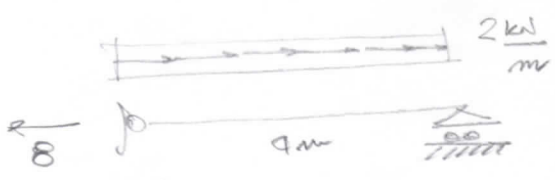
modo ②



$$\begin{cases} -5 - N_{12} - N_{2b} \frac{\sqrt{2}}{2} = 0 \\ 5 - N_{2b} \frac{\sqrt{2}}{2} - 10 = 0 \end{cases} \Rightarrow \begin{cases} N_{12} = 0 \\ N_{2b} = -5\sqrt{2} \end{cases}$$



ES 3



$A = 100 \text{ cm}^2 = 10^{-2} \text{ m}^2$
 $E = 21000 \frac{\text{N}}{\text{mm}^2}$

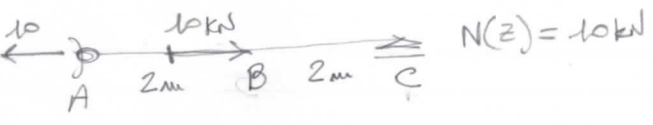


$N(z) = 8 - 2z$

$$\epsilon_z(z) = \frac{N(z)}{EA} = \frac{8 - 2z}{210000 \times 10^{-2}} = \frac{8 - 2z}{210000}$$

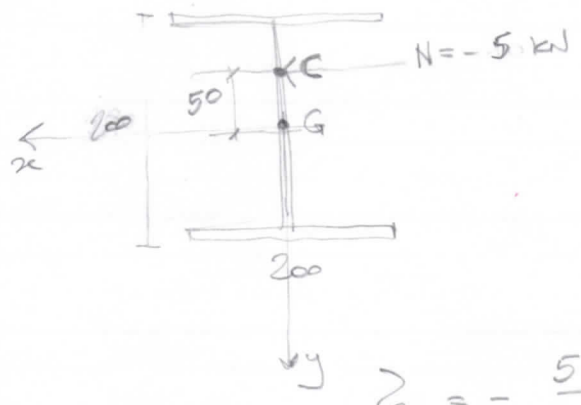
$E = 210000000 \frac{\text{kN}}{\text{m}^2}$

$$\Delta p = \int_0^4 \frac{N(z)}{EA} dz = \frac{1}{210000} \left(8 \left[z \right]_0^4 - 2 \left[\frac{z^2}{2} \right]_0^4 \right) = \frac{1}{210000} (32 - 16) = \frac{16}{210000} = 7.62 \times 10^{-5}$$



$N(z) = 10 \text{ kN}$
 $\epsilon_z^{AB} = \frac{10}{210000} = 4.76 \times 10^{-5}$
 $\epsilon_z^{BC} = 0$
 $\Delta e_{AC} = \Delta e_{AB} = 4.76 \times 10^{-5} \times 2000 = 9.52 \times 10^{-2} \text{ mm}$

HEB 200



$A = 78.08 \text{ cm}^2$
 $I_z = 5696 \text{ cm}^4$
 $I_y = 2003$

ES.4

$M_x = 5 \times 0.05 = 0.25 \text{ kNm}$

$$\sigma_z = - \frac{5 \cdot 10^3}{7808} + \frac{0.25 \cdot 10^6}{5696 \cdot 10^4} y = -0.640 + 0.004389 y$$

$$y = \frac{0.64}{0.004389} = 146 \text{ mm}$$

