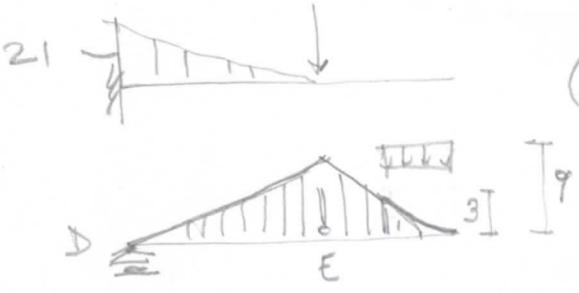


$T(z)$

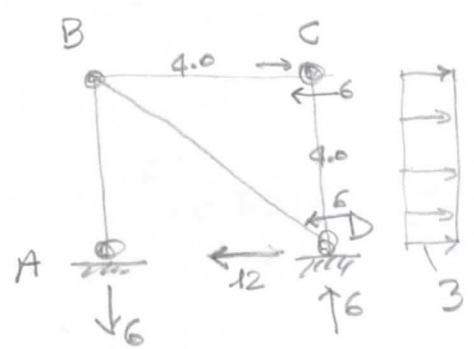
ES.1

$M(z)$

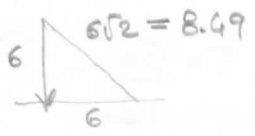
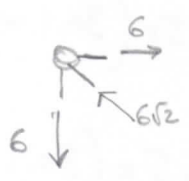


$$M(z)_{DE} = -4.5 z^2$$

$$\Delta R_{DE} = \frac{10.5 \cdot 1000 \cdot 2000}{10000 \cdot 5000} = 0.42 \text{ mm}$$



modo B

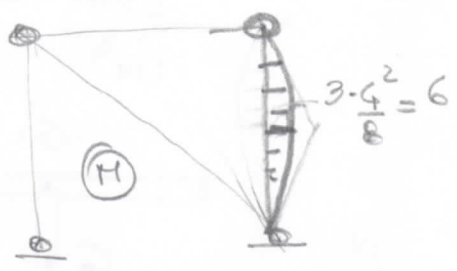
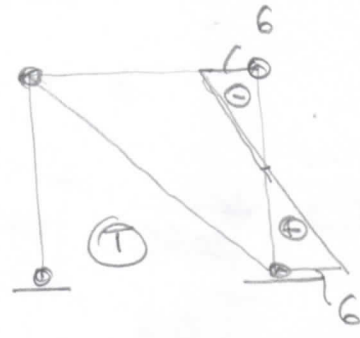
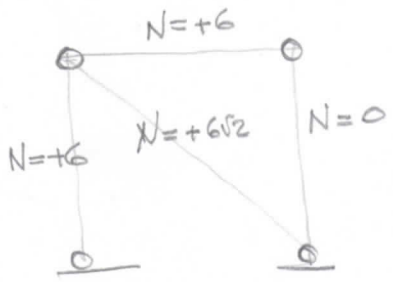
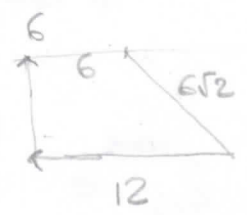
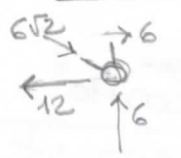


ES.2

modo C



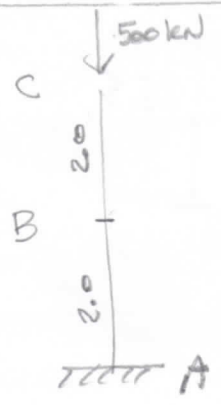
modo D



ES.3

$$A = 15 \times 15 = 225 \text{ cm}^2 = 22500 \text{ mm}^2$$

$$E = 20000 \frac{\text{N}}{\text{mm}^2}$$

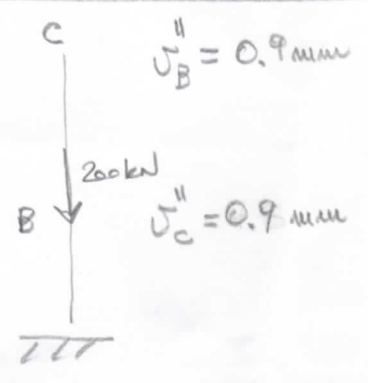


$$J_B^I = \frac{500000 \times 2000}{20000 \cdot 22500} = 2.2 \text{ mm}$$

$$J_C^I = \frac{500000 \times 4000}{20000 \cdot 22500} = 4.4 \text{ mm}$$

$$J_B^{II} = 3.1 \text{ mm}$$

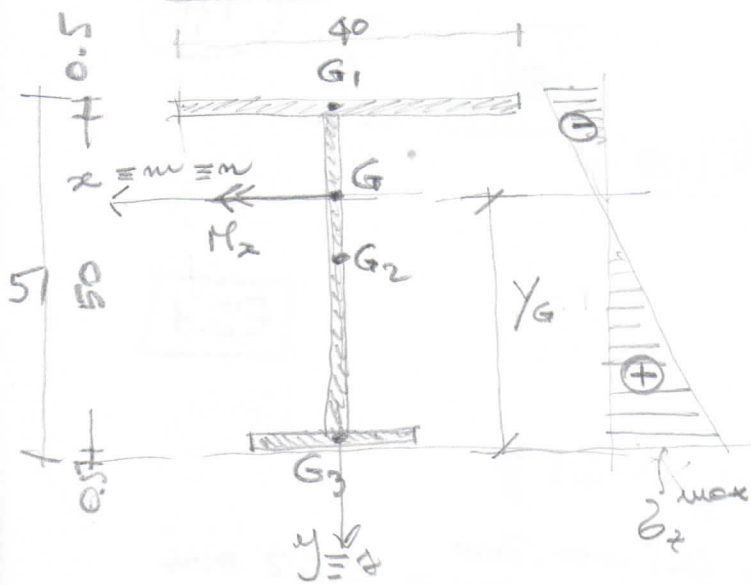
$$J_C^{II} = 5.3 \text{ mm}$$



$$J_B^{II} = 0.9 \text{ mm}$$

$$J_C^{II} = 0.9 \text{ mm}$$

ES. 4



$$A = \overbrace{40 \times 0.5}^{A_1} + \overbrace{50 \times 0.5}^{A_2} + \overbrace{20 \times 0.5}^{A_3} = 55 \text{ cm}^2$$

$$S_x = 20 \times \frac{0.5^2}{2} + 50 \times 0.5 \times 25.5 + 40 \times 0.5 \times 50.75 = 1655 \text{ cm}^3$$

$$y_G = \frac{1655}{55} = 30.1 \text{ cm}$$

$$I_x = \frac{20 \times 0.5^3}{12} + 20 \times 0.5 \times (30.1 - 0.25)^2 + \frac{0.5 \times 50^3}{12} + 50 \times 0.5 \times (30.1 - 25.5)^2 + \frac{40 \times 0.5^3}{12} + 40 \times 0.5 \times (30.1 - 50.75)^2 = 23177 \text{ cm}^4$$

$$\sigma_z^{\max} = \frac{200 \times 10^6}{23177 \times 10^4} \cdot 301 = 260 \frac{\text{N}}{\text{mm}^2}$$

