Remarks: See §4.4, pages 168 till 170
See §4.5, pages 171 till 184

Answers:

d. $\sigma_t = +11 \text{ N/mm}^2$

$\sigma_b = +0,5 \text{ N/mm}^2$

e. $\sigma_t = +1 \text{ N/mm}^2$

$\sigma_b = +5,5 \text{ N/mm}^2$

Explanation:

a. Distance between NC to bottom of the profile:

$$\frac{(600 \times 10 \times 300 \text{ mm}^3)}{(600 \times 5 \text{ mm}^2) + (600 \times 10 \text{ mm}^2)} = 200 \text{ mm}$$

b. units in mm:

$$I_{yy} = I_{yy(\text{cent})}^{\text{flange}} = \tfrac{1}{12} \times 5 \times 600^3 = 90 \times 10^6 \text{ mm}^4$$

$$I_{zz} = I_{zz(\text{steiner})}^{\text{flange}} + I_{zz(cent)}^{web} + I_{zz(\text{steiner})}^{web} =$$

$$= 600 \times 5 \times 200^2 + \tfrac{1}{12} \times 10 \times 600^3 + 600 \times 10 \times 100^2 =$$

$$= 360 \times 10^6 \text{ mm}^4$$

c. The bending moment varies linearly:

$x = 0$: $M_z = -6,3 \text{ kNm}$

$x = 3 \text{ m}$: $M_z = +7,2 \text{ kNm}$

The normal force is constant: $N = +36 \text{ kN}$

d. $$\sigma^{(N)} = \frac{+36 \times 10^3 \text{ N}}{9 \times 10^3 \text{ mm}^2} = +4 \text{ N/mm}^2$$

$$\sigma_t^{(M)} = \frac{(-6,3 \times 10^6 \text{ Nmm})(-400 \text{ mm})}{360 \times 10^6 \text{ mm}^4} = +7 \text{ N/mm}^2$$

$$\sigma_b^{(M)} = \frac{(-6,3 \times 10^6 \text{ Nmm})(+200 \text{ mm})}{360 \times 10^6 \text{ mm}^4} = -3,5 \text{ N/mm}^2$$

e At $x = 2 \text{ m}$: $M_z = +2,7 \text{ kNm}$

$$\sigma^{(N)} = +4 \text{ N/mm}^2$$

$$\sigma_t^{(M)} = \frac{(+2,7 \times 10^6 \text{ Nmm})(-400 \text{ mm})}{360 \times 10^6 \text{ mm}^4} = -3 \text{ N/mm}^2$$

$$\sigma_b^{(M)} = \frac{(+2,7 \times 10^6 \text{ Nmm})(+200 \text{ mm})}{360 \times 10^6 \text{ mm}^4} = +1,5 \text{ N/mm}^2$$