Remarks: See §4.4, pages 168 till 170
See §4.5.4, pages 179 till 182

Hints:

Schematize the beam as a line element and draw all the forces and couples that act on this line. Then make sketches of the M and the N diagrams.

Answers:

a. $N = -6720$ kN en $M_z = +864$ kNm

b. $F_p = 6720$ kN

c. $F = 1037$ kN

e. $\sigma_t = 0$ and $\sigma_b = -33,6$ N/mm^2

Explanation:

a. $N = \sigma_{NC} A = (-14 \text{ N/mm}^2)(480 \times 10^3 \text{ mm}^2) = -6720 \times 10^3$ N

For the top fiber: $z = -375$ mm ; $\sigma^{(M)} = -10$ N/mm^2

$$M_z = \frac{\sigma^{(M)} I_{zz}}{z} = \frac{(-10 \text{ N/mm}^2)(32,4 \times 10^9 \text{ mm}^4)}{-375 \text{ mm}} = +864 \times 10^6 \text{ Nmm}$$

c. The pre-stressing tendon applies eccentric compressive forces on the beam ends. This causes a normal force $N = -6720$ kN and a moment $M_z = N \cdot e_z = -1210$ kNm.

Taking the moment balance at right side C :

$$\sum T_y \big| C = (2 \text{ m}) \times F - (1210 \text{ kNm}) = 864 \text{ kNm} \Rightarrow F = 1037 \text{ kN}$$

e. in B: $N = -6720$ kN ; $M_z = -1210$ kNm

$\sigma^{(N)} = -14,0$ N/mm^2

$\sigma_b^{(M)} = -19,6$ N/mm^2 and $\sigma_t^{(M)} = +14,0$ N/mm^2