Remarks: See §2.2.1, pages 19 till 21
See §2.3, pages 24 till 26
See §2.6, pages 34 onwards

Hint:

First express the tension in the vertical bars in terms of F.
Do not forget the weight of the beam.

Answers:

a. $F = 12\frac{6}{7}$ kN

b. $\Delta\ell = 0,64$ mm

c. $\sigma_{st} = 90$ N/mm^2

d. $\sigma_{ko} = 38,57$ N/mm^2

Explanation:

a. $\Delta\ell_{ko} = \Delta\ell_{st}$

$$\frac{(2\text{ m})\{(\frac{9}{4}\text{ kN}) + \frac{1}{8}F\}}{(120\text{ GPa})(100\text{ mm}^2)} = \frac{(1,5\text{ m})\{(\frac{27}{4}\text{ kN}) + \frac{7}{8}F\}}{(210\text{ GPa})(200\text{ mm}^2)} \rightarrow F = \frac{90}{7}\text{ kN}$$

b. $u = \Delta\ell_s = \dfrac{(18\times10^3\text{ N})(1,5\times10^3\text{ mm})}{(210\times10^3\text{ N/mm}^2)(200\text{ mm}^2)} = 0,64\text{ mm}$

c. $\sigma_s = \dfrac{18\times10^3\text{ N}}{200\text{ N/mm}^2} = 90\text{ N/mm}^2$

d. $\sigma_k = \dfrac{3,857\times10^3\text{ N}}{100\text{ N/mm}^2} = 38,57\text{ N/mm}^2$