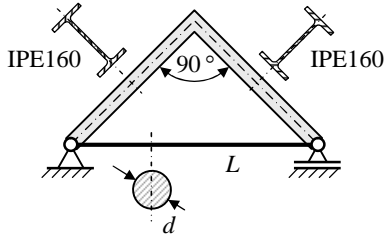


2



IPE 160  
 $d = 0,02 \text{ m}$   
 $30^\circ$

$L = 1 \text{ m}; E = 2,1 \cdot 10^{11} \text{ Pa}; \alpha = 12,5 \cdot 10^{-6} \text{ 1/}^\circ$

1.

1.1.

,  $AC = BC = AB \sin 45^\circ = \frac{\sqrt{2}}{2} L$ .

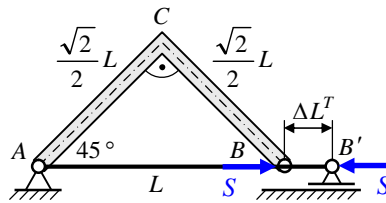
1.2.

1.3.

$L^T$ .

1.4.

S.



2.

),

N.

(

T.

:

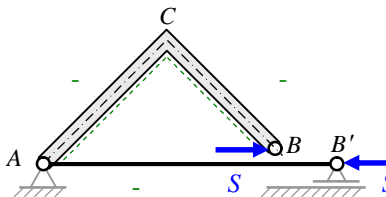
$$\delta U = \frac{\partial U}{\partial S} = \int_{L_1} \frac{N_1}{EA_1} \frac{\partial N_1}{\partial S} dx + \int_{L_2} \frac{M_{y2}}{EI_{y2}} \frac{\partial M_{y2}}{\partial S} dx + \int_{L_3} \frac{M_{y3}}{EI_{y3}} \frac{\partial M_{y3}}{\partial S} dx = \Delta L^T = \Delta T L. \quad (1)$$

S e

$N_1, N_2, N_3$

S.

$N_2, N_3$ .



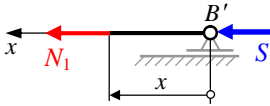
3.

4.

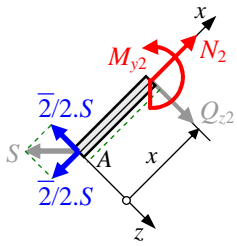
S

N

(1)

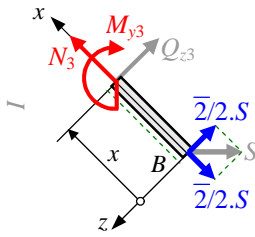
4.1. \_\_\_\_\_ ( ), \_\_\_\_\_,  $x \in [0; L]$ 

$$\sum x_i = 0: \quad N_1 + S = 0; \quad N_1 = -S; \quad \frac{\partial N_1}{\partial S} = -1.$$

4.2. \_\_\_\_\_ ( ), \_\_\_\_\_,  $x \in \left[0; \frac{\sqrt{2}}{2} L\right]$ 

$$\sum x_i = 0: \quad N_2 - \frac{\sqrt{2}}{2} S = 0; \quad N_2 = \frac{\sqrt{2}}{2} S.$$

$$\sum M_{y_i} = 0: \quad M_{y_2} - \frac{\sqrt{2}}{2} S \cdot x = 0; \quad M_{y_2} = \frac{\sqrt{2}}{2} S \cdot x; \quad \frac{\partial M_{y_2}}{\partial S} = \frac{\sqrt{2}}{2} x.$$

4.3. \_\_\_\_\_ (BC), \_\_\_\_\_,  $x \in \left[0; \frac{\sqrt{2}}{2} L\right]$ 

$$\sum x_i = 0: \quad N_3 - \frac{\sqrt{2}}{2} S = 0; \quad N_3 = \frac{\sqrt{2}}{2} S.$$

$$\sum M_{y_i} = 0: \quad M_{y_3} - \frac{\sqrt{2}}{2} S \cdot x = 0; \quad M_{y_3} = \frac{\sqrt{2}}{2} S \cdot x; \quad \frac{\partial M_{y_3}}{\partial S} = \frac{\sqrt{2}}{2} x.$$

5.

(1)

$$\frac{1}{EA_1} \int_0^L N_1 \frac{\partial N_1}{\partial S} dx + \frac{1}{EI_{y_2}} \int_0^{\frac{\sqrt{2}}{2} L} M_{y_2} \frac{\partial M_{y_2}}{\partial S} dx + \frac{1}{EI_{y_3}} \int_0^{\frac{\sqrt{2}}{2} L} M_{y_3} \frac{\partial M_{y_3}}{\partial S} dx = \Delta T L;$$

$$-\frac{4}{d^2 E} \int_0^L (-S)(-1) dx + \frac{2}{EI_y} \int_0^{\frac{\sqrt{2}}{2} L} \frac{\sqrt{2}}{2} S x \frac{\sqrt{2}}{2} x dx = \Delta T L; \quad \frac{4SL}{d^2 E} + \frac{S}{EI_y} \int_0^{\frac{\sqrt{2}}{2} L} x^2 dx = \Delta T L;$$

$$S \left[ \frac{4L}{d^2} + \frac{1}{I_y} \left( \frac{\sqrt{2}}{2} L \right)^3 \right] = \Delta T L E; \quad S = \frac{\Delta T E}{\frac{4}{d^2} + \frac{\sqrt{2}}{12} \frac{L^2}{I_y}}.$$

6.

$$S = \frac{\Delta T E}{\frac{4}{d^2} + \frac{\sqrt{2}}{12} \frac{L^2}{I_y}} = \frac{12,5 \cdot 10^{-6} \cdot 30,2 \cdot 1 \cdot 10^{11}}{\frac{4}{0,02^2} + \frac{\sqrt{2}}{12} \frac{1^2}{869 \cdot 10^{-8}}} = 4703 \text{ N}.$$

7.

7.1. \_\_\_\_\_ ( \_\_\_\_\_ 4):

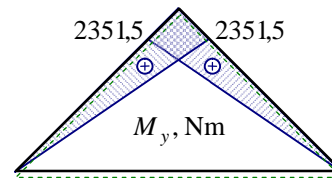
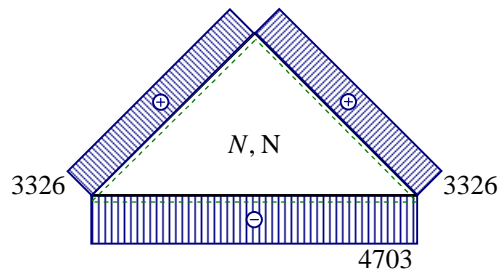
$$N_1 = -S = -4703 \text{ N} = \text{const};$$

$$N_2 = N_3 = \frac{\sqrt{2}}{2} S = \frac{\sqrt{2}}{2} 4703 = 3326 \text{ N} = \text{const};$$

$$M_{y_2} = M_{y_3} = \frac{\sqrt{2}}{2} S \cdot x = 3326 \cdot x -$$

$$x = \frac{\sqrt{2}}{2} L: \quad \max M_{y_2} = \max M_{y_3} = 3326 \frac{\sqrt{2}}{2} \cdot 1 = 2351,5 \text{ Nm}.$$

N



7.2. \_\_\_\_\_.

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(Q<sub>2</sub>)

7.3. \_\_\_\_\_.

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$$\max N_1 = -S = -4703 \text{ N.}$$

$$N_2 = N_3 = 3326 \text{ N} \quad M_2 = M_3 = 2351,5 \text{ Nm.}$$

7.4. \_\_\_\_\_.

- 
- 

$$\sigma_x = \frac{N}{A} + \max \frac{M_y}{W_y}$$

7.5. \_\_\_\_\_.

$$\sigma_x = \frac{N_1}{A_1} = -\frac{S}{d^2} = -\frac{4703,4}{0,02^2} = -14970114 \text{ Pa} = -14,97 \text{ MPa.}$$

7.6. \_\_\_\_\_.

$$\max \sigma_x = \frac{N_2}{A_2} + \frac{\max M_{y2}}{W_{y2}} = \frac{3326}{20,1 \cdot 10^{-4}} + \frac{2351,5}{109 \cdot 10^{-6}} = 1,65 \cdot 10^6 + 21,57 \cdot 10^6 = 23,22 \text{ MPa.}$$

W<sub>2</sub>

IPE 160.

7.7. \_\_\_\_\_.

$$\max \sigma_x = 23,22 \text{ MPa.}$$