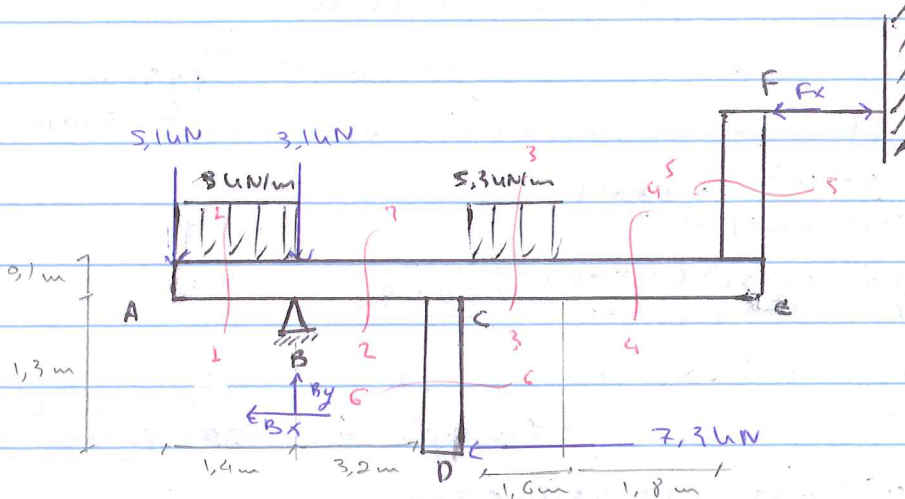


Project 10 Traversing Apples - 2018050055



$$\sigma_{\text{max}} = 190 \text{ MPa}$$

$$\sigma_{\text{min}} = 120 \text{ MPa}$$

$$\tau_{\text{max}} = 108 \text{ MPa}$$

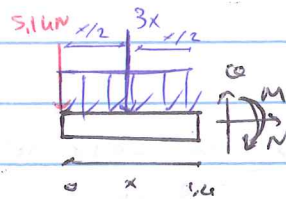
$$\sum M_B = 0 \Rightarrow 5.1 \cdot 1.4 + 4.2 \cdot 0.7 - 15.3 \cdot 4.1 - 7.3 \cdot 1.3 + F_x \cdot 1.3 = 0$$

$$\sum F_x = 0 \Rightarrow B_x = 402.7 \text{ kN} \leftarrow$$

$$\Rightarrow F_x = 49.69 \approx 50 \text{ kN} \leftarrow$$

$$\sum F_y = 0 \Rightarrow B_y = 20.88 \approx 21 \text{ kN} \uparrow$$

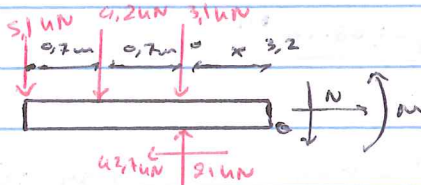
Section 1-1



$$N = 0, \quad Q = 5.1 + 3 \cdot x$$

$$M = 5.1x + \frac{3x^2}{2}$$

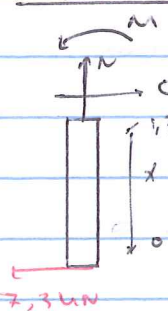
Section 2-2



$$Q = 8.6 \text{ kN}, \quad N = 42.7 \text{ kN}$$

$$M = (21 - 3.1)x - 4.2(0.7 + x) - 5.1(1.4 + x)$$

Section 3-3

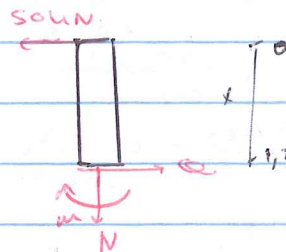


$$Q = 7.3 \text{ kN}$$

$$M = 7.3x$$

$$N = 0$$

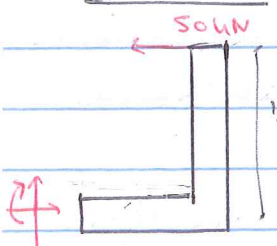
Section 4-4



$$Q = 50 \text{ kN}$$

$$M = 50x$$

Section 5-5

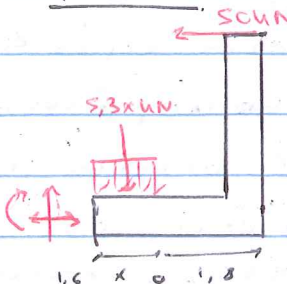


$$N = 50 \text{ kN}$$

$$Q = 0$$

$$M = 50x$$

Section 6-6

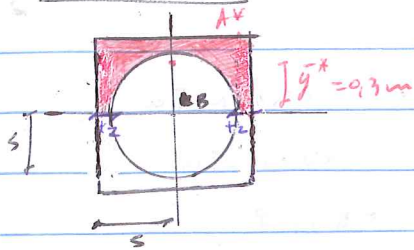


$$M = 50 \cdot 1.3 - \frac{5.3 \cdot 2}{2}$$

$$Q = 0$$

$$N = 50 \text{ kN}$$

Diagrama 1



$$I_z = \frac{0,1 \cdot 0,13}{12} - \frac{1}{4} \pi \cdot 0,03^4 = 7,7 \cdot 10^{-6} \text{ m}^4$$

Diagrama 1
Mipom, oedin ian narectin cu 4-4
p = 50 kN
M = 65 kN

$$\sigma = \frac{P}{A} = \frac{50 \cdot 10^3}{(0,12 - \pi \cdot 0,03^2)} = 7 \text{ MPa}$$

$$\frac{Mz}{I_z} = \frac{65 \cdot 10^3 (\pm 0,05)}{7,7 \cdot 10^{-6}} = 422 \text{ MPa}$$

$$\frac{My}{I_y} = 0, \quad \sigma_y = 0$$

$$\sigma_{y \text{ max}} = 50 \text{ kN}$$

$$\frac{T}{I_y} = 0$$

$$\tau = \frac{V_y \cdot Q_y}{I_z \cdot t_z} = \frac{50 \cdot 10^3 \cdot 3,6 \cdot 10^{-3} \cdot 0,03}{7,7 \cdot 10^{-6} \cdot 0,04} = 17,5 \text{ MPa} < \tau_{\text{car}}$$

$$\frac{V_z \cdot Q_z}{I_y \cdot t_y} = 0$$

Indicăm $\sigma = 422 \text{ MPa} > \sigma_{\text{car. Cl.}}$

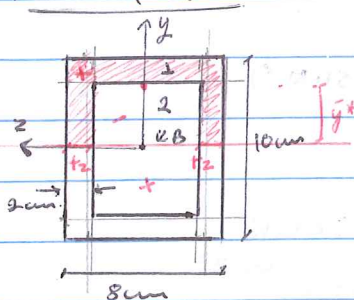
cu alia ian oedin cu oedin

$$A^* = \frac{0,12}{2} - \frac{\pi \cdot 0,03^2}{2} = 3,6 \cdot 10^{-3} \text{ m}^2$$

$$\bar{y}^* = \frac{A_1 \cdot y_1 + A_2 \cdot y_2}{A^*} = \frac{0,05 \cdot 0,1 \cdot 0,025 - \frac{\pi \cdot 0,03^2 \cdot 0,03}{3\pi}}{3,6 \cdot 10^{-3}} = \frac{1,25 \cdot 10^{-4} - 0,18 \cdot 10^{-4}}{3,6 \cdot 10^{-4}} = 0,0297$$

$$t_z = 2 \cdot 0,02 = 0,04 \text{ m}$$

Diagrama 2



$$I_z = I_{z1} - I_{z2} = \frac{0,08 \cdot 0,1^3}{12} - \frac{0,04 \cdot 0,06^3}{12} = 5,94 \cdot 10^{-6} \text{ m}^4$$

$$Q_y = A^* \bar{y}^* = 8,4 \cdot 10^{-5} \text{ m}^3$$

$$A^* = 0,08 \cdot 0,05 - 0,04 \cdot 0,03 = 2,8 \cdot 10^{-3} \text{ m}^2$$

$$\bar{y} = \frac{A_1 \cdot y_1 + A_2 \cdot y_2}{A^*} = \frac{0,08 \cdot 0,05 \cdot 0,05 - 0,04 \cdot 0,03 \cdot 0,03}{2,8 \cdot 10^{-3}} = 0,029 \approx 0,03 \text{ m}$$

$$\frac{P}{A} = \frac{50 \cdot 10^3}{0,08 \cdot 0,1 - 0,04 \cdot 0,06} = 9 \text{ MPa}$$

$$\frac{Mz}{I_z} = \frac{65 \cdot 10^3 (\pm 0,05)}{6 \cdot 10^{-6}} = 542 \text{ MPa} > \sigma_{\text{car. Cl.}} > \sigma_{\text{car. Cl.}}$$

$$\tau = \frac{V_y \cdot Q_y}{I_z \cdot t_z} = \frac{50 \cdot 10^3 \cdot 8,4 \cdot 10^{-5}}{6 \cdot 10^{-6} \cdot 0,02 \cdot 2} = 17,5 \text{ MPa} < \tau_{\text{car. Cl.}}$$

Este cunoscut ca pentru 4-4, pentru care am calculat
si rezultatele continutului, suntate marimilor. Avem accepi-
ce care, dar de fapt, accepi uita la alie.

Aici se poate observa din nou ca accepi cu 4-4
nu este de o mare utilitate, si odata obtinut sau rezultat, oedin
tace.

Εξισώσεις ελαστών για τις ακόλουθες περιπτώσεις.

Τελική 1-1

Διατέμνιση 1

$$\sigma_1 = \frac{10,1 \cdot 10^3 \cdot (\pm 0,05)}{7,7 \cdot 10^{-6}} = 65,6 \text{ MPa} < \sigma_{\text{επ}} \quad \underline{\text{OK}}$$

$$\tau_1 = \frac{9,3 \cdot 10^3 \cdot 1,08 \cdot 10^{-4}}{7,7 \cdot 10^{-6} \cdot 0,004} = 3,2 \text{ MPa} < \tau_{\text{επ}} \quad \underline{\text{OK}}$$

Διατέμνιση 2

$$\sigma_1 = \frac{10,1 \cdot 10^3 (\pm 0,05)}{6 \cdot 10^{-6}} = 84,2 \text{ MPa} < \sigma_{\text{επ}} \quad \underline{\text{OK}}, \quad \tau_1 = \frac{9,3 \cdot 10^3 \cdot 8,4 \cdot 10^{-5}}{6 \cdot 10^{-6} \cdot 0,004} = 3,25 \text{ MPa} < \tau_{\text{επ}} \quad \underline{\text{OK}}$$

Τελική 2-2

$$\sigma_2 \xrightarrow{P} \frac{42,7 \cdot 10^3}{(0,12 - \pi \cdot 0,03^2)} = 6 \text{ MPa}$$

Διατέμνιση 1

$$\sigma_2 \xrightarrow{M_2} \frac{17,5 \cdot 10^3 (\pm 0,05)}{7,7 \cdot 10^{-6}} = 114 \text{ MPa}$$

$$\tau_2 = \frac{8,6 \cdot 10^3 \cdot 1,08 \cdot 10^{-4}}{7,7 \cdot 10^{-6} \cdot 0,004} = 3,2 \text{ MPa} < \tau_{\text{επ}} \quad \underline{\text{OK}}$$

$\sigma_2 = 120 \text{ MPa} = \sigma_{\text{επ}}$ Ολίσθηση
Στο όριο παραμόρφησης
σε ολίσθηση

Διατέμνιση 2

$$\sigma_2 \xrightarrow{P} \frac{42,7 \cdot 10^3}{2,8 \cdot 10^{-3}} = 15,25 \text{ MPa}$$

$$\sigma_2 \xrightarrow{M_2} \frac{17,5 \cdot 10^3 (\pm 0,05)}{6 \cdot 10^{-6}} = 146 \text{ MPa}$$

$$\tau_2 = \frac{8,6 \cdot 10^3 \cdot 8,4 \cdot 10^{-5}}{6 \cdot 10^{-6} \cdot 0,004} = 3 \text{ MPa} < \tau_{\text{επ}} \quad \underline{\text{OK}}$$

$\sigma_2 = 161 \text{ MPa} > \sigma_{\text{επ}}$ Ολίσθηση
παραμόρφωση

Τελική 3-3

$$\sigma_3 \xrightarrow{P} \frac{50 \cdot 10^3}{\pi \cdot 1,7 \cdot 10^{-6}} = 7 \text{ MPa}$$

Διατέμνιση 1

$$\sigma_3 \xrightarrow{M_2} \frac{58,2 \cdot 10^3 (\pm 0,05)}{7,7 \cdot 10^{-6}} = 388 \text{ MPa}$$

$$\tau_3 = 0 \text{ γιατί } V_y = V_z = 0, \quad T = 0$$

Διατέμνιση 2

$$\sigma_3 \xrightarrow{P} \frac{50 \cdot 10^3}{2,8 \cdot 10^{-6}} = 17,8 \text{ MPa}$$

$$\sigma_3 \xrightarrow{M_2} \frac{58,2 \cdot 10^3 (\pm 0,05)}{6 \cdot 10^{-6}} = 485 \text{ MPa}$$

$\sigma_3 = 503 \text{ MPa} > \sigma_{\text{επ}} \rightarrow$ ολίσθηση
 $\tau_3 = 0$ γιατί $V_y = V_z = 0, \quad T = 0$

Τελική 5-5

Διατέμνιση 1: $\sigma_5 = \frac{65 \cdot 10^3 (\pm 0,05)}{7,7 \cdot 10^{-6}} = 422 \text{ MPa} > \sigma_{\text{επ}}$ παραμόρφωση

$$\tau_5 = \frac{50 \cdot 10^3 \cdot 1,08 \cdot 10^{-4}}{7,7 \cdot 10^{-6} \cdot 0,004} = 17,5 \text{ MPa} < \tau_{\text{επ}} \quad \underline{\text{OK}}$$

Διατέμνιση 2

$$\sigma_5 = \frac{65 \cdot 10^3 (\pm 0,05)}{6 \cdot 10^{-6}} = 542 \text{ MPa} > \sigma_{\text{επ}}$$
 παραμόρφωση

$$\tau_5 = \frac{50 \cdot 10^3 \cdot 8,4 \cdot 10^{-5}}{6 \cdot 10^{-6} \cdot 0,004} = 17,5 \text{ MPa} < \tau_{\text{επ}} \quad \underline{\text{OK}}$$

Τελική 6-6

Διατέμνιση 1: $\sigma_6 = \frac{9,5 \cdot 10^3 (\pm 0,05)}{7,7 \cdot 10^{-6}} = 61,7 \text{ MPa} < \sigma_{\text{επ}} \quad \underline{\text{OK}}$

$$\tau_6 = \frac{7,3 \cdot 10^3 \cdot 1,08 \cdot 10^{-4}}{7,7 \cdot 10^{-6} \cdot 0,004} = 2,6 \text{ MPa} < \tau_{\text{επ}} \quad \underline{\text{OK}}$$

Διατέμνιση 2

$$\sigma_6 = \frac{9,5 \cdot 10^3 (\pm 0,05)}{6 \cdot 10^{-6}} = 79 \text{ MPa} < \sigma_{\text{επ}} \quad \underline{\text{OK}}$$

$$\tau_6 = \frac{7,3 \cdot 10^3 \cdot 8,4 \cdot 10^{-5}}{6 \cdot 10^{-6} \cdot 0,004} = 3,3 \text{ MPa} < \tau_{\text{επ}} \quad \underline{\text{OK}}$$