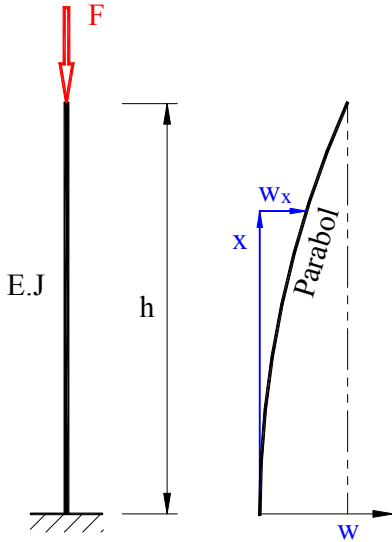


Zorlama: Yalnız aksenal kuvvet

Bilinen değerler:



Malzeme := "S235"

$f_y := 235 \cdot \text{MPa}$

$E := 210000 \cdot \text{MPa}$

$\gamma_M := 1.1$

$h_S := 4 \cdot \text{m}$

Emniyetli akma mukavemeti

$f_{EM} := \frac{f_y}{\gamma_M}$

$f_{EM} = 213.6 \cdot \text{MPa}$

$F_x := 700 \cdot \text{kN}$

Kabul: Eğrinin şekli parabol

z akseni değerleri y akseni değerlerinden küçük olduğundan hesaplar z eksenine göre yapılır.

$b := 480 \cdot \text{mm}$

$h := 480 \cdot \text{mm}$

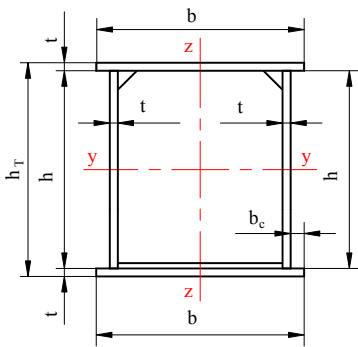
$t := 10 \cdot \text{mm}$

$b_c := 10 \cdot \text{mm}$

$y := 0.5 \cdot (b + t) - b_c$

$y = 235 \cdot \text{mm}$

Resim 1



$$J_z := 2 \cdot \frac{b^3 \cdot t}{12} + 2 \cdot \frac{t^3 \cdot h}{12} + 2 \cdot t \cdot h \cdot y^2$$

$$J_z = 714.6 \cdot 10^6 \cdot \text{mm}^4$$

$$W_z := \frac{2 \cdot J_z}{b}$$

$$W_z = 2977.3 \cdot 10^3 \cdot \text{mm}^3$$

$$EJ_z := E \cdot J_z$$

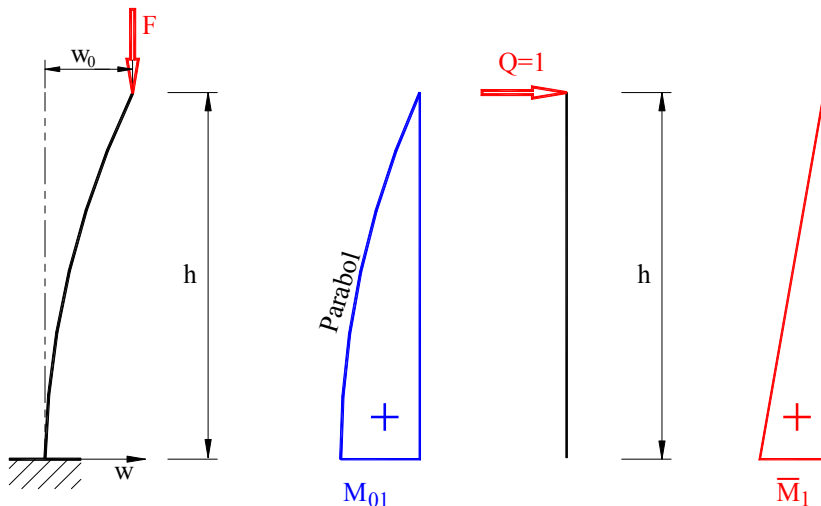
$$EJ_z = 150.1 \cdot \text{MN} \cdot \text{m}^2$$

$$A_0 := 2 \cdot t \cdot (b + h)$$

$$A_0 = 19200 \cdot \text{mm}^2$$

Resim 2

Çözüm:



$$M_{01} = F_x \cdot w_0$$

$$M_1 := h_S$$

$$w_1 = \int_0^{h_S} M_{01} \cdot M_1 \cdot \frac{1}{EJ} dx$$

$$w_1 = \frac{5}{12} \cdot M_{01} \cdot M_1 \cdot \frac{h_S}{EJ}$$

$$w_1 = \frac{5}{12} \cdot H_z \cdot h_S \cdot h_S \cdot \frac{h_S}{EJ}$$

$$w_1 = \frac{5 \cdot F_x \cdot w_0 \cdot h_S^2}{12 \cdot EJ}$$

Kritik burkulma kuvveti

$$w_1 = \frac{5 \cdot F_x \cdot w_0 \cdot h_S^2}{12 \cdot EJ}$$

eğer $F_x = F_{kr}$ ve $w_0 = w_1$ ise

$$\text{veya } \alpha_F = \frac{w_1}{w_0} = 1$$

$$1 = \frac{5 \cdot F_{kr} \cdot h_S^2}{12 \cdot EJ}$$

$$F_{kr} := \frac{12 \cdot EJ_z}{5 \cdot h_S^2}$$

$$F_{kr} = 22508.6 \cdot \text{kN}$$

$$F_x = 700 \cdot \text{kN}$$

Eulere göre burkulma boyu kabulü ve kuvveti:

$$L_E := 2 \cdot h_S$$

$$F_E := \frac{\pi^2 \cdot EJ_z}{L_E^2}$$

$$F_E = 23140.8 \cdot \text{kN}$$

Sonuç: Çubukta burkulma tehlikesi yoktur.**Mukavemet hesabı:**

Eylemsizlik radyusu $i_z := \sqrt{\frac{J_z}{A_0}}$ $i_z = 192.9 \cdot \text{mm}$

Euler burkulma boyu $L_B := \sqrt{\frac{E \cdot J_z \cdot \pi^2}{F_{kr}}}$ $L_B = 8.112 \text{ m}$

Akma narinliği $\lambda_E := \pi \cdot \sqrt{\frac{E}{f_y}}$ $\lambda_E = 93.9$

Narinlik $\lambda_z := \frac{L_B}{i_z}$ $\lambda_z = 42$

Bağıntılı narinlik $\lambda_{Bz} := \frac{\lambda_z}{\lambda_E}$ $\lambda_{Bz} = 0.448$

Merkez noktası mesafesi $k_{el} := \frac{W_z}{A_0}$ $k_{el} = 155.1 \cdot \text{mm}$

Akma kuvveti $F_{pl} := A_0 \cdot f_{EM}$ $F_{pl} = 4101.8 \cdot \text{kN}$

Burkulma parametresi $\alpha_B := 0.34$ Kaynaklı kutular her ekseninde.

Max burkulma sehimi $w_{0max} := k_{el} \cdot \alpha_B \cdot (\lambda_{Bz} - 0.2)$ $w_{0max} = 13.1 \cdot \text{mm}$

Burkulma yardımcı faktörü $\varphi_{Bz} := 0.5 \cdot \left[1 + \alpha_B \cdot (\lambda_{Bz} - 0.2) + \lambda_{Bz}^2 \right]$ $\varphi_{Bz} = 0.64$

Azaltma faktörü $\chi_{Bz} := \frac{1}{\varphi_{Bz} + \sqrt{\varphi_{Bz}^2 - \lambda_{Bz}^2}}$ $\chi_{Bz} = 0.907$

Kuvvetin mukavemet emniyeti $S_{Fz} := \frac{F_x}{\chi_{Bz} \cdot F_{pl}}$ $S_{Fz} = 0.188$

Burkulma sehimi momenti:

$$M_{plz} := W_z \cdot f_{EM}$$

$$M_{plz} = 636.1 \cdot \text{kN} \cdot \text{m}$$

$$M_{bvor} := F_x \cdot w_{0max}$$

$$M_{bvor} = 9.1 \cdot \text{kN} \cdot \text{m}$$

$$M_0 := F_x \cdot w_{0max}$$

$$M_0 = 9.1 \cdot \text{kN} \cdot \text{m}$$

$$\Delta M \leq 1$$

$$\Delta M := \frac{M_0}{M_{bvor}}$$

$$\Delta M = 1.000$$

$$\beta_{mz} := 0.66 + 0.44 \cdot \Delta M$$

$$\beta_{mz} = 1.10$$

$$S_{Mz} := \frac{\beta_{mz} \cdot M_{bvor}}{M_{plz}}$$

$$S_{Mz} = 0.016$$

$$\Delta n := 0.1$$

$$S_{Totz} := S_{Fz} + S_{Mz} + \Delta n$$

$$S_{Totz} = 0.304$$

Sonuç: S_{Totz} değeri 1 den küçük olduğundan konstrüksiyon fonksiyonunu yapar.

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