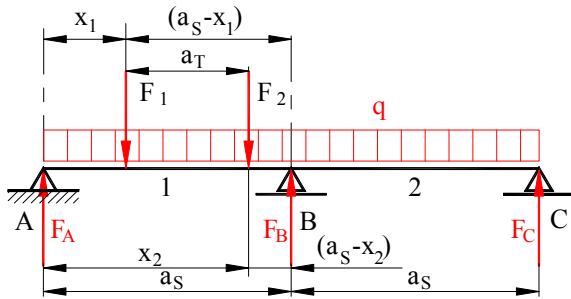
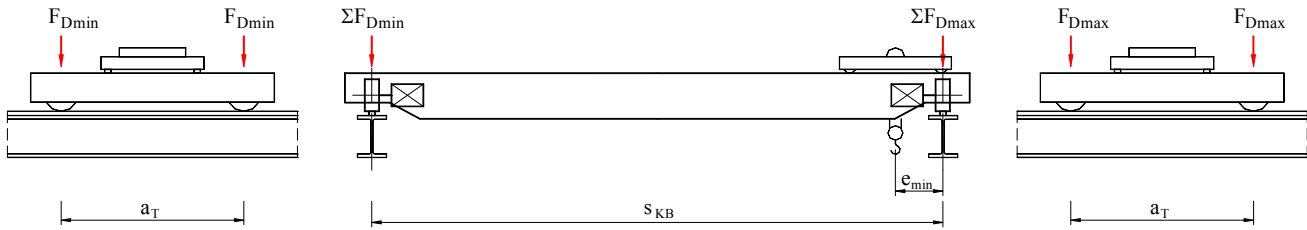
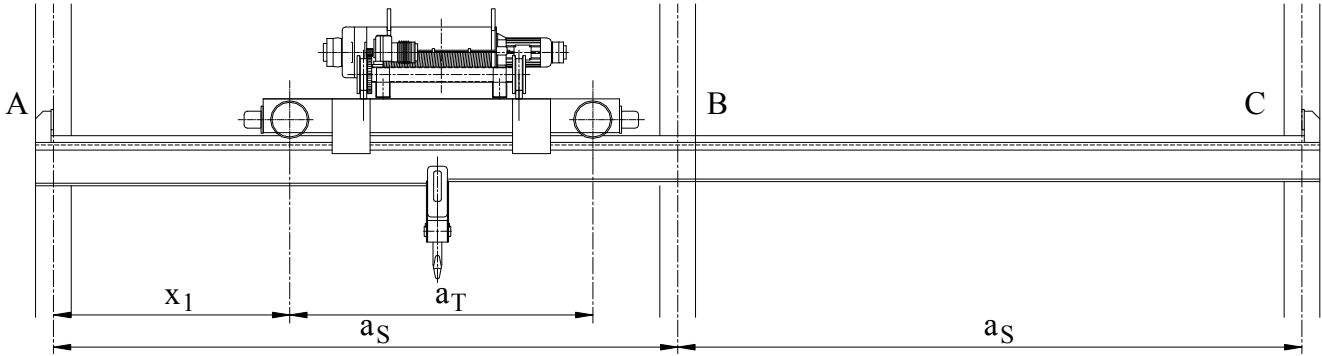


## 2 Aralıklı Vinç Yolu, Tekerlek kuvvetleri eşit

### Değerler Ornek\_01\_01\_Kiris100kNx20m.pdf dosyasından

Reference:C:\0\42\_00\_Ornek\_01\_0\_Giris-TK-Esit.xmcd

#### Vinç ve vinç yolu hakkında bilgiler



#### Hesaplar için gereken değerler

VY nun birim ağırlık kuvveti

$$q = 1138.8 \cdot \text{N} \cdot \text{m}^{-1}$$

**Raya dik dikey kuvvetler:**

$$F_{Dmax} = 93.50 \cdot \text{kN}$$

**Raya dik yatay kuvvetler:**

$$F_Y = 13.75 \cdot \text{kN}$$

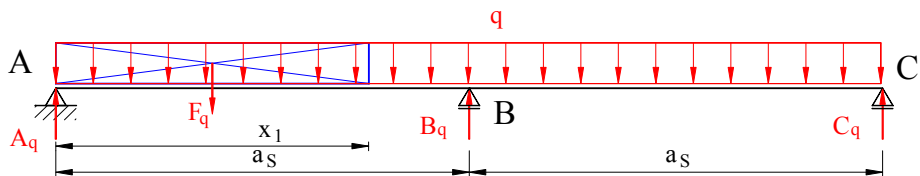
**Ray boyunca kuvvetler:**

$$F_B = 18.70 \cdot \text{kN}$$

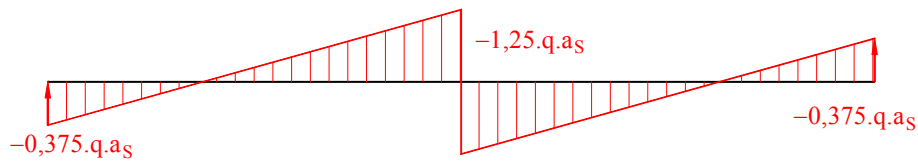
**Tekerlek kuvvetlerinin torsiyon momenti:**

$$M_{tmax} = 7.86 \cdot \text{kN} \cdot \text{m}$$

#### Vinç yolunun kendi ağırlığından oluşan değerler



kesme kuvveti dağılımı



Kritik kesit  $x_1$  de moment

$$M_{2qx1} := 0.5 \cdot q \cdot x_1 \cdot (0.75 \cdot a_S - x_1)$$

$$M_{2qx1} = 3.923 \cdot \text{kN} \cdot \text{m}$$

max kesme kuvveti

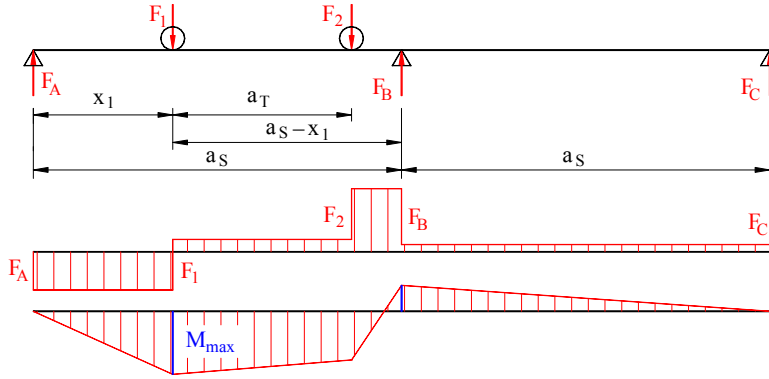
$$F_{2\tau q} := 1.25q \cdot a_S$$

$$F_{2\tau q} = 9.96 \cdot \text{kN}$$

Aralık ortasında sehim

$$w_{2qm} := \frac{q \cdot a_S^4}{64 \cdot E \cdot I_y}$$

$$w_{2qm} = 0.413 \cdot \text{mm}$$

**Vinç yolunda tekerlek kuvvetlerinden oluşan değerler**

$$M_{2Fy\max} := \frac{F_{D\max} \cdot x_1}{4 \cdot a_S^3} \cdot \left[ x_1^3 + x_2^3 + 8 \cdot a_S^3 - 5 \cdot a_S^2 \cdot (x_1 + x_2) \right] \cdot \varphi_{dy}$$

$$M_{2Fy\max} = 230.96 \cdot \text{kN} \cdot \text{m}$$

$$M_{2Fz\max} := M_{2Fy\max} \cdot \varphi_Y$$

$$M_{2Fz\max} = 33.95 \cdot \text{kN} \cdot \text{m}$$

$$F_{2\tau F} := F_{D\max} \cdot \left( 1 + \frac{a_S - a_T}{a_S} \right)$$

$$F_{2\tau F} = 141.59 \cdot \text{kN}$$

$$w_{2mF1z} := \frac{F_{D\max} \cdot x_1}{192 \cdot E \cdot I_y \cdot a_S^2} \cdot \left( 15 \cdot a_S^4 - 3 \cdot a_S^3 \cdot x_1 - 22 \cdot a_S^2 \cdot x_1^2 + 4 \cdot a_S \cdot x_1^3 + 4 \cdot x_1^4 \right)$$

$$w_{2mF1z} = 6.73 \cdot \text{mm}$$

$$w_{2mF2z} := -\frac{F_{D\max} \cdot x_2}{192 \cdot E \cdot I_y \cdot a_S^2} \cdot \left( 9 \cdot a_S^4 - 3 \cdot a_S^3 \cdot x_2 - 16 \cdot a_S^2 \cdot x_2^2 + 4 \cdot a_S \cdot x_2^3 + 4 \cdot x_2^4 \right)$$

$$w_{2mF2z} = 1.02 \cdot \text{mm}$$

$$w_{2mFz} := w_{2mF1z} + w_{2mF2z}$$

$$w_{2mFz} = 7.75 \cdot \text{mm}$$

$$w_{2mFy} := w_{2mFz} \cdot \varphi_Y \cdot I_y \cdot I_{züT}^{-1}$$

$$w_{2mFy} = 6.22 \cdot \text{mm}$$

**Vinç yolunun toplam değerleri:**

x1 deki toplam moment

$$M_{2y\max} := M_{2Fy\max} + M_{2qx1}$$

$$M_{2y\max} = 234.88 \cdot \text{kN} \cdot \text{m}$$

$$M_{2z\max} := M_{2Fy\max} \cdot \varphi_Y$$

$$M_{2z\max} = 33.95 \cdot \text{kN} \cdot \text{m}$$

Maksimum kesme kuvvet

$$F_{2\tau\max} := F_{2\tau F} + F_{2\tau q}$$

$$F_{2\tau\max} = 151.56 \cdot \text{kN}$$

maksimum sehim

$$w_{2z} := w_{2mFz} + w_{2qm}$$

$$w_{2z} = 8.17 \cdot \text{mm}$$

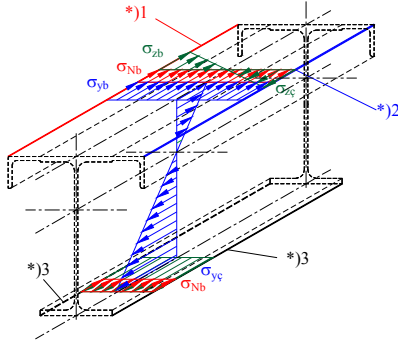
$$w_{2y} := w_{2mFy}$$

$$w_{2y} = 6.22 \cdot \text{mm}$$

Maksimum torsiyon momenti

$$M_{t\max} = 7.86 \cdot \text{kN} \cdot \text{m}$$

## 1. Gerilmelerin kontrolü



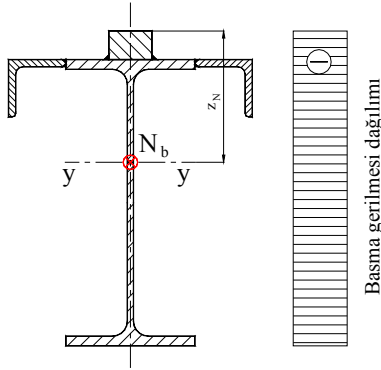
### 1. Hal üst kuşakta gerilmeler

$$\sigma_{1H} = \sigma_{Nb} + \sigma_{yb} + \sigma_{zb}$$

### 2. Hal alt kuşakta gerilmeler

$$\sigma_{2H} = \sigma_N + \sigma_{yç}$$

## Boyuna kuvvetten oluşan gerilme

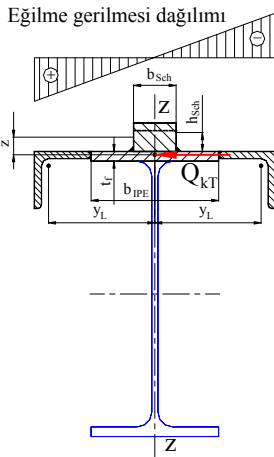


Gerilmeler alanın her noktasında sabit kabul edilir.

$$A_{Si} = 14780.00 \cdot \text{mm}^2$$

$$\sigma_{Nb} := \frac{F_B \cdot \varphi_{dy}}{A_{Si}}$$

$$\sigma_{Nb} = 1.90 \cdot \text{MPa}$$



## z-eksenine göre eğilme gerilmesi

$$y_L = 159.60 \cdot \text{mm}$$

$$b_{Tot} := b_p + 2 \cdot b_L$$

$$b_{Tot} = 370.00 \cdot \text{mm}$$

$$b_R = 60.00 \cdot \text{mm}$$

$$h_R = 30.00 \cdot \text{mm}$$

xy-Düzleminde eğilme gerilmesi " $\sigma_{zBi}$ "

$$M_{2zmax} = 34 \cdot \text{kN} \cdot \text{m}$$

$$W_{züT} = 487.4 \cdot 10^3 \text{ mm}^3$$

$$\sigma_{2zmax} := \frac{M_{2zmax}}{W_{züT}}$$

$$\sigma_{2zmax} = 69.7 \cdot \text{MPa}$$

**Yalnız köşebent köşelerinde. Alt kuşakta etkisi yok.**

## y-eksenine göre eğilme gerilmesi

Alt kuşakta eğilme gerilmesi

$$\sigma_{yç} := \frac{M_{2ymax}}{W_y}$$

$$\sigma_{yç} = 141.26 \cdot \text{MPa}$$

Üst kuşakta eğilme gerilmesi

$$h_{\bar{u}} := e_o - h_R$$

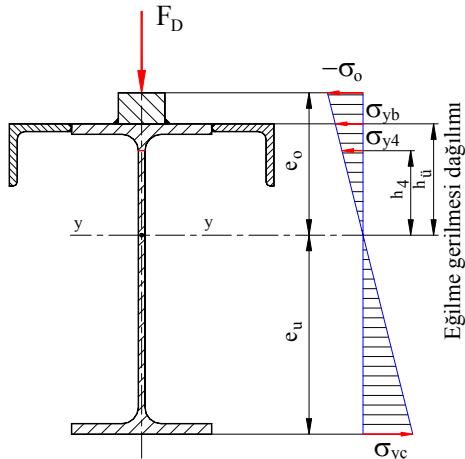
$$\sigma_{yb} := \sigma_{yç} \cdot \frac{h_{\bar{u}}}{e_u}$$

$$\sigma_{yb} = 73.42 \cdot \text{MPa}$$

$$h_{\bar{u}} = 153.91 \cdot \text{mm}$$

$$e_o = 183.91 \cdot \text{mm}$$

$$e_u = 296.09 \cdot \text{mm}$$



**1. Hal üst kuşakta gerilmeler**

$$\sigma_{1H} := \sigma_{Nb} + \sigma_{yb} + \sigma_{2zmax} \quad \sigma_{1H} = 144.98 \cdot \text{MPa}$$

**2. Hal alt kuşakta gerilmeler**

$$\sigma_{2H} := \sigma_{Nb} + \sigma_{yç} \quad \sigma_{2H} = 143.16 \cdot \text{MPa}$$

**Maksimum toplam gerilme**

$$\sigma_{2y_{max}} := \sigma_{1H} \quad \sigma_{2y_{max}} = 144.98 \cdot \text{MPa}$$

$$\sigma_{2y_{max}} = 145 \cdot \text{MPa} < f_{\sigma EM} = 214 \cdot \text{MPa} \quad \text{yeterli}$$

$$\sigma_{2z_{max}} = 70 \cdot \text{MPa} < f_{\sigma EM} = 214 \cdot \text{MPa} \quad \text{yeterli}$$

**1.2. Kayma gerilmeleri kontrolü**

$$\text{Üst kuşakta} \quad h_{\tau} := e_o - h_R - 0.5 \cdot t_f$$

$$F_{2\tau} := \frac{M_{tmax}}{h_{\tau}} \quad F_{2\tau} = 53.62 \cdot \text{kN}$$

$$\tau_{2max} := \frac{F_{2\tau}}{A_{üT}}$$

$$\tau_{2max} = 6.99 \cdot \text{MPa} < f_{\tau EM} = 123 \cdot \text{MPa} \quad \text{yeterli}$$

$$\text{Dikmede} \quad h_{Di} := h_p - 2 \cdot t_f - 2 \cdot r_p$$

$$A_{Di} := h_{Di} \cdot t_w \quad A_{Di} = 3560.72 \cdot \text{mm}^2$$

$$\tau_{2Di} := \frac{F_{2\tau_{max}}}{A_{Di}} \quad F_{2\tau_{max}} = 151.56 \cdot \text{kN}$$

$$\tau_{2Di} = 42.56 \cdot \text{MPa} < f_{\tau EM} = 123 \cdot \text{MPa} \quad \text{yeterli}$$

**Sütunda minimum dikme boyu**

$$h_{2Dimin} := \frac{F_{2\tau_{max}}}{t_w \cdot f_{\tau EM}}$$

$$h_{2Dimin} = 130.72 \cdot \text{mm} < h_{Di} = 378.80 \cdot \text{mm} \quad \text{yeterli}$$

**1.3. Toplam gerilim kontrolü**

$$\sigma_{2top} := \sqrt{\sigma_{2y_{max}}^2 + 3 \cdot \tau_{2max}^2}$$

$$\sigma_{2top} = 145.48 \cdot \text{MPa} < f_{\sigma EM} = 214 \cdot \text{MPa} \quad \text{yeterli}$$

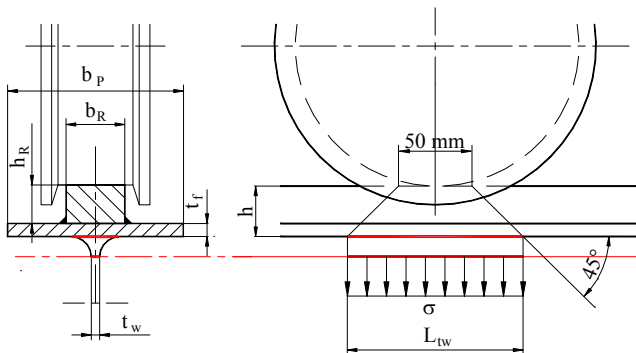
**2. Sehim kontrolü**

$$\text{Dikey z-yönünde sehim} \quad w_{zEM} := \frac{a_S}{700}$$

$$w_{zEM} = 10.00 \cdot \text{mm} > w_{zz} = 8.17 \cdot \text{mm} \quad \text{yeterli}$$

$$\text{Yatay y-yönünde sehim} \quad w_{yEM} := \frac{a_S}{800}$$

$$w_{yEM} = 8.75 \cdot \text{mm} > w_{yy} = 6.22 \cdot \text{mm} \quad \text{yeterli}$$

**3. Lokal kuvvetlerin iletim kontrolü**

$$L_{tw} := 2 \cdot (h_R + t_f) + 50 \cdot \text{mm} \quad L_{tw} = 139.20 \cdot \text{mm}$$

$$A_{tw} := L_{tw} \cdot t_w \quad A_{tw} = 1308.48 \cdot \text{mm}^2$$

Kesitin taşıyacağı emniyetli kuvvet

$$F_{TDEM} := \frac{f_y \cdot A_{tw}}{\gamma_{M1}} \quad F_{TDEM} = 293 \cdot \text{kN}$$

Tekerlerde max kuvvet

$$F_{Dmax} = 94 \cdot \text{kN} < F_{TDEM} = 293 \cdot \text{kN} \quad \text{yeterli}$$

#### 4. Stabilité kontrolü

Profil flanşının narinlik sayısı

$$\beta_{1s} := \sqrt[4]{\frac{b_p}{10 \cdot t_f}} \quad \beta_{1s} = 1.07 \quad \beta_{1s} < 1,25$$

Tek taraflı yüklemenin narinlik sayısı

$$\beta_{2s} := \sqrt{\frac{60 t_w}{h_p - t_f}} \quad \beta_{2s} = 1.14 \quad \beta_{2s} > 1,0$$

Kuvvet etkisinin faktörü

$$\beta_{3s} := 1 + \frac{L_{tw}}{h_p - t_f} \quad \beta_{3s} = 1.32 \quad \beta_{3s} < 1,5$$

$$h_4 := e_o - t_f - r_p$$

$$h_4 = 148.31 \cdot \text{mm} \quad \sigma_{y4eg} := \sigma_{yç} \cdot \frac{h_4}{-e_u} \quad \sigma_{y4eg} = -71 \cdot \text{MPa}$$

$$\sigma_{\beta 4} := \sigma_{y4eg} + \sigma_{Nb}$$

$$\sigma_{\beta 4} = -68.86 \cdot \text{MPa}$$

Boyuna gerilme faktörü

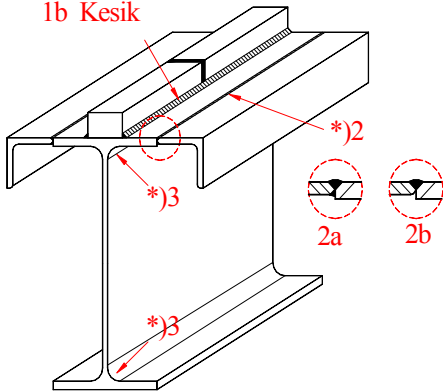
$$\beta_{4sx} := 1.5 - \frac{\sigma_{\beta 4} \cdot \gamma_{M1}}{f_y} \quad \beta_{4sx} = 1.81 \quad \beta_{4s} < 1,0 \quad \beta_{4s} := 1.0$$

$$F_{TEM} := \frac{f_y \cdot t_w^2}{2 \gamma_{M1}} \cdot \sqrt{\frac{E \cdot t_f}{f_y \cdot t_w}} \cdot \beta_{1s} \cdot \beta_{2s} \cdot \beta_{3s} \cdot \beta_{4s}$$

$$F_{TEM} = 591 \cdot \text{kN} > F_{Dmax} = 93.5 \cdot \text{kN} \quad \text{yeterli}$$

#### 5. Yorulma kontrolleri

\*)1 la Devamlı  
1b Kesik



Yorulma mukavemet değerleri

$$*)1a \quad \Delta \sigma_{c1} := 125 \cdot \text{MPa}$$

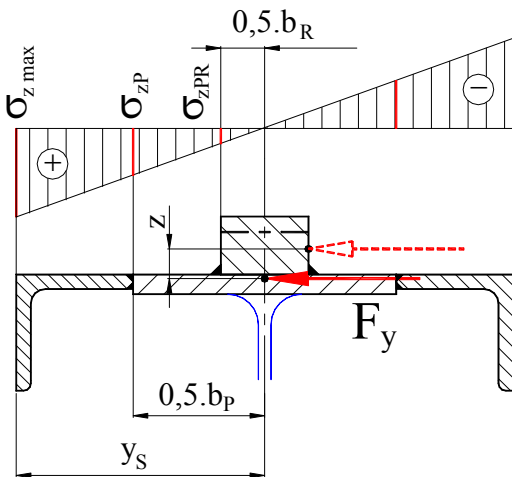
$$*)2b \quad \Delta \sigma_{c2} := 100 \cdot \text{MPa}$$

$$*)3 \quad \Delta \sigma_{c3} := 125 \cdot \text{MPa}$$

#### 5.1. Yorulma kontrolü; Ray/profil kaynak bağlantısı \*)1a

Profil Ray kaynak bağlantısında mukavemet değeri:

$$\Delta \sigma_{c1} = 125.00 \cdot \text{MPa}$$



$$\sigma_{zPR} := \sigma_{zmax} \cdot \frac{b_R}{2 \cdot y_S}$$

$$\sigma_{zPR} = 11.30 \cdot \text{MPa}$$

\*)1 de eşdeğer gerilmeler

$$\sigma_{2maxE} := \sigma_{Nb} + \sigma_{yb} + \sigma_{zPR}$$

$$\sigma_{2maxE} = 86.62 \cdot \text{MPa}$$

$$\sigma_{2minE} := \frac{M_{2qx1}}{W_y}$$

$$\sigma_{2minE} = 2.36 \cdot \text{MPa}$$

Gerilme farkı

$$\Delta \sigma_{zzPR} := (\sigma_{2maxE} - \sigma_{2minE}) \cdot \lambda_E \quad \Delta \sigma_{zzPR} = 41 \cdot \text{MPa}$$

$$\text{Emniyetli gerilme} \quad \Delta \sigma_{1EM} := \frac{\Delta \sigma_{c1}}{\gamma_{Mf}}$$

$$\Delta \sigma_{1EM} = 109 \cdot \text{MPa} > \Delta \sigma_{zzPR} = 41 \cdot \text{MPa} \quad \text{yeterli}$$

**5.2. Yorulma kontrolü; L/IP kaynak bağlantısı \*)2b**

Profil L-Profilin kaynak bağlantısında mukavemet değeri:

$$\Delta\sigma_{c2} = 100.00 \cdot \text{MPa}$$

$$\sigma_{zP2} := \sigma_{2z\max} \cdot \frac{b_p}{2 \cdot y_S}$$

$$\sigma_{zP2} = 35.77 \cdot \text{MPa}$$

\*)2 de eşdeğer gerilmeler

$$\sigma_{2\max2E} := \sigma_{Nb} + \sigma_{yb} + \sigma_{zP2}$$

$$\sigma_{2\max2E} = 111.09 \cdot \text{MPa}$$

$$\sigma_{2\min E} = 2.36 \cdot \text{MPa}$$

Gerilme farkı

$$\Delta\sigma_{2zP} := (\sigma_{2\max2E} - \sigma_{2\min E}) \cdot \lambda_E$$

$$\Delta\sigma_{2zP} = 53 \cdot \text{MPa}$$

Emniyetli gerilme

$$\Delta\sigma_{2EM} := \frac{\Delta\sigma_{c2}}{\gamma_{Mf}}$$

$$\Delta\sigma_{2EM} = 87 \cdot \text{MPa}$$

$$> \Delta\sigma_{2zP} = 53 \cdot \text{MPa} \quad \text{yeterli}$$

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**5.3. Yorulma kontrolü; Dikmeye bağlanan radyusta \*)3**

Dikmeye bağlanan yerde mukavemet değeri:

$$\Delta\sigma_{c3} = 125.00 \cdot \text{MPa}$$

\*)3 de gerilmeler

$$\sigma_{23\max} := \frac{F_{D\max}}{L_{tw} \cdot t_w}$$

$$\sigma_{23\max} = 71.46 \cdot \text{MPa}$$

$$\sigma_{23\min} := 0 \cdot \text{MPa}$$

Gerilme farkı

$$\Delta\sigma_{23} := (\sigma_{23\max} - \sigma_{23\min}) \cdot \lambda_E$$

$$\Delta\sigma_{23} = 35 \cdot \text{MPa}$$

$$\Delta\sigma_{3EM} := \frac{\Delta\sigma_{c3}}{\gamma_{Mf}}$$

$$\Delta\sigma_{3EM} = 109 \cdot \text{MPa}$$

$$> \Delta\sigma_{23} = 35 \cdot \text{MPa} \quad \text{yeterli}$$

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**Sonuç: Hesaplara ve kabullere göre düşünülen konstrüksiyon üretime verilebilir.**

Son

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