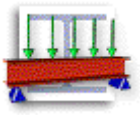
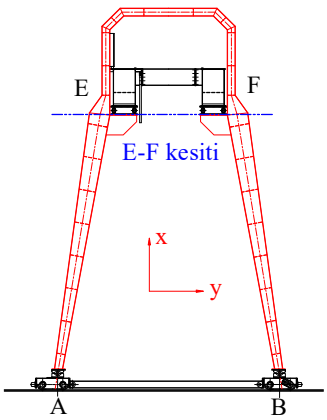


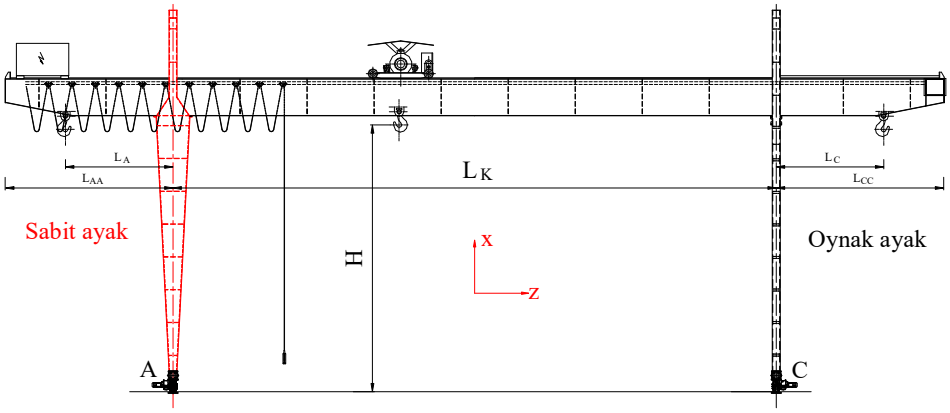
Portal vinç kiriş altı sabit ayak

Reference:C:\0\43_01_01_PV_320kN_18m_00_Giris.xmcd
Reference:C:\0\43_01_01_PV_320kN_18m_01_Kiris_ve_UB_Genel.xmcd
Reference:C:\0\43_01_01_PV_320kN_18m_02_0_Ayak_Ondegerleri.xmcd

4 0

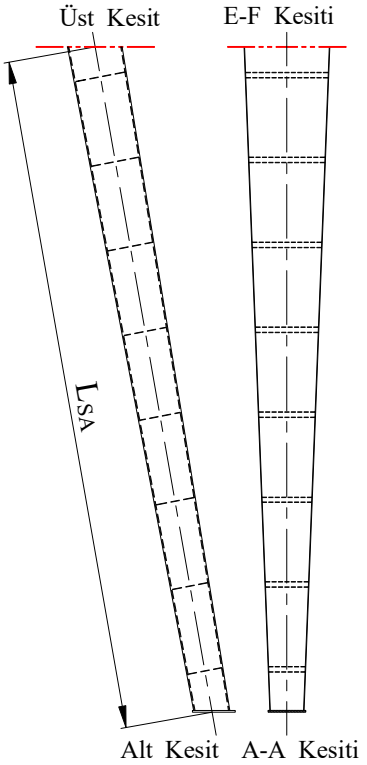
Sabit Ayak

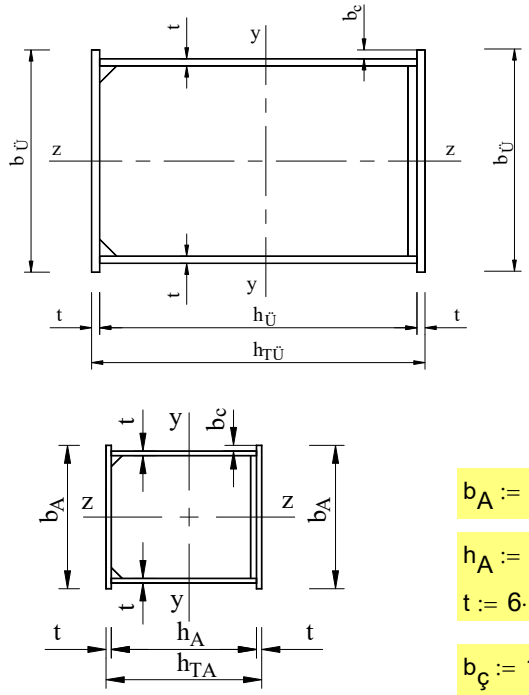




Sabit ayak konstrüksiyonu ve hesabı:

Ekonomik konstrüksiyon için ayak alt kesitinin montaj ölçüleri oynak ayağın aynısı alınır





$b_A := 300 \cdot mm$

$h_A := 300 \cdot mm$

$t := 6 \cdot mm$

$b_ç := 10 \cdot mm$

$h_{TA} := h_A + 2 \cdot t$

$h_{TA} = 312 \cdot mm$

$z_A := 0.5 \cdot (h_A + t)$

$z_A = 153 \cdot mm$

$$J_{yA} := 2 \cdot \frac{b_A \cdot t^3}{12} + 2 \cdot \frac{t \cdot h_A^3}{12} + 2 \cdot t \cdot b_A \cdot z_A^2$$

$J_{yA} = 111.283 \cdot 10^6 \cdot mm^4$

$$W_{yA} := \frac{2 \cdot J_{yA}}{h_{TA}}$$

$W_{yA} = 713.354 \cdot 10^3 \cdot mm^3$

$A_A := 2\cdot t\cdot(b_A + h_A)$ $A_A = 7200\cdot mm^2$

$y_A := 0.5\cdot(b_A - t) - b_ç$ $y_A = 137\cdot mm$

$J_{zA} := 2\cdot\frac{b_A^3\cdot t}{12} + 2\cdot\frac{t^3\cdot h_A}{12} + 2\cdot t\cdot h_A\cdot y_A^2$ $J_{zA} = 94.6\cdot 10^6\cdot mm^4$

$W_{zA} := \frac{2\cdot J_{zA}}{b_A}$ $W_{zA} = 630.5\cdot 10^3\cdot mm^3$

$J_{yK} := J_y$ $k_{xz} := \frac{L_K^2}{J_{yK}}$ $k_{xz} = 46083\frac{1}{m^2}$ $k_{xy} := \frac{L_{AR}^2}{J_{uY}}$ $k_{xy} = 1492\frac{1}{m^2}$

$k_{xz} > k_{xy}$ olduğundan hesaplar xz kesitinde yapılacaktır.

$o_{SA} := 7700\cdot mm$

Eğik ayak boyu $\alpha_{SA} := 9.180\cdot deg$ $L_{SA} := o_{SA}\cdot\cos(\alpha_{SA})^{-1}$ $L_{SA} = 7800\cdot mm$

Kesit E:

$b_E := 780\cdot mm$ $h_E := 780\cdot mm$ $f_{EM} = 213.6\cdot MPa$

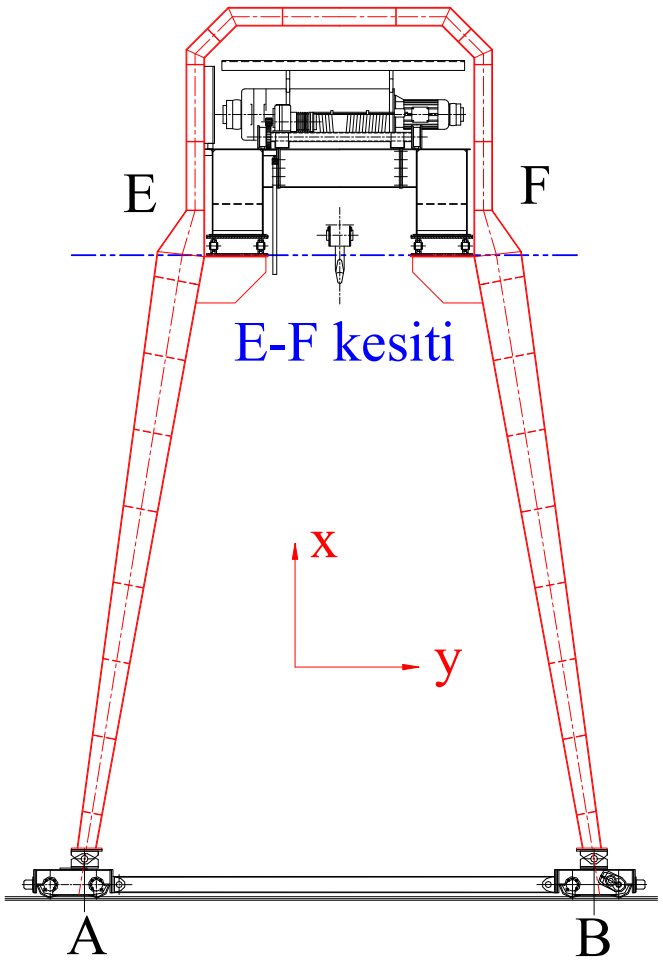
Faktörler:

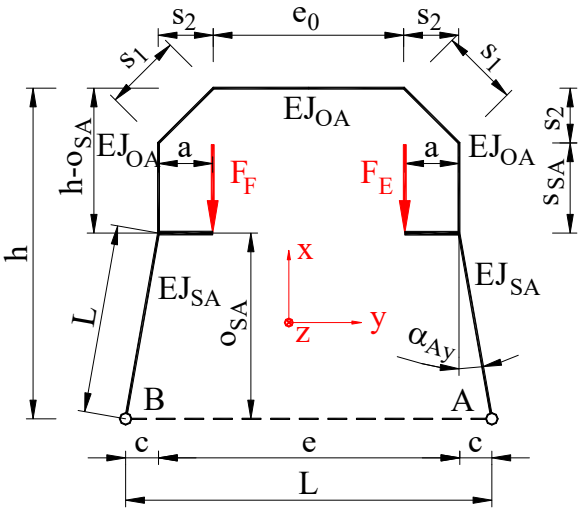
$k_{8b} := \frac{b_E}{b_A}$ $k_{8b} = 2.60000$ $k_b := \frac{k_{8b} - 1}{L_{SA}}$ $k_b = 0.2051\,m^{-1}$

$k_{8h} := \frac{h_E}{h_A}$ $k_{8h} = 2.60000$ $k_h := \frac{k_{8h} - 1}{L_{SA}}$ $k_h = 0.2051\,m^{-1}$

Bütün değerler konstrüksiyon resminden alınmıştır.

$A_E := 2\cdot t\cdot(b_E + h_E)$ $A_E = 18720\cdot mm^2$





Konstrüksiyondan bilinen değerler:

$L_1 := 6570\cdot mm$ $h := 10800\cdot mm$

$e_0 := 2780\cdot mm$ $a_S := 950\cdot mm$

$s_{SA} := 2440\cdot mm$ $s_{1SA} := 925\cdot mm$

$s_{2SA} := 660\cdot mm$

$c_{SA} := L_{SA}\cdot\tan(\alpha_{SA})$ $c_{SA} = 1261\cdot mm$

E ve F dayanağındaki kuvvetler kiriş altı ayak konstrüksiyonunun aynısıdır ve E ve F noktalarındaki zorlamalar eşittir ve $F_{xÜ}$ denir.

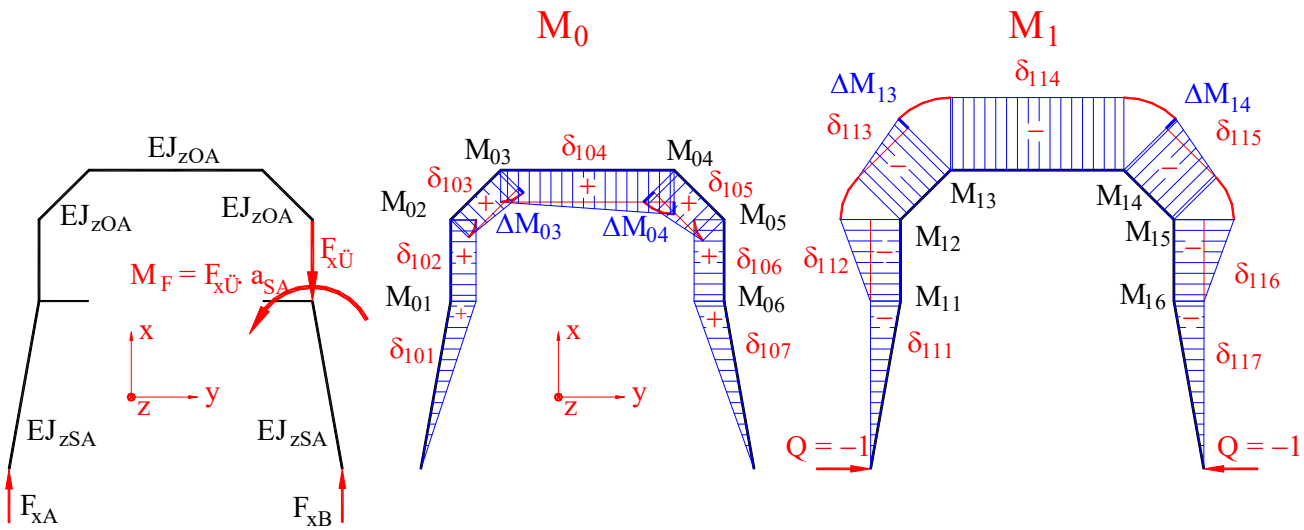
$F_{xG} = F_{xH} = F_{xÜ}$ $F_{xÜ} = 322\cdot kN$

Malzeme = "St 37" Emniyetli akma mukavemeti $E = 2.1 \times 10^5 \cdot MPa$ $f_{EM} = 214 \cdot MPa$ $J_{zOA} := 112\ 10^6 \cdot mm^4$

Sabit ayakları çerçevelerden etkileyen kuvvetler:

Burada F_F=F_E olduğundan hesabı bir kuvvetle yapıp iki katını alalım. Eğer kuvvetler eşit değilse her kuvvet için hesap yapılıp değerler toplanır.

Hakiki Hareket Durumu **HHD** Virtüel Yükleme Durumu **VYD**



$$F_{xA} := F_{xÜ} \cdot \frac{(a_S + c_{SA})}{L_1} \qquad F_{xB} := F_{xÜ} \cdot \frac{L_1 - (a_S + c_{SA})}{L_1}$$

$F_{xA} = 108.224 \cdot kN$ $F_{xB} = 213.435 \cdot kN$

$X_{1SA} = H_A = H_B$ $X_{1SA} = -\frac{\delta_{10}}{\delta_{11}}$

$\delta_{10} = \delta_{101} + \delta_{102} + \delta_{103} + \delta_{104} + \delta_{105} + \delta_{106} + \delta_{107}$ $Q := -1$

$M_E := F_{xÜ} \cdot a_S$ $M_E = 305.576\ m \cdot kN$

$M_{01SA} := F_{xA} \cdot c_{SA}$	$M_{01SA} = 136.418\ m \cdot kN$	$M_{11SA} := Q \cdot o_{SA}$	$M_{11SA} = -7.7\ m$
$M_{02SA} := F_{xA} \cdot c_{SA}$	$M_{02SA} = 136.418\ m \cdot kN$	$M_{12SA} := Q \cdot (h - s_{2SA})$	$M_{12SA} = -10.14\ m$
$M_{03SA} := F_{xA} \cdot (c_{SA} + s_{2SA})$	$M_{03SA} = 207.846\ m \cdot kN$	$M_{13SA} := Q \cdot h$	$M_{13SA} = -10.8\ m$
$\Delta M_{03SA} := M_{03SA} - M_{02SA}$	$\Delta M_{03SA} = 71.428 \cdot kN \cdot m$	$\Delta M_{13SA} := M_{13SA} - M_{12SA}$	$\Delta M_{13SA} = -0.66\ m$
$M_{06SA} := F_{xB} \cdot c_{SA} + F_{xÜ} \cdot a_S$	$M_{06SA} = 574.613\ m \cdot kN$	$M_{14SA} := M_{13SA}$	$M_{14SA} = -10.8\ m$
$M_{05SA} := M_{06SA}$	$M_{05SA} = 574.613\ m \cdot kN$	$\Delta M_{14SA} := M_{13SA} - M_{12SA}$	$\Delta M_{13SA} = -0.66\ m$
$M_{04SA} := F_{xÜ} \cdot a_S + F_{xB} \cdot (c_{SA} + s_{2SA})$	$M_{04SA} = 715.48\ m \cdot kN$	$M_{15SA} := M_{12SA}$	$M_{15SA} = -10.14\ m$
$\Delta M_{04SA} := M_{04SA} - M_{03SA}$	$\Delta M_{04SA} = 507.635 \cdot kN \cdot m$	$M_{16SA} := M_{11SA}$	$M_{16SA} = -7.7\ m$
		$\Delta M_{12SA} := M_{12SA} - M_{11SA}$	$\Delta M_{12SA} = -2.44\ m$
		$\Delta M_{15SA} := M_{15SA} - M_{16SA}$	$\Delta M_{15SA} = -2.44\ m$

Burada hesap şeklini daha iyi anlayabilmek için, hesabı detaylı yapalım. $x := L_{SA}$

x e bağlı Eylemsizlik ve karşı koyma momentleri:

$$J_{ySAx} = \frac{t}{6}\cdot\left[b_A\cdot\left(1+k_b\cdot x\right)\cdot t^2 + \left[h_A\cdot\left(1+k_h\cdot x\right)\right]^3 + 3\cdot b_A\cdot\left(1+k_b\cdot x\right)\cdot\left[h_A\cdot\left(1+k_h\cdot x\right)+t\right]^2\right] \qquad W_{yx} = \frac{2\cdot J_{yx}}{h_A\cdot\left(1+k_h\cdot x\right)+2\cdot t}$$

$$J_{zSAx} = \frac{t}{6}\cdot\left[{b_A}^3\cdot\left(1+k_b\cdot x\right)^3 + t^2\cdot h_A\cdot\left(1+k_h\cdot x\right) + 3\cdot h_A\cdot\left(1+k_h\cdot x\right)\cdot\left[b_A\cdot\left(1+k_b\cdot x\right)-t-b_ç\right]^2\right] \qquad W_{zx} = \frac{2\cdot J_{zx}}{b_A\cdot\left(1+k_b\cdot x\right)}$$

δ_{101SA} nın değeri

HHD VYD

$$\delta_{101SA} = \int_0^{L_{SA}} M_{01SA}\cdot M_{11SA}\cdot\frac{1}{E\cdot J_{zSAx}}\,dx$$

EJ x e göre değiştiğinden normal integral yapılır.

$$\delta_{101SA} := \int_0^{L_{SA}} \frac{M_{01SA}\cdot M_{11SA}}{E\cdot\frac{t}{6}\cdot\left[{b_A}^3\cdot\left(1+k_b\cdot x\right)^3 + t^2\cdot h_A\cdot\left(1+k_h\cdot x\right) + 3\cdot h_A\cdot\left(1+k_h\cdot x\right)\cdot\left[b_A\cdot\left(1+k_b\cdot x\right)-t-b_ç\right]^2\right]}\,dx$$

$\delta_{101SA} = -0.102\,m$

δ_{102SA} nın değeri

$\delta_{102SA} = \delta_{102SAa} + \delta_{102SAb}$

Burada VYD deki moment dağılımını a) ve b) olarak iki kısımda düşünebiliriz.

δ_{102SAa} nın değeri:

HHD VYD

$$\delta_{102SAa} = \int_0^{s_{SA}} M_{02SA}\cdot\Delta M_{12SA}\cdot\frac{1}{E\cdot J_{zOA}}\,dx$$

EJ sabit olduğundan integral tablosundan

$$\delta_{102SAa} := \frac{1}{2}\cdot M_{02SA}\cdot\Delta M_{12SA}\cdot\frac{s_{SA}}{E\cdot J_{zOA}}$$

$\delta_{102SAa} = -0.017\,m$

δ_{102SAb} nın değeri:

HHD VYD

$$\delta_{102SAb} = \int_0^{s_{SA}} M_{02SA}\cdot M_{11SA}\cdot\frac{1}{E\cdot J_{zOA}}\,dx$$

EJ sabit olduğundan integral tablosundan

$$\delta_{102SAb} := M_{02SA}\cdot M_{11SA}\cdot\frac{s_{SA}}{E\cdot J_{zOA}}$$

$\delta_{102SAb} = -0.109\,m$

$\delta_{102SA} := \delta_{102SAa} + \delta_{102SAb}$

$\boxed{\delta_{102SA} = -0.126\,m}$

δ_{103OA} nın değeri

HHD VYD

M_{01} M_{02} M_{11} M_{12}

EJ sabit olduğundan integral tablosundan

$$\delta_{103SA} := \frac{1}{6}\cdot\left[M_{01SA}\cdot\left(2\cdot M_{11SA} + M_{12SA}\right) + M_{02SA}\cdot\left(M_{11SA} + 2M_{12SA}\right)\right]\cdot\frac{s_{1SA}}{E\cdot J_{zOA}} \qquad \delta_{103SA} = -0.048\,m$$

δ_{104SA} nın değeri

$\delta_{104SA} = \delta_{104SAa} + \delta_{104SAb}$

δ_{104SAa} nın değeri:

HHD VYD

$$\delta_{104SAa} = \int_0^{e_0} \Delta M_{04SA}\cdot M_{14SA}\,dx$$

EJ sabit olduğundan integral tablosundan

$$\delta_{104SAa} := \frac{1}{2}\cdot\Delta M_{04SA}\cdot M_{14SA}\cdot\frac{e_0}{E\cdot J_{zOA}} \qquad \delta_{104SAa} = -0.324\,m$$

δ_{104SAb} nin değeri:

HHD VYD

$$\delta_{104SAb} = \int_0^{e_0} M_{03SA}\cdot M_{14SA}\,dx$$

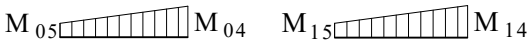
EJ sabit olduğundan integral tablosundan

$$\delta_{104SAb} := M_{03SA}\cdot M_{14SA}\cdot\frac{e_0}{E\cdot J_{zOA}} \qquad \delta_{104SAb} = -0.265\,m$$

$$\delta_{104SA} := \delta_{104SAa} + \delta_{104SAb} \qquad \boxed{\delta_{104SA} = -0.589\,m}$$

δ_{105SA} nın değeri

HHD VYD



EJ sabit olduğundan integral tablosundan

$$\delta_{105SA} := \frac{1}{6}\cdot\left[M_{05SA}\cdot\left(2\cdot M_{15SA} + M_{14SA}\right) + M_{04SA}\cdot\left(M_{15SA} + 2M_{14SA}\right)\right]\cdot\frac{s_{1SA}}{E\cdot J_{zOA}} \qquad \delta_{103SA} = -0.048\,m$$

δ_{106SA} nın değeri

$\delta_{106SA} = \delta_{106SAa} + \delta_{106SAb}$

Burada VYD deki moment dağılımını a)  ve b)  olarak iki kısımda düşünebiliriz.

δ_{106SAa} nın değeri:

HHD VYD

$$\delta_{106SAa} = \int_0^{s_{SA}} M_{05SA}\cdot\Delta M_{15SA}\cdot\frac{1}{E\cdot J_{zOA}}\,dx$$

EJ sabit olduğundan integral tablosundan

$$\delta_{106SAa} := \frac{1}{2}\cdot M_{05SA}\cdot\Delta M_{15SA}\cdot\frac{s_{SA}}{E\cdot J_{zOA}} \qquad \delta_{106SAa} = -0.073\,m$$

δ_{106SAb} nın değeri:

HHD VYD

$$\delta_{106SAb} = \int_0^{s_{SA}} M_{05SA} \cdot M_{16SA} \cdot \frac{1}{E \cdot J_{zOA}}\, dx$$

EJ sabit olduğundan integral tablosundan

$$\delta_{106SAb} := M_{05SA} \cdot M_{16SA} \cdot \frac{s_{SA}}{E \cdot J_{zOA}}$$

$\delta_{106SAb} = -0.459\,m$

$\delta_{106SA} := \delta_{106SAa} + \delta_{106SAb}$

$\boxed{\delta_{106SA} = -0.532\,m}$

δ_{107SA} nın değeri

HHD VYD

$$\delta_{107SA} = \int_0^{L_{SA}} M_{06SA} \cdot M_{16SA} \cdot \frac{1}{E \cdot J_{zSAx}}\, dx$$

EJ x e göre değiştiğinden normal integral yapılır.

$$\delta_{107SA} := \int_0^{L_{SA}} \frac{6 \cdot M_{06SA} \cdot M_{16SA}}{E \cdot t \cdot \left[b_A^{\,3} \cdot \left(1 + k_b \cdot x\right)^3 + t^2 \cdot h_A \cdot \left(1 + k_h \cdot x\right) + 3 \cdot h_A \cdot \left(1 + k_h \cdot x\right) \cdot \left[b_A \cdot \left(1 + k_b \cdot x\right) - t - b_ç \right]^2 \right]}\, dx$$

$\delta_{107SA} = -0.43\,m$

$\delta_{10SA} := \delta_{101SA} + \delta_{102SA} + \delta_{103SA} + \delta_{104SA} + \delta_{105SA} + \delta_{106SA} + \delta_{107SA}$

$\boxed{\delta_{10SA} = -2.093\,m}$

$\delta_{11} = \delta_{111} + \delta_{112} + \delta_{113} + \delta_{114} + \delta_{115}$

δ_{111OA} nın değeri

VYD VYD

$$\delta_{111SA} = \int_0^{L_{SA}} M_{11SA} \cdot M_{11SA}\, dx$$

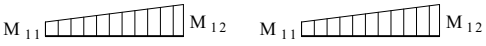
EJ x e göre değiştiğinden normal integral yapılır.

$$\delta_{111SA} := \int_0^{L_{SA}} \frac{6 \cdot M_{11SA} \cdot M_{11SA}}{E \cdot t \cdot \left[b_A^{\,3} \cdot \left(1 + k_b \cdot x\right)^3 + t^2 \cdot h_A \cdot \left(1 + k_h \cdot x\right) + 3 \cdot h_A \cdot \left(1 + k_h \cdot x\right) \cdot \left[b_A \cdot \left(1 + k_b \cdot x\right) - t - b_ç \right]^2 \right]}\, dx$$

$\delta_{111SA} = 5.763 \cdot \frac{mm}{kN}$

δ_{112SA} nın değeri

VYD VYD



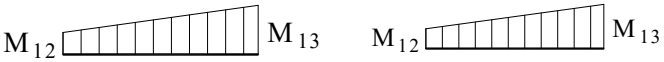
EJ sabit olduğundan integral tablosundan

$$\delta_{112SA} := \frac{1}{6} \cdot \left[M_{11SA} \cdot \left(2 \cdot M_{11SA} + M_{12SA}\right) + M_{12SA} \cdot \left(M_{11SA} + 2 \cdot M_{12SA}\right) \right] \cdot \frac{s_{SA}}{E \cdot J_{zOA}}$$

$\boxed{\delta_{112SA} = 8.306 \cdot \frac{mm}{kN}}$

δ_{113SA} nın değeri

VYD VYD



EJ sabit olduğundan integral tablosundan

$$\delta_{113SA} := \frac{1}{6}\cdot\left[M_{12SA}\cdot\left(2\cdot M_{12SA}+M_{13SA}\right)+M_{13SA}\cdot\left(M_{12SA}+2\cdot M_{13SA}\right)\right]\cdot\frac{s_{1SA}}{E\cdot J_{zOA}}$$

$$\delta_{113SA} = 4.313\cdot\frac{mm}{kN}$$

δ_{114SA} nın değeri

VYD VYD

$$\delta_{114SA} = \int_0^{e_0} M_{13SA}\cdot M_{13SA}\cdot\frac{1}{E\cdot J_{zOA}}\,dx$$

EJ sabit olduğundan integral tablosundan

$$\delta_{114SA} := M_{13SA}\cdot M_{13SA}\cdot\frac{e_0}{E\cdot J_{zOA}}$$

$$\delta_{114SA} = 13.787\cdot\frac{mm}{kN}$$

δ_{115SA} nın değeri

VYD VYD

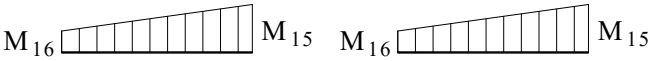
EJ sabit olduğundan integral tablosundan

$$\delta_{115SA} := \frac{1}{6}\cdot\left[M_{15SA}\cdot\left(2\cdot M_{15SA}+M_{14SA}\right)+M_{14SA}\cdot\left(M_{15SA}+2\cdot M_{14SA}\right)\right]\cdot\frac{s_{1SA}}{E\cdot J_{zOA}}$$

$$\delta_{115SA} = 0.004\cdot\frac{m}{kN}$$

δ_{116SA} nın değeri

VYD VYD



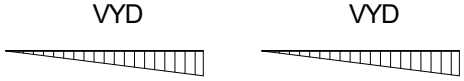
EJ sabit olduğundan integral tablosundan

$$\delta_{116SA} := \frac{1}{6}\cdot\left[M_{16SA}\cdot\left(2\cdot M_{16SA}+M_{15SA}\right)+M_{15SA}\cdot\left(M_{16SA}+2\cdot M_{15SA}\right)\right]\cdot\frac{s_{1SA}}{E\cdot J_{zOA}}$$

$$\delta_{116SA} = 3.149\cdot\frac{mm}{kN}$$

δ_{117SA} nın değeri

VYD VYD



$$\delta_{117SA} = \int_0^{L_{OA}} M_{16SA}\cdot M_{16SA}\cdot\frac{1}{E\cdot J_{zSAx}}\,dx$$

$$\delta_{117SA} := \int_0^{L_{SA}} \frac{6\cdot M_{16SA}\cdot M_{16SA}}{E\cdot t\cdot\left[b_A^{\,3}\cdot\left(1+k_b\cdot x\right)^3+t^2\cdot h_A\cdot\left(1+k_h\cdot x\right)+3\cdot h_A\cdot\left(1+k_h\cdot x\right)\cdot\left[b_A\cdot\left(1+k_b\cdot x\right)-t-b_ç\right]^2\right]}\,dx$$

$$\delta_{117SA} = 5.763\cdot\frac{mm}{kN}$$

$$\delta_{11SA} := \delta_{111SA}+\delta_{112SA}+\delta_{113SA}+\delta_{114SA}+\delta_{115SA}+\delta_{116SA}+\delta_{117SA}$$

$$\delta_{11SA} = 0.045\cdot\frac{m}{kN}$$

$H_A = H_B = X_1$

$X_{1SA} := -\frac{\delta_{10SA}}{\delta_{11SA}}$ $X_{1SA} = 46.1 \cdot kN$

$H_A := 2 \cdot X_{1SA}$ $H_A = 92.2 \cdot kN$

$H_B := 2 \cdot X_{1SA}$ $H_B = 92.2 \cdot kN$

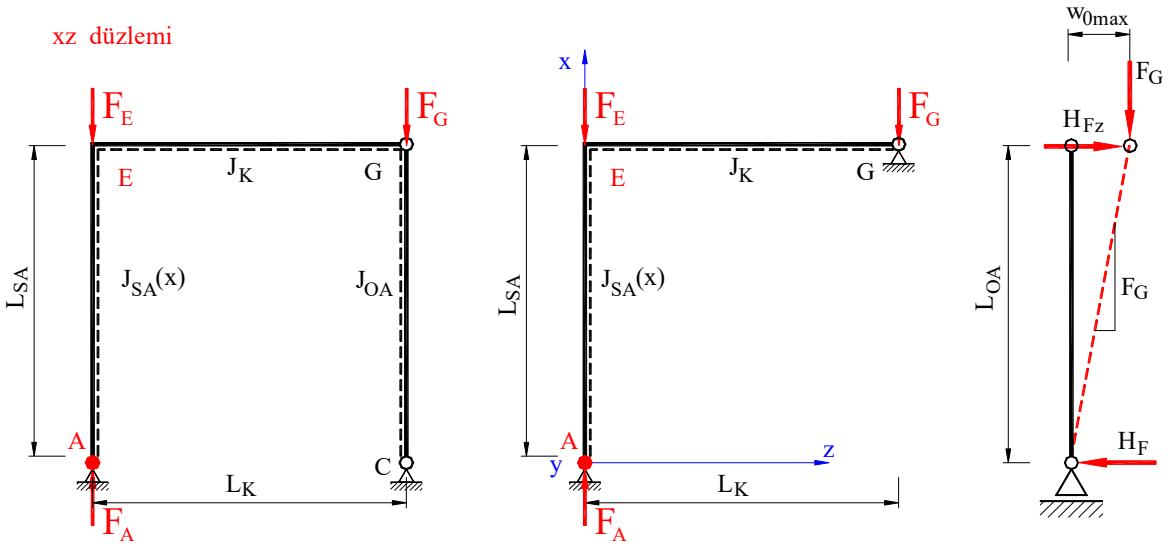
Çeşitli etkenlerden (Rüzgar, Frenleme, Kasılma gibi) bir dayanağı etkileyen yatay kuvvet $F_{yAlt} := 11 \cdot kN$

Bir sabit ayağı etkileyen yatay kuvvet $F_{ySAAlt} := H_A + F_{yAlt}$ $F_{ySAAlt} = 103.2 \cdot kN$

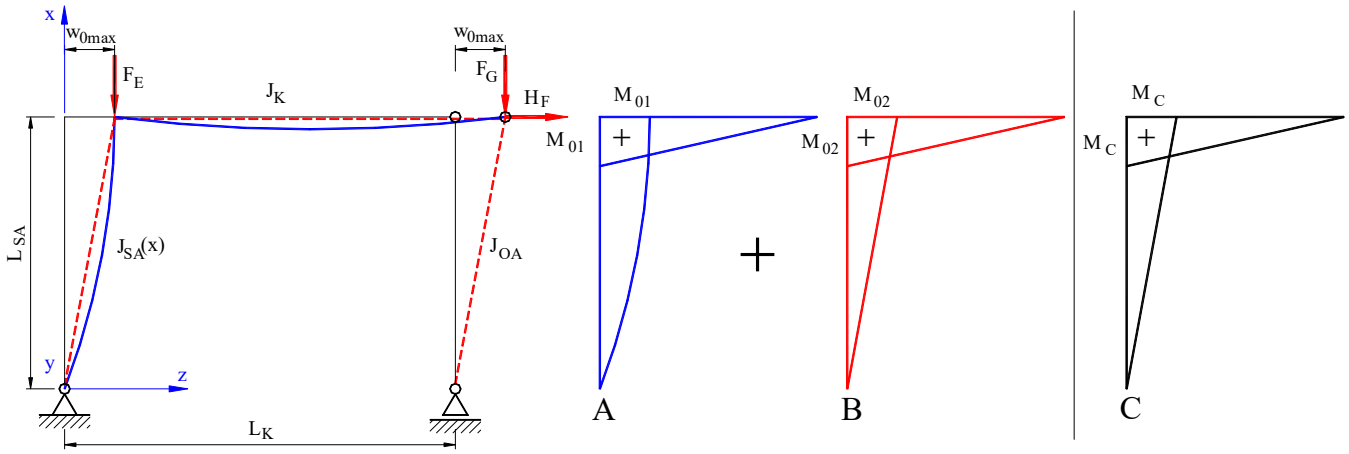
Bir sabit ayağı etkileyen eksenel kuvvet $F_{SAeks} := F_{ySAAlt} \cdot \sin(\alpha_{SA}) + F_{xÜ} \cdot \cos(\alpha_{SA})$ $F_{SAeks} = 334 \cdot kN$

Bir sabit ayağı etkileyen moment $M_{SA} := F_{ySAAlt} \cdot o_{SA} - (F_{xÜ} \cdot a_S + F_{xÜ} \cdot c_{SA})$ $M_{SA} = 83.8 \cdot kN \cdot m$

Vianelloya göre çözüm:



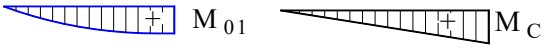
Sabit ayağın hesabı Vianello metodu ile xz düzlemine göre yapılır.



$F_E \cdot w_{0max} = H_F \cdot L_{SA}$ $H_F = \frac{F_E \cdot w_{0max}}{L_{SA}}$ $w_{01} = w_{0max}$ kabul edileceğinden w_{0max} ı hesaplamaya gerek yoktur.

Sabit ayakta F_E etkili 1. sehim

HHD VYD



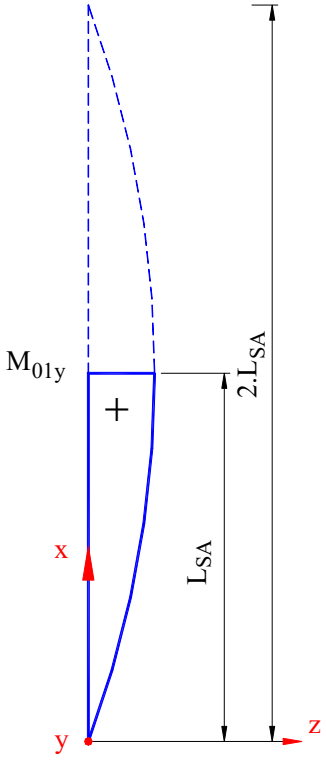
$$w_{11x} = \int_0^{L_{SA}} \frac{M_{01x} \cdot M_{Cx}}{E \cdot J_{ySAx}} dx$$

x e bağlı momentler:

$$M_{Cx} = \frac{x}{L_{SA}} \cdot L_{SA} = x$$

$$M_{01} = F_E \cdot w_{0max}$$

Aşağıda hesaplanan M_{01x} değerini yerleştirelim ve $F_E.w_{0max}$ sabit olduğundan integralin dışına alalım



M_{01} dağılımı parabol olursa parabolün genel formülü:

$M_{01x} = a \cdot x^2 + b \cdot x + c$

$M_{0ASx}(x=0) = 0$

$M_{0ASx}(x=L_{SA}) = F_E \cdot w_{0max}$ $c = 0$

$M_{0ASx}(x=2 \cdot L_{SA}) = 0$

Eğer $x=2 \cdot L_{SA}$ yerleştirirsek:

$0 = (2 \cdot L_{SA})^2 a + 2 \cdot L_{SA} \cdot b$

$0 = 2 \cdot L_{SA} a + b$ $b = -2 \cdot a \cdot L_{SA}$ $x = L_{SA}$

$M_{01x} = a \cdot x^2 + b \cdot x + c$ $F_E \cdot w_{0max} = a \cdot L_{SA}^2 + b \cdot L_{SA} + 0$

$F_E \cdot w_{0max} = a \cdot L_{SA}^2 - 2 \cdot a \cdot L_{SA}^2$

$F_E \cdot w_{0max} = -a \cdot L_{SA}^2$ $a = \frac{-F_E \cdot w_{0max}}{L_{SA}^2}$

$b = -2 \cdot a \cdot L_{SA}$ $b = \frac{-2 \cdot F_E \cdot w_{0max}}{L_{SA}}$

x e bağlı parabol olarak dağılımlı moment:

$$M_{01x} = -F_E \cdot w_{0max} \cdot \left(\frac{x^2}{L_{SA}^2} + \frac{2 \cdot x}{L_{SA}} \right)$$

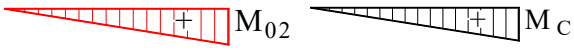
$$w_{11x} = \int_0^{L_{SA}} \frac{-F_E \cdot w_{0max} \cdot \left(\frac{x^2}{L_{SA}^2} + \frac{2 \cdot x}{L_{SA}} \right) \cdot x}{E \cdot \frac{t}{6} \cdot \left[b_A \cdot (1 + k_b \cdot x) \cdot t^2 + \left[h_A \cdot (1 + k_h \cdot x) \right]^3 + 3 \cdot b_A \cdot (1 + k_b \cdot x) \cdot \left[h_A \cdot (1 + k_h \cdot x) + t \right]^2 \right]} dx$$

$$w_{11x} := \int_0^{L_{SA}} \frac{\frac{x^3}{L_{SA}^2} + \frac{2 \cdot x^2}{L_{SA}}}{E \cdot \frac{t}{6} \cdot \left[b_A \cdot (1 + k_b \cdot x) \cdot t^2 + \left[h_A \cdot (1 + k_h \cdot x) \right]^3 + 3 \cdot b_A \cdot (1 + k_b \cdot x) \cdot \left[h_A \cdot (1 + k_h \cdot x) + t \right]^2 \right]} dx$$

$$w_{11x} = 0.256 \cdot \frac{10^{-6}}{N}$$

Sabit ayağın H_F etkili 2. sehimi

HHD VYD



xe bağlı momentler:

$$w_{12x} = \int_0^{L_{SA}} \frac{M_{02x} \cdot M_{Cx}}{E \cdot J_{ySAx}} dx \qquad M_C = \frac{x}{L_{SA}} \cdot L_{SA} = x$$

$$M_{02} = H_F \cdot L_{SA} = F_E \cdot w_{0max} \qquad M_{02x} = H_F \cdot x = \frac{x}{L_{SA}} \cdot F_E \cdot w_{0max} \qquad w_{12x} = \int_0^{L_{SA}} \frac{\frac{x}{L_{SA}} \cdot F_E \cdot w_{0max} \cdot x}{E \cdot J_{ySAx}} dx$$

$$w_{12x} = \int_0^{L_{SA}} \frac{6 \cdot F_E \cdot w_{0max} \cdot \frac{x^2}{L_{SA}}}{E \cdot t \cdot \left[b_A \cdot (1 + k_b \cdot x) \cdot t^2 + \left[h_A \cdot (1 + k_h \cdot x) \right]^3 + 3 \cdot b_A \cdot (1 + k_b \cdot x) \cdot \left[h_A \cdot (1 + k_h \cdot x) + t \right]^2 \right]} dx$$

$F_E \cdot w_{0max}$ = sabit olduğundan integralin dışına alalım.

$$w_{12x} := \int_0^{L_{SA}} \frac{6 \cdot x^2}{E \cdot t \cdot \left[b_A \cdot (1 + k_b \cdot x) \cdot t^2 + \left[h_A \cdot (1 + k_h \cdot x) \right]^3 + 3 \cdot b_A \cdot (1 + k_b \cdot x) \cdot \left[h_A \cdot (1 + k_h \cdot x) + t \right]^2 \right] \cdot L_{SA}} dx$$

$$w_{12x} = 0.097 \cdot \frac{10^{-6}}{N}$$

EG Kirişinde F_E etkili 3. sehim

HHD VYD

$$M_{01} = F_E \cdot w_{0max} \qquad M_C = L_K$$

$$w_{13} = \int_0^{L_K} \frac{M_{01} \cdot M_C}{E \cdot J_{yK}} dx \qquad E \cdot J_{yK} = \text{sabit}$$

İntegral tablosundan Üçgen + Üçgen

$$w_{13} = \frac{1}{3} \cdot \frac{F_E \cdot w_{0max} \cdot L_K^2}{E \cdot J_{yK}}$$

$F_E \cdot w_{0max}$ = sabit olduğundan integralin dışına alalım.

$$w_{13} := \frac{1}{3} \cdot \frac{L_K^2}{E \cdot J_{yK}} \qquad w_{13} = 0.073 \cdot \frac{10^{-6}}{N}$$

EG Kirişinde H_F etkili 4. sehim

HHD VYD

$$M_{02} = F_E \cdot w_{0max} \qquad M_C = L_K$$

$$w_{14} = \int_0^{L_K} \frac{M_{02} \cdot M_C}{E \cdot J_{yK}} dx \qquad E \cdot J_{yK} = \text{sabit}$$

İntegral tablosundan Üçgen + Üçgen

$$w_{14} = \frac{1}{3} \cdot \frac{F_E \cdot w_{0max} \cdot L_K^2}{E \cdot J_{yK}}$$

$F_E \cdot w_{0max}$ = sabit olduğundan integralin dışına alalım. $w_{14} := \frac{1}{3} \cdot \frac{L_K^2}{E \cdot J_{yK}}$ $w_{14} = 0.073 \cdot \frac{10^{-6}}{N}$

$w_{01} = F_E \cdot w_{0max} \cdot (w_{11x} + w_{12x} + w_{13} + w_{14})$ $F_E = F_{kr}$ $w_{01} = w_{0max}$ kabul edersek

$$F_{kr} := \frac{1}{w_{11x} + w_{12x} + w_{13} + w_{14}}$$

$F_{kr} = 2000 \cdot kN$ $F_{SAeks} = 334 \cdot kN$

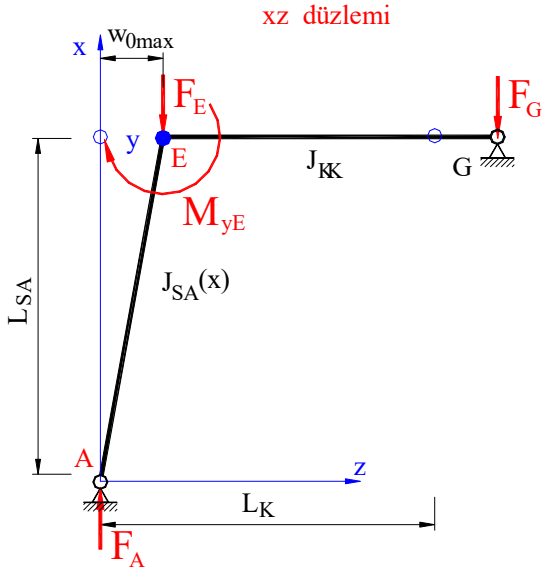
Sonuç: Çubukta burkulma tehlikesi yoktur.

E Kesitinde mukavemet hesabı:

xz düzlemi

$xE := L_{SA}$

Eğilme momenti M_{yE}



$$J_{yE} := \frac{t}{6} \cdot \left[b_A \cdot (1 + k_b \cdot xE) \cdot t^2 + h_A^3 \cdot (1 + k_h \cdot xE)^3 + 3 b_A \cdot (1 + k_b \cdot xE) \cdot \left[h_A \cdot (1 + k_h \cdot xE) + t \right]^2 \right] \qquad J_{yE} = 1920 \cdot 10^6 \cdot mm^4$$

$$W_{yE} := \frac{2 \cdot J_{yE}}{h_A \cdot (1 + k_h \cdot x) + 2 \cdot t} \qquad W_{yE} = 4849 \cdot 10^3 \cdot mm^3$$

Eylemsizlik radyusu $i_{yE} := \sqrt{\frac{J_{yE}}{A_E}}$ $i_{yE} = 320.3 \cdot mm$

Euler burkulma boyu $L_{ByE} := \sqrt{\frac{E \cdot J_{yE} \cdot \pi^2}{F_{kr}}}$ $L_{ByE} = 44.607\,m$

Akma narinliği $\lambda_{Ef} := \pi \cdot \sqrt{\frac{E}{f_y}}$ $\lambda_{Ef} = 93.913$

Temel narinlik $\lambda_{yE} := \frac{L_{ByE}}{i_{yE}}$ $\lambda_{yE} = 139.278$

Bağıntılı narinlik

$$\lambda_{ByE} := \frac{\lambda_{yE}}{\lambda_{Ef}}$$

$\lambda_{ByE} = 1.483$

Merkez noktası mesafesi

$$k_{elyE} := \frac{W_{yE}}{A_E}$$

$k_{elyE} = 259.03 \cdot mm$

Akma kuvveti

$F_{plE} := A_E \cdot f_{EM}$

$F_{plE} = 3999.3 \cdot kN$

Burkulma parametresi

$\alpha_B := 0.34$ Kaynaklı kutular her eksende.

Max burkulma sehimi

$w_{ymaxE} := k_{elyE} \cdot \alpha_B \cdot (\lambda_{ByE} - 0.2)$

$w_{ymaxE} = 112.999 \cdot mm$

Burkulma yardımcı faktörü

$$\varphi_{ByE} := 0.5 \cdot \left[1 + \alpha_B \cdot (\lambda_{ByE} - 0.2) + \lambda_{ByE}^2\right]$$

$\varphi_{ByE} = 1.82$

Azaltma faktörü

$$\chi_{ByE} := \frac{1}{\varphi_{ByE} + \sqrt{\varphi_{ByE}^2 - \lambda_{ByE}^2}}$$

$\chi_{ByE} = 0.349$

Kuvvetin mukavemet emniyeti

$$S_{FyE} := \frac{F_{SAeks}}{\chi_{ByE} \cdot F_{plE}}$$

$S_{FyE} = 0.240$

Plastikliğin en küçük momenti

$M_{plyE} := W_{yE} \cdot f_{EM}$

$M_{plyE} = 1035.9 \cdot kN \cdot m$

$F_{zSA} := F_{zAlt1}$

$F_{zSA} = 65 \cdot kN$

$M_{0yE} := 0 \cdot kN \cdot m$

$M_{yE} := F_{zSA} \cdot o_{SA}$

$M_{yE} = 504.1 \cdot kN \cdot m$

$-1 \le \psi_y \le 1$

$$\psi_{yE} := \frac{M_{0yE}}{M_{yE}}$$

$\psi_{yE} = 0.000$

$\beta_{MyE} := 1.8 - 0.7 \cdot \psi_{yE}$

$\beta_{MyE} = 1.8$

$\alpha_{pl} \ge 1$

$$\alpha_{plyE} := \frac{M_{plyE}}{M_{yE}}$$

$\alpha_{plyE} = 2.055$

$a_y \le 0.8$

$a_{yxE} := \lambda_{ByE} \cdot (2 \cdot \beta_{MyE} - 4) + (\alpha_{plyE} - 1)$

$a_{yxE} = 0.462$

$$a_{yE} := \begin{cases} a_{yxE} & \text{if } a_{yxE} \le 0.8 \\ 0.8 & \text{otherwise} \end{cases}$$

$a_{yE} = 0.462$

$k_y \le 1,5$

$$k_{yxE} := 1 - \frac{F_{SAeks}}{\chi_{ByE} \cdot F_{plE}} \cdot a_{yE}$$

$k_{yxE} = 0.889$

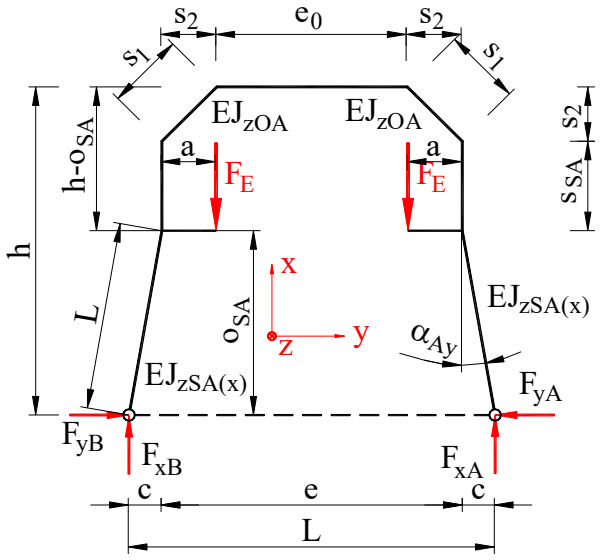
$$k_{yE} := \begin{cases} k_{yxE} & \text{if } k_{yxE} \le 1.5 \\ 1.5 & \text{otherwise} \end{cases}$$

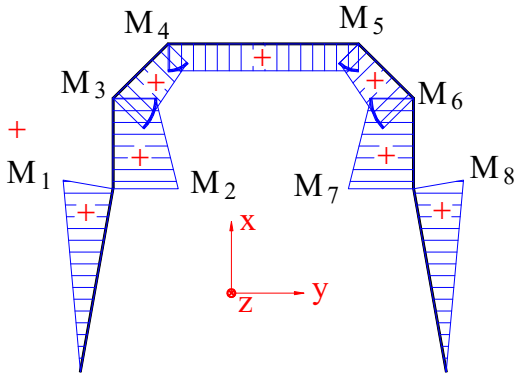
$k_{yE} = 0.889$

$$S_{MyE} := \frac{M_{yE}}{M_{plyE}} \cdot k_{yE}$$

$S_{MyE} = 0.433$

Eğilme momenti M_{zE}





Konstrüksiyon resminden $c_1 := o_{SA}\cdot\tan(\alpha_{Ay})$ $F_{yB} := F_{ySAAlt}$ $c_1 = 1358\cdot mm$

$F_{xB} = 213.435\cdot kN$ $F_{yB} = 103\cdot kN$

$M_{zE} := F_{yB}\cdot o_{SA} - (F_{xÜ}\cdot a_S + F_{xÜ}\cdot c_{SA})$ $M_{zE} = 84\cdot kN\cdot m$

$$J_{zE} := \frac{t}{6}\cdot\left[b_A^{\,3}\cdot(1+k_b\cdot xE)^3 + t^2\cdot h_A\cdot(1+k_h\cdot xE) + 3\cdot h_A\cdot(1+k_h\cdot xE)\cdot\left[b_A\cdot(1+k_b\cdot xE) - t - b_ç\right]^2\right]$$

$J_{zE} = 1840\cdot 10^6\cdot mm^4$ $W_{zE} := \frac{2\cdot J_{zE}}{b_E}$ $W_{zE} = 4719\cdot 10^3\cdot mm^3$

Eylemsizlık radyusu $i_{zE} := \sqrt{\frac{J_{zE}}{A_E}}$ $i_{zE} = 313.5\cdot mm$

Euler burkulma boyu $L_{BzE} := \sqrt{\frac{E\cdot J_{zE}\cdot\pi^2}{F_{kr}}}$ $L_{BzE} = 43.670\,m$

Narinlik $\lambda_{zE} := \frac{L_{BzE}}{i_{zE}}$ $\lambda_{zE} = 139.278$

Bağıntılı narinlik $\lambda_{BzE} := \frac{\lambda_{zE}}{\lambda_{Ef}}$ $\lambda_{BzE} = 1.483$

Merkez noktası mesafesi $k_{elzE} := \frac{W_{zE}}{A_E}$ $k_{elzE} = 252.086\cdot mm$

Max burkulma sehimi $w_{zmaxE} := k_{elzE}\cdot\alpha_B\cdot(\lambda_{BzE} - 0.2)$ $w_{zmaxE} = 110\cdot mm$

Burkulma yardımcı faktörü $\varphi_{BzE} := 0.5\cdot\left[1 + \alpha_B\cdot(\lambda_{BzE} - 0.2) + \lambda_{BzE}^2\right]$ $\varphi_{BzE} = 1.82$

Azaltma faktörü $\chi_{BzE} := \frac{1}{\varphi_{BzE} + \sqrt{\varphi_{BzE}^2 - \lambda_{BzE}^2}}$ $\chi_{BzE} = 0.349$

Kuvvetin mukavemet emniyeti

$$S_{FzE} := \frac{F_{SAeks}}{\chi_{BzE} \cdot F_{plE}} \qquad S_{FzE} = 0.240$$

Plastikliğin en küçük momenti

$$M_{plzE} := W_{zE} \cdot f_{EM} \qquad M_{plzE} = 1008.2 \cdot kN \cdot m$$

$$M_{0zE} := F_{yB} \cdot o_{SA} \qquad M_{0zE} = 794.9 \cdot kN \cdot m$$

$-1 \le \psi_z \le 1$

$$\psi_{zE} := \frac{M_{0zE}}{M_{zE}} \qquad \psi_{zE} = 9.482$$

$$\beta_{MzE} := 1.8 - 0.7 \cdot \psi_{zE} \qquad \beta_{MzE} = -4.837$$

$\alpha_{pl} > 1$

$$\alpha_{plzE} := \frac{M_{plzE}}{M_{zE}} \qquad \alpha_{plzE} = 12.026$$

$$a_{zEx} := \lambda_{BzE} \cdot \left(2 \cdot \beta_{MzE} - 4\right) + \left(\alpha_{plzE} - 1\right) \qquad a_{zEx} = -9.254$$

$$a_{zE} := \begin{cases} a_{zEx} & \text{if } a_{zEx} \le 0.8 \\ 0.8 & \text{otherwise} \end{cases} \qquad a_{zE} = -9.254$$

$$k_{zEx} := 1 - \frac{F_{xÜ}}{\chi_{BzE} \cdot F_{plE}} \cdot a_{zE} \qquad k_{zEx} = 3.135$$

$$k_{zE} := \begin{cases} k_{zEx} & \text{if } k_{zEx} \le 1.5 \\ 1.5 & \text{otherwise} \end{cases} \qquad k_{zE} = 1.5$$

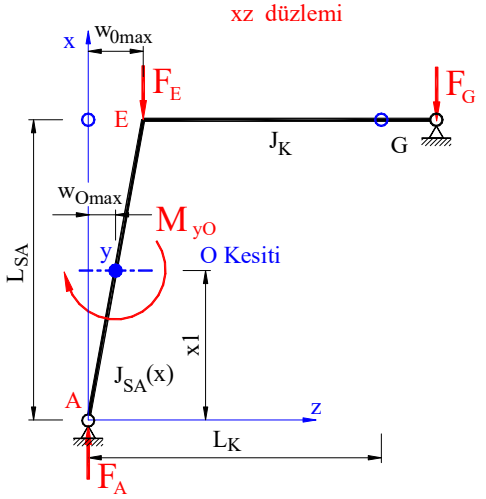
$$S_{MzE} := \frac{M_{zE}}{M_{plzE}} \cdot k_{zE} \qquad S_{MzE} = 0.125$$

$$S_{Ey} := \frac{F_{SAeks}}{\chi_{ByE} \cdot F_{plE}} + \frac{M_{yE}}{M_{plyE}} \cdot k_{yE} + \frac{M_{zE}}{M_{plzE}} \cdot k_{zE} \qquad S_{Ey} = 0.797$$

$$S_{Ez} := \frac{F_{SAeks}}{\chi_{BzE} \cdot F_{plE}} + \frac{M_{yE}}{M_{plyE}} \cdot k_{yE} + \frac{M_{zE}}{M_{plzE}} \cdot k_{zE} \qquad S_{Ez} = 0.797$$

Sonuç: S_{Ey} ve S_{Ez} değerleri 1 den küçük olduğundan E kesitinin hesaplarına göre konstrüksiyon fonksiyonunu yapar.

O Kesitinde mukavemet hesabı:



$$x1 := 0.5 \cdot L_{SA} \qquad x1 = 3900 \cdot mm$$

$$z_O := 0.5 \cdot \left[h_A \cdot \left(\left(1 + k_h \cdot x1\right)\right) + t\right] \qquad z_O = 273 \cdot mm$$

$$J_{yO} := \frac{t}{6}\cdot\left[b_A\cdot\left(1+k_b\cdot x1\right)\cdot t^2 + h_A^3\cdot\left(1+k_h\cdot x1\right)^3 + 12\cdot b_A\cdot\left(1+k_b\cdot x1\right)\cdot z_O^2\right] \qquad J_{yO} = 640\cdot 10^6\cdot mm^4$$

$$W_{yO} := \frac{2\cdot J_{yO}}{h_A\cdot\left(1+k_h\cdot x1\right)+2\cdot t} \qquad W_{yO} = 2320\cdot 10^3\cdot mm^3$$

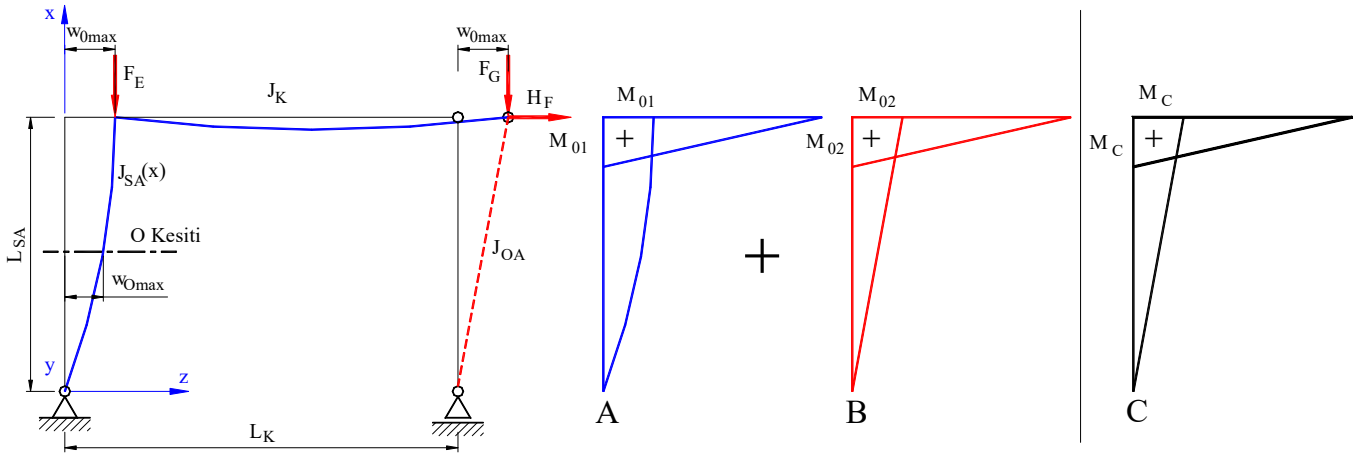
$$A_O := 2\cdot t\cdot\left[b_A\cdot\left(1+k_b\cdot x1\right)+h_A\cdot\left(1+k_h\cdot x1\right)\right] \qquad A_O = 12960\cdot mm^2$$

$$y_O := 0.5\cdot\left[b_A\cdot\left(1+k_b\cdot x1\right)-t\right]-b_ç \qquad y_O = 257\cdot mm$$

$$J_{zO} := \frac{t}{6}\cdot\left[b_A^3\cdot\left(1+k_b\cdot x1\right)^3 + t^2\cdot h_A\cdot\left(1+k_h\cdot x1\right) + 12\cdot h_A\cdot\left(1+k_h\cdot x1\right)\cdot y_O^2\right] \qquad J_{zO} = 585\cdot 10^6\cdot mm^4$$

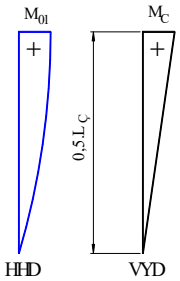
$$W_{zO} := \frac{2\cdot J_{zO}}{b_A\cdot\left(1+k_b\cdot x1\right)} \qquad W_{zO} = 2168\cdot 10^3\cdot mm^3$$

O Kesitinde moment kontrolü:



$w_{O1} = w_{Omax}$ kabul edileceğinden w_{Omax} ı hesaplamaya gerek yoktur.

O Kesitinde sabit ayağın F_E etkili 1. sehim



$$w_{O1x} = \int_0^{\frac{L_{SA}}{2}} \frac{M_{01x}\cdot M_{Cx}}{E\cdot J_{yO}}\,dx$$

$$M_{01x} = F_E\cdot w_{Omax}\cdot f(x1)$$

x1 e bağlı momentler:

$$M_{Cx} = \frac{2\cdot x1}{L_{SA}}\cdot\frac{L_{SA}}{2} = x1$$

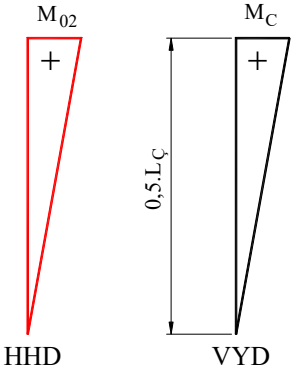
M_{01} dağılımı parabol olursa, parabolün genel formülünde değerleri yerleştirirsek:

$$w_{zO1x} = \int_0^{\frac{L_{SA}}{2}} \frac{\left(-\frac{F_E\cdot w_{Omax}}{L_{SA}^2}\cdot x1^2 - \frac{2\cdot F_E\cdot w_{Omax}}{L_{SA}}\cdot x1\right)\cdot x1}{2\cdot E\cdot\left[\frac{b_A\cdot\left(1+k_b\cdot x1\right)\cdot t^3}{12} + \frac{t\cdot h_A^3\cdot\left(1+k_h\cdot x1\right)^3}{12} + t\cdot b_A\cdot\left(1+k_b\cdot x1\right)\cdot\left[0.5\cdot\left[h_A\cdot\left(1+k_h\cdot x1\right)+t\right]\right]^2\right]}\,dx1$$

$$w_{zO1x} := \int_0^{\frac{L_{SA}}{2}} \frac{\frac{x1^3}{L_{SA}^2} + \frac{2\cdot x1^2}{L_{SA}}}{2\cdot E\cdot\left[\frac{b_A\cdot(1+k_b\cdot x1)\cdot t^3}{12} + \frac{t\cdot h_A^3\cdot(1+k_h\cdot x1)^3}{12} + t\cdot b_A\cdot(1+k_b\cdot x1)\cdot\left[0.5\cdot\left[h_A\cdot(1+k_h\cdot x1)+t\right]\right]^2\right]}\,dx1$$

$$w_{zO1x} = 0.067\cdot\frac{10^{-6}}{N}$$

O Kesitinde sabit ayağın H_F etkili 2. sehim



$$w_{zO2x} = \int_0^{\frac{L_{SA}}{2}} \frac{M_{O2x}\cdot M_{Cx}}{E\cdot J_{yx}}\,dx$$

x1 e bağlı momentler:

$$M_C = \frac{2\cdot x1}{L_{SA}}\cdot\frac{L_{SA}}{2} = x1$$

$$M_{02x} = H_F\cdot x1 = \frac{x1}{L_{SA}}\cdot F_E\cdot w_{Omax}$$

$$w_{zO2x} = \int_0^{\frac{L_{SA}}{2}} \frac{\frac{x1}{L_{SA}}\cdot F_E\cdot w_{Omax}\cdot x1}{E\cdot J_{yx}}\,dx1$$

$$w_{zO2x} = \int_0^{\frac{L_{SA}}{2}} \frac{F_E\cdot w_{Omax}\cdot\frac{x1^2}{L_{SA}}}{2\cdot E\cdot\left[\frac{b_A\cdot(1+k_b\cdot x1)\cdot t^3}{12} + \frac{t\cdot h_A^3\cdot(1+k_h\cdot x1)^3}{12} + t\cdot b_A\cdot(1+k_b\cdot x1)\cdot\left[0.5\cdot\left[h_A\cdot(1+k_h\cdot x1)+t\right]\right]^2\right]}\,dx$$

$F_E\cdot w_{Omax}$ = sabit olduğundan integralin dışına alalım.

$$w_{zO2x} := \left[\int_0^{\frac{L_{SA}}{2}} \frac{\frac{x1^2}{L_{SA}}}{2\cdot E\cdot\left[\frac{b_A\cdot(1+k_b\cdot x1)\cdot t^3}{12} + \frac{t\cdot h_A^3\cdot(1+k_h\cdot x1)^3}{12} + t\cdot b_A\cdot(1+k_b\cdot x1)\cdot\left[0.5\cdot\left[h_A\cdot(1+k_h\cdot x1)+t\right]\right]^2\right]}\,dx\right]$$

$$w_{zO2x} = 0.057\cdot\frac{10^{-6}}{N}$$

$w_{O1} = F_E\cdot w_{Omax}\cdot(w_{zO1x} + w_{zO2x})$ $F_E = F_{kr}$ $w_{O1} = w_{Omax}$ kabul edersek

$$F_{krO} := \frac{1}{w_{zO1x} + w_{zO2x}}$$

$F_{krO} = 8094\cdot kN$ $F_{SAeks} = 334\cdot kN$

O Kesitinde burkulma tehlikesi yoktur.

O Kesitinde mukavemet hesabı

Eylemsizlik radyusu $i_{yO} := \sqrt{\frac{J_{yO}}{A_O}}$ $i_{yO} = 222.3 \cdot mm$

Euler burkulma boyu $L_{ByO} := \sqrt{\frac{E \cdot J_{yO} \cdot \pi^2}{F_{kr}}}$ $L_{ByO} = 25.761\,m$

Akma narinliği

Narinlik $\lambda_{yO} := \frac{L_{ByO}}{i_{yO}}$ $\lambda_{yO} = 115.886$

Bağıntılı narinlik $\lambda_{ByO} := \frac{\lambda_{yO}}{\lambda_{Ef}}$ $\lambda_{ByO} = 1.234$

Merkez noktası mesafesi $k_{elyO} := \frac{W_{yO}}{A_O}$ $k_{elyO} = 179.043 \cdot mm$

Akma kuvveti $F_{plO} := A_O \cdot f_{EM}$ $F_{plO} = 2768.7 \cdot kN$

Burkulma parametresi $\alpha_B = 0.34$ Kaynaklı kutular her eksende.

Max burkulma sehimi $w_{ymaxO} := k_{elyO} \cdot \alpha_B \cdot (\lambda_{ByO} - 0.2)$ $w_{ymaxO} = 62.943 \cdot mm$

Burkulma yardımcı faktörü $\varphi_{ByO} := 0.5 \cdot \left[1 + \alpha_B \cdot (\lambda_{ByO} - 0.2) + \lambda_{ByO}^2\right]$ $\varphi_{ByO} = 1.44$

Azaltma faktörü $\chi_{ByO} := \frac{1}{\varphi_{ByO} + \sqrt{\varphi_{ByO}^2 - \lambda_{ByO}^2}}$ $\chi_{ByO} = 0.460$

Kuvvetin mukavemet emniyeti $S_{FyO} := \frac{F_{xÜ}}{\chi_{ByO} \cdot F_{plO}}$ $S_{FyO} = 0.253$

Eylemsizlik radyusu $i_{zO} := \sqrt{\frac{J_{zO}}{A_O}}$ $i_{zO} = 212.5 \cdot mm$

Euler burkulma boyu $L_{BzO} := \sqrt{\frac{E \cdot J_{zO} \cdot \pi^2}{F_{kr}}}$ $L_{BzO} = 24.631\,m$

Narinlik $\lambda_{zO} := \frac{L_{BzO}}{i_{zO}}$ $\lambda_{zO} = 115.886$

Bağıntılı narinlik $\lambda_{BzO} := \frac{\lambda_{zO}}{\lambda_{Ef}}$ $\lambda_{BzO} = 1.234$

Merkez noktası mesafesi $k_{elzO} := \frac{W_{zO}}{A_O}$ $k_{elzO} = 167.319 \cdot mm$

Max burkulma sehimi $w_{zmaxO} := k_{elzO} \cdot \alpha_B \cdot (\lambda_{BzO} - 0.2)$ $w_{zmaxO} = 58.821 \cdot mm$

Burkulma yardımcı faktörü $\varphi_{BzO} := 0.5 \cdot \left[1 + \alpha_B \cdot (\lambda_{BzO} - 0.2) + \lambda_{BzO}^2\right]$ $\varphi_{BzO} = 1.44$

Azaltma faktörü

$$\chi_{BzO} := \frac{1}{\varphi_{BzO} + \sqrt{\varphi_{BzO}^{2} - \lambda_{BzO}^{2}}} \qquad \chi_{BzO} = 0.460$$

Kuvvetin mukavemet emniyeti

$$S_{FzO} := \frac{F_{xÜ}}{\chi_{BzO} \cdot F_{plO}} \qquad S_{FzO} = 0.253$$

Plastikliğin en küçük momenti

$$M_{plyO} := W_{yO} \cdot f_{EM} \qquad M_{plyO} = 495.7 \cdot kN \cdot m$$

$$M_{yO} := F_{xÜ} \cdot w_{ymaxO} \qquad M_{yO} = 20.246 \cdot kN \cdot m$$

$$M_{yA} := 0 \cdot kN \cdot m$$

$-1 \le \psi_y \le 1$

$$\psi_{yO} := \frac{M_{yA}}{M_{yO}} \qquad \psi_{yO} = 0.000$$

$$\beta_{MyO} := 1.8 - 0.7 \cdot \psi_{yO} \qquad \beta_{MyO} = 1.8$$

$\alpha_{pl} \ge 1$

$$\alpha_{plyO} := \frac{M_{plyO}}{M_{yO}} \qquad \alpha_{plyO} = 24.485$$

$a_y \le 0.8$

$$a_{yxO} := \lambda_{ByO} \cdot \left(2 \cdot \beta_{MyO} - 4\right) + \left(\alpha_{plyO} - 1\right) \qquad a_{yxO} = 22.991$$

$$a_{yO} := \begin{cases} a_{yxO} & \text{if } a_{yxO} \le 0.8 \\ 0.8 & \text{otherwise} \end{cases} \qquad a_{yO} = 0.8$$

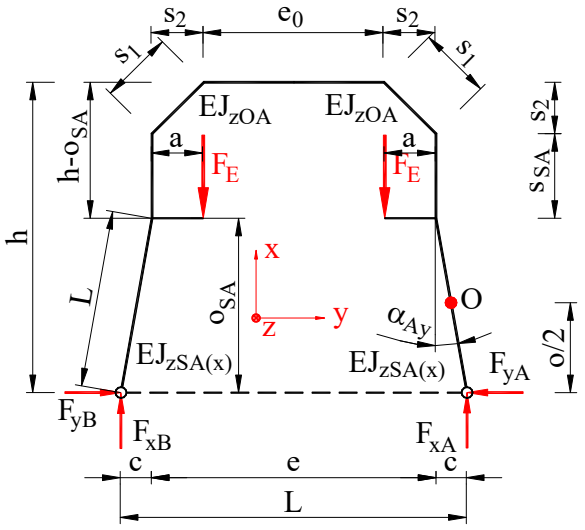
$k_y \le 1{,}5$

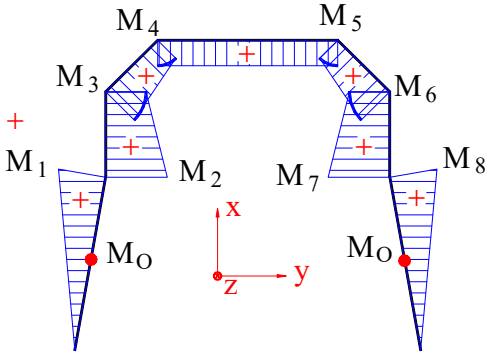
$$k_{yxO} := 1 - \frac{F_{xÜ}}{\chi_{ByO} \cdot F_{plO}} \cdot a_{yO} \qquad k_{yxO} = 0.798$$

$$k_{yO} := \begin{cases} k_{yxO} & \text{if } k_{yxO} \le 1.5 \\ 1.5 & \text{otherwise} \end{cases} \qquad k_{yO} = 0.798$$

$$S_{MyO} := \frac{M_{yO}}{M_{plyO}} \cdot k_{yO} \qquad S_{MyO} = 0.033$$

Eğilme momenti M_{zO}





$M_{zO} := 0.5 \cdot M_{zE}$ $M_{zO} = 42 \cdot kN \cdot m$

Plastikliğin en küçük momenti $M_{plzO} := W_{zO} \cdot f_{EM}$ $M_{plzO} = 463.3 \cdot kN \cdot m$

$-1 \le \psi_z \le 1$ $\psi_{zO} := \frac{M_{zO}}{M_{zO}}$ $\psi_{zO} = 1.000$

$\beta_{MzO} := 1.8 - 0.7 \cdot \psi_{zO}$ $\beta_{MzO} = 1.1$

$\alpha_{pl} > 1$ $\alpha_{plzO} := \frac{M_{plzO}}{M_{zO}}$ $\alpha_{plzO} = 11.053$

$a_{zOx} := \lambda_{BzO} \cdot \left(2 \cdot \beta_{MzO} - 4\right) + \left(\alpha_{plzO} - 1\right)$ $a_{zOx} = 7.831$

$a_{zO} := \begin{cases} a_{zOx} & \text{if } a_{zOx} \le 0.8 \\ 0.8 & \text{otherwise} \end{cases}$ $a_{zO} = 0.8$

$k_{zOx} := 1 - \frac{F_{xÜ}}{\chi_{BzO} \cdot F_{plO}} \cdot a_{zO}$ $k_{zOx} = 0.798$

$k_{zO} := \begin{cases} k_{zOx} & \text{if } k_{zOx} \le 1.5 \\ 1.5 & \text{otherwise} \end{cases}$ $k_{zO} = 0.798$

$S_{MzO} := \frac{M_{zO}}{M_{plzO}} \cdot k_{zO}$ $S_{MzO} = 0.072$

$S_{yO} := \frac{F_{SAeks}}{\chi_{ByO} \cdot F_{plO}} + \frac{M_{yO}}{M_{plyO}} \cdot k_{yO} + \frac{M_{zO}}{M_{plzO}} \cdot k_{zO}$ $S_{yO} = 0.367$

$S_{zO} := \frac{F_{SAeks}}{\chi_{BzO} \cdot F_{plO}} + \frac{M_{yO}}{M_{plyO}} \cdot k_{yO} + \frac{M_{zO}}{M_{plzO}} \cdot k_{zO}$ $S_{zO} = 0.367$

Sonuç: S_{yO} ve S_{zO} değerleri 1 den küçük olduğundan x_1 kesitinin hesaplarına göre konstrüksiyon fonksiyonunu yapar.

O kesitinin emniyetli mukavet değerine göre kontrolü:

$\sigma_{heO} := \frac{F_{SAeks}}{A_O} + \frac{M_{yO}}{W_{yO}} + \frac{M_{zO}}{W_{zO}}$ $\sigma_{heO} = 54 \cdot MPa$ $f_{EM} = 214 \cdot MPa$

$k_{EMO} := \frac{\sigma_{heO}}{f_{EM}}$ $k_{EMO} = 0.25$

E kesitinin emniyetli mukavet değerine göre kontrolü:

$\sigma_{heE} := \frac{F_{SAeks}}{A_E} + \frac{M_{yE}}{W_{yE}} + \frac{M_{zE}}{W_{zE}}$ $\sigma_{heE} = 140 \cdot MPa$ $f_{EM} = 214 \cdot MPa$

$k_{EME} := \frac{\sigma_{heE}}{f_{EM}}$ $k_{EME} = 0.65$

Sonuç: Sistemin emniyetli mukavet değerine göre kontrolündede görüldüğü gibi konstrüksiyon fonksiyonunu yapar.

Sabit ayak ağırlığı:

Tolerans ve kaynak katsayısı $k_{tol} := 1.03$

$b_A = 0.3\,m$ $b_E = 0.78\,m$ $b_{SA} := 0.5\cdot(b_A + b_E)$ $b_{SA} = 0.54\,m$

$A_b := b_{SA}\cdot L_{SA}$ $A_b = 4.212\,m^2$

$h_A = 0.3\,m$ $h_E = 0.78\,m$ $h_{SA} := 0.5\cdot(h_A + h_E)$ $h_{SA} = 0.54\,m$

$A_h := h_{SA}\cdot L_{SA}$ $A_h = 4.212\,m^2$

$F_b := 2\cdot b_{SA}\cdot L_{SA}\cdot t\cdot \rho_{St}\cdot g$ $g = 9.807\,\frac{m}{s^2}$ $F_b = 3890.9\,N$

$F_h := 2\cdot h_{SA}\cdot L_{SA}\cdot t\cdot \rho_{St}\cdot g$ $F_h = 3890.9\,N$

Perde adedi: $n_{Pex} := \frac{L_{SA}}{m} - 1$ $n_{Pex} = 6.8$ $n_{Pe} := 7$

$F_{Pe} := \left[b_{SA} - 2\cdot(b_ç + t)\right]\cdot(h_{SA} - 20\cdot mm)\cdot t\cdot \rho_{St}\cdot n_{Pe}\cdot g$ $F_{Pe} = 854.1\,N$

Alt bağlantı kapağı ağırlık kuvveti:

Konstrüksiyondan: $b_{Ba} := 250\cdot mm$ $h_{Ba} := 400\cdot mm$ $t_{Ba} := 20\cdot mm$

$F_{aBa} := b_{Ba}\cdot h_{Ba}\cdot t_{Ba}\cdot \rho_{St}\cdot g$ $F_{aBa} = 154\cdot N$

Üst bağlantı kapağı ağırlık kuvveti:

Konstrüksiyondan: $b_{Bü} := 1140\cdot mm$ $h_{Bü} := 800\cdot mm$ $t_{Bü} := 20\cdot mm$

$F_{üBa} := b_{Bü}\cdot h_{Bü}\cdot t_{Bü}\cdot \rho_{St}\cdot g$ $F_{üBa} = 1404\cdot N$

Sabit bir ayağın toplam ağırlık kuvveti:

$F_{SAg} := \left(F_b + F_h + F_{Pe} + F_{aBa} + F_{üBa}\right)\cdot k_{tol}$ $F_{SAg} = 10.5\cdot kN$

$m_{SA} := F_{SAg}\cdot g^{-1}$ $m_{SA} = 1071\,kg$

Sabit ayak rüzgar alanı:

y eksenine dik bir ayak alanı: $A_{SAyRüx} := \left(h_{SA} + 2\cdot t\right)\cdot L_{SA}$ $A_{SAyRüx} = 4.306\,m^2$

z eksenine dik bir ayak alanı: $A_{SAzRüx} := b_{SA}\cdot L_{SA}$ $A_{SAzRüx} = 4.21\,m^2$

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