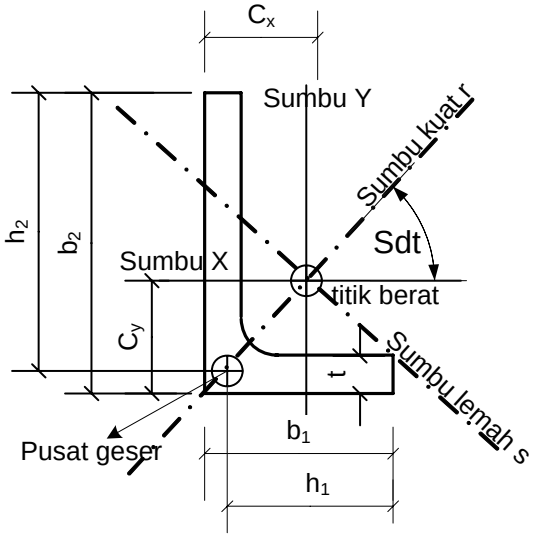
DESAIN TEKAN PROFIL SIKU TIDAK SAMA KAKI YANG ELEMENNYA LANGSING

Satuan : $kN := 1000N$ $MPa := 1\frac{N}{mm^2}$



Panjang Efektif $kLr := 2m$ $kLs := 2m$ $kLz := 2m$

Data Penampang: Profil L40.80.6

Momen Inersia $Ir := 47.6cm^4$ $Is := 4.9cm^4$ $Ix := 44.9cm^4$ $Iy := 7.59cm^4$

Luas Penampang $A := 6.89cm^2$ $sdt := atan(0.259)$ $sdt = 14.521\,deg$

Tinggi total profil $b2 := 80mm$

Lebar sayap $b1 := 40mm$

Tebal profil $t := 6mm$

Jari2 sudut flens-badan $r := 7mm$

Koordinat pusat berat dari tepi atas flens $Cx := 0.88cm$ $Cy := 2.85cm$

Data Bahan $E := 2\cdot10^5 MPa$ $G := \frac{E}{2.6}$ $Fy := 250MPa$ (Bj. 41)

Beban Terfaktor $Pu := 16kN$

Cek kelangsingan penampang $b := \max(b1, b2)$

$\frac{b}{t} = 13.33$

$0.45\sqrt{\frac{E}{Fy}} = 12.73$

$Cek := \begin{cases} \text{"Penampang Tidak Langsing"} & \text{if } \frac{b}{t} \le 0.45\sqrt{\frac{E}{Fy}} \\ \text{"Penampang LANGSING"} & \text{otherwise} \end{cases}$

Cek = "Penampang LANGSING"

$0.91\cdot\sqrt{\frac{E}{Fy}} = 25.739$

$$Qs := \begin{cases} 1.340 - 0.76\cdot\frac{b}{t}\cdot\sqrt{\frac{Fy}{E}} & \text{if } 0.45\cdot\sqrt{\frac{E}{Fy}} < \frac{b}{t} < 0.91\cdot\sqrt{\frac{E}{Fy}} \\ 0.53\cdot\left[\frac{E}{Fy\cdot\left(\frac{b}{t}\right)^2}\right] & \text{if } \frac{b}{t} > 0.91\cdot\sqrt{\frac{E}{Fy}} \end{cases}$$

$Qs = 0.982$

$Qa := 1$ untuk penampang yang semua elemennya "unstiffened"

$Q := Qs\cdot Qa$ $Q = 0.982$

Menghitung kuat tekuk lentur terhadap sumbu utama penampang

$ir := \sqrt{\frac{Ir}{A}}$ $ir = 2.628\,cm$ $is := \sqrt{\frac{Is}{A}}$ $is = 0.843\,cm$

$\lambda := \max\left(\frac{kLr}{ir}, \frac{kLs}{is}\right)$ $\lambda = 237.16$ $Cek := \begin{cases} \text{"OK"} & \text{if } \lambda \le 200 \\ \text{"Tidak OK!"} & \text{otherwise} \end{cases}$

$Cek = \text{"Tidak OK!"}$ karena langsing

$\lambda c := \frac{\lambda}{\pi}\cdot\sqrt{\frac{Fy}{E}}$ $\lambda c = 2.67$ $\lambda c\cdot\sqrt{Q} = 2.644$

$$Fcr1 := \begin{cases} Q\cdot 0.658^{Q\cdot\lambda c^2}\cdot Fy & \text{if } \lambda c\cdot\sqrt{Q} \le 1.5 \\ \frac{0.877}{\lambda c^2}\cdot Fy & \text{if } \lambda c\cdot\sqrt{Q} > 1.5 \end{cases}$$

$\phi c := 0.85$

$Fcr1 = 30.78\,MPa$

$\phi c\cdot A\cdot Fcr1 = 18.025\,kN$

Menghitung Kuat Tekuk Torsi Lentur

$h1 := b1 - 0.5\cdot t$ $h1 = 37\,mm$ $x0 := -Cx + \frac{t}{2}$ $x0 = -0.58\,cm$

$h2 := b2 - 0.5\cdot t$ $h2 = 77\,mm$

$Cw := \frac{1}{36}\left(h1^3\cdot t^3 + h2^3\cdot t^3\right)$ $Cw = 3.043\,cm^6$ $y0 := -Cy + \frac{t}{2}$ $y0 = -2.55\,cm$

$J := \frac{1}{3}\left(h1\cdot t^3 + h2\cdot t^3\right)$ $J = 0.821\,cm^4$

$r_nol := x0\cdot\cos(sdt) + y0\cdot\sin(sdt)$ $r_nol = -12.008\,mm$

$s_nol := -x0\cdot\sin(sdt) + y0\cdot\cos(sdt)$ $s_nol = -23.231\,mm$

$r0 := \sqrt{r_nol^2 + s_nol^2 + \frac{Ir + Is}{A}}$ $r0^2 = 14.459\,cm^2$ (notasi AISC pakai tanda bar dan indeks nol)

$H := 1 - \left(\frac{r_nol^2 + s_nol^2}{r0^2}\right)$ $H = 0.53$

$Fer := \frac{\pi^2 E}{\left(\frac{kLr}{ir}\right)^2}$ $Fer = 340.924\,MPa$ $Fes := \frac{\pi^2 E}{\left(\frac{kLs}{is}\right)^2}$ $Fes = 35.095\,MPa$

$$Fez := \left(\frac{\pi^2 E\,Cw}{kLz^2} + G\cdot J\right)\cdot\frac{1}{A\cdot r0^2} \qquad Fez = 635.3\,MPa$$

Fe diambil dari akar persamaan berikut:

$$f(Fe) := \left[(Fe - Fer)\cdot(Fe - Fes)\cdot(Fe - Fez) - Fe^2\cdot(Fe - Fer)\cdot\left(\frac{s_nol}{r0}\right)^2 - Fe^2\cdot(Fe - Fes)\cdot\left(\frac{r_nol}{r0}\right)^2\right]$$

harga awal untuk iterasi solusi persamaan: $Fe := 30MPa$

$Fe1 := root(f(Fe), Fe)$ $\qquad Fe1 = 34.361\,MPa$

Cek hasil $\qquad f(Fe1) = -6.365\times 10^{-10}\,MPa^3$

$$\lambda e := \sqrt{\frac{Fy}{Fe1}}$$

$$Fcr2 := \begin{cases} \left[\left[\left[0.658^{(Q\cdot\lambda e)^2}\right]\cdot Fy\right]\right] & \text{if } \lambda e\cdot\sqrt{Q} \le 1.5 \\ \left(\frac{0.877}{\lambda e^2}\cdot Fy\right) & \text{otherwise} \end{cases} \qquad Fcr2 = 30.13\,MPa$$

Kuat Desain Batang Tekan ini

$\phi c := 0.85$ $\qquad Fcr := \min(Fcr1, Fcr2)$ $\qquad Fcr = 30.13\,MPa$

$\phi c\cdot Fcr\cdot A = 17.65\,kN$

$$Cek := \begin{cases} \text{"OK"} & \text{if } \phi c\cdot Fcr\cdot A > Pu \\ \text{"Tidak OK"} & \text{otherwise} \end{cases} \qquad \boxed{Cek = \text{"OK"}}$$

Catatan : menurut AISC, khusus untuk profil siku tunggal, ϕc dapat diambil sama dengan 0.9