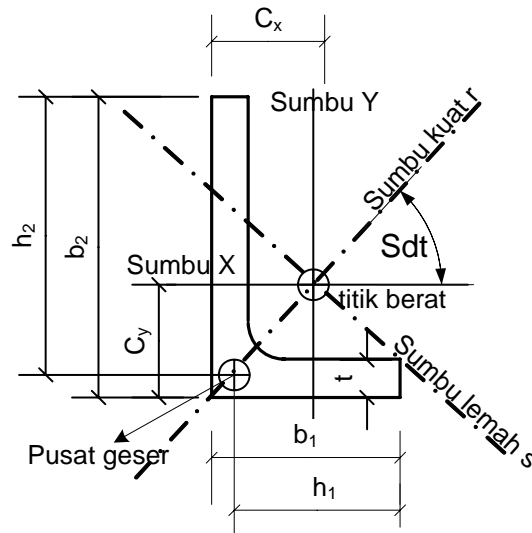


DESAIN TEKAN PROFIL SIKU TIDAK SAMA KAKI YANG ELEMENNYA LANGSING

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



Panjang Efektif $kL_r := 2\text{m}$ $kL_s := 2\text{m}$ $kL_z := 2\text{m}$

Data Penampang: Profil L100.150.10

Momen Inersia $I_r := 47.6\text{cm}^4$ $I_s := 4.9\text{cm}^4$ $I_x := 44.9\text{cm}^4$ $I_y := 7.59\text{cm}^4$

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

Tinggi total profil $b_2 := 80\text{mm}$

Lebar sayap $b_1 := 40\text{mm}$

Tebal profil $t := 6\text{mm}$

Jari2 sudut flens-badan $r := 7\text{mm}$

Koordinat pusat berat dari tepi atas flens $C_x := 0.88\text{cm}$ $C_y := 2.85\text{cm}$

Data Bahan $E := 2 \cdot 10^5 \text{ MPa}$ $G := \frac{E}{2.6}$ $F_y := 250\text{MPa}$ (Bj. 41)

Beban Terfaktor $P_u := 16\text{kN}$

Cek kelangsingan penampang $b := \max(b_1, b_2)$

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

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

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

Cek = "Penampang LANGSING"

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

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

$$Q_s = 0.982$$

$$Q_a := 1 \quad \text{untuk penampang yang semua elemennya "unstiffened"}$$

$$Q := Q_s \cdot Q_a \quad Q = 0.982$$

Menghitung kuat tekuk lentur terhadap sumbu utama penampang

$$i_r := \sqrt{\frac{I_r}{A}} \quad i_r = 2.628 \text{ cm} \quad i_s := \sqrt{\frac{I_s}{A}} \quad i_s = 0.843 \text{ cm}$$

$$\lambda := \max\left(\frac{kL_r}{i_r}, \frac{kL_s}{i_s}\right) \quad \lambda = 237.16 \quad \text{Cek} := \begin{cases} \text{"OK"} & \text{if } \lambda \leq 200 \\ \text{"Tidak OK!"} & \text{otherwise} \end{cases}$$

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

$$\lambda_c := \frac{\lambda}{\pi} \cdot \sqrt{\frac{F_y}{E}} \quad \lambda_c = 2.67 \quad \lambda_c \cdot \sqrt{Q} = 2.644$$

$$F_{cr1} := \begin{cases} Q \cdot 0.658 \left(Q \cdot \lambda_c^2 \right) \cdot F_y & \text{if } \lambda_c \cdot \sqrt{Q} \leq 1.5 \\ \left(\frac{0.877}{\lambda_c^2} \right) \cdot F_y & \text{if } \lambda_c \cdot \sqrt{Q} > 1.5 \end{cases} \quad \phi_c := 0.85$$

$$F_{cr1} = 30.78 \text{ MPa}$$

$$\phi_c \cdot A \cdot F_{cr1} = 18.025 \text{ kN}$$

Menghitung Kuat Tekuk Torsi Lentur

$$h_1 := b_1 - 0.5 \cdot t \quad h_1 = 37 \text{ mm} \quad x_0 := -C_x + \frac{t}{2} \quad x_0 = -0.58 \text{ cm}$$

$$h_2 := b_2 - 0.5 \cdot t \quad h_2 = 77 \text{ mm}$$

$$C_w := \frac{1}{36} (h_1^3 \cdot t^3 + h_2^3 \cdot t^3) \quad C_w = 3.043 \text{ cm}^6 \quad y_0 := -C_y + \frac{t}{2} \quad y_0 = -2.55 \text{ cm}$$

$$J := \frac{1}{3} (h_1 \cdot t^3 + h_2 \cdot t^3) \quad J = 0.821 \text{ cm}^4$$

$$r_{\text{ nol}} := x_0 \cdot \cos(\text{sdt}) + y_0 \cdot \sin(\text{sdt}) \quad r_{\text{ nol}} = -12.008 \text{ mm}$$

$$s_{\text{ nol}} := -x_0 \cdot \sin(\text{sdt}) + y_0 \cdot \cos(\text{sdt}) \quad s_{\text{ nol}} = -23.231 \text{ mm}$$

$$r_0 := \sqrt{r_{\text{ nol}}^2 + s_{\text{ nol}}^2 + \frac{(I_r + I_s)}{A}} \quad r_0^2 = 14.459 \text{ cm}^2 \text{ (notasi AISC pakai tanda bar dan indeks nol)}$$

$$H := 1 - \left(\frac{r_{\text{ nol}}^2 + s_{\text{ nol}}^2}{r_0^2} \right) \quad H = 0.53$$

$$F_{er} := \frac{\pi^2 E}{\left(\frac{kL_r}{i_r}\right)^2} \quad F_{er} = 340.924 \text{ MPa} \quad F_{es} := \frac{\pi^2 E}{\left(\frac{kL_s}{i_s}\right)^2} \quad F_{es} = 35.095 \text{ MPa}$$

$$F_{ez} := \left[\frac{\pi^2 E C_w}{(kL_z)^2} + G \cdot J \right] \cdot \frac{1}{A \cdot r_0^2} \quad F_{ez} = 635.3 \text{ MPa}$$

Fe diambil dari akar persamaan berikut:

$$f(Fe) := \left[(Fe - F_{er}) \cdot (Fe - F_{es}) \cdot (Fe - F_{ez}) - Fe^2 \cdot (Fe - F_{er}) \cdot \left(\frac{s_{nol}}{r_0}\right)^2 - Fe^2 \cdot (Fe - F_{es}) \cdot \left(\frac{r_{nol}}{r_0}\right)^2 \right]$$

harga awal untuk iterasi solusi persamaan: $Fe := 30 \text{ MPa}$

$$Fe1 := \text{root}(f(Fe), Fe) \quad Fe1 = 34.361 \text{ MPa}$$

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

$$\lambda_e := \sqrt{\frac{F_y}{Fe1}}$$

$$F_{cr2} := \begin{cases} \left[0.658^{(Q \cdot \lambda_e)^2} \right] \cdot F_y & \text{if } \lambda_e \cdot \sqrt{Q} \leq 1.5 \\ \left(\frac{0.877}{\lambda_e^2} \cdot F_y \right) & \text{if } \lambda_e \cdot \sqrt{Q} > 1.5 \end{cases} \quad F_{cr2} = 30.13 \text{ MPa}$$

Kuat Desain Batang Tekan ini

$$\phi_c := 0.85 \quad F_{cr} := \min(F_{cr1}, F_{cr2}) \quad F_{cr} = 30.13 \text{ MPa}$$

$$\phi_c \cdot F_{cr} \cdot A = 17.65 \text{ kN}$$

$$Cek := \begin{cases} \text{"OK"} & \text{if } \phi_c \cdot F_{cr} \cdot A > P_u \\ \text{"Tidak OK"} & \text{otherwise} \end{cases}$$

Cek = "OK"

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