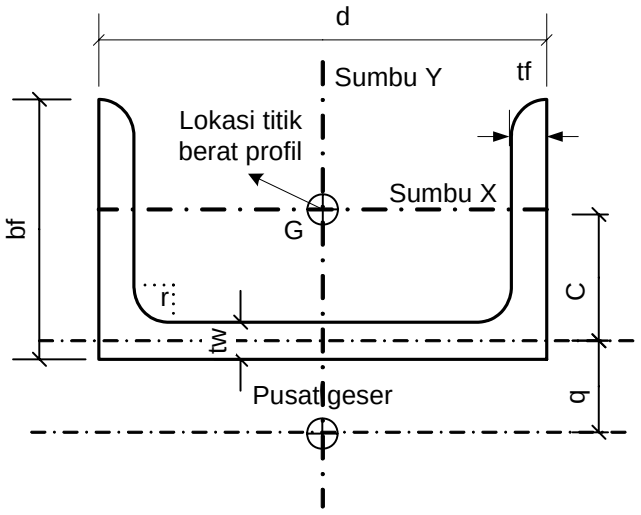
DESAIN TEKAN PROFIL C (Simetri Tunggal)

Ketentuan LRFD: Sumbu simetri penampang harus sumbu y

Satuan : $kN := 1000N$

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



Panjang Efektif

$kLx := 4m \quad kLy := 4m \quad kLz := 4m$

Data Penampang

Profil U Channel 200 x 70

Momen Inersia

$Ix := 113cm^4$

$Iy := 1620cm^4$

Awas hati-hati, nilai momen inersia terbalik dengan nilai dalam tabel, karena sumbu y adalah sumbu simetri

Luas Penampang $A := 26.92cm^2$

Tinggi total profil $d := 200mm$

Tebal sayap $tf := 10mm$

Tebal badan $tw := 7mm$

Lebar sayap $bf := 70mm$

Jari2 sudut flens-badan $r := 0cm$ tidak ada dalam tabel profil

Jarak titik berat dari tepi luar web $C := 1.85cm$ (pusat titik berat)

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

Beban Tekan Terfaktor $Pu := 5000kN$

Cek kelangsingan penampang $h := d - 2\cdot tf - 2r \quad h = 18\,cm$

$\frac{bf}{tf} = 7$ harus $\leq$ $0.56\sqrt{\frac{E}{Fy}} = 15.84$ $\quad \frac{h}{tw} = 25.71$ harus $\leq$ $1.49\sqrt{\frac{E}{Fy}} = 42.14$

$$Cek := \begin{cases} \text{"Penampang LANGSING"} & \text{if } \frac{bf}{2\cdot tf} \geq 0.56\cdot\sqrt{\frac{E}{Fy}} \\ \text{"Penampang LANGSING"} & \text{if } \frac{h}{tw} \geq 1.49\cdot\sqrt{\frac{E}{Fy}} \\ \text{"Penampang TIDAK LANGSING"} & \text{otherwise} \end{cases}$$

Cek = "Penampang TIDAK LANGSING"

Menghitung kuat tekuk lentur untuk sumbu x (sumbu lemah)

$rx := \sqrt{\frac{Ix}{A}} \quad rx = 2.049\,cm$

$\lambda x := \frac{kLx}{rx} \quad \lambda x = 195.235$

$$Cek := \begin{cases} \text{"OK"} & \text{if } \frac{kLx}{rx} \leq 200 \\ \text{"Tidak OK!"} & \text{otherwise} \end{cases}$$

Cek = "OK"

$\lambda c := \frac{kLx}{rx\cdot\pi}\cdot\sqrt{\frac{Fy}{E}} \quad \lambda c = 2.2$

$$Fcrx := \begin{cases} \left(0.658^{\lambda c^2}\right)\cdot Fy & \text{if } \lambda c \leq 1.5 \\ \left(\frac{0.877}{\lambda c^2}\cdot Fy\right) & \text{if } \lambda c > 1.5 \end{cases}$$

$Fcrx = 45.416\,MPa$

Menghitung Kuat Tekuk Torsi Lentur untuk Sumbu Y

Prosedur yang digunakan adalah AISC Appendix E3, AISC Section E3 hanya untuk penampang siku ganda dan T

Besaran penampang yang perlu dihitung:

$h1 := d - tf$ $\quad h1 = 19\,cm$

$xbar := C - 0.5tw$ $\quad xbar = 1.5\,cm$

$b := bf - 0.5tw$ $\quad b = 6.65\,cm$

$$q := \frac{tf \cdot h1^2 \cdot b^2}{4 \cdot Iy} \qquad q = 2.464\,cm$$

$$Cw := \frac{h1^2}{4} \cdot \left(Ix + A \cdot xbar^2 - q \cdot xbar \cdot A\right) \qquad Cw = 6686.5\,cm^6$$

$$J := \frac{1}{3}\left(2 \cdot b \cdot tf^3 + h1 \cdot tw^3\right) \qquad J = 6.606\,cm^4$$

$x0 := 0mm$ $\qquad y0 := q + C - 0.5 \cdot tw$ $\qquad y0 = 3.964\,cm$

$$r0 := \sqrt{x0^2 + y0^2 + \frac{(Ix + Iy)}{A}} \qquad r0^2 = 80.086\,cm^2$$

(notasi AISC pakai tanda bar dan indeks nol)

$$H := 1 - \left(\frac{x0^2 + y0^2}{r0^2}\right) \qquad H = 0.8$$

$$ry := \sqrt{\frac{Iy}{A}} \qquad ry = 7.757\,cm$$

$$\lambda y := \frac{kLy}{ry} \qquad \lambda y = 51.563$$

$$Cek := \begin{cases} \text{"OK"} & \text{if } \frac{kLy}{ry} \le 200 \\ \text{"Tidak OK!"} & \text{otherwise} \end{cases}$$

Cek = "OK"

$$Fey := \frac{\pi^2 E}{\lambda y^2} \qquad Fey = 742.42\,MPa$$

$$Fez := \left[\frac{\pi^2 E\, Cw}{(kLz)^2} + G \cdot J\right] \cdot \frac{1}{A \cdot r0^2} \qquad Fez = 273.95\,MPa$$

$$Fe := \frac{Fey + Fez}{2 \cdot H}\left[1 - \sqrt{1 - \frac{4 \cdot Fey \cdot Fez \cdot H}{(Fey + Fez)^2}}\right] \qquad Fe = 249.24\,MPa$$

$$\lambda e := \sqrt{\frac{Fy}{Fe}} \qquad \lambda e = 1$$

$$Fcry := \begin{cases} \left(0.658^{\lambda e^2}\right) \cdot Fy & \text{if } \lambda e \le 1.5 \\ \left(\frac{0.877}{\lambda e^2} \cdot Fy\right) & \text{if } \lambda e > 1.5 \end{cases} \qquad Fcry = 164.29\,MPa$$

Kuat Desain Batang Tekan ini

$\phi c := 0.85$ $\qquad Fcr := \min(Fcrx, Fcry)$ $\qquad Fcr = 45.42\,MPa$

$\phi c \cdot Fcr \cdot A = 103.92\,kN$

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

Cek = "Tidak OK"