DESAIN TEKAN PROFIL I

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

Panjang Efektif $kLx := 20m$ $kLy := 10m$ $kLz := 20m$

Data Penampang Profil WF400x400x45x70

$Ix := 298000cm^4$ $A := 770.1cm^2$ $bf := 432mm$ $d := 498mm$

$Iy := 94400cm^4$ $tf := 70mm$ $tw := 45mm$ $r := 22mm$

Data Bahan $E := 2\cdot10^5 MPa$ $G := \frac{E}{2.6}$ $Fy := 240MPa$ (Bj. 37)

Beban Terfaktor $PD := 2000kN$ $PL := 4000kN$

$rx := \sqrt{\frac{Ix}{A}}$ $rx = 19.67\,cm$ $ry := \sqrt{\frac{Iy}{A}}$ $ry = 11.07\,cm$

$h := d - 2\cdot tf - 2r$ $h = 31.4\,cm$

$Cw := \frac{Iy\cdot(d - tf)^2}{4}$ $Cw = 4.32 \times 10^7\,cm^6$

$J := \frac{2bf\cdot tf^3 + (d - tf)\cdot tw^3}{3}$ $J = 1.12 \times 10^4\,cm^4$

Besaran Cw dan J dicari untuk digunakan dalam pengecekan tekuk torsional.

Cek kelangsingan penampang

$\frac{bf}{2tf} = 3.09$ harus $\le$ $0.56\sqrt{\frac{E}{Fy}} = 16.17$

$\frac{h}{tw} = 6.98$ harus $\le$ $1.49\sqrt{\frac{E}{Fy}} = 43.01$

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

Cek = "Penampang TIDAK LANGSING"

Menghitung kuat tekuk lentur untuk sumbu x (sumbu lemah)

$\lambda := \max\left(\frac{kLx}{rx}, \frac{kLy}{ry}\right)$ $\lambda = 101.67$

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

$$\lambda c := \frac{\lambda}{\pi}\cdot\sqrt{\frac{Fy}{E}} \qquad \lambda c = 1.12$$

$$Fcr1 := \begin{cases} \left(0.658^{\lambda c^2}\right)\cdot Fy & \text{if } \lambda c \le 1.5 \\ \left(\frac{0.877}{\lambda c^2}\cdot Fy\right) & \text{if } \lambda c > 1.5 \end{cases} \qquad Fcr1 = 141.83\,\text{MPa}$$

Menghitung Kuat Tekuk Torsi Lentur untuk Sumbu Y (Sumbu Kuat)

Tekuk torsional terjadi pada penampang simetri ganda. Untuk profil gilas standar biasanya tidak menentukan. Berikut pengecekan untuk sekedar ilustrasi

$$Fe := \left[\frac{\pi^2 E\,Cw}{(kLz)^2} + G\cdot J\right]\cdot\frac{1}{Ix + Iy} \qquad Fe = 2.25\times 10^3\,\text{MPa}$$

$$\lambda e := \sqrt{\frac{Fy}{Fe}} \qquad \lambda e = 0.33$$

$$Fcr2 := \begin{cases} \left(0.658^{\lambda e^2}\right)\cdot Fy & \text{if } \lambda e \le 1.5 \\ \left(\frac{0.877}{\lambda e^2}\cdot Fy\right) & \text{if } \lambda e > 1.5 \end{cases} \qquad Fcr2 = 229.5\,\text{MPa}$$

Kuat Desain Batang Tekan ini

$\phi c := 0.85$ $\qquad Fcr := \min(Fcr1, Fcr2)$ $\qquad Fcr = 141.83\,\text{MPa}$

$\phi c\cdot Fcr\cdot A = 9.28\times 10^3\,\text{kN}$

$Pu := 1.2\cdot PD + 1.6PL$ $\qquad Pu = 8.8\times 10^3\,\text{kN}$

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

$Cek = \text{"BATANG KUAT"}$