Lampiran 1

Analisis Perencanaan Kolom

Diketahui:

- Dipakai baja dengan jenis BJ-37 (fy = 240 MPa ; fu = 370 MPa)
- Mux sebesar 69 KNm
- Muy sebesar 13 KNm
- Gaya aksial Nu sebesar 1200 KN (kombinasi 1,2 D + 1,6 L)
- Perencanaan kolom mengikuti SNI 03-1729-2002 tentang Tata Cara Perencanaan Struktur Baja Untuk Bangunan Gedung.

Maka:

1. Aksi Penampang Kolom
   a) Kelangsingan Batang
      - Tekuk kearah sumbu-x

        $L_{kx} = k.L$ = 0,71 . (3185) = 2261,35 mm

        $\lambda_c = \frac{L_{kx}}{r_x} = \frac{2261,35}{108}$ = 20,93842593 < 200 **(Memenuhi)**

      - Tekuk kearah sumbu-y

        $L_{ky} = k.L$ = 0,71 . (3185) = 2261,35 mm

        $\lambda_c = \frac{L_{ky}}{r_y} = \frac{2261,35}{62,9}$ = 35,95151033 < 200 **(Memenuhi)**

   b) Kekuatan Nominal Terfaktor Batang Tekan

$$J = 2\left(\frac{B.t_2^3}{3}\right) + \frac{(d-2.t_2).t_1^3}{3}$$

$$= 2\left(\frac{250.13^3}{3}\right) + \frac{(250-2.13).8^3}{3} = 404396 \text{ mm}^4$$

$$r_o^2 = \left(\frac{I_x+I_y}{A}\right).100$$

$$= \left(\frac{9930+3350}{84,70}\right).100 = 15678,86659 \text{ mm}^2$$

$$f_{crz} = \frac{8.10^4.J}{A.r_o^2} = \frac{8.10^4.404396}{8470\ .15678,86659} = 243,6120482$$

- Kearah sumbu-x

$$\lambda_{cx} = \frac{1}{\pi} \cdot \frac{L_{kx}}{r_x} \cdot \left(\sqrt{\frac{f_y}{E}}\right)$$

$$= \frac{1}{\pi} \cdot (20{,}93842593) \cdot \left(\sqrt{\frac{240}{200000}}\right) = 0{,}2308791848$$

Untuk 0,25 < λ_{cx} < 1,2 , maka:

$$\omega_x = \frac{1{,}43}{1{,}6-0{,}67.\lambda_{cx}} = \frac{1{,}43}{1{,}6-0{,}67.(0{,}2308791848)} = 0{,}9894064691$$

Kekuatan nominal batang tekan

$$f_{crx} = \frac{f_y}{\omega_x} = \frac{240}{0{,}9894064691} = 242{,}5696693$$

$$N_{nx} = \left(\frac{f_{crx}+f_{crz}}{2}\right) \cdot \left(1 - \sqrt{1 - \frac{(4.f_{crz}.f_{crx})}{(f_{crz}+f_{crx})^2}}\right) \cdot A$$

$$= \left(\frac{242{,}57+243{,}612}{2}\right) \cdot \left(1 - \sqrt{1 - \frac{(4.243{,}612.242{,}57)}{(243{,}612 + 242{,}57)^2}}\right) \cdot 8470$$

= 2054567,9 N = 2054,5679 kN

Kekuatan nominal terfaktor

$N_{ux} = \emptyset N_{nx}$

N_{ux} = 0,85 . (2054,5679 kN)

= 1746,382715 kN > N_u = 1200 kN **(Memenuhi)**

- Kearah sumbu-y

$$\lambda_{cy} = \frac{1}{\pi} \cdot \frac{L_{ky}}{r_y} \cdot \left(\sqrt{\frac{f_y}{E}}\right)$$

$$= \frac{1}{\pi} \cdot (35{,}95151033) \cdot \left(\sqrt{\frac{240}{200000}}\right) = 0{,}3964221296$$

Untuk 0,25 < λ_{cy} < 1,2 , maka:

$$\omega_y = \frac{1{,}43}{1{,}6-0{,}67.\lambda_{cy}} = \frac{1{,}43}{1{,}6-0{,}67.(0{,}3964221296)} = 1{,}071644956$$

Kekuatan nominal batang tekan

$f_{cry} = \frac{f_y}{\omega_y} = \frac{240}{1{,}071644956}$ = 223,9547703

$N_{ny} = \left(\frac{f_{cry}+f_{crz}}{2}\right).\left(1-\sqrt{1-\frac{(4.f_{crz}.f_{cry})}{(f_{crz}+f_{cry})^2}}\right).A$

$= \left(\frac{223{,}96+243{,}612}{2}\right).\left(1-\sqrt{1-\frac{(4.243{,}612.223{,}96)}{(243{,}612+223{,}96)^2}}\right).8470$

= 1896941,2 N = 1896,9412 kN

Kekuatan nominal terfaktor

$N_{uy} = \emptyset N_{ny}$

N_{uy} = 0,85 . (1896,9412 kN)

= 1612,40002 kN > N_u = 1200 kN **(Memenuhi)**

2. Cek Berdasarkan FLB

λ $= \frac{b}{t} = \frac{125}{13} = 9{,}615384615$

λ_p $= \frac{170}{\sqrt{f_y}} = \frac{170}{\sqrt{240}} = 10{,}97345281$

Karena nilai $\lambda < \lambda_p$, maka termasuk Penampang Kompak

Z_x $= t_1.\frac{h^2}{4} + (b-t_1).(h-t_2).t_2$

$= 8.\frac{250^2}{4} + (250-8).(250-13).13$

= 870602 mm^3

Z_y $= t_2.\frac{h^2}{2} + (h-2.t_2).\frac{t_1^2}{4}$

$= 13.\frac{250^2}{2} + (250-2.13).\frac{8^2}{4}$

= 409834 mm^3

- Arah x

M_{px} $= Z_x . f_y$

$= 870602 . 240 . 10^{-6}$

= 208,94448 kNm

ϕM_{nx} = ϕM_{px}

= 0,9 . 208,94448

= 188,050032 kNm > M_{ux} = 69 kNm **(Memenuhi)**

- Arah y

M_{py} = Z_y . f_y

= $409834 . 240 . 10^{-6}$

= 98,36016 kNm

ϕM_{ny} = ϕM_{py}

= 0,9 . 98,36016

= 88,524144 kNm > M_{uy} = 13 kNm **(Memenuhi)**

3. Cek Berdasarkan LTB

I_w = $\frac{I_y}{2} . \frac{h^2}{2} = \frac{33500000}{2} . \frac{250^2}{2}$ = 5,234375. 10^{11} mm^6

x_1 = $\frac{\pi}{S_x} . \sqrt{\frac{E.G.J.A}{2}} = \frac{\pi}{801000} . \sqrt{\frac{200000 . 80000 .404396 .8470}{2}}$

= 20530,87604 MPa

x_2 = $4 . \left(\frac{S_x}{G . J}\right)^2 . \frac{I_w}{I_y} = 4 . \left(\frac{801000}{80000 . 404396}\right)^2 . \frac{5,234375 .10^{11}}{33500000}$

= 3,831345993. 10^{-5} mm^4/N^2

f_L = $f_y - f_r$ = 240 – 70 = 170 MPa

L_p = $1,76 . r_y . \sqrt{\frac{E}{f_y}}$

= $1,76 . (62,9) . \sqrt{\frac{200000}{240}} . 10^{-3}$ = 3,19574921 m

Karena L ≤ L_p , maka:

M_n = M_p

- Arah x

M_{nx} = M_{px}

= 208,94448 kNm > M_{ux}= 69 kNm **(Memenuhi)**

- Arah y

M_{ny} = M_{py}

= 98,36016 kNm > M_{uy}= 13 kNm **(Memenuhi)**

4. Faktor Pembesaran Momen

- Arah x

N_{cr} = $\frac{\pi^2 E A_g}{\left(\frac{k_c L}{r_x}\right)^2}$

= $\frac{\pi^2.200000.\ 8470}{\left(\frac{0{,}8\ .3185}{108}\right)^2}\ .10^{-3}$ = 30037,36383 kN

Dengan beban tranversal untuk komponen struktur dengan ujung sederhana $c_m = 1{,}00,$ maka:

δ_b = $\frac{C_m}{1-\left(\frac{N_u}{N_{cr}}\right)} \geq 1{,}0$

= $\frac{1{,}00}{1-\left(\frac{1200}{30037{,}36383}\right)}$

δ_b = 1,004161268 ≥ 1,0 **(Memenuhi)**

- Arah y

N_{cr} = $\frac{\pi^2 E A_g}{\left(\frac{k_c L}{r_y}\right)^2}$

= $\frac{\pi^2.200000.\ 8470}{\left(\frac{0{,}8\ .3185}{62{,}9}\right)^2}\ .10^{-3}$ = 10188,6254 kN

Dengan beban tranversal untuk komponen struktur dengan ujung sederhana $c_m = 1{,}00,$ maka:

δ_b = $\frac{C_m}{1-\left(\frac{N_u}{N_{cr}}\right)} \geq 1{,}0$

= $\frac{1{,}00}{1-\left(\frac{1200}{10188{,}6254}\right)}$

δ_b = 1,133502059 ≥ 1,0 **(Memenuhi)**

5. Interaki Momen Aksial

- Arah x

$\frac{N_u}{\emptyset N_{nx}}$ $= \frac{1200}{1746{,}382715\ \text{kN}} = 0{,}6871346067 \geq 0{,}2$

M_{ux} $= \delta_b \, . M_{ux} = 1{,}004161268 \, .(69) = 69{,}28712749$ kNm

M_{uy} $= \delta_b \, . M_{uy} = 1{,}004161268 \, .(13) = 13{,}05409648$ kNm

Maka:

IMA $= \frac{N_u}{\emptyset N_n} + \frac{8}{9} \, . \left(\frac{M_{ux}}{\emptyset_b M_{nx}} + \frac{M_{uy}}{\emptyset_b M_{ny}} \right)$

$= \frac{1200}{(1746{,}382715)} + \frac{8}{9} \left(\frac{69{,}28712749}{188{,}050032} + \frac{13{,}05409648}{88{,}524144} \right)$

$= 1{,}145724989 > 1{,}0$ **(Tidak Memenuhi)**

PROFIL WF 250.250.8.13 TIDAK MEMENUHI.