BAB IV
PERENCANAAN ATAP

Perencanaan atap meliputi, perencanaan gording, perencanaan sagrod, dan perencanaan rangka baja atap, dengan metoda LRFD 2000. Perencanaan atap disajikan dalam Gambar 4.1.

4.1 Perencanaan Gording

4.1.1 Pembebanan Gording

Pembebanan gording terdiri dari:

a. Beban Mati (D)

- Penutup atap genting, reng dan usuk bidang miring : 0,5 kN/m^2 x 2,197 m = 1,099 kN/m
- Berat gording sendiri C 6 x 10,5 : = 0,153 kN/m +

q_D = 1,252 kN/m

b. Beban hidup (L)

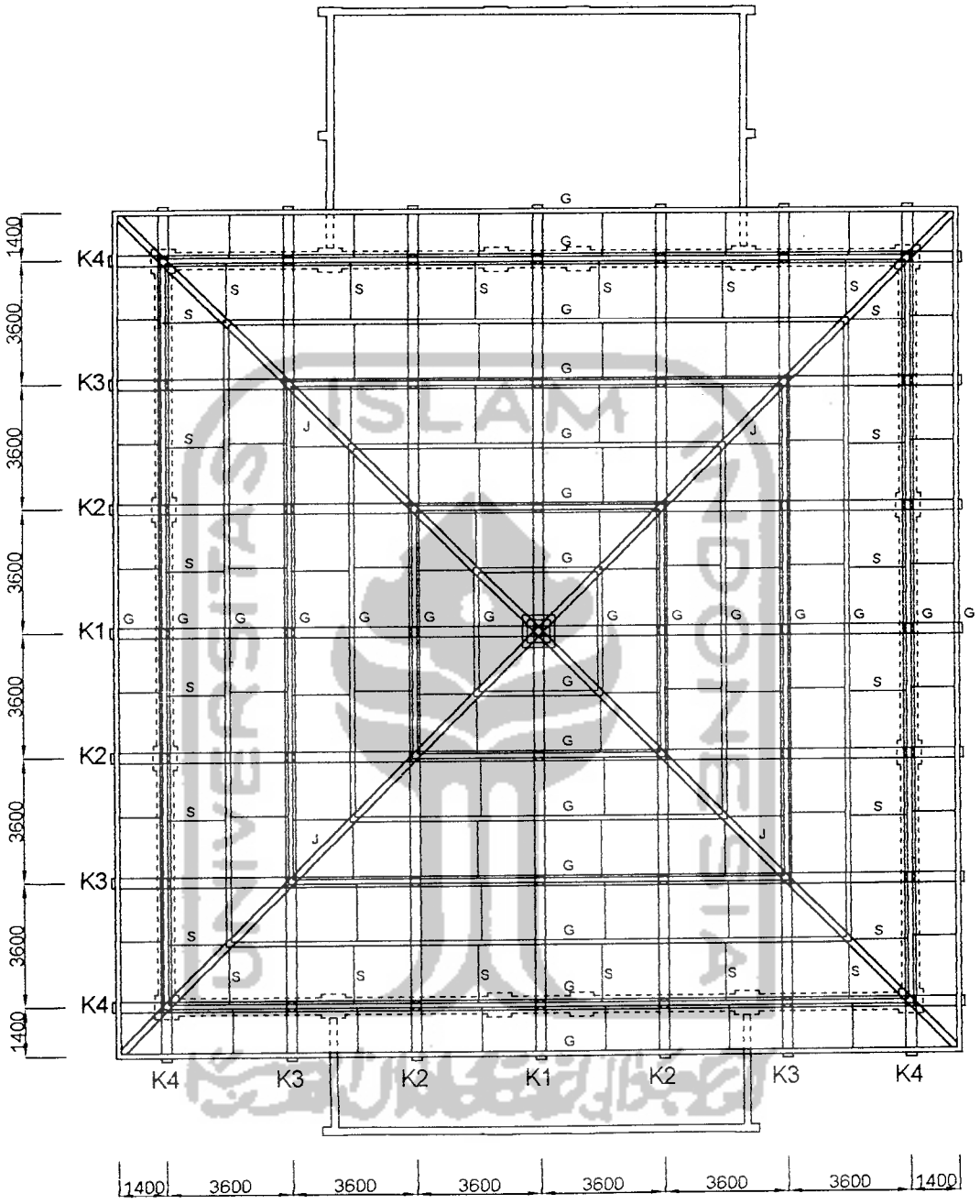
- Beban pekerja pada atap : P_L = 1 kN

c. Beban Air Hujan (H)

- Beban air hujan : q_H = (40-0,8.α) kg/m^2 x 2,197 m = 26,364 kg/m
  = 0,264 kN/m

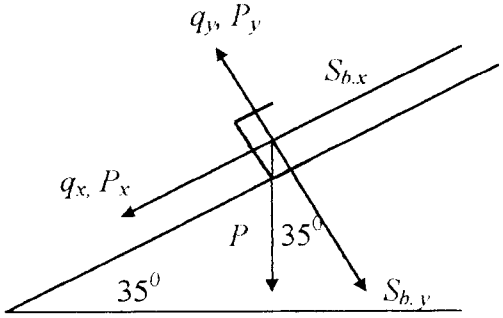
d. Beban Angin (W)

- Tiup angin : $q_{W,tiup}$ = (0,02 .α-0,4) x 60 kg/m^2 x 2,197 m = 39,546 kg/m
  = 0,396 kN/m
- Hisap angin : $q_{W,hisap}$ = - 0,4 x 60 kg/m^2 x 2,197 m = -52,728 Kg/m
  = -0,527 KN/m



Gambar 4.1 Perencanaan atap (Skala 1 : 200)

Keterangan:
K : Kuda-kuda
G : Gording
S : Sagrog
J : Jurai



Gambar. 4.2 Arah pembebanan gording

Tabel. 4.1 Pembebanan dan Momen Arah Sumbu x dan Sumbu y Gording

No	Jenis Pembebanan	q_x / P_x	q_y/P_y	M_x	M_y
		(1)	(2)	(3)	(4)
1	Beban Mati (D)	q_x = 0,718	q_y = 1,026	1,163	1,662
2	Beban Hidup (L)	P_x = 0,574	P_y = 0,819	0,517	0,737
3	Beban Hujan (H)	q_x = 0,115	q_y = 0,164	0,186	0,266
4	Beban Angin (W)				
	- Tiup	0	q_y = 0,396	0	0,641
	- Hisap	0	q_y = -0,527	0	-0,854

Keterangan Tabel 4.1:

(1) Pembebanan sejajar gording: $q_x = q\ .sin\ 35^0$ (kN/m: untuk beban merata)

$P_x = P\ .sin\ 35^0$ (kN: untuk beban terpusat)

(2) Pembebanan tegak lurus gording: $q_y = q\ cos\ 35^0$ (kN/m: untuk beban merata)

$P_y = P\ .cos\ 35^0$ (kN: untuk beban terpusat)

(3) Momen sejajar gording: $M_x = 1/8.q_x.L^2$ (kNm: untuk beban merata)

$M_x = ¼.\ P_x L$ (kNm: untuk beban terpusat)

(4) Momen tegak lurus gording: $M_y = 1/8.q_y.L^2$ (kNm: untuk beban merata)

$M_y = ¼.\ P_y L$ (kNm: untuk beban terpusat)

dengan : L = 3,6 m

Tabel. 4.2 Kombinasi Pembebanan LRFD

No.	Kombinasi	$M_{u,x}$ (kNm)	$M_{u,y}$ (kNm)
1	1,4 M_D	1,628	2,327
2	1,2 M_D + 0,5M_L	1,654	2,363
2	1,2 M_D + 0,5 M_H	1,490	2,127
3	1,2 M_D + 1,6 M_L + 0,8 $M_{W,tiup}$	**2,223**	**3,686**
4	1,2 M_D + 1,6 M_L + 0,8 $M_{W,hisap}$	2,223	2,490
5	1,2 M_D + 1,3 $M_{W,tiup}$+ 0,5 M_L	1,654	3,196
6	1,2 M_D + 1,3 $M_{W,hisap}$ + 0,5 M_L	1,654	1,474

4.1.2 Pendimensian Gording

a. Tinjauan searah sumbu x (sejajar gording)

$M_{u,x}$ = 2,223 kNm (kombinasi maksimum)

Diambil mutu baja f_y = 240 MPa, asumsi penampang kompak

Kekuatan desainnya adalah : $\phi_b . Z_x . F_y \geq M_{u,x}$

Z_x (yang diminta) = $\frac{M_{u,x}}{\phi_b . f_y} = \frac{2,223 \,.\, 10^6}{0,9 \,.\, 240}$ = 10291,67 mm^3 = 0,628 in^3

Pilih profil dari tabel LRFD

coba C 6 x 10,5 Z_x = 1,15 in^3 = 18845,12 mm^3 > 10291,67 mm^3 - aman -

Cek batas penampang kompak untuk C Shape

- Untuk sayap

$\lambda = \frac{b_f}{t_f} = \frac{51,6636}{8,7122} = 5,93 < \lambda_p = \frac{170}{\sqrt{f_y}} = \frac{170}{\sqrt{240}} = 10,97$ - aman -

- Untuk badan

$\lambda = \frac{h_c}{t_w} = \frac{111,125}{7,9756} = 13,93 < \lambda_p = \frac{1680}{\sqrt{f_y}} = \frac{1680}{\sqrt{240}} = 108,44$ -aman-

b. Tinjauan searah sumbu y (tegak lurus gording)

$M_{u,y}$ = 3,686 kNm (kombinasi pembebanan maksimum)

Kekuatan desainnya adalah: $\phi_b . Z_x . f_y \geq M_{u,y}$

Z_x (yang diminta) = $\frac{M_{u,y}}{\phi_b . f_y} = \frac{3,686 . 10^6}{0,9 . 240}$ = 17064,81 mm^3

Z_x profil = 100780,44 mm^3 > 17064,81 mm^3 - Ok –

c. Cek lendutan sejajar gording

Cek lendutan sejajar gording:

- $q_x = 1{,}2.qD_x + 1{,}6.qL_x = 1{,}2.0{,}718 + 1{,}6.0 = 0{,}862$ kN/m (kombinasi maks.)
- $P_x = 1{,}2.PD_x + 1{,}6.PL_x = 1{,}2.0 + 1.6.0{,}574$ kN = 0,918 kN (kombinasi maks)
- Panjang gording L = 3600 mm
- E = 200.000 MPa
- Iy = 0,866 in^4 = 360456,4 mm^4

$$\Delta_x = \frac{5.q_x.L^4}{384.E.I_y} + \frac{P_x.L^3}{48.E.I_y}$$

$$= \frac{5.\ 0{,}862.3600^4}{384.\ 200000.\ 360456{,}4} + \frac{0{,}918.10^3.3600^3}{48.\ 200000.\ 360456{,}41}$$

$$= 26{,}15 + 12{,}37$$

$$= 38{,}52 \text{ mm} > L/360 = 3600/360 = 10 \text{ mm}$$ - tidak aman -

- Perlu dipasang sagrod pada tengah bentang gording sehingga

L= 3600/2 = 1800 mm

- Cek kembali Lendutan sejajar gording

$$\Delta_x = \frac{5.q_x.L^4}{384.E.I_y} + \frac{P_x.L^3}{48.E.I_y}$$

$$= \frac{5.\ 0{,}862\ .\ 1800^4}{384.\ 200000.\ 360456{,}41} + \frac{0{,}918\ .\ 10^3.\ 1800^3}{48.\ 200000.\ 360456{,}41}$$

$$= 1{,}63 + 1{,}55$$

$$= 3{,}18 \text{ mm} < L/360 = 1800/360 = 5 \text{ mm}$$ - aman –

Cek lendutan tegak lurus gording

- $q_y = 1{,}2q.D_y + 1{,}6q.L_y + 0{,}8.qW_{y,tiup} = 1{,}2.1{,}026 + 1{,}6.0 + 0{,}8.0{,}396$
  $= 1{,}548$ kN/m (kombinasi maks.)
- $P_y = 1{,}2.PD_y + 1{,}6.PL_y + 0{,}8.PW_{y,tiup} = 1{,}2.0 + 1{,}6.0{,}819 + 0{,}8.0$
  $= 1{,}310$ kN (kombinasi maks.)
- Panjang gording L = 3600 mm
- E = 200.000 MPa
- I_x = 15,2 in^4 = 6326717,67 mm^4

$$\Delta_y = \frac{5.q_y.L^4}{384.E.I_x} + \frac{P_y.L^3}{48.E.I_x}$$

$$= \frac{5.\ 1{,}548\ .\ 3600^4}{384.\ 200000.\ 6326717{,}67} + \frac{1{,}310\ .\ 10^3.\ 3600^3}{48.\ 200000.\ 6326717{,}67}$$

= 2,673 + 1,053

= 3,726 mm < L/360 = 3600/360 = 10 mm - aman –

Profil C 6 x 10,5 dapat dipakai dengan memasang sagrod ditengah bentang gording

4.2 Perencanaan Sagrod

4.2.1 Pembebanan Sagrod

a. Beban Mati (D)

-Beban penutup atap : 0,5 kN/m^2 x 13,184 m x 3,6 m = 23,73 kN

- Beban gording : 0,153 kN/m^2 x 3,6 m x 6 m = 3,31 kN

- Beban sagrod taksiran : 0,05 kN/m^2 x 13,118 m = 0,66 kN +

P_D = 27,70 kN

b. Beban Hidup (L)

- Beban pekerja : P_L = 1 kN x 6 pekerja tiap gording = 6 kN

d. Beban Hujan (H)

- Beban hujan: P_H = 0,264 kN/m^2 x 13,184 m x 3,6 m = 9,4925 kN

Kombinasi pembebanan terbesar

$N_u = 1{,}2\ P_D + 1{,}6\ P_L + 0{,}5\ P_H$

= 1,2 . 27,7004 + 1,6 . 6 + 0,5 . 9,4925

= 47,5867 kN

$N_{u,x} = 47{,}5867.sin\ 35^0 = 27{,}2946$ kN

4.2.2 Pendimensian Sagrod

$N_u \leq \phi N_n$

$N_u \leq 0{,}90.A_g.f_y$

$A_g = \dfrac{N_{u,x}}{0{,}9\ .\ f_y} = \dfrac{27{,}2946\ .\ 10^3}{0{,}9.\ 240} = 226{,}36$ mm^2

$A_g = ¼\ \pi D^2$

$126{,}36 = ¼\ .\pi D^2$

D = 12,68 mm , diambil D = 16,93 mm = 2/3 inch

A_g profil = ¼. π. 16,93^2 = 225,115 mm^2 > 126,36 mm^2 - aman -

berat sendiri = 78,5 kN/m^3 x 225,115.10^{-6} m^2

= 0,022 kN/m < berat taksiran = 0,05 kN/m –aman-

4.3 Perencanaan Kuda-Kuda Rangka Baja

Perencanaan kuda-kuda rangka baja meliputi, pembebanan kuda-kuda, analisis struktur, gaya batang rencana, pendimensian, dan perencanaan sambumgan titik buhul. Jenis kuda-kuda yang direncanakan disajikan dalam Gambar 4.3 s/d Gambar 4.6.

4.3.1 Perencanaan Pembebanan Kuda-Kuda

1. Perencanaan Berat Sendiri Kuda-Kuda

Profil rangka baja di rencanakan terlebih dahulu untuk mendapatkan berat sendiri, disajikan pada Tabel 4.3 berikut ini.

Tabel 4.3 Berat Sendiri Profil Rangka Baja Kuda-Kuda

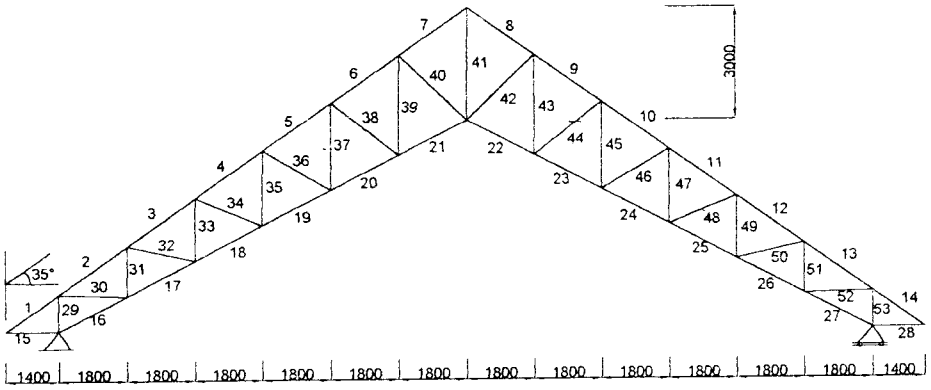
Nama Batang	Profil	Berat (q) (kN/m)
Batang atas (a)	2.80.80.8	0,1932
Batang bawah (b)	2.70.70.7	0,1476
Batang diagonal (d)	2.60.60.6	0,1084
Batang pertemuan (vp)	O d = 3", t = 4 mm	0,0713
Batang vertikal (v)	2.50.50.5	0,0754

a. Perencanaan Beban sendiri Kuda-Kuda K1

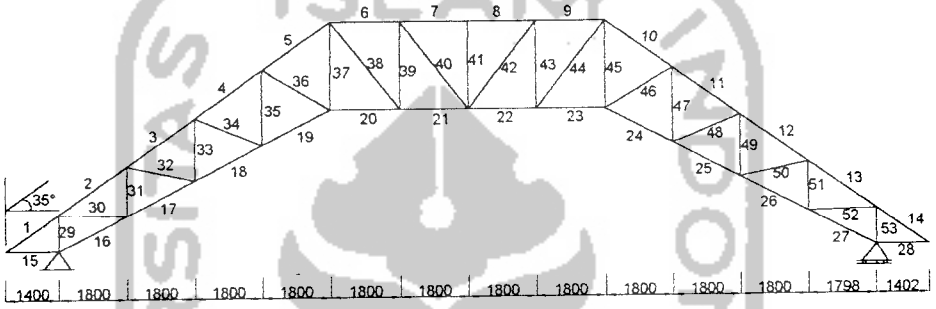
Beban sendiri kuda-kuda K1 disajikan pada Tabel 4.4 berikut ini.

Tabel 4.4 Beban Sendiri Total Kuda-Kuda K1

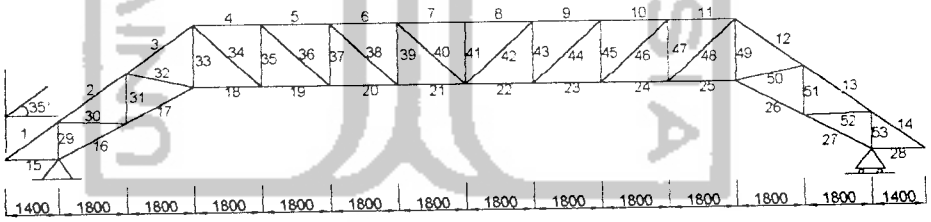
Nama Batang	(L) Panjang (m)	$P = q$ x L (kN)
Atas (a)	29,782	5,75
Bawah (b)	27,076	4,00
Diagonal (d)	24,924	2,70
Vertikal (v)	11,94	0,90
Vertikal pertemuan (vp)	12,918	0,92
	P total =	14,27 kN



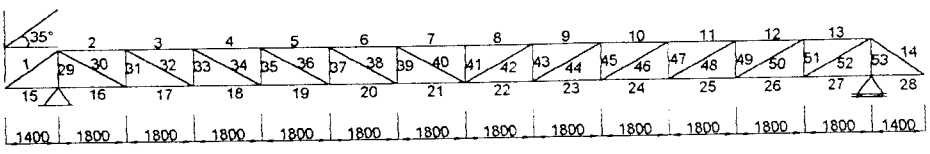
Gambar 4.3 Perencanaan Kuda-Kuda Rangka Baja K1



Gambar 4.4 Perencanaan Kuda-Kuda Rangka Baja K2



Gambar 4.5 Perencanaan Kuda-Kuda Rangka Baja K3



Gambar 4.6 Perencanaan Kuda-Kuda Rangka Baja K4

$P_{\text{profil+plat buhul}}$ = 14,27 x 1,25 = 17,84 kN

- Beban titik masing-masing joint oleh berat sendiri

  $Pk1$ = 17,84/15 = 1,19 kN

- P jurai = (L x q).1,25 = 1.25(6,2152 x 0,1502) = 0,94 kN

- $P'k1 = Pk1 + P$ jurai = 1,19 + 1,18 = 2,37 kN

b. Perencanaan Beban Sendiri Kuda-Kuda K2

Beban sendiri kuda-kuda K2 disajikan pada Tabel 4.5, berikut ini

Tabel 4.5 Beban Sendiri Total Kuda-Kuda K2

Nama Batang	(L) Panjang (m)	$P = q$ x L (kN)
Atas (a)	28,194	5,45
Bawah (b)	26,184	3,85
Diagonal (d)	27,118	2,94
Vertikal (v)	11,266	0,85
Vertikal pertemuan (vp)	12,244	0,87
	P total =	13,96 kN

$P_{\text{profil+plat buhul}}$ = 13,96 x 1,25 = 17,45 kN

- Beban titik masing-masing joint oleh berat sendiri

  $Pk1$ = 17,45/15 = 1,16 kN

- P jurai = (L x q).1,25 = 1.25(6,2152 x 0,1502) = 1,18 kN

- $P'k1 = Pk1 + P$ jurai = 1,16 + 1,18 = 2,34 kN

c. Perencanaan Beban Sendiri Kuda-Kuda K3

Beban sendiri kuda-kuda K3 disajikan pada Tabel 4.6 berikut ini.

Tabel 4.6 Beban Sendiri Total Kuda-Kuda K3

Nama Batang	(L) Panjang (m)	$P = q$ x L (kN)
Atas (a)	26,606	5,14
Bawah (b)	25,292	3,73
Diagonal (d)	26,838	2,91
Vertikal (v)	9,246	0,70
Vertikal pertemuan (vp)	10,225	0,73
	P total =	13,21 kN

$P_{\text{profil+plat buhul}}$ = 13,21 x 1,25 = 16,51 kN

- Beban titik masing-masing joint oleh berat sendiri

  $Pk1$ = 16,51/15 = 1,10 kN
- P jurai = (L x q).1,25 = 1.25(6,2152 x 0,1502) = 1,18 kN
- $P'k1 = Pk1 + P$ jurai = 1,10 + 1,18 = 2,28 kN

d. Perencanaan Beban Sendiri Kuda-Kuda K4

Beban sendiri kuda-kuda K4 disajikan pada Tabel 4.7 berikut ini

Tabel 4.7 Beban Sendiri Total Kuda-Kuda K4

Nama Batang	(L) Panjang (m)	$P = q$ x L (kN)
Atas (a)	25,018	4,83
Bawah (b)	24,4	3,60
Diagonal (d)	24,588	2,67
Vertikal (v)	5,88	0,44
Vertikal pertemuan (vp)	6,86	0,49
	P total =	12,03 kN

$P_{\text{profil+plat buhul}}$ = 12,03 x 1,25 = 15,04 kN

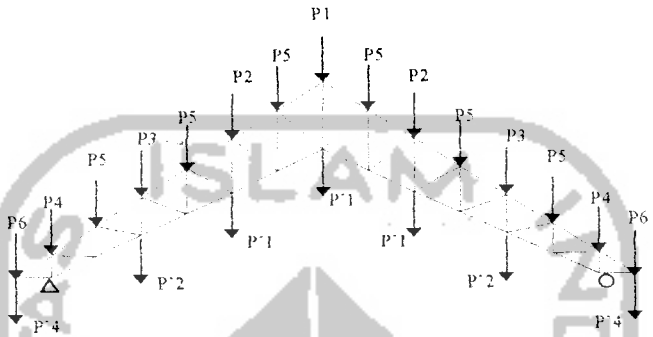
- Beban titik masing-masing joint oleh berat sendiri

  $Pk1$ = 15,04/15 = 1,0 kN
- P jurai = (L x q).1,25 = 1.25(5,5246 x 0,1502) = 1,04 kN

- $P'k1 = Pk1 + P$ jurai = 1,0 + 1,04 = 1,04 kN

2. Perencanaan Beban Mati Kuda-Kuda

a. Perencanaan Beban Mati Kuda-Kuda K1



Gambar 4.7 Perencanaan beban mati kuda-kuda K1

1. Beban titik $P1$

- Berat sendiri: $2 . P'K1 = 2.2,37 = 4,74$ kN
- Berat penutup atap: $0,5 . (2,197 . 3,6)/2 = 1,98$ kN
- Berat gording: $0,153 . 3,6.1,25 = 0,69$ kN
- Berat sagrod: $0,022 . 2,197.2.1,25 = 0,121$ kN +

$P1 = 7,531$ kN

2. Beban titik $P2$

- Berat sendiri: $PK1 + PK2 = 1,19 + 1,16 = 2,35$ kN
- Berat penutup atap: $0,5 . 2,197. 3,6 = 3,95$ kN
- Berat gording: $0,153 . 3,6.1,25 = 0,69$ kN
- Berat sagrod: $0,022 . 2,197.2.1,25 = 0,121$ kN +

$P2 = 7,111$ kN

3. Beban titik $P3$

- Berat sendiri: $PK1 + PK3 = 1,19 + 1,10 = 2,29$ kN
- Berat penutup atap: $0,5 . 2,197. 3,6 = 3,95$ kN
- Berat gording: $0,153 . 3,6.1,25 = 0,69$ kN
- Berat sagrod: $0,022 . 2,197.2.1,25 = 0,121$ kN +

$P3 = 7{,}051$ kN

4. Beban titik $P4$

- Berat sendiri: $PK1 + PK4 = 1{,}19 + 1{,}00 = 2{,}19$ kN
- Berat penutup atap: $0{,}5 \cdot 2{,}197 \cdot 3{,}6 = 3{,}95$ kN
- Berat gording: $0{,}153 \cdot 3{,}6 \cdot 1{,}25 = 0{,}69$ kN
- Berat sagrod: $0{,}022 \cdot 1{,}953 \cdot 2 \cdot 1{,}25 = \underline{0{,}054 \text{ kN}} +$

$P4 = 6{,}884$ kN

5. Beban titik $P5$

- Berat sendiri: $PK1 = 1{,}19$ kN
- Berat penutup atap: $0{,}5 \cdot 2{,}197 \cdot 3{,}6 = 3{,}95$ kN
- Berat gording: $0{,}153 \cdot 3{,}6 \cdot 1{,}25 = 0{,}69$ kN
- Berat sagrod: $0{,}022 \cdot 2{,}197 \cdot 2 \cdot 1{,}25 = \underline{0{,}121 \text{ kN}} +$

$P5 = 5{,}951$ kN

6. Beban titik $P6$

- Berat sendiri: $PK1 = 1{,}19$ kN
- Berat penutup atap: $0{,}5 \cdot 1{,}099 \cdot 3{,}6 = 1{,}99$ kN
- Berat gording: $0{,}153 \cdot 3{,}6 \cdot 1{,}25 = 0{,}69$ kN
- Berat sagrod: $0{,}022 \cdot 0{,}855 \cdot 2 \cdot 1{,}25 = \underline{0{,}047 \text{ kN}} +$

$P6 = 3{,}917$kN

7. Beban titik $P'1$

- Langit-langit (rusuk-rusuk kayu dan asbes) :

  $= 0{,}11$ x Luas pembebanan $= 0{,}11 \times 3{,}6 \times 3{,}6 = 1{,}426$ kN
- Penggantung baja (d =3/4") $= 0{,}022 \times 5{,}541 = \underline{0{,}122 \text{ kN}} +$

$P'1 = 1{,}548$ kN

8. Beban titik $P'2$

- Langit-langit (rusuk-rusuk kayu dan asbes) :

  $= 0{,}11$ x Luas pembebanan $= 0{,}11 \times 3{,}6 \times 5{,}4 = 2{,}138$ kN
- Penggantung baja (d =3/4") $= 0{,}022 \times 1{,}848 = \underline{0{,}041 \text{ kN}} +$

$P'2 = 2{,}179$ kN

9. Beban titik $P'4$

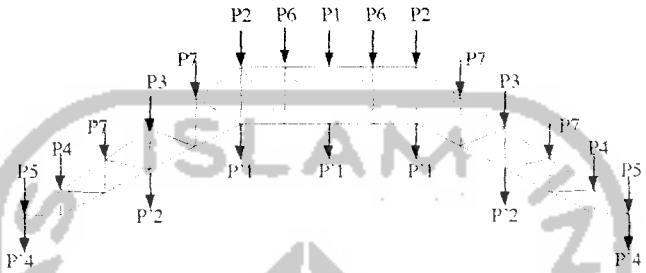
- Langit-langit (rusuk-rusuk kayu dan asbes) :

  $= 0{,}11$ x Luas pembebanan $= 0{,}11 \times 3{,}6 \times 1{,}8 = 0{,}713$ kN

- Penggantung baja (d =3/4") = 0,022 x 0 = 0,000 kN +

$P'4$ = 0,713 kN

b. Perencanaan Beban Mati Kuda-Kuda K2



Gambar. 4.8 Perencanaan pembebanan mati kuda-kuda K2

1. Beban titik $P1$

- Berat sendiri $PK1 + PK2$ = 1,19 + 1,16 = 2,35 kN
- Berat penutup atap: 0,5 . 2,197 . 3,6= 3,95 kN
- Berat gording: 0,153 . 3,6.1,25 = 0,69 kN
- Berat sagrod: 0,022 . 2,197.2.1,25 = 0,121 kN +

$P1$ = 7,111 kN

2. Beban titik $P2$

- Berat sendiri: $2.P'K2$ = 2.2,34 = 4,68 kN
- Berat penutup atap: 0,5 . 2,197. 3,6 = 3,95 kN
- Berat gording: 0,153 . 3,6.1,25 = 0,69 kN
- Berat sagrod: 0,022 . 2,197.2.1,25 = 0,121 kN +

$P2$ = 9,441 kN

3. Beban titik $P3$

- Berat sendiri: $PK2 + PK3$ = 1,16 + 1,10 = 2,26 kN
- Berat penutup atap: 0,5 . 2,197. 3,6 = 3,95 kN
- Berat gording: 0,153 . 3,6.1,25 = 0,69 kN
- Berat sagrod: 0,022 . 2,197.2.1,25 = 0,121 kN +

$P3$ = 7,021 kN

4. Beban titik $P4$

- Berat sendiri: $PK2 + PK4 = 1,16 + 1,00 = 2,16$ kN
- Berat penutup atap: $0,5 \cdot 2,197 \cdot 3,6 = 3,95$ kN
- Berat gording: $0,153 \cdot 3,6 \cdot 1,25 = 0,69$ kN
- Berat sagrod: $0,022 \cdot 1,953 \cdot 2 \cdot 1,25 = \underline{0,054 \text{ kN}} +$

$P4 = 6,424$ kN

5. Beban titik $P5$

- Berat sendiri: $PK2 = 1,16$ kN
- Berat penutup atap: $0,5 \cdot 1,099 \cdot 3,6 = 1,99$ kN
- Berat gording: $0,153 \cdot 3,6 \cdot 1,25 = 0,69$ kN
- Berat sagrod: $0,022 \cdot 0,855 \cdot 2 \cdot 1,25 = \underline{0,047 \text{ kN}} +$

$P5 = 4,289$ kN

6. Beban titik $P6$

- Berat sendiri: $PK2 = 1,16$ kN

$P6 = 1,16$ kN

7. Beban titik $P7$

- Berat sendiri: $PK2 = 1,16$ kN
- Berat penutup atap: $0,5 \cdot 2,197 \cdot 3,6 = 3,95$ kN
- Berat gording: $0,153 \cdot 3,6 \cdot 1,25 = 0,69$ kN
- Berat sagrod: $0,022 \cdot 2,197 \cdot 2 \cdot 1,25 = \underline{0,121 \text{ kN}} +$

$P5 = 5,921$ kN

8. Beban titik $P'1$

- Langit-langit (rusuk-rusuk kayu dan asbes) :

$= 0,11$ x Luas pembebanan $= 0,11 \times 3,6 \times 3,6 = 1,426$ kN

- Penggantung baja (d =3/4") $= 0,022 \times 5,541 = \underline{0,122 \text{ kN}} +$

$P'1 = 1,548$ kN

9. Beban titik $P'2$

- Langit-langit (rusuk-rusuk kayu dan asbes) :

$= 0,11$ x Luas pembebanan $= 0,11 \times 3,6 \times 5,4 = 2,138$ kN

- Penggantung baja (d =3/4") $= 0,022 \times 1,848 = \underline{0,041 \text{ kN}} +$

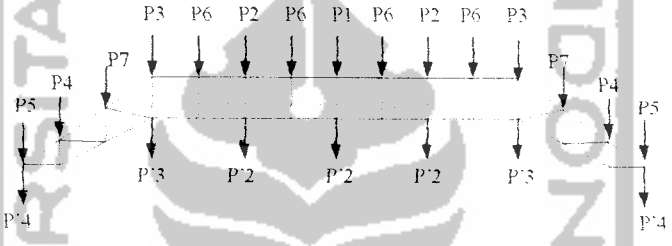
$P'2 = 2,179$ kN

10. Beban titik *P*'4

- Langit-langit (rusuk-rusuk kayu dan asbes) :
  = 0,11 x Luas pembebanan = 0,11 x 3,6 x 1,8 = 0,713 kN
- Penggantung baja (*d* =3/4") = 0,022 x 0 = 0,000 kN +

P'4 = 0,713 kN

c. Perencanaan Beban Mati Kuda-Kuda K3



Gambar. 4.9 Perencanaan beban mati kuda-kuda K3

1. Beban titik P1

- Berat sendiri PK1 + PK3 = 1,19 + 1,10 = 2,29 kN
- Berat penutup atap: 0,5 . 2,197 . 3,6= 3,95 kN
- Berat gording: 0,153 . 3,6.1,25 = 0,69 kN
- Berat sagrod: 0,022 . 2,197.2.1,25 = 0,121 kN +

P1 = 7,051 kN

2. Beban titik P2

- Berat sendiri: PK2 + PK3 = 1,16 + 1,1 = 2,26 kN
- Berat penutup atap: 0,5 . 2,197. 3,6 = 3,95 kN
- Berat gording: 0,153 . 3,6.1,25 = 0,69 kN
- Berat sagrod: 0,022 . 2,197.2.1,25 = 0,121 kN +

P2 = 7,021 kN

3. Beban titik P3

- Berat sendiri: 2. P'K3 = 2. 2,28 = 4,56 kN
- Berat penutup atap: 0,5 . 2,197. 3,6 = 3,95 kN

- Berat gording: 0,153 . 3,6.1,25 = 0,69 kN
- Berat sagrod: 0,022 . 2,197.2.1,25 = 0,121 kN +

P3 = 9,321 kN

4. Beban titik P4

- Berat sendiri: PK3 + PK4 = 1,1 + 1,00 = 2,1 kN
- Berat penutup atap: 0,5 . 2,197. 3,6 = 3,95 kN
- Berat gording: 0,153 . 3,6.1,25 = 0,69 kN
- Berat sagrod: 0,022 . 1,953.2.1,25 = 0,054 kN +

P4 = 6,364 kN

5. Beban titik P5

- Berat sendiri: PK3 = 1,1 kN
- Berat penutup atap: 0,5 . 1,099. 3,6 = 1,99 kN
- Berat gording: 0,153 . 3,6.1,25 = 0,69 kN
- Berat sagrod: 0,022 . 0,855.2.1,25 = 0,047 kN +

P5 = 4,229 kN

6. Beban titik P6

- Berat sendiri: PK3 = 1,1 kN

P6 = 1,1 kN

7. Beban titik P7

- Berat sendiri: PK3 = 1,1 kN
- Berat penutup atap: 0,5 . 2,197. 3,6 = 3,95 kN
- Berat gording: 0,153 . 3,6.1,25 = 0,69 kN
- Berat sagrod: 0,022 . 2,197.2.1,25 = 0,121 kN +

P5 = 5,861 kN

8. Beban titik P'2

- Langit-langit (rusuk-rusuk kayu dan asbes) :

  = 0,11 x Luas pembebanan = 0,11 x 3,6 x 5,4 = 2,138 kN
- Penggantung baja (d =3/4") = 0,022 x 1,848 = 0,041 kN +

P'2 = 2,179 kN

9 Beban titik P'3

- Langit-langit (rusuk-rusuk kayu dan asbes) :

  = 0,11 x Luas pembebanan = 0,11 x 5,4 x 5,4 = 3,2076 kN

- Penggantung baja (d =3/4") = 0,022 x 1,848 = 0,041 kN +

  P'3 = 3,2486 kN

10. Beban titik P'4

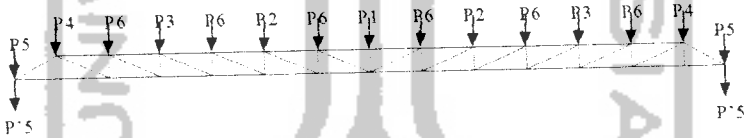
- Langit-langit (rusuk-rusuk kayu dan asbes) :

  = 0,11 x Luas pembebanan = 0,11 x 3,6 x 1,8 = 0,713 kN

- Penggantung baja (d =3/4") = 0,022 x 0 = 0,000 kN +

  P'4 = 0,713 kN

d. Perencanaan Beban Mati Kuda-Kuda K4



Gambar. 4.10 Perencanaan pembebanan mati kuda-kuda K4

1. Beban titik P1

- Berat sendiri PK1 + PK4 = 1,19 + 1,0 = 2,29 kN
- Berat penutup atap: 0,5 . 2,197 . 3,6= 3,95 kN
- Berat gording: 0,153 . 3,6.1,25 = 0,69 kN
- Berat sagrod: 0,022 . 1,953.2.1,25 = 0,054 kN +

  P1 = 6,454 kN

2. Beban titik P2

- Berat sendiri: PK2 + PK4 = 1,16 + 1,0 = 2,16 kN
- Berat penutup atap: 0,5 . 2,197. 3,6 = 3,95 kN
- Berat gording: 0,153 . 3,6.1,25 = 0,69 kN
- Berat sagrod: 0,022 . 1,953.2.1,25 = 0,054 kN +

P2 = 6,424 kN

3. Beban titik P3

- Berat sendiri: PK3 + PK4 = 1,1 + 1,0 = 2,1 kN
- Berat penutup atap: 0,5 . 2,197. 3,6 = 3,95 kN
- Berat gording: 0,153 . 3,6.1,25 = 0,69 kN
- Berat sagrod: 0,022 . 1,953.2.1,25 = 0,054 kN +

P3 = 6,364 kN

4. Beban titik P4

- Berat sendiri: 2. P'K4 = 2. 2,04 = 4,08 kN
- Berat penutup atap: 0,5 . 2,197. 3,6 = 3,95 kN
- Berat gording: 0,153 . 3,6.1,25 = 0,69 kN
- Berat sagrod: 0,022 . 1,953.2.1,25 = 0,054 kN +

P4 = 8,344 kN

5. Beban titik P5

- Berat sendiri: PK4 = 1,0 kN
- Berat penutup atap: 0,5 . 2,197. 3,6 = 3,95 kN
- Berat gording: 0,153 . 3,6.1,25 = 0,69 kN
- Berat sagrod: 0,022 . 1,953.2.1,25 = 0,047 kN +

P5 = 5,687kN

6. Beban titik P6

- Berat sendiri: PK4 = 1,0 kN

P6 = 1,0 kN

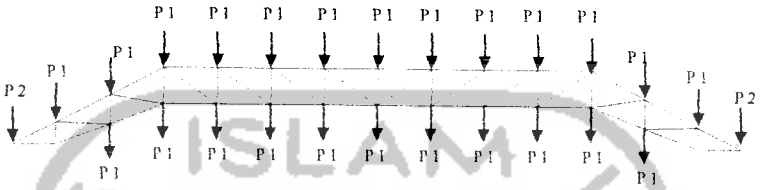
7. Beban titik P'5

- Langit-langit (rusuk-rusuk kayu dan asbes) :

  = 0,11 x Luas pembebanan = 0,11 x 4,86 = 0,5346 kN
- Penggantung baja (d =3/4") = 0,022 x 0 = 0,000 kN +

P'5 = 0,5346 kN

c. Perencanaan Beban Hidup Kuda-Kuda K3

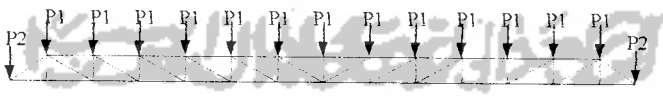


Gambar. 4.13 Perencanaan beban hidup kuda-kuda K3

Beban hidup: P1 = 1 kN

P2 = 2 kN

d. Perencahaan beban hidup kuda-kuda K4



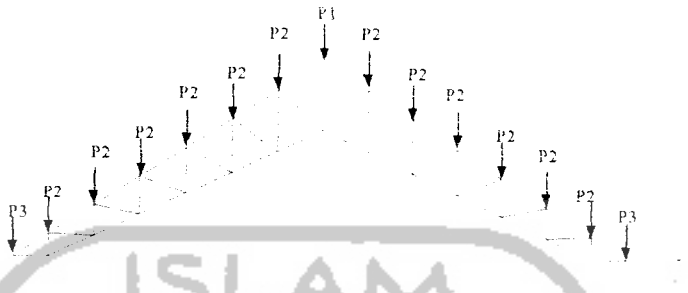
Gambar. 4.14 Perencanaan beban hidup kuda-kuda K4

Beban hidup: P1 = 1 kN

P2 = 2 kN

4. Perencanaan Beban Air Hujan Kuda-Kuda

a. Perencanaan beban air hujan kuda-kuda K1

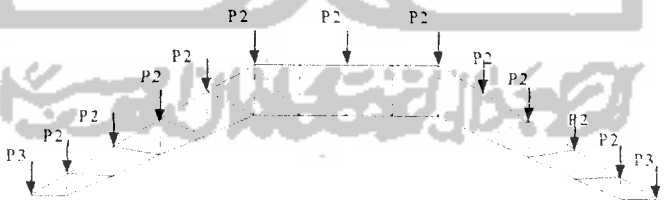


Gambar. 4.15 Perencanaan beban air hujan kuda-kuda K1

Beban air hujan :

- P1 = 0,01 x (40-0,8. 35) x (2,197 x 3,6 : 2) = 0,48 kN
- P2 = 0,01 x (40-0,8. 35) x (2,197 x 3,6) = 0,95 kN
- P3 = 0,01 x (40-0,8. 35) x (1,099 x 3,6) = 0,58 kN

b. Perencanaan beban air hujan kuda-kuda K2

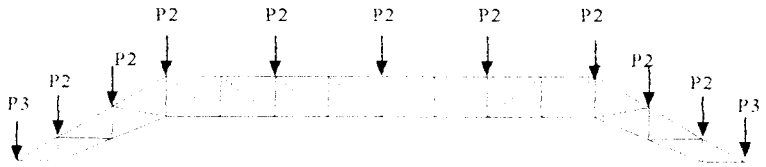


Gambar. 4.16 Perencanaan beban air hujan kuda-kuda K2

Beban air hujan :

- P2 = 0,01 x (40-0,8. 35) x (2,197 x 3,6) = 0,95 kN
- P3 = 0,01 x (40-0,8. 35) x (1,099 x 3,6) = 0,58 kN

c. Perencanaan beban air hujan kuda-kuda K3



Gambar. 4.17 Perencanaan beban air hujan kuda-kuda K3

Beban air hujan :

- P2 = 0,01 x (40-0,8. 35) x (2,197 x 3,6) = 0,95 kN
- P3 = 0,01 x (40-0,8. 35) x (1,099 x 3,6) = 0,58 kN

d. Perencanaan beban air hujan kuda-kuda K4

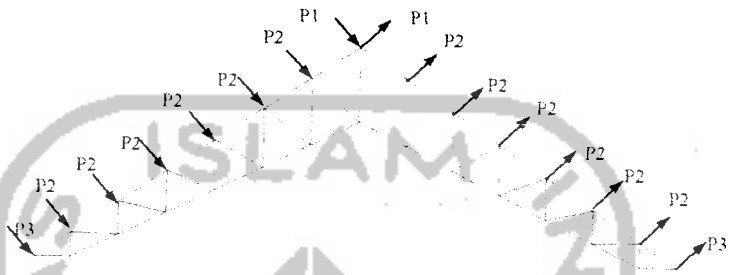
Gambar. 4.18 Perencanaan beban air hujan kuda-kuda K4

Beban air hujan :

- P1 = 0,01 x (40-0,8. 35) x (2,197 x 3,6) = 0,95 kN
- P3 = 0,01 x (40-0,8. 35) x (1,099 x 3,6) = 0,58 kN

5. Perencanaan Beban Angin Kuda-Kuda

a. Perencanaan beban angin kuda-kuda K1



Gambar. 4.19 Perencanaan beban angin kuda-kuda K1

Beban Angin:

- P1

Tiup angin = (0,02. 35 – 0,4) .0,6.(2,197 x 3,6 : 2) = 0,18 kN

$Wy = W.cos35^0 = 0,15$ kN

$Wx = W.sin35^0 = 0,10$ kN

Hisap angin = - 0,4 .0,6 . (2,197 x 3,6 : 2) = 0,24 kN

$Wy = W.cos35^0 = 0,19$ kN

$Wx = W.sin35^0 = 0,14$ kN

- P2

Tiup angin = (0,02. 35 – 0,4) .0,6.(2,197 x 3,6) = 1,42 kN

$Wy = W.cos35^0 = 1,17$ kN

$Wx = W.sin35^0 = 0,82$ kN

Hisap angin = - 0,4 .0,6 . (2,197 x 3,6) = 1,9 kN

$Wy = W.cos35^0 = 1,55$ kN

$Wx = W.sin35^0 = 1,09$ kN

- P3

Tiup angin = (0,02. 35 – 0,4) .0,6.(2,197 x 3,6) = 0,87 kN

$Wy = W.cos35^0 = 0,72$ kN

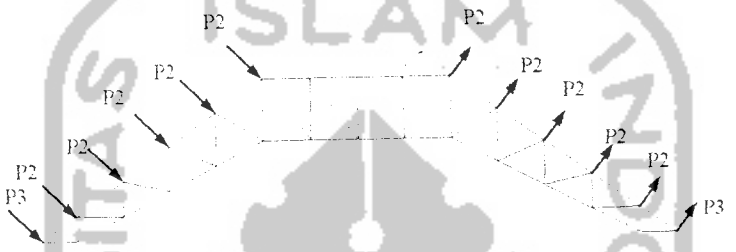
$Wx = W.sin35^0 = 0,50$ kN

Hisap angin = - 0,4 .0,6 . (1,099 x 3,6) = 1,16 kN

$Wy = W.cos35^0$ = 0,95 kN

$Wx = W.sin35^0$ = 0,67 kN

b. Perencanaan beban angin kuda-kuda K2



Gambar. 4.20 Perencanaan beban angin kuda-kuda K2

- P2

Tiup angin = (0,02. 35 – 0,4) .0,6.(2,197 x 3,6) = 1,42 kN

$Wy = W.cos35^0$ = 1,17 kN

$Wx = W.sin35^0$ = 0,82 kN

Hisap angin = - 0,4 .0,6 . (2,197 x 3,6) = 1,9 kN

$Wy = W.cos35^0$ = 1,55 kN

$Wx = W.sin35^0$ = 1,09 kN

- P3

Tiup angin = (0,02. 35 – 0,4) .0,6.(2,197 x 3,6) = 0,87 kN

$Wy = W.cos35^0$ = 0,72 kN

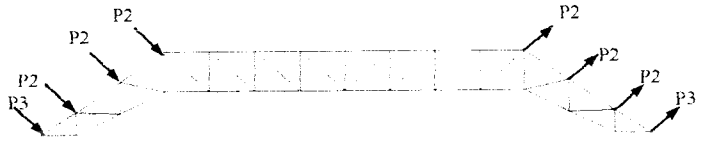
$Wx = W.sin35^0$ = 0,50 kN

Hisap angin = - 0,4 .0,6 . (1,099 x 3,6) = 1,16 kN

$Wy = W.cos35^0$ = 0,95 kN

$Wx = W.sin35^0$ = 0,67 kN

c. Perencanaan beban angin kuda-kuda K3



Gambar. 4.21 Perencanaan beban angin kuda-kuda K3

- P2

Tiup angin = (0,02. 35 – 0,4) .0,6.(2,197 x 3,6) = 1,42 kN

$Wy = W.cos35^0$ = 1,17 kN

$Wx = W.sin35^0$ = 0,82 kN

Hisap angin = - 0,4 .0,6 . (2,197 x 3,6) = 1,9 kN

$Wy = W.cos35^0$ = 1,55 kN

$Wx = W.sin35^0$ = 1,09 kN

- P3

Tiup angin = (0,02. 35 – 0,4) .0,6.(2,197 x 3,6) = 0,87 kN

$Wy = W.cos35^0$ = 0,72 kN

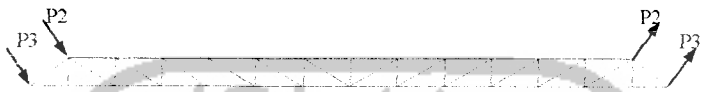
$Wx = W.sin35^0$ = 0,50 kN

Hisap angin = - 0,4 .0,6 . (1,099 x 3,6) = 1,16 kN

$Wy = W.cos35^0$ = 0,95 kN

$Wx = W.sin35^0$ = 0,67 kN

d. Perencanaan beban angin kuda-kuda K4



Gambar. 4.22 Perencanaan beban angin kuda-kuda K4

- P2

Tiup angin = (0,02. 35 – 0,4) .0,6.(2,197 x 3,6) = 1,42 kN

$Wy = W.cos35^0$ = 1,17 kN

$Wx = W.sin35^0$ = 0,82 kN

Hisap angin = - 0,4 .0,6 . (2,197 x 3,6) = 1,9 kN

$Wy = W.cos35^0$ = 1,55 kN

$Wx = W.sin35^0$ = 1,09 kN

- P3

Tiup angin = (0,02. 35 – 0,4) .0,6.(2,197 x 3,6) = 0,87 kN

$Wy = W.cos35^0$ = 0,72 kN

$Wx = W.sin35^0$ = 0,50 kN

Hisap angin = - 0,4 .0,6 . (1,099 x 3,6) = 1,16 kN

$Wy = W.cos350$ = 0,95 kN

$Wx = W.sin350$ = 0,67 kN

4.3.2 Analisis Struktur Kuda-Kuda

Analisis struktur kuda-kuda rangka baja menggunakan program aplikasi komputer SAP 90, dengan input data-data sebagai berikut ini:

1. Nomor joint dan element, sesuai bentuk dan ukuran rangka
2. Dukungan rangka baja dianggap sendi dan roll.
3. Luas profil baja yang dipakai.

4. Inersia profil baja.

5. Modulus elastisitas baja, E = 200000 MPa

6. Pembebanan berupa beban terpusat.

Input data-data program dan hasil output program disajikan dalam lampiran.

4.3.3 Gaya Batang Rencana Kuda-Kuda

Gaya batang rencana kuda-kuda rangka baja merupakan hasil dari kombinasi gaya-gaya batang hasil analisis stuktur, menurut LRFD,2000 sebagai berikut.

$N_{u1} = 1{,}4\ N_D$

$N_{u2} = 1{,}2\ N_D + 0{,}5\ NL$

$N_{u3} = 1{,}2\ N_D + 0{,}5\ N_H$

$N_{u4} = 1{,}2\ N_D + 1{,}6\ N_L + 0{,}8\ N_{Wkiri}$

$N_{u5} = 1{,}2\ N_D + 1{,}6\ N_L + 0{,}8\ N_{Wkanan}$

$N_{u6} = 1{,}2\ N_D + 1{,}3\ N_{W,kiri} + 0{,}5\ N_L$

$N_{u7} = 1{,}2\ N_D + 1{,}3\ N_{W,kanan} + 0{,}5\ N_L$

$N_{u8} = 0{,}9\ N_D - 1{,}3\ N_{W,kiri}$

$N_{u9} = 0{,}9\ N_D - 1{,}3\ N_{W,kanan}$

Sebagai contoh perhitungan dinjau pada gaya batang rencana kuda-kuda K1 nomor batang 1.

Diketahui:

ND = 8,7000 kN ; NL = 3,4100 kN ; NR = 0,9800 kN ;

$NWki$ = 1,2300 kN ; $NWka$ = -1,6200 kN

$Nu = 1{,}2.ND + 1{,}6.NL + 0{,}8.NWki$

$= 1{,}2.8{,}7000 + 1{,}6.3{,}4100 + 0{,}8.1{,}2300$

= 16,8800 kN (kombinasi terbesar)

Dengan cara yang sama dapat dihitung gaya batang rencana kuda-kuda yang lainnya berdasarkan kombinasi faktor beban, dipilih yang terbesar yang disajikan pada Tabel 4.8

Tabel 4.8 Gaya Batang Kuda-Kuda (Satuan kN)

Kuda-kuda	No.	N_D	N_L	N_H	N_{Wki}	N_{Wka}	$N_{u.1}$	$N_{u.2}$	$N_{u.3}$	$N_{u.4}$	$N_{u.5}$	$N_{u.6}$	$N_{u.7}$	$N_{u.8}$	$N_{u.9}$	N_u tarik	N_u tekan	Jenis
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]	[19]
K1	1	8,7000	3,4100	0,9800	1,2300	-1,6200	12,1800	12,1450	10,9300	16,8800	14,6000	13,7440	10,0390	6,2310	9,9360	16,8800	-	a
	2	-60,1900	-15,6600	-7,5300	-8,8800	11,9100	-84,2660	-80,0580	-75,9930	-104,3880	-87,7560	-91,6020	-64,5750	-42,6270	-69,6540	-	-104,3880	a
	3	-93,7200	-24,4800	-11,3800	-13,1900	17,6700	-131,2080	-124,7040	-118,1540	-162,1840	-137,4960	-141,8510	-101,7330	-67,2010	-107,3190	-	-162,1840	a
	4	-105,6000	-28,0700	-12,8700	-14,4000	19,3200	-147,8400	-140,7550	-133,1550	-183,1520	-156,1760	-159,4750	-115,6390	-76,3200	-120,1560	-	-183,1520	a
	5	-108,4200	-28,7300	-13,0300	-13,9100	18,7000	-151,7880	-144,4690	-136,6190	-187,2000	-161,1120	-162,5520	-120,1590	-79,4950	-121,8880	-	-187,2000	a
	6	-103,3900	-27,5800	-12,3700	-12,3500	16,6600	-144,7460	-137,8580	-130,2530	-178,0760	-154,8680	-153,9130	-116,2000	-76,9960	-114,7090	-	-178,0760	a
	7	-94,9400	-25,1700	-11,1400	-10,0700	13,6600	-132,9160	-126,5130	-119,4980	-162,2560	-143,2720	-139,6040	-108,7550	-72,3550	-103,2040	-	-162,2560	a
	8	-94,9400	-25,1700	-11,1400	-10,3600	13,9500	-132,9160	-126,5130	-119,4980	-162,4880	-143,0400	-139,9810	-108,3780	-71,9780	-103,5810	-	-162,4880	a
	9	-103,3900	-27,5800	-12,3700	-5,9000	10,2200	-144,7460	-137,8580	-130,2530	-172,9160	-160,0200	-145,5280	-124,5720	-85,3810	-106,3370	-	-172,9160	a
	10	-108,4200	-28,7300	-13,0300	-1,9100	6,7200	-151,7880	-144,4690	-136,6190	-177,6000	-170,6960	-146,9520	-135,7330	-95,0950	-106,3140	-	-177,6000	a
	11	-105,6000	-28,0700	-12,8700	1,3300	3,6300	-147,8400	-140,7550	-133,1550	-170,5680	-168,7280	-139,0260	-136,0360	-96,7690	-99,7590	-	-170,5680	a
	12	-93,7200	-24,4800	-11,3800	3,3500	1,1800	-131,2080	-124,7040	-118,1540	-148,9520	-150,6880	-120,3490	-123,1700	-88,7030	-85,8820	-	-150,6880	a
	13	-60,1900	-15,6600	-7,5300	3,3700	-0,2200	-84,2660	-80,0580	-75,9930	-94,5880	-97,4600	-75,6770	-80,3440	-58,5520	-53,8850	-	-97,4600	a
	14	8,7000	3,4100	0,9800	0,0100	0,0000	12,1800	12,1450	10,9300	15,9040	15,8960	12,1580	12,1450	7,8170	7,8300	15,8960	-	a
	15	-7,1200	-2,7900	-0,8000	-1,5100	2,0000	-9,9680	-9,9390	-8,9440	-14,2160	-11,4080	-11,9020	-7,8390	-4,4450	-9,0080	-	-14,2160	b
	16	-7,9100	-3,1200	-0,8900	11,2800	-11,0400	-11,0740	-11,0520	-9,9370	-5,4600	-23,3160	3,6120	-25,4040	-21,7830	7,2330	-	-25,4040	b
	17	55,4500	14,4300	6,9300	19,8100	-22,4400	77,6300	73,7550	70,0050	105,4760	71,6760	99,5080	44,5830	24,1520	79,0770	105,4760	-	b
	18	86,3000	22,5400	10,4800	22,8300	-26,5000	120,8200	114,8300	108,8000	157,8880	118,4240	144,5090	80,3800	47,9910	112,1200	157,8880	-	b
	19	97,2300	25,8500	11,8500	23,0400	-26,8000	136,1220	129,6010	122,6010	176,4680	136,5960	159,5530	94,7610	57,5550	122,3470	176,4680	-	b
	20	99,8500	26,4600	12,0000	21,6600	-25,0100	139,7900	133,0500	125,8200	179,4840	142,1480	161,2080	100,5370	61,7070	122,3780	179,4840	-	b
	21	95,0600	25,3600	11,3700	19,2900	-21,8900	133,0840	126,7520	119,7570	170,0800	137,1360	151,8290	98,2950	60,4770	114,0110	170,0800	-	b
	22	95,0600	25,3600	11,3700	10,9200	-13,5200	133,0840	126,7520	119,7570	163,3840	143,8320	140,9480	109,1760	71,3580	103,1300	163,3840	-	b
	23	99,8500	26,4600	12,0000	6,0500	-9,4200	139,7900	133,0500	125,8200	166,9960	154,6200	140,9150	120,8040	82,0000	102,1110	166,9960	-	b
	24	97,2300	25,8500	11,8500	1,8400	-5,6400	136,1220	129,6010	122,6010	159,5080	153,5240	131,9930	122,2690	85,1150	94,8390	159,5080	-	b
	25	86,3000	22,5400	10,4800	-1,2400	-2,4700	120,8200	114,8300	108,8000	138,6320	137,6480	113,2180	111,6190	79,2820	80,8810	138,6320	-	b
	26	55,4500	14,4300	6,9300	-2,3500	-0,3600	77,6300	73,7550	70,0050	87,7480	89,3400	70,7000	73,2870	52,9600	50,3730	89,3400	-	b
	27	-7,9100	-3,1200	-0,8900	-0,0100	0,0000	-11,0740	-11,0520	-9,9370	-14,4920	-14,4840	-11,0650	-11,0520	-7,1060	-7,1190	-	-14,4920	b
	28	-7,1200	-2,7900	-0,8000	-0,0100	0,0000	-9,9680	-9,9390	-8,9440	-13,0160	-13,0080	-9,9520	-9,9390	-6,3950	-6,4080	-	-13,0160	b
	29	-48,0200	-12,5100	-5,9700	-7,1000	9,4900	-67,2280	-63,8790	-60,6090	-83,3200	-70,0480	-73,1090	-51,5420	-33,9880	-55,5550	-	-83,3200	vp
	33	-17,7800	-4,2500	-2,2900	-1,9300	2,6000	-24,8920	-23,4610	-22,4810	-29,6800	-26,0560	-25,9700	-20,0810	-13,4930	-19,3820	-	-29,6800	vp
	37	-1,0400	0,3900	-0,1500	1,3500	-1,7600	-1,4560	-1,0530	-1,3230	0,4560	-2,0320	0,7020	-3,3410	-2,6910	1,3520	-	-3,3410	vp
	41	100,7300	27,7000	12,2200	11,6800	-15,6900	141,0220	134,7260	126,9860	174,5400	152,6440	149,9100	114,3290	75,4730	111,0540	152,6440	-	vp
	45	-1,0400	0,3900	-0,1500	-4,1300	3,7100	-1,4560	-1,0530	-1,3230	-3,9280	2,3440	-6,4220	3,7700	4,4330	-5,7590	-	-6,4220	vp
	49	-17,7800	-4,2500	-2,2900	-0,7200	1,3700	-24,8920	-23,4610	-22,4810	-28,7120	-27,0400	-24,3970	-21,6800	-15,0660	-17,7830	-	-28,7120	vp
	53	-48,0200	-12,5100	-5,9700	2,9500	-0,8300	-67,2280	-63,8790	-60,6090	-75,2800	-78,3040	-60,0440	-64,9580	-47,0530	-42,1390	-	-78,3040	vp
	30	56,2200	15,5700	6,9400	7,5600	-10,1100	78,7080	75,2490	70,9340	98,4240	84,2880	85,0770	62,1060	40,7700	63,7410	98,4240	-	d
	32	28,1300	7,4000	3,2400	2,7800	-3,7200	39,3820	37,4560	35,3760	47,8200	42,6200	41,0700	32,6200	21,7030	30,1530	47,8200	-	d
	34	10,4700	3,1700	1,3100	0,1900	-0,2900	14,6580	14,1490	13,2190	17,7880	17,4040	14,3960	13,7720	9,1760	9,8000	17,7880	-	d
	36	2,7000	0,6400	0,1500	-1,4200	1,8500	3,7800	3,5600	3,3150	3,1280	5,7440	1,7140	5,9650	4,2760	0,0250	5,9650	-	d
	38	-5,3400	-1,2300	-0,7000	-2,6600	3,5100	-7,4760	-7,0230	-6,7580	-10,5040	-5,5680	-10,4810	-2,4600	-1,3480	-9,3690	-	-10,5040	d
	40	-9,0900	-2,6000	-1,3400	-3,6800	4,8500	-12,7260	-12,2080	-11,5780	-18,0120	-11,1880	-16,9920	-5,9030	-3,3970	-14,4860	-	-18,0120	d
	42	-9,0900	-2,6000	-1,3400	6,6600	-5,4700	-12,7260	-12,2080	-11,5780	-9,7400	-19,4440	-3,5500	-19,3190	-16,8390	-1,0700	-	-19,4440	d
	44	-5,3400	-1,2300	-0,7000	5,4900	-4,6400	-7,4760	-7,0230	-6,7580	-3,9840	-12,0880	0,1140	-13,0550	-11,9430	1,2260	-	-13,0550	d
	46	2,7000	0,6400	0,1500	4,3400	-3,8900	3,7800	3,5600	3,3150	7,7360	1,1520	9,2020	-1,4970	-3,2120	7,4870	9,2020	-	d

Tabel 4.8 Lanjutan

Kuda-kuda	No.	N_D	N_L	N_H	N_{Wki}	N_{Wka}	$N_{u.1}$	$N_{u.2}$	$N_{u.3}$	$N_{u.4}$	$N_{u.5}$	$N_{u.6}$	$N_{u.7}$	$N_{u.8}$	$N_{u.9}$	N_u tarik	N_u tekan	Jenis
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]	[19]
K1	48	10,4700	3,1700	1,3100	2,9600	-3,0400	14,6580	14,1490	13,2190	20,0040	15,2040	17,9970	10,1970	5,5750	13,3750	20,0040	-	d
	50	28,1300	7,4000	3,2400	1,0000	-1,9200	39,3820	37,4560	35,3760	46,3960	44,0600	38,7560	34,9600	24,0170	27,8130	46,3960	-	d
	52	56,2200	15,5700	6,9400	-2,0700	-0,3200	78,7080	75,2490	70,9340	90,7200	92,1200	72,5580	74,8330	53,2890	51,0140	92,7200	-	d
	31	-31,0100	-7,5900	-3,8300	-4,2100	5,6100	-43,4140	-41,0070	-39,1270	-52,7240	-44,8680	-46,4800	-33,7140	-22,4360	-35,2020	-	-52,7240	v
	35	-8,9300	-1,7000	-1,1200	-0,1700	0,2500	-12,5020	-11,5660	-11,2760	-13,5720	-13,2360	-11,7870	-11,2410	-7,8160	-8,3620	-	-13,5720	v
	39	5,5700	2,2800	0,7300	2,7300	-3,5900	7,7980	7,8240	7,0490	12,5160	7,4600	11,3730	3,1570	1,4640	9,6800	12,5160	-	v
	43	5,5700	2,2800	0,7300	-5,5700	4,6900	7,7980	7,8240	7,0490	5,8760	14,0840	0,5830	13,9210	12,2540	-1,0840	14,0840	-	v
	47	-8,9300	-1,7000	-1,1200	-2,5100	2,5800	-12,5020	-11,5660	-11,2760	-15,4440	-11,3720	-14,8290	-8,2120	-4,7740	-11,3910	-	-15,4440	v
	51	-31,0100	-7,5900	-3,8300	1,1500	0,1700	-43,4140	-41,0070	-39,1270	-48,4360	-49,2200	-39,5120	-40,7860	-29,4040	-28,1300	-	-49,2200	v
K2	1	8,6600	3,4100	0,9900	1,2300	-1,6200	12,1240	12,0970	10,8870	16,8320	14,5520	13,6960	9,9910	6,1950	9,9000	16,8320	-	a
	2	-55,6500	-15,6600	-5,9500	-9,2200	11,3100	-77,9100	-74,6100	-69,7550	-99,2120	-82,7880	-86,5960	-59,9070	-38,0990	-64,7880	-	-99,2120	a
	3	-86,4600	-24,4800	-8,8600	-13,7100	16,7000	-121,0440	-115,9920	-108,1820	-153,8880	-129,5600	-133,8150	-94,2820	-59,9910	-99,5240	-	-153,8900	a
	4	-96,5900	-28,0700	-9,7300	-15,0600	18,1200	-135,2260	-129,9430	-120,7730	-172,8680	-146,3240	-149,5210	-106,3870	-67,3530	-110,4870	-	-172,8680	a
	5	-98,1100	-28,7100	-9,4400	-14,6400	17,3000	-137,3540	-132,0870	-122,4520	-175,3800	-149,8280	-151,1190	-109,5970	-69,2670	-110,7890	-	-175,3800	a
	6	-84,7100	-25,8600	-7,9300	-9,9800	12,4400	-118,5940	-114,5820	-105,6170	-151,0120	-133,0760	-127,5560	-98,4100	-63,2650	-92,4110	-	-151,0120	a
	7	-88,0000	-26,6300	-8,1100	-7,1200	9,5700	-123,2000	-118,9150	-109,6550	-153,9040	-140,5520	-128,1710	-106,4740	-69,9440	-91,6410	-	-153,9040	a
	8	-88,0000	-26,6300	-8,1100	-7,1100	9,5600	-123,2000	-118,9150	-109,6550	-153,8960	-140,5600	-128,1580	-106,4870	-69,9570	-91,6280	-	-153,8960	a
	9	-84,7100	-25,8600	-7,9300	-4,2500	6,7000	-118,5940	-114,5820	-105,6170	-146,4280	-137,6680	-120,1070	-105,8720	-70,7140	-84,9490	-	-146,4280	a
	10	-98,1100	-28,7100	-9,4400	-3,0300	5,7000	-137,3540	-132,0870	-122,4520	-166,0920	-159,1080	-136,0260	-124,6770	-84,3600	-95,7090	-	-166,0920	a
	11	-96,5900	-28,0700	-9,7300	0,2700	2,7900	-135,2260	-129,9430	-120,7730	-160,6040	-158,5880	-129,5920	-126,3160	-87,2820	-90,5580	-	-160,6040	a
	12	-86,4600	-24,4800	-8,8600	2,3900	0,6000	-121,0440	-115,9920	-108,1820	-141,0080	-142,4400	-112,8850	-115,2120	-80,9210	-78,5940	-	-142,4400	a
	13	-55,6500	-15,6600	-5,9500	2,4100	-0,3200	-77,9100	-74,6100	-69,7550	-89,9080	-92,0920	-71,4770	-75,0260	-53,2180	-49,6690	-	-92,0920	a
	14	8,6600	3,4100	0,9900	-1,6300	1,2400	12,1240	12,0970	10,8870	14,5440	16,8400	9,9780	13,7090	9,9130	6,1820	16,8400	-	a
	15	-7,0800	-2,7900	-0,8100	-1,5100	2,0000	-9,9120	-9,8910	-8,9010	-14,1680	-11,3600	-11,8540	-7,2910	-4,4090	-8,9720	-	-14,1680	b
	16	-7,8800	-3,1200	-0,9000	10,0900	-9,5400	-11,0320	-11,0160	-9,9060	-6,3760	-22,0800	2,1010	-23,4180	-20,2090	5,3100	-	-23,4180	b
	17	51,2600	14,4300	5,4800	18,9300	-20,3900	71,7640	68,7270	64,2520	99,7440	68,2880	93,3360	42,2200	21,5250	72,6410	99,7440	-	b
	18	79,6300	22,5400	8,1600	22,1300	-24,1200	111,4820	106,8260	99,6360	149,3240	112,3240	135,5950	75,4700	42,8980	103,0230	149,3240	-	b
	19	88,8800	25,8300	8,9500	22,4400	-24,1900	124,4320	119,5710	111,1310	165,9360	128,6320	148,7430	88,1240	50,8200	111,4390	165,9360	-	b
	20	80,4300	23,5400	7,7400	18,8100	-19,7700	112,6020	108,2860	100,3860	149,2280	118,3640	132,7390	82,5850	47,9340	98,0880	149,2280	-	b
	21	84,7100	25,8600	7,9300	15,9800	-16,9400	118,5940	114,5820	105,6170	155,8120	129,4760	135,3560	92,5600	55,4650	98,2610	155,8120	-	b
	22	84,7100	25,8600	7,9300	10,2500	-11,2200	118,5940	114,5820	105,6170	151,2280	134,0520	127,9070	99,9960	62,9140	90,8250	151,2280	-	b
	23	80,4300	23,5400	7,7400	7,4000	-8,3700	112,6020	108,2860	100,3860	140,1000	127,4840	117,9060	97,4050	62,7670	83,2680	140,1000	-	b
	24	88,8800	25,8300	8,9500	4,0400	-5,7900	124,4320	119,5710	111,1310	151,2160	143,3520	124,8230	112,0440	74,7400	87,5190	151,2160	-	b
	25	79,6300	22,5400	8,1600	0,8700	-2,8600	111,4820	106,8260	99,6360	132,3160	129,3320	107,9570	103,1080	70,5360	75,3850	132,3160	-	b
	26	51,2600	14,4300	5,4800	-0,3700	-1,0900	71,7640	68,7270	64,2520	84,3040	83,7280	68,2460	67,3100	46,6150	47,5510	84,3040	-	b
	27	-7,8800	-3,1200	-0,9000	2,2500	-1,7100	-11,0320	-11,0160	-9,9060	-12,6480	-15,8160	-8,0910	-13,2390	-10,0170	-4,8690	-	-15,8160	b
	28	-7,0800	-2,7900	-0,8100	2,0100	-1,5200	-9,9120	-9,8910	-8,9010	-11,3520	-14,1760	-7,2780	-11,8670	-8,9850	-4,3960	-	-14,1760	b
	29	-45,2200	-12,5100	-5,0200	-7,3000	9,1300	-63,3080	-60,5190	-56,7740	-80,1200	-66,9760	-70,0090	-48,6500	-31,2080	-52,5670	-	-80,1200	vp
	33	-16,1800	-4,2500	-1,7300	-2,0600	2,3900	-22,6520	-21,5410	-20,2810	-27,8640	-24,3040	-24,2190	-18,4340	-11,8840	-17,6690	-	-27,8640	vp
	37	41,1200	12,4000	4,2000	10,8700	-12,0100	57,5680	55,5440	51,4440	77,8800	59,5760	69,6750	39,9310	22,8770	52,6210	77,8800	-	vp
	41	-7,0700	-1,0100	-0,4800	-0,0100	0,0100	-9,8980	-8,9890	-8,7240	-10,1080	-10,0920	-9,0020	-8,9760	-6,3500	-6,3760	-	-10,1080	vp
	45	41,1200	12,4000	4,2000	-0,4100	-0,7300	57,5680	55,5440	51,4440	68,8560	68,6000	55,0110	54,5950	37,5410	37,9570	68,8560	-	vp
	49	-16,1800	-4,2500	-1,7300	-0,8100	1,1400	-22,6520	-21,5410	-20,2810	-26,8640	-25,3040	-22,5940	-20,0590	-13,5090	-16,0440	-	-26,8640	vp
	53	-45,2200	-12,5100	-5,0200	3,7900	-1,9600	-63,3080	-60,5190	-56,7740	-71,2480	-75,8480	-55,5920	-63,0670	-45,6250	-38,1500	-	-75,8480	vp

Tabel 4.8 Lanjutan

Kuda-kuda	No.	N_D	N_L	N_H	N_{Wki}	N_{Wka}	$N_{u.1}$	$N_{u.2}$	$N_{u.3}$	$N_{u.4}$	$N_{u.5}$	$N_{u.6}$	$N_{u.7}$	$N_{u.8}$	$N_{u.9}$	N_u tarik	N_u tekan	Jenis
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]	[19]
K2	30	52,4800	15,5700	5,6600	7,8300	-9,6200	73,4720	70,7610	65,8060	94,1520	80,1920	80,9400	58,2550	37,0530	59,7380	94,1520	-	d
	32	25,8600	7,4000	2,4400	2,9400	-3,4100	36,2040	34,7320	32,2520	45,2240	40,1440	38,5540	30,2990	19,4520	27,7070	45,2240	-	d
	34	8,8900	3,1600	0,7600	0,3000	-0,0700	12,4460	12,2480	11,0480	15,9640	15,6680	12,6380	12,1570	7,6110	8,0920	15,9640	-	d
	36	1,5800	0,6500	-0,2600	-1,3300	2,0100	2,2120	2,2210	1,7660	1,8720	4,5440	0,4920	4,8340	3,1510	-1,1910	4,5440	-	d
	38	7,0200	3,8000	0,3100	-4,6100	4,6100	9,8280	10,3240	8,5790	10,8160	18,1920	4,3310	16,3170	12,3110	0,3250	18,1920	-	d
	40	5,3600	1,2500	0,3000	-4,6700	4,6700	7,5040	7,0570	6,5820	4,6960	12,1680	0,9860	13,1280	10,8950	-1,2470	12,1680	-	d
	42	5,3600	1,2500	0,3000	4,6700	-4,6600	7,5040	7,0570	6,5820	12,1680	4,7040	13,1280	0,9990	-1,2470	10,8820	13,1280	-	d
	44	7,0200	3,8000	0,3100	4,6500	-4,6500	9,8280	10,3240	8,5790	18,2240	10,7840	16,3690	4,2790	0,2730	12,3630	18,2240	-	d
	46	1,5800	0,6500	-0,2600	4,4200	-3,7300	2,2120	2,2210	1,7660	6,4720	-0,0480	7,9670	-2,6280	-4,3240	6,2710	7,9670	-	d
	48	8,8900	3,1600	0,7600	3,0400	-2,8100	12,4460	12,2480	11,0480	18,1560	13,4760	16,2000	8,5950	4,0490	11,6540	18,1560	-	d
	50	25,8600	7,4000	2,4400	1,1300	-1,6000	36,2040	34,7320	32,2520	43,7760	41,5920	36,2010	32,6520	21,8050	25,3540	43,7760	-	d
	52	52,4800	15,5700	5,6600	-2,3300	0,5400	73,4720	70,7610	65,8060	86,0240	88,3200	67,7320	71,4630	50,2610	46,5300	88,3200	-	d
	31	-28,9500	-7,5900	-3,1200	-4,3500	5,3400	-40,5300	-38,5350	-36,3000	-50,3640	-42,6120	-44,1900	-31,5930	-20,4000	-32,9970	-	-50,3640	v
	35	-7,2500	-1,6800	-0,6400	-0,2400	0,0500	-10,1500	-9,5400	-9,0200	-11,5800	-11,3480	-9,8520	-9,4750	-6,2130	-6,5900	-	-11,5800	v
	39	-5,3400	-1,9500	-0,2300	3,6800	-3,6900	-7,4760	-7,3830	-6,5230	-6,5840	-12,4800	-2,5990	-12,1800	-9,5900	-0,0090	-	-12,4800	v
	43	-5,3400	-1,9500	-0,2300	-3,6600	3,6600	-7,4760	-7,3830	-6,5230	-12,4560	-6,6000	-12,1410	-2,6250	-0,0480	-9,5640	-	-12,1410	v
	47	-7,5200	-1,6800	-0,6400	-2,5800	2,3900	-10,5280	-9,8640	-9,3440	-13,7760	-9,8000	-13,2180	-6,7570	-3,4140	-9,8750	-	-13,7760	v
	51	-28,9500	-7,5700	-3,1200	1,2900	-0,3000	-40,5300	-38,5250	-36,3000	-45,8200	-47,0920	-36,8480	-38,9150	-27,7320	-25,6650	-	-47,0920	v
K3	1	8,1900	3,4100	0,9900	1,2300	-1,6300	11,4660	11,5330	10,3230	16,2680	13,9800	13,1320	9,4140	5,7720	9,4900	16,2680	-	a
	2	-50,9500	-15,6600	-4,7600	-6,3200	7,1500	-71,3300	-68,9700	-63,5200	-91,2520	-80,4760	-77,1860	-59,6750	-37,6390	-55,1500	-	-91,2520	a
	3	-78,7200	-24,4700	-6,9600	-9,0300	10,0000	-110,2080	-106,6990	-97,9440	-140,8400	-125,6160	-118,4380	-93,6990	-59,1090	-83,8480	-	-140,8400	a
	4	-81,9900	-27,6600	-7,2600	-6,9800	8,0400	-114,7860	-112,2180	-102,0180	-148,2280	-136,2120	-121,2920	-101,7660	-64,7170	-84,2430	-	-148,2280	a
	5	-98,1900	-33,1000	-8,8000	-5,7200	6,7800	-137,4660	-134,3780	-122,2280	-175,3640	-165,3640	-141,8140	-125,5640	-80,9350	-97,1850	-	-175,3640	a
	6	-104,5100	-36,3600	-9,3300	-4,4600	5,5300	-146,3140	-143,5920	-130,0770	-187,1560	-179,1640	-149,3900	-136,4030	-88,2610	-101,2480	-	-187,1560	a
	7	-109,5300	-37,4600	-9,8400	-3,2100	4,2700	-153,3420	-150,1660	-136,3560	-193,9400	-187,9560	-154,3390	-144,6150	-94,4040	-104,1280	-	-193,9400	a
	8	-109,5300	-37,4600	-9,8400	-3,2000	4,2700	-153,3420	-150,1660	-136,3560	-193,9320	-187,9560	-154,3260	-144,6150	-94,4170	-104,1280	-	-193,9320	a
	9	-104,5100	-36,3600	-9,3300	-1,9400	3,0000	-146,3140	-143,5920	-130,0770	-185,1400	-181,1880	-146,1140	-139,6920	-91,5370	-97,9590	-	-185,1400	a
	10	-98,1900	-33,1000	-8,8000	-0,6800	1,7500	-137,4660	-134,3780	-122,2280	-171,3320	-169,3880	-135,2620	-132,1030	-87,4870	-90,6460	-	-171,3320	a
	11	-81,9900	-27,6600	-7,2600	0,5700	0,4900	-114,7860	-112,2180	-102,0180	-142,1880	-142,2520	-111,4770	-111,5810	-74,5320	-74,4280	-	-142,1880	a
	12	-78,7200	-24,4700	-6,9600	0,9000	0,0600	-110,2080	-106,6990	-97,9440	-132,8960	-133,5680	-105,5290	-106,6210	-72,0180	-70,9260	-	-133,5680	a
	13	-50,9500	-15,6600	-4,7600	1,4800	-0,6500	-71,3300	-68,9700	-63,5200	-85,0120	-86,7160	-67,0460	-69,8150	-47,7790	-45,0100	-	-86,7160	a
	14	8,1900	3,4100	0,9900	-1,6400	1,2400	11,4660	11,5330	10,3230	13,9720	16,2760	9,4010	13,1450	9,5030	5,7590	16,2760	-	a
	15	-6,6900	-2,7900	-0,8100	-1,5100	2,0000	-9,3660	-9,4230	-8,4330	-13,7000	-10,8920	-11,3860	-6,8230	-4,0580	-8,6210	-	-11,3860	b
	16	-7,4400	-3,1100	-0,9000	5,8100	-5,2500	-10,4160	-10,4830	-9,3780	-9,2560	-18,1040	-2,9300	-17,3080	-14,2490	0,1290	-	-18,1040	b
	17	46,8900	14,4100	4,3800	11,9500	-12,2600	65,6460	63,4730	58,4580	88,8840	69,5160	79,0080	47,5350	26,6660	58,1390	88,8840	-	b
	18	64,5900	20,0900	5,7100	12,0400	-12,2600	90,4260	87,5530	80,3630	119,2840	99,8440	103,2050	71,6150	42,4790	74,0690	119,2840	-	b
	19	82,0300	27,6700	7,2600	10,7900	-10,9100	114,8420	112,2710	102,0660	151,3400	133,9800	126,2980	98,0880	59,8000	88,0100	151,3400	-	b
	20	98,2400	33,1200	8,8100	9,5300	-9,6500	137,5360	134,4480	122,2930	178,5040	163,1600	146,8370	121,9030	76,0270	100,9610	178,5040	-	b
	21	104,5200	36,3700	9,3300	8,2800	-8,3900	146,3280	143,6090	130,0890	190,2400	176,9040	154,3730	132,7020	83,3040	104,9750	190,2400	-	b
	22	104,5200	36,3700	9,3300	5,7600	-5,8800	146,3280	143,6090	130,0890	188,2240	178,9120	151,0970	135,9650	86,5800	101,7120	188,2240	-	b
	23	98,2400	33,1200	8,8100	4,5100	-4,6200	137,5360	134,4480	122,2930	174,4880	167,1840	140,3110	128,4420	82,5530	94,4220	174,4880	-	b
	24	82,0300	27,6700	7,2600	3,2500	-3,3600	114,8420	112,2710	102,0660	145,3080	140,0200	116,4960	107,9030	69,6020	78,1950	145,3080	-	b
	25	64,5900	20,0900	5,7100	1,9900	-2,1100	90,4260	87,5530	80,3630	111,2440	107,9640	90,1400	84,8100	55,5440	60,8740	111,2440	-	b
	26	46,8900	14,4100	4,3800	0,4800	-0,7900	65,6460	63,4730	58,4580	79,7080	78,6920	64,0970	62,4460	41,5770	43,2280	79,7080	-	b

Tabel 4.8 Lanjutan

Kuda-kuda	No.	*ND*	*NL*	*NH*	*NWki*	*NWka*	*Nu.1*	*Nu.2*	*Nu.3*	*Nu.4*	*Nu.5*	*Nu.6*	*Nu.7*	*Nu.8*	*Nu.9*	*Nu* tarik	*Nu* tekan	Jenis
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]	[19]
K3	27	-7,4400	-3,1100	-0,9000	2,2600	-1,7100	-10,4160	-10,4830	-9,3780	-12,0960	-15,2720	-7,5450	-12,7060	-9,6340	-4,4730	-	-15,2720	b
	28	-6,6900	-2,7900	-0,8100	2,0100	-1,5200	-9,3660	-9,4230	-8,4330	-10,8840	-13,7080	-6,8100	-11,3990	-8,6340	-4,0450	-	-13,7080	b
	29	-42,0600	-12,5200	-4,3100	-5,5600	6,6300	-58,8840	-56,7320	-52,6270	-74,9520	-65,2000	-63,9600	-48,1130	-30,6260	-46,4730	-	-74,9520	vp
	33	19,6700	6,0000	1,6100	5,1400	-5,3100	27,5380	26,6040	24,4090	37,3160	28,9560	33,2860	19,7010	11,0210	24,6060	37,3160	-	vp
	37	-12,7000	-3,9800	-1,4200	1,1500	-1,1500	-17,7800	-17,2300	-15,9500	-20,6880	-22,5280	-15,7350	-18,7250	-12,9250	-9,9350	-	-20,6880	vp
	41	-7,0400	-1,0000	-0,9400	0,0000	0,0000	-9,8560	-8,9480	-8,9180	-10,0480	-10,0480	-8,9480	-8,9480	-6,3360	-6,3360	-	-10,0480	vp
	45	-12,7000	-3,9800	-1,4200	-1,1500	1,1500	-17,7800	-17,2300	-15,9500	-22,5280	-20,6880	-18,7250	-15,7350	-9,9350	-12,9250	-	-20,6880	vp
	49	19,6700	6,0000	1,6100	-0,1200	-0,0500	27,5380	26,6040	24,4090	33,1080	33,1640	26,4480	26,5390	17,8590	17,7680	33,1640	-	vp
	53	-42,0600	-12,5200	-4,3100	3,2300	-2,1600	-58,8840	-56,7320	-52,6270	-67,9200	-72,2320	-52,5330	-59,5400	-42,0530	-35,0460	-	-72,2320	vp
	30	48,2400	15,5500	4,6900	5,4500	-6,2100	67,5360	65,6630	60,2330	87,1280	77,8000	72,7480	57,5900	36,3310	51,4890	87,1280	-	d
	32	23,3900	7,4300	1,8500	1,4600	-1,3000	32,7460	31,7830	28,9930	41,1240	38,9160	33,6810	30,0930	19,1530	22,7410	41,1240	-	d
	34	23,6200	10,2800	2,1000	-1,6800	1,6800	33,0680	33,4840	29,3940	43,4480	46,1360	31,3000	35,6680	23,4420	19,0740	46,1360	-	d
	36	21,9300	7,3600	2,0900	-1,7000	1,7000	30,7020	29,9960	27,3610	36,7320	39,4520	27,7860	32,2060	21,9470	17,5270	39,4520	-	d
	38	8,4900	4,4100	0,7000	-1,7000	1,7000	11,8860	12,3930	10,5380	15,8840	18,6040	10,1830	14,6030	9,8510	5,4310	18,6040	-	d
	40	6,8000	1,4800	0,6900	-1,7000	1,7000	9,5200	8,9000	8,5050	9,1680	11,8880	6,6900	11,1100	8,3300	3,9100	11,8880	-	d
	42	6,8000	1,4800	0,6900	1,7100	-1,7100	9,5200	8,9000	8,5050	11,8960	9,1600	11,1230	6,6770	3,8970	8,3430	11,9860	-	d
	44	8,4900	4,4100	0,7000	1,7000	-1,7000	11,8860	12,3930	10,5380	18,6040	15,8840	14,6030	10,1830	5,4310	9,8510	18,6040	-	d
	46	21,9300	7,3600	2,0900	1,7000	-1,7000	30,7020	29,9960	27,3610	39,4520	36,7320	32,2060	27,7860	17,5270	21,9470	39,4520	-	d
	48	23,6200	10,2800	2,1000	1,7000	-1,7000	33,0680	33,4840	29,3940	46,1520	43,4320	35,6940	31,2740	19,0480	23,4680	46,1520	-	v
	50	23,3900	7,4300	1,8500	1,5900	-1,4300	32,7460	31,7830	28,9930	41,2280	38,8120	33,8500	29,9240	18,9840	22,9100	41,2280	-	v
	52	48,2400	15,5500	4,6900	-1,5800	0,8100	67,5360	65,6630	60,2330	81,5040	83,4160	63,6090	66,7160	45,4700	42,3630	83,4160	-	v
	31	-26,5700	-7,5700	-2,5900	-3,0200	3,4400	-37,1980	-35,6690	-33,1790	-46,4120	-41,2440	-39,5950	-31,1970	-19,9870	-28,3850	-	-46,4120	v
	35	-15,8800	-5,9300	-1,4100	1,1500	-1,1500	-22,2320	-22,0210	-19,7610	-27,6240	-29,4640	-20,5260	-23,5160	-15,7870	-12,7970	-	-29,4640	v
	39	-5,7300	-1,9900	-0,4700	1,1500	-1,1500	-8,0220	-7,8710	-7,1110	-9,1400	-10,9800	-6,3760	-9,3660	-6,6520	-3,6620	-	-10,9800	v
	43	-5,7300	-1,9900	-0,4700	-1,1500	1,1500	-8,0220	-7,8710	-7,1110	-10,9800	-9,1400	-9,3660	-6,3760	-3,6620	-6,6520	-	-10,9800	v
	47	-15,8800	-5,9300	-1,4100	-1,1500	1,1500	-22,2320	-22,0210	-19,7610	-29,4640	-27,6240	-23,5160	-20,5260	-12,7970	-15,7870	-	-29,4640	v
	51	-26,5700	-7,5700	-2,5900	0,8700	-0,4500	-37,1980	-35,6690	-33,1790	-43,3000	-44,3560	-34,5380	-36,2540	-25,0440	-23,3280	-	-44,3560	v
K4	1	7,2500	3,4500	0,8500	1,0400	-1,3800	10,1500	10,4250	9,1250	15,0520	13,1160	11,7770	8,6310	5,1730	8,3190	15,0520	-	a
	2	2,9500	1,0000	0,4200	0,4900	-0,4400	4,1300	4,0400	3,7500	5,5320	4,7880	4,6770	3,4680	2,0180	3,2270	5,5320	-	a
	3	1,6800	0,9300	0,1400	0,8500	-0,7100	2,3520	2,4810	2,0860	4,1840	2,9360	3,5860	1,5580	0,4070	2,4350	4,1840	-	a
	4	0,3300	-0,1400	0,0900	0,8400	-0,6700	0,4620	0,3260	0,4410	0,8440	-0,3640	1,4180	-0,5450	-0,7950	1,1680	0,8440	-	a
	5	0,7800	0,5600	0,0400	0,8200	-0,6300	1,0920	1,2160	0,9560	2,4880	1,3280	2,2820	0,3970	-0,3640	1,5210	2,4900	-	a
	6	0,2500	-0,2300	0,0800	0,7000	-0,5300	0,3500	0,1850	0,3400	0,4920	-0,4920	1,0950	-0,5040	-0,6850	0,9140	0,9140	-	a
	7	1,5200	0,7500	0,1200	0,5700	-0,4300	2,1280	2,1990	1,8840	3,4800	2,6800	2,9400	1,6400	0,6270	1,9270	3,4800	-	a
	8	1,5200	0,7500	0,1200	0,5700	-0,4300	2,1280	2,1990	1,8840	3,4800	2,6800	2,9400	1,6400	0,6270	1,9270	3,4800	-	a
	9	0,2500	-0,2300	0,0800	0,6800	-0,5100	0,3500	0,1850	0,3400	0,4760	-0,4760	1,0690	-0,4780	-0,6590	0,8880	1,0690	-	a
	10	0,7800	0,5600	0,0400	0,7800	-0,5900	1,0920	1,2160	0,9560	2,4560	1,3600	2,2300	0,4490	-0,3120	1,4690	1,4690	-	a
	11	0,3300	-0,1400	0,0900	0,6800	-0,5100	0,4620	0,3260	0,4410	0,7160	-0,2360	1,2100	-0,3370	-0,5870	0,9600	0,9600	-	a
	12	1,6800	0,9300	0,1400	0,5700	-0,4300	2,3520	2,4810	2,0860	3,9600	3,1600	3,2220	1,9220	0,7710	2,0710	3,9600	-	a
	13	2,9500	1,0000	0,4200	0,2000	-0,1500	4,1300	4,0400	3,7500	5,3000	5,0200	4,3000	3,8450	2,3950	2,8500	5,3000	-	a
	14	7,2500	3,4500	0,8500	-1,3800	1,0300	10,1500	10,4250	9,1250	13,1160	15,0440	8,6310	11,7640	8,3190	5,1860	15,0440	-	a
	15	-0,9400	-2,8300	-0,6900	-1,2700	1,6900	-1,3160	-2,5430	-1,4730	-6,6720	-4,3040	-4,1940	-0,3460	0,8050	-3,0430	-	-6,6720	b
	16	-5,9300	-2,8200	-0,6900	1,4000	-0,9800	-8,3020	-8,5260	-7,4610	-10,5080	-12,4120	-6,7060	-9,8000	-7,1570	-4,0630	-	-12,4120	b
	17	-2,9200	-0,9900	-0,4200	1,4000	-0,9800	-4,0880	-3,9990	-3,7140	-3,9680	-5,8720	-2,1790	-5,2730	-4,4480	-1,3540	-	-5,8720	b

Tabel 4.8 Lanjutan

Kuda-kuda	No.	N_D	N_L	N_H	N_{Wki}	N_{Wka}	$N_{u.1}$	$N_{u.2}$	$N_{u.3}$	$N_{u.4}$	$N_{u.5}$	$N_{u.6}$	$N_{u.7}$	$N_{u.8}$	$N_{u.9}$	N_u tarik	N_u tekan	Jenis
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]	[19]
K4	18	-1,6600	-0,9200	-0,1400	1,0300	-0,7000	-2,3240	-2,4520	-2,0620	-2,6400	-4,0240	-1,1130	-3,3620	-2,8330	-0,5840	-	-4,0240	b
	19	-0,3200	0,1500	-0,0800	0,6700	-0,4400	-0,4480	-0,3090	-0,4240	0,3920	-0,4960	0,5620	-0,8810	-1,1590	0,2840	-	-1,1590	b
	20	-0,7700	-0,5600	-0,0400	0,6900	-0,4800	-1,0780	-1,2040	-0,9440	-1,2680	-2,2040	-0,3070	-1,8280	-1,5900	-0,0690	-	-2,2040	b
	21	-0,2500	0,2300	-0,0800	0,8300	-0,6200	-0,3500	-0,1850	-0,3400	0,7320	-0,4280	0,8940	-0,9910	-1,3040	0,5810	-	-0,9910	b
	22	-0,2500	0,2300	-0,0800	0,8500	-0,6400	-0,3500	-0,1850	-0,3400	0,7480	-0,4440	0,9200	-1,0170	-1,3300	0,6070	0,9200	-	b
	23	-0,7700	-0,5600	-0,0400	0,7500	-0,5600	-1,0780	-1,2040	-0,9440	-1,2200	-2,2680	-0,2290	-1,9320	-1,6680	0,0350	-	-2,2680	b
	24	-0,3200	0,1500	-0,0800	0,8500	-0,6400	-0,4480	-0,3090	-0,4240	0,5360	-0,6560	0,7960	-1,1410	-1,3930	0,5440	-	-1,3930	b
	25	-1,6600	-0,9200	-0,1400	0,9500	-0,7200	-2,3240	-2,4520	-2,0620	-2,7040	-4,0400	-1,2170	-3,3880	-2,7290	-0,5580	-	-4,0400	b
	26	-2,9200	-0,9900	-0,4200	1,3300	-1,0000	-4,0880	-3,9990	-3,7140	-4,0240	-5,8880	-2,2700	-5,2990	-4,3570	-1,3280	-	-5,8880	b
	27	-5,9300	-2,8200	-0,6900	1,6900	-1,2700	-8,3020	-8,5260	-7,4610	-10,2760	-12,6440	-6,3290	-10,1770	-7,5340	-3,6860	-	-12,6440	b
	28	-5,9400	-2,8300	-0,6900	1,6900	-1,2700	-8,3160	-8,5430	-7,4730	-10,3040	-12,6720	-6,3460	-10,1940	-7,5430	-3,6950	-	-12,6720	b
	29	-14,1400	-3,9900	-1,4700	-1,4400	3,0200	-19,7960	-18,9630	-17,7030	-24,5040	-20,9360	-20,8350	-15,0370	-10,8540	-16,6520	-	-24,5040	vp
	33	-7,0800	-1,6000	-0,8600	-0,0100	0,0200	-9,9120	-9,2960	-8,9260	-11,0640	-11,0400	-9,3090	-9,2700	-6,3590	-6,3980	-	-11,0640	vp
	37	-6,7000	-1,4500	-0,8100	-0,0700	0,0500	-9,3800	-8,7650	-8,4450	-10,4160	-10,3200	-8,8560	-8,7000	-5,9390	-6,0950	-	-10,4160	vp
	41	-6,4500	-1,0200	-0,8400	0,0000	0,0000	-9,0300	-8,2500	-8,1600	-9,3720	-9,3720	-8,2500	-8,2500	-5,8050	-5,8050	-	-9,3720	vp
	45	-6,7000	-1,4500	-0,8400	-0,0600	0,0400	-9,3800	-8,7650	-8,4600	-10,4080	-10,3280	-8,8430	-8,7130	-5,9520	-6,0820	-	-10,4080	vp
	49	-7,0800	-1,6000	-0,8100	0,0500	-0,0400	-9,9120	-9,2960	-8,9010	-11,0160	-11,0880	-9,2310	-9,3480	-6,4370	-6,3200	-	-11,0880	vp
	53	-14,1400	-3,9900	-1,4700	2,3700	-1,7800	-19,7960	-18,9630	-17,7030	-21,4560	-24,7760	-15,8820	-21,2770	-15,8070	-10,4120	-	-24,7760	vp
	30	3,4000	2,0700	0,3100	-0,4100	0,3100	4,7600	5,1150	4,2350	7,0640	7,6400	4,5820	5,5180	3,5930	2,6570	7,6400	-	d
	32	1,4200	0,0700	0,3200	-0,4000	0,3000	1,9880	1,7390	1,8640	1,4960	2,0560	1,2190	2,1290	1,7980	0,8880	2,1290	-	d
	34	1,5100	1,2100	0,0600	0,0200	-0,0500	2,1140	2,4170	1,8420	3,7640	3,7080	2,4430	2,3520	1,3330	1,4240	3,7640	-	d
	36	-0,5300	-0,8000	0,0500	0,0200	-0,0500	-0,7420	-1,0360	-0,6110	-1,9000	-1,9560	-1,0100	-1,1010	-0,5030	-0,4120	-	-1,9560	d
	38	0,5900	0,8900	-0,0500	0,1400	-0,1100	0,8260	1,1530	0,6830	2,2440	2,0440	1,3350	1,0100	0,3490	0,6740	2,2440	-	d
	40	-1,4500	-1,1200	-0,0500	0,1500	-0,1200	-2,0300	-2,3000	-1,7650	-3,4120	-3,6280	-2,1050	-2,4560	-1,5000	-1,1490	-	-3,6280	d
	42	-1,4500	-1,1200	-0,0500	0,1200	-0,0900	-2,0300	-2,3000	-1,7650	-3,4360	-3,6040	-2,1440	-2,4170	-1,4610	-1,1880	-	-3,6040	d
	44	0,5900	0,8900	-0,0500	0,1200	-0,0900	0,8260	1,1530	0,6830	2,2280	2,0600	1,3090	1,0360	0,3750	0,6480	2,2280	-	d
	46	-0,5300	-0,8000	0,0600	-0,1100	0,0900	-0,7420	-1,0360	-0,6060	-2,0040	-1,8440	-1,1790	-0,9190	-0,3340	-0,5940	-	-2,0040	d
	48	1,5100	1,2100	0,0600	-0,1200	0,0900	2,1140	2,4170	1,8420	3,6520	3,8200	2,2610	2,5340	1,5150	1,2420	3,8200	-	d
	50	1,4200	0,0700	0,3200	-0,4200	0,3100	1,9880	1,7390	1,8640	1,4800	2,0640	1,1930	2,1420	1,8240	0,8750	2,0640	-	d
	52	3,4200	2,0700	0,3100	-0,4000	0,3000	4,7880	5,1390	4,2590	7,0960	7,6560	4,6190	5,5290	3,5980	2,6880	7,6560	-	d
	31	-1,6700	-9,8600	-0,1500	0,1900	-0,1400	-2,3380	-6,9340	-2,0790	-17,6280	-17,8920	-6,6870	-7,1160	-1,7500	-1,3210	-	-17,8920	v
	35	-0,7500	-5,9400	-0,0300	-0,0100	0,0200	-1,0500	-3,8700	-0,9150	-10,4120	-10,3880	-3,8830	-3,8440	-0,6620	-0,7010	-	-10,4120	v
	39	-1,6700	-1,9800	0,0200	-0,0700	0,0500	-2,3380	-2,9940	-1,9940	-5,2280	-5,1320	-3,0850	-2,9290	-1,4120	-1,5680	-	-5,2280	v
	43	3,4000	-1,9800	0,0200	-0,0600	0,0400	4,7600	3,0900	4,0900	0,8640	0,9440	3,0120	3,1420	3,1380	3,0080	4,0900	-	v
	47	1,4200	-5,9400	-0,0300	0,0600	-0,0400	1,9880	-1,2660	1,6890	-7,7520	-7,8320	-1,1880	-1,3180	1,2000	1,3300	-	-7,8320	v
	51	-1,6700	-9,8600	-0,1500	0,2000	-0,1500	-2,3380	-6,9340	-2,0790	-17,6200	-17,9000	-6,6740	-7,1290	-1,7630	-1,3080	-	-17,9000	v

Keterangan **Tabel 4.8** :

[1] Kuda-Kuda yang ditinjau
[2] Nomer batang
[3] N_D = Gaya batang akibat beban mati
[4] N_L = Gaya batang akibat beban hidup atap
[5] N_H = Gaya batang akibat beban hujan
[6] N_{Wki} = Gaya batang akibat beban angin kiri
[7] N_{Wka} = Gaya batang akibat beban angin kanan
[8] $N_{u.1} = 1{,}4N_D$
[9] $N_{u.2} = 1{,}2N_D + 1{,}6N_L$
[10] $N_{u.3} = 1{,}2N_D + 1{,}6N_H$
[11] $N_{u.4} = 1{,}2N_D + 1{,}6N_L + 0{,}8N_{Wki}$
[12] $N_{u.4} = 1{,}2N_D + 1{,}6N_L + 0{,}8N_{Wka}$
[13] $N_{u.6} = 1{,}2N_D + 1{,}3N_{Wki} + 0{,}5N_L$
[14] $N_{u.6} = 1{,}2N_D + 1{,}3N_{Wka} + 0{,}5N_L$
[15] $N_{u.8} = 0{,}9N_D - 1{,}3N_{Wki}$
[16] $N_{u.8} = 0{,}9N_D - 1{,}3N_{Wka}$
[17] N_u Tarik = Gaya batang tarik kombinasi maksimum
[18] N_u Tekan = Gaya batang tekan kombinasi maksimum
[19] Jenis batang: a = batang atas, b = batang bawah
d = batang diagonal, v = batang vertikal
vp = batang pertemuan antar kuda-kuda

4.3.4 Pendimensian Kuda-Kuda Rangka Baja

Sebagai contoh perhitungan ditinjau pada pendimensian rangka baja kuda-kuda K1, untuk pendimensian batang tekan adalah batang atas (a) nomor 5, dan untuk pendimensian batang tarik adalah batang bawah (b) nomor 20.

1. Pendimensian Batang Tekan (Batang atas (a) Nomor: 5)

- L = 2197 mm
- N_u = 187,2000 kN
- di coba profil 2L 70.70.7

  data-data profil:

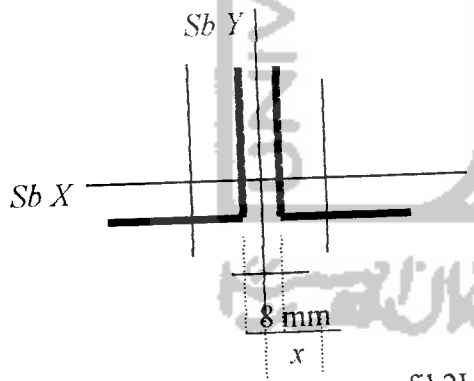
  $A\ profil$ = 940 mm^2

  $r_x = r_y$ = 21,24 mm

  $I_x = I_y$ = 424000 mm^4
- Cek angka perbandingan kelangsingan batang tekan: $L_k/r < 200$

  $L_k = k.L = 1.2197 = 2197$ mm

  mencari r pilih yang terkecil untuk profil 2L 70.70.7



Gambar 4.23 Penampang profil 2L 70.70.7

$x = e + tp/2 = 19,7 + 8/2 = 23,7$ mm

I_y dua profil = $2\ (I_y + A.x^2)$

$= 2.(42,4.10^4 + 940.23,7^2)$

$= 1903977,2$ mm^4

$r_y = \sqrt{(I_y/A_g)} = \sqrt{(1903977,2/(2.940))} = 31,45$ mm

I_x dua profil = $2.I_x = 2.424000 = 848000$ mm^4

$r_x = \sqrt{(I_x/A_g)} = \sqrt{(848000/(2.940))} = 21,24$ mm

di pilih r terkecil $r = r_x = 21,24$ mm

$L_k/r_x = 2197/21,24 = 103,437 < 200$ - aman-

- parameter kelangsingan batang tekan

$$\lambda c = \frac{1}{\pi}\frac{L_k}{r}\sqrt{\frac{f_y}{E}}$$

$$\lambda_c = \frac{1}{\pi}\frac{2197}{21,24}\sqrt{\frac{240}{200000}}$$

$$= 1,141$$

untuk $0,25 < (\lambda_c = 1,141) < 1,2$

maka $\omega = 1,43 / (1,6-0,67.\lambda_c)$

$= 1,43 / (1,6-0,67.1,141) = 1,711$

- Kuat tekan nominal

$\phi.N_n = \phi.A_g.(f_y/\omega)$

$= 0,87.2.940.(240/1,711)$

$= 224165,6$ N $= 224,1656$ kN

$(\phi.N_n = 224,1656 \text{ kN}) > (N_u = 187,2000 \text{ kN})$ - aman-

2. Pendimensian Batang Tarik (Batang bawah (b) Nomor: 20)

- $L = 2023$ mm
- $N_u = 179,4840$ kN
- dicoba profil 2L50.50.5

  data-data profil:

  $A\ profil = 480\ mm^2$

  $r = r_x = 15,1$ mm (jari-jari girasi terkecil)
- Cek angka perbandingan kelangsingan batang tarik

  $L/r = 2023/15,1 = 133,974 < 240$ - aman-
- Kuat tarik nominal batang tarik

  $\phi.N_n = \phi.A_g.f_y$

  $= 0,90.(2.480).240$

  $= 207360$ N $= 207,3600$ kN

  $(\phi.N_n = 207,3600 \text{ kN}) > (N_u = 179,4840 \text{ kN})$ -aman-

Dengan cara yang sama dapat dihitung pendimensian seluruh rangka baja kuda-kuda disajikan pada Tabel 4.9.

Tabel 4.9 Pendimensian Rangka Baja Kuda-Kuda

Kuda-Kuda	No.	Panjang (mm)	N_u tarik (kN)	N_u tekan (kN)	Profil	A (mm^2)	r_x (mm)	Analisis Batang Tekan						Analisis Batang Tarik		Ket.	Jenis Batang
								L_k/r_x <200	λ_c	$\omega 1$	$\omega 2$	ϕN_{n1} (kN)	ϕN_{n2} (kN)	L/r_x <240	ϕN_n (kN)		
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]
K1	1	1709	16,8800	-	2L 70 70 7	940	21,24	-	-	-	-	-	-	80,461	406,0800	Aman	a
	2	2197	-	-104,3880	2L 70 70 7	940	21,24	103,437	1,141	1,711	-	224,1656	-	-	-	Aman	a
	3	2197	-	-162,1840	2L 70 70 7	940	21,24	103,437	1,141	1,711	-	224,1656	-	-	-	Aman	a
	4	2197	-	-183,1520	2L 70 70 7	940	21,24	103,437	1,141	1,711	-	224,1656	-	-	-	Aman	a
	5	2197	-	-187,2000	2L 70 70 7	940	21,24	103,437	1,141	1,711	-	224,1656	-	-	-	Aman	a
	6	2197	-	-178,0760	2L 70 70 7	940	21,24	103,437	1,141	1,711	-	224,1656	-	-	-	Aman	a
	7	2197	-	-162,2560	2L 70 70 7	940	21,24	103,437	1,141	1,711	-	224,1656	-	-	-	Aman	a
	8	2197	-	-162,4880	2L 70 70 7	940	21,24	103,437	1,141	1,711	-	224,1656	-	-	-	Aman	a
	9	2197	-	-172,9160	2L 70 70 7	940	21,24	103,437	1,141	1,711	-	224,1656	-	-	-	Aman	a
	10	2197	-	-177,6000	2L 70 70 7	940	21,24	103,437	1,141	1,711	-	224,1656	-	-	-	Aman	a
	11	2197	-	-170,5680	2L 70 70 7	940	21,24	103,437	1,141	1,711	-	224,1656	-	-	-	Aman	a
	12	2197	-	-150,6880	2L 70 70 7	940	21,24	103,437	1,141	1,711	-	224,1656	-	-	-	Aman	a
	13	2197	-	-97,4600	2L 70 70 7	940	21,24	103,437	1,141	1,711	-	224,1656	-	-	-	Aman	a
	14	1709	15,8960	-	2L 70 70 7	940	21,24	-	-	-	-	-	-	80,461	406,0800	Aman	a
	15	1400	-	-14,2160	2L 50.50.5	480	15,1	92,715	1,022	1,563	-	125,3154	-	-	-	Aman	b
	16	2023	-	-25,4040	2L 50.50.5	480	15,1	133,974	1,477	-	2,728	-	71,7913	-	-	Aman	b
	17	2023	105,4760	-	2L 50.50.5	480	15,1	-	-	-	-	-	-	133,974	207,3600	Aman	b
	18	2023	157,8880	-	2L 50.50.5	480	15,1	-	-	-	-	-	-	133,974	207,3600	Aman	b
	19	2023	176,4680	-	2L 50.50.5	480	15,1	-	-	-	-	-	-	133,974	207,3600	Aman	b
	20	2023	179,4840	-	2L 50.50.5	480	15,1	-	-	-	-	-	-	133,974	207,3600	Aman	b
	21	2023	170,0800	-	2L 50.50.5	480	15,1	-	-	-	-	-	-	133,974	207,3600	Aman	b
	22	2023	163,3840	-	2L 50.50.5	480	15,1	-	-	-	-	-	-	133,974	207,3600	Aman	b
	23	2023	166,9960	-	2L 50.50.5	480	15,1	-	-	-	-	-	-	133,974	207,3600	Aman	b
	24	2023	159,5080	-	2L 50.50.5	480	15,1	-	-	-	-	-	-	133,974	207,3600	Aman	b
	25	2023	138,6320	-	2L 50.50.5	480	15,1	-	-	-	-	-	-	133,974	207,3600	Aman	b
	26	2023	89,3400	-	2L 50.50.5	480	15,1	-	-	-	-	-	-	133,974	207,3600	Aman	b
	27	2023	-	-14,4920	2L 50.50.5	480	15,1	133,974	1,477	-	2,728	-	71,7913	-	-	Aman	b
	28	1400	-	-13,0160	2L 50.50.5	480	15,1	92,715	1,022	1,563	-	125,3154	-	-	-	Aman	b
	29	980	-	-83,3200	O 76,3.3,2	734,9	25,9	37,838	0,417	1,083	-	138,4357	-	-	-	Aman	vp
	33	1653	-	-29,6800	O 76,3.3,2	734,9	25,9	63,822	0,704	1,267	-	118,3099	-	-	-	Aman	vp
	37	2326	-	-3,3410	O 76,3.3,2	734,9	25,9	89,807	0,990	-	1,226	-	122,3058	-	-	Aman	vp
	41	3000	152,6440	-	O 76,3.3,2	734,9	25,9	-	-	-	-	-	-	115,830	158,7384	Aman	vp
	45	2326	-	-6,4220	O 76,3.3,2	734,9	25,9	89,807	0,990	-	1,226	-	122,3058	-	-	Aman	vp
	49	1653	-	-28,7120	O 76,3.3,2	734,9	25,9	63,822	0,704	1,267	-	118,3099	-	-	-	Aman	vp
	53	980	-	-78,3040	O 76,3.3,2	734,9	25,9	37,838	0,417	1,083	-	138,4357	-	-	-	Aman	vp
	30	1801	98,4240	-	2L 45.45.5	430	13,5	-	-	-	-	-	-	133,407	185,7600	Aman	d
	32	1842	47,8200	-	2L 45.45.5	430	13,5	-	-	-	-	-	-	136,444	185,7600	Aman	d
	34	1942	17,7880	-	2L 45.45.5	430	13,5	-	-	-	-	-	-	143,852	185,7600	Aman	d
	36	2092	5,9650	-	2L 45.45.5	430	13,5	-	-	-	-	-	-	154,963	185,7600	Aman	d
	38	2282	-	-10,5040	2L 45.45.5	430	13,5	169,037	1,864	-	4,343	-	40,3993	-	-	Aman	d
	40	2503	-	-18,0120	2L 45.45.5	430	13,5	185,407	2,044	-	5,225	-	33,5802	-	-	Aman	d
	42	2503	-	-19,4440	2L 45.45.5	430	13,5	185,407	2,044	-	5,225	-	33,5802	-	-	Aman	d
	44	2282	-	-13,0550	2L 45.45.5	430	13,5	169,037	1,864	-	4,343	-	40,3993	-	-	Aman	d
	46	2092	9,2020	-	2L 45.45.5	430	13,5	-	-	-	-	-	-	154,963	185,7600	Aman	d
	48	1942	20,0040	-	2L 45.45.5	430	13,5	-	-	-	-	-	-	143,852	185,7600	Aman	d
	50	1842	46,3960	-	2L 45.45.5	430	13,5	-	-	-	-	-	-	136,444	185,7600	Aman	d
	52	1801	92,7200	-	2L 45.45.5	430	13,5	-	-	-	-	-	-	133,407	185,7600	Aman	d
	31	1317	-	-52,7240	2L 45.45.5	430	13,5	97,556	1,076	-	1,446	-	121,2923	-	-	Aman	v
	35	1990	-	-13,5720	2L 45.45.5	430	13,5	147,407	1,625	-	3,302	-	53,1249	-	-	Aman	v
	39	2663	12,5160	-	2L 45.45.5	430	13,5	-	-	-	-	-	-	197,259	185,7600	Aman	v
	43	2663	14,0840	-	2L 45.45.5	430	13,5	-	-	-	-	-	-	197,259	185,7600	Aman	v
	47	1990	-	-15,4440	2L 45.45.5	430	13,5	147,407	1,625	-	3,302	-	53,1249	-	-	Aman	v
	51	1317	-	-49,2200	2L 45.45.5	430	13,5	97,556	1,076	-	1,446	-	121,2923	-	-	Aman	v
K2	1	1709	16,8320	-	2L 70 70 7	940	21,24	-	-	-	-	-	-	80,461	406,08	Aman	a
	2	2197	-	-99,2120	2L 70 70 7	940	21,24	103,437	1,141	1,711	-	224,1656	-	-	-	Aman	a
	3	2197	-	-153,8900	2L 70 70 7	940	21,24	103,437	1,141	1,711	-	224,1656	-	-	-	Aman	a
	4	2197	-	-172,8680	2L 70 70 7	940	21,24	103,437	1,141	1,711	-	224,1656	-	-	-	Aman	a
	5	2197	-	-175,3800	2L 70 70 7	940	21,24	103,437	1,141	1,711	-	224,1656	-	-	-	Aman	a
	6	1800	-	-151,0120	2L 70 70 7	940	21,24	84,746	0,934	1,468	-	261,1998	-	-	-	Aman	a
	7	1800	-	-153,9040	2L 70 70 7	940	21,24	84,746	0,934	1,468	-	261,1998	-	-	-	Aman	a
	8	1800	-	-153,8960	2L 70 70 7	940	21,24	84,746	0,934	1,468	-	261,1998	-	-	-	Aman	a
	9	1800	-	-146,4280	2L 70 70 7	940	21,24	84,746	0,934	1,468	-	261,1998	-	-	-	Aman	a
	10	2197	-	-166,0920	2L 70 70 7	940	21,24	103,437	1,141	1,711	-	224,1656	-	-	-	Aman	a
	11	2197	-	-160,6040	2L 70 70 7	940	21,24	103,437	1,141	1,711	-	224,1656	-	-	-	Aman	a
	12	2197	-	-142,4400	2L 70 70 7	940	21,24	103,437	1,141	1,711	-	224,1656	-	-	-	Aman	a
	13	2197	-	-92,0920	2L 70 70 7	940	21,24	103,437	1,141	1,711	-	224,1656	-	-	-	Aman	a
	14	1709	16,8400	-	2L 70 70 7	940	21,24	-	-	-	-	-	-	80,461	406,08	Aman	a
	15	1400	-	-14,1680	2L 50.50.5	940	21,24	65,913	0,727	1,285	-	298,5139	-	-	-	Aman	b
	16	2023	-	-23,4180	2L 50.50.5	480	15,1	133,974	1,477	-	2,728	-	71,7913	-	-	Aman	b
	17	2023	99,7440	-	2L 50.50.5	480	15,1	-	-	-	-	-	-	133,974	207,36	Aman	b
	18	2023	149,3240	-	2L 50.50.5	480	15,1	-	-	-	-	-	-	133,974	207,36	Aman	b
	19	2023	165,9360	-	2L 50.50.5	480	15,1	-	-	-	-	-	-	133,974	207,36	Aman	b
	20	1800	149,2280	-	2L 50.50.5	480	15,1	-	-	-	-	-	-	119,205	207,36	Aman	b

Tabel 4.9.Lanjutan

Kuda-Kuda	No.	Panjang (mm)	N_u tarik (kN)	N_u tekan (kN)	Profil	A (mm^2)	r_x (mm)	Analisis Batang Tekan						Analisis Batang Tarik		Ket.	Jenis Batang
								L_k/r_x <200	λc	$\omega 1$	$\omega 2$	ϕN_{n1} (kN)	ϕN_{n2} (kN)	L/r_x <240	ϕN_n (kN)		
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]
K2	21	1800	155,8120	-	2L 50.50.5	480	15,1	-	-	-	-	-	-	119,205	207,36	Aman	b
	22	1800	151,2280	-	2L 50.50.5	480	15,1	-	-	-	-	-	-	119,205	207,36	Aman	b
	23	1800	140,1000	-	2L 50.50.5	480	15,1	-	-	-	-	-	-	119,205	207,36	Aman	b
	24	2023	151,2160	-	2L 50.50.5	480	15,1	-	-	-	-	-	-	133,974	207,36	Aman	b
	25	2023	132,3160	-	2L 50.50.5	480	15,1	-	-	-	-	-	-	133,974	207,3600	Aman	b
	26	2023	84,3040	-	2L 50.50.5	480	15,1	-	-	-	-	-	-	133,974	207,3600	Aman	b
	27	2023	-	-15,8160	2L 50.50.5	480	15,1	133,974	1,477	-	2,728	-	71,7913	-	-	Aman	b
	28	1400	-	-14,1760	2L 50.50.5	480	15,1	92,715	1,022	1,563	-	125,3154	-	-	-	Aman	b
	29	980	-	-80,1200	O 76,3.3,2	734,9	25,9	37,838	0,417	1,083	-	138,4357	-	-	-	Aman	vp
	33	1653	-	-27,8640	O 76,3.3,2	734,9	25,9	63,822	0,704	1,267	-	118,3099	-	-	-	Aman	vp
	37	2326	77,8800	-	O 76,3.3,2	734,9	25,9	-	-	-	-	-	-	89,807	158,7384	Aman	vp
	41	2326	-	-10,1080	O 76,3.3,2	734,9	25,9	89,807	0,990	-	1,226	-	122,3058		-	Aman	vp
	45	2326	68,8560	-	O 76,3.3,2	734,9	25,9	-	-	-	-	-	-	89,807	158,7384	Aman	vp
	49	1653	-	-26,8640	O 76,3.3,2	734,9	25,9	63,822	0,704	1,267	-	118,3099	-	-	-	Aman	vp
	53	980	-	-75,8480	O 76,3.3,2	734,9	25,9	37,838	0,417	1,083	-	138,4357	-	-	-	Aman	vp
	30	1801	94,1520	-	2L 45.45.5	338	13,5	-	-	-	-	-	-	133,407	146,0160	Aman	d
	32	1842	45,2240	-	2L 45.45.5	338	13,5	-	-	-	-	-	-	136,444	146,0160	Aman	d
	34	1942	15,9640	-	2L 45.45.5	338	13,5	-	-	-	-	-	-	143,852	146,0160	Aman	d
	36	2092	4,5440	-	2L 45.45.5	338	13,5	-	-	-	-	-	-	154,963	146,0160	Aman	d
	38	2941	18,1920	-	2L 45.45.5	338	13,5	-	-	-	-	-	-	217,852	146,0160	Aman	d
	40	2941	12,1680	-	2L 45.45.5	338	13,5	-	-	-	-	-	-	217,852	146,0160	Aman	d
	42	2941	13,1280	-	2L 45.45.5	338	13,5	-	-	-	-	-	-	217,852	146,0160	Aman	d
	44	2941	18,2240	-	2L 45.45.5	338	13,5	-	-	-	-	-	-	217,852	146,0160	Aman	d
	46	2092	7,9670	-	2L 45.45.5	338	13,5	-	-	-	-	-	-	154,963	146,0160	Aman	d
	48	1942	18,1560	-	2L 45.45.5	338	13,5	-	-	-	-	-	-	143,852	146,0160	Aman	d
	50	1842	43,7760	-	2L 45.45.5	338	13,5	-	-	-	-	-	-	136,444	146,0160	Aman	d
	52	1801	88,3200	-	2L 45.45.5	338	13,5	-	-	-	-	-	-	133,407	146,0160	Aman	d
	31	1317	-	-50,3640	2L 45.45.5	338	13,5	97,556	1,076	1,626	-	84,7944	-	97,556	-	Aman	v
	35	1990	-	-11,5800	2L 45.45.5	338	13,5	147,407	1,625	-	3,302	-	41,7587	147,407	-	Aman	v
	39	2663	-	-12,4800	2L 45.45.5	338	13,5	197,259	2,175	-	5,914	-	23,3190	197,259	-	Aman	v
	43	2663	-	-12,1410	2L 45.45.5	338	13,5	197,259	2,175	-	5,914	-	23,3190	197,259	-	Aman	v
	47	1990	-	-13,7760	2L 45.45.5	338	13,5	147,407	1,625	-	3,302	-	41,7587	147,407	-	Aman	v
	51	1317	-	-47,0920	2L 45.45.5	338	13,5	97,556	1,076	1,626	-	84,7944	-	97,556	-	Aman	v
K3	1	1709	16,2680	-	2L 70 70 7	940,00	21,24	-	-	-	-	-	-	80,461	406,0800	Aman	a
	2	2197	-	-91,2520	2L 70 70 7	940,00	21,24	103,437	1,141	1,711	-	224,1656	-	-	-	Aman	a
	3	2197	-	-140,8400	2L 70 70 7	940,00	21,24	103,437	1,141	1,711	-	224,1656	-	-	-	Aman	a
	4	1800	-	-148,2280	2L 70 70 7	940,00	21,24	84,746	0,934	1,468	-	261,1998	-	-	-	Aman	a
	5	1800	-	-175,3640	2L 70 70 7	940,00	21,24	84,746	0,934	1,468	-	261,1998	-	-	-	Aman	a
	6	1800	-	-187,1560	2L 70 70 7	940,00	21,24	84,746	0,934	1,468	-	261,1998	-	-	-	Aman	a
	7	1800	-	193,9400	2L 70 70 7	940,00	21,24	84,746	0,934	1,468	-	261,1998	-	-	-	Aman	a
	8	1800	-	-193,9320	2L 70 70 7	940,00	21,24	84,746	0,934	1,468	-	261,1998	-	-	-	Aman	a
	9	1800	-	-185,1400	2L 70 70 7	940,00	21,24	84,746	0,934	1,468	-	261,1998	-	-	-	Aman	a
	10	1800	-	-171,3320	2L 70 70 7	940,00	21,24	84,746	0,934	1,468	-	261,1998	-	-	-	Aman	a
	11	1800	-	-142,1880	2L 70 70 7	940,00	21,24	84,746	0,934	1,468	-	261,1998	-	-	-	Aman	a
	12	2197	-	-133,5680	2L 70 70 7	940,00	21,24	103,437	1,141	1,711	-	224,1656	-	-	-	Aman	a
	13	2197	-	-86,7160	2L 70 70 7	940,00	21,24	103,437	1,141	1,711	-	224,1656	-	-	-	Aman	a
	14	1709	16,2760	-	2L 70 70 7	940,00	21,24	-	-	-	-	-	-	80,461	406,0800	Aman	a
	15	1400	-	-11,3860	2L 50.50.5	940,00	21,24	65,913	0,727	1,285	-	298,5139	-	-	-	Aman	a
	16	2023	-	-18,1040	2L 50.50.5	480,00	15,10	133,974	1,477	-	2,728	-	71,7913	-	-	Aman	b
	17	2023	88,8840	-	2L 50.50.5	480,00	15,10	-	-	-	-	-	-	133,974	207,3600	Aman	b
	18	1800	119,2840	-	2L 50.50.5	480,00	15,10	-	-	-	-	-	-	119,205	207,3600	Aman	b
	19	1800	151,3400	-	2L 50.50.5	480,00	15,10	-	-	-	-	-	-	119,205	207,3600	Aman	b
	20	1800	178,5040	-	2L 50.50.5	480,00	15,10	-	-	-	-	-	-	119,205	207,3600	Aman	b
	21	1800	190,2400	-	2L 50.50.5	480,00	15,10	-	-	-	-	-	-	119,205	207,3600	Aman	b
	22	1800	188,2240	-	2L 50.50.5	480,00	15,10	-	-	-	-	-	-	119,205	207,3600	Aman	b
	23	1800	174,4880	-	2L 50.50.5	480,00	15,10	-	-	-	-	-	-	119,205	207,3600	Aman	b
	24	1800	145,3080	-	2L 50.50.5	480,00	15,10	-	-	-	-	-	-	119,205	207,3600	Aman	b
	25	1800	111,2440	-	2L 50.50.5	480,00	15,10	-	-	-	-	-	-	133,974	207,3600	Aman	b
	26	2023	79,7080	-	2L 50.50.5	480,00	15,10	133,974	1,477	-	2,728	-	71,7913	-	-	Aman	b
	27	2023	-	-15,2720	2L 50.50.5	480,00	15,10	92,715	1,022	1,563	-	125,3154	-	-	-	Aman	b
	28	1400	-	-13,7080	2L 50.50.5	480,00	15,10	37,838	0,417	1,083	-	138,4357	-	-	-	Aman	vp
	29	980	-	-74,9520	O 76,3.3,2	734,90	25,90	63,822	0,704	1,267	-	118,3099	-	-	-	Aman	vp
	33	1653	37,3160	-	O 76,3.3,2	734,9	25,9	-	-	-	-	-	-	63,822	158,7384	Aman	vp
	37	1653	-	-20,6880	O 76,3.3,2	734,9	25,9	63,822	0,704		0,619	-	242,1702	-	-	Aman	vp
	41	1653	-	-10,0480	O 76,3.3,2	734,9	25,9	-	-	-	-	-	-	63,822	158,7384	Aman	vp
	45	1653	-	-20,6880	O 76,3.3,2	734,9	25,9	63,822	0,704	1,267	-	118,3099	-	-	-	Aman	vp
	49	1653	33,1640	-	O 76,3.3,2	734,9	25,9	37,838	0,417	1,083	-	138,4357	-	-	-	Aman	vp
	53	980	-	-72,2320	O 76,3.3,2	734,9	25,9	-	-	-	-	-	-	133,407	146,0160	Aman	d
	30	1801	87,1280	-	2L 45.45.5	338	13,5	-	-	-	-	-	-	136,444	146,0160	Aman	d
	32	1842	41,1240	-	2L 45.45.5	338	13,5	-	-	-	-	-	-	181,037	146,0160	Aman	d
	34	2444	46,1360	-	2L 45.45.5	338	13,5	-	-	-	-	-	-	181,037	146,0160	Aman	d
	36	2444	39,4520	-	2L 45.45.5	338	13,5	-	-	-	-	-	-	181,037	146,0160	Aman	d
	38	2444	18,6040	-	2L 45.45.5	338	13,5	-	-	-	-	-	-	181,037	146,0160	Aman	d
	40	2444	11,8880	-	2L 45.45.5	338	13,5	-	-	-	-	-	-	181,037	146,0160	Aman	d

Tabel 4.9.Lanjutan

Kuda-Kuda	No.	Panjang (mm)	N_u tarik (kN)	N_u tekan (kN)	Profil	A (mm^2)	r_x (mm)	Analisis Batang Tekan						Analisis Batang Tarik		Ket.	Jenis Batang
								L_k/r_x <200	λ_c	ω_1	ω_2	ϕN_{n1} (kN)	ϕN_{n2} (kN)	L/r_x <240	ϕN_n (kN)		
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]
K3	42	2444	11,9860	-	2L 45.45.5	338	13,5	-	-	-	-	-	-	181,037	146,0160	Aman	d
	44	2444	18,6040	-	2L 45.45.5	338	13,5	-	-	-	-	-	-	181,037	146,0160	Aman	d
	46	2444	39,4520	-	2L 45.45.5	338	13,5	-	-	-	-	-	-	181,037	146,0160	Aman	d
	48	2444	46,1520	-	2L 45.45.5	338	13,5	-	-	-	-	-	-	181,037	146,0160	Aman	d
	50	1842	41,2280	-	2L 45.45.5	338	13,5	-	-	-	-	-	-	181,037	146,0160	Aman	d
	52	1801	83,4160	-	2L 45.45.5	338	13,5	-	-	-	-	-	-	136,444	146,0160	Aman	d
	31	1317	-	-46,4120	2L 45.45.5	338	13,5	97,556	1,076	1,626	-	84,794	-	133,407	146,0160	Aman	d
	35	1653	-	-29,4640	2L 45.45.5	338	13,5	122,444	1,350	-	2,279	-	60,52	97,556	-	Aman	v
	39	1653	-	-10,9800	2L 45.45.5	338	13,5	122,444	1,350	-	2,279	-	60,52	122,444	-	Aman	v
	43	1653	-	-10,9800	2L 45.45.5	338	13,5	122,444	1,350	-	2,279	-	60,52	122,444	-	Aman	v
	47	1653	-	-29,4640	2L 45.45.5	338	13,5	122,444	1,350	-	2,279	-	60,52	122,444	-	Aman	v
	51	1317	-	-44,3560	2L 45.45.5	338	13,5	97,556	1,076	1,626	-	84,794	-	97,556	-	Aman	v
K4	1	1709	15,0520	-	2l 45 45 5	430	13,5	-	-	-	-	-	-	126,593	185,7600	Aman	a
	2	1800	5,5320	-	2l 45 45 5	430	13,5	-	-	-	-	-	-	133,333	185,7600	Aman	a
	3	1800	4,1840	-	2l 45 45 5	430	13,5	-	-	-	-	-	-	133,333	185,7600	Aman	a
	4	1800	0,8440	-	2l 45 45 5	430	13,5	-	-	-	-	-	-	133,333	185,7600	Aman	a
	5	1800	2,4900	-	2l 45 45 5	430	13,5	-	-	-	-	-	-	133,333	185,7600	Aman	a
	6	1800	0,9140	-	2l 45 45 5	430	13,5	-	-	-	-	-	-	133,333	185,7600	Aman	a
	7	1800	3,4800	-	2l 45 45 5	430	13,5	-	-	-	-	-	-	133,333	185,7600	Aman	a
	8	1800	3,4800	-	2l 45 45 5	430	13,5	-	-	-	-	-	-	133,333	185,7600	Aman	a
	9	1800	1,0690	-	2l 45 45 5	430	13,5	-	-	-	-	-	-	133,333	185,7600	Aman	a
	10	1800	1,4690	-	2l 45 45 5	430	13,5	-	-	-	-	-	-	133,333	185,7600	Aman	a
	11	1800	0,9600	-	2l 45 45 5	430	13,5	-	-	-	-	-	-	133,333	185,7600	Aman	a
	12	1800	3,9600	-	2l 45 45 5	430	13,5	-	-	-	-	-	-	133,333	185,7600	Aman	a
	13	1800	5,3000	-	2l 45 45 5	430	13,5	-	-	-	-	-	-	133,333	185,7600	Aman	a
	14	1709	15,0440	-	2l 45 45 5	430	13,5	-	-	-	-	-	-	133,333	185,7600	Aman	a
	15	1400	-	-6,6720	2l 45 45 5	430	13,5	103,704	1,143	1,715	-	102,3020	-	126,593	185,7600	Aman	a
	16	1800	-	-12,4120	2l 45 45 5	430	13,5	133,333	1,470	-	2,702	-	64,9321	-	-	Aman	b
	17	1800	-	-5,8720	2l 45 45 5	430	13,5	133,333	1,470	-	2,702	-	64,9321	-	-	Aman	b
	18	1800	-	-4,0240	2l 45 45 5	430	13,5	133,333	1,470	-	2,702	-	64,9321	-	-	Aman	b
	19	1800	-	-1,1590	2l 45 45 5	430	13,5	133,333	1,470	-	2,702	-	64,9321	-	-	Aman	b
	20	1800	-	-2,2040	2l 45 45 5	430	13,5	133,333	1,470	-	2,702	-	64,9321	-	-	Aman	b
	21	1800	-	-0,9910	2l 45 45 5	430	13,5	133,333	1,470	-	2,702	-	64,9321	-	-	Aman	b
	22	1800	0,9200	-	2l 45 45 5	430	13,5	-	-	-	-	-	-	133,333	185,7600	Aman	b
	23	1800	-	-2,2680	2l 45 45 5	430	13,5	133,333	1,470	-	2,702	-	64,9321	-	-	Aman	b
	24	1800	-	-1,3930	2l 45 45 5	430	13,5	133,333	1,470	-	2,702	-	64,9321	-	-	Aman	b
	25	1800	-	-4,0400	2l 45 45 5	430	13,5	133,333	1,470	-	2,702	-	64,9321	-	-	Aman	b
	26	1800	-	-5,8880	2l 45 45 5	430	13,5	133,333	1,470	-	2,702	-	64,9321	-	-	Aman	b
	27	1800	-	-12,6440	2l 45 45 5	430	13,5	133,333	1,470	-	2,702	-	64,9321	-	-	Aman	b
	28	1400	-	-12,6720	2l 45 45 5	430	13,5	103,704	1,143	1,715	-	102,3020	-	-	-	Aman	b
	29	980	-	-24,5040	O 76,3.3,2	734,9	25,9	37,838	0,417	1,083	-	138,4357	-	-	-	Aman	vp
	33	980	-	-11,0640	O 76,3.3,2	734,9	25,9	37,838	0,417	1,083	-	138,4357	-	-	-	Aman	vp
	37	980	-	-10,4160	O 76,3.3,2	734,9	25,9	37,838	0,417	1,083	-	138,4357	-	-	-	Aman	vp
	41	980	-	-9,3720	O 76,3.3,2	734,9	25,9	37,838	0,417	1,083	-	138,4357	-	-	-	Aman	vp
	45	980	-	-10,4080	O 76,3.3,2	734,9	25,9	37,838	0,417	1,083	-	138,4357	-	-	-	Aman	vp
	49	980	-	-11,0880	O 76,3.3,2	734,9	25,9	37,838	0,417	1,083	-	138,4357	-	-	-	Aman	vp
	53	980	-	-24,7760	O 76,3.3,2	734,9	25,9	37,838	0,417	1,083	-	138,4357	-	-	-	Aman	vp
	30	2049	7,6400	-	2L 45.45.5	338	13,5	-	-	-	-	-	-	151,778	146,0160	Aman	d
	32	2049	2,1290	-	2L 45.45.5	338	13,5	-	-	-	-	-	-	151,778	146,0160	Aman	d
	34	2049	3,7640	-	2L 45.45.5	338	13,5	-	-	-	-	-	-	151,778	146,0160	Aman	d
	36	2049	-	-1,9560	2L 45.45.5	338	13,5	151,778	1,674	-	3,501	-	39,3885	-	-	Aman	d
	38	2049	2,2440	-	2L 45.45.5	338	13,5	-	-	-	-	-	-	151,778	146,0160	Aman	d
	40	2049	-	-3,6280	2L 45.45.5	338	13,5	151,778	1,674	-	3,501	-	39,3885	-	-	Aman	d
	42	2049	-	-3,6040	2L 45.45.5	338	13,5	151,778	1,674	-	3,501	-	39,3885	-	-	Aman	d
	44	2049	2,2230	-	2L 45.45.5	338	13,5	-	-	-	-	-	-	151,778	146,0160	Aman	d
	46	2049	-	-2,0040	2L 45.45.5	338	13,5	151,778	1,674	-	3,501	-	39,3885	-	-	Aman	d
	48	2049	3,8200	-	2L 45.45.5	338	13,5	-	-	-	-	-	-	151,778	146,0160	Aman	d
	50	2049	2,0640	-	2L 45.45.5	338	13,5	-	-	-	-	-	-	151,778	146,0160	Aman	d
	52	2049	7,6560	-	2L 45.45.5	338	13,5	-	-	-	-	-	-	151,778	146,0160	Aman	d
	31	980	-	-17,8920	2L 45.45.5	338	13,5	72,593	0,800	1,344	-	102,5794	-	-	-	Aman	v
	35	980	-	-10,4120	2L 45.45.5	338	13,5	72,593	0,800	1,344	-	102,5794	-	-	-	Aman	v
	39	980	-	-5,2280	2L 45.45.5	338	13,5	72,593	0,800	1,344	-	102,5794	-	-	-	Aman	v
	43	980	4,0900	-	2L 45.45.5	338	13,5	-	-	-	-	-	-	72,593	146,0160	Aman	v
	47	980	-	-7,8320	2L 45.45.5	338	13,5	72,593	0,800	1,344	-	102,5794	-	-	-	Aman	v
	51	980	-	-17,9000	2L 45.45.5	338	13,5	72,593	0,800	1,344	-	102,5794	-	-	-	Aman	v

Keterangan **Tabel 4.9**:

[1] Kuda-Kuda
[2] Nomor batang
[3] Panjang batang
[4] Nu tarik = gaya batang tarik
[5] Nu tekan = gaya batang tekan
[6] Profil terpasang
[7] A = luas penampang profil
[8] r_x = jari-jari girasi profil terkecil
[9] L_k/r_x < 200 (syarat angka perbandingan kelangsingan batang tekan)
[10] $\lambda_c = (1/\pi).(Lk/r).(fy/E)^{0,5}$ (parameter kelangsingan batang tekan)
[11] $\omega 1 = 1,43/(1,6-0,67\lambda c)$ untuk: $0,25<\lambda c<1,2$
[12] $\omega 2 = 1,25.(\lambda c)^2$ untuk: $\lambda c \geq 1,2$
[13] $\phi Nn1 = 0,85.Ag.(fy/\omega 1)$: kuat tekan nominal
[14] $\phi Nn2 = 0,85.Ag.(fy/\omega 2)$: kuat tekan nominal
[15] L/r_x < 240 (syarat angka perbandingan kelangsingan batang tarik)
[16] $\phi Nn = 0,9.Ag.fy$
[17] $Nu \leq \phi Nn$: profil aman dipakai
[18] Jenis batang: a = batang atas, b = batang bawah, d = batang diagonal, v = batang vertikal, vp = batang pertemuan antar kuda-kuda

4.3.5 Perencanaan Sambungan Titik Buhul Rangka Baja

a. Perencanaan Sambungan Las

Sebagai contoh perhitungan ditinjau pada sambungan las kuda-kuda K1 batang 20b dengan plat buhul 14, sebagai berikut ini:

- Profil 2L 50.50.5 dengan:

  tegangan putus minimum baja profil, f_u profil = 370 MPa

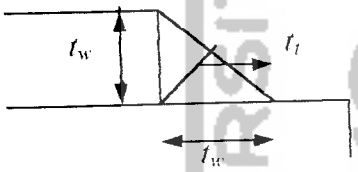
  Gaya batang kombinasi faktor beban maksimum, N_u = 179,4840 kN

- Data-data las yang digunakan untuk menyambung:

  mutu las, E60

  tegangan tarik putus logam las, f_{uw} = 413,7 MPa

  tebal kaki las, t_w = 3 mm, tebal rencana las, t_t = 2 mm



Gambar 4.24 Ukuran las sudut

- Kuat las sudut per satuan panjang

  1. Dari bahan las

  $\phi_f R_{nw} = 0{,}75.t_t\,(0{,}6.f_{uw})$

  $= 0{,}75.2.(0{,}6.413{,}7)$

  $= 372{,}3300$ N/mm

  2. Dari bahan dasar profil

  $\phi_f R_{nw} = 0{,}75.t_t\,(0{,}6.f_u)$

  $= 0{,}75.2.(0{,}6.370)$

  $= 333{,}0000$ N/mm

  dipilih kuat las sudut per satuan panjang yang terkecil

  $\phi_f R_{nw} = 333{,}0000$ N/mm

- Tentukan panjang las (l_n)

$N_u = \phi_f R_{nw}.l_n$

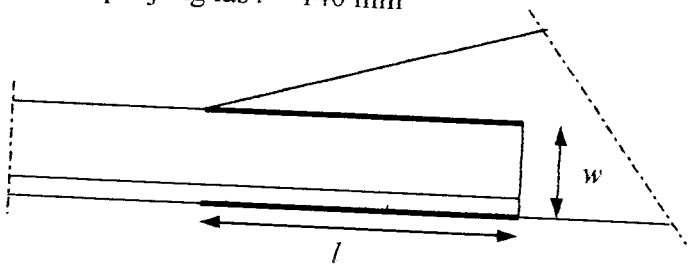
$179{,}4840 = 333.10^{-3}.l_n$

$l_n = 538{,}99$ mm

Panjang las pada masing-masing profil, tiap sisi:

$l = l_n/4 = 538{,}99/4 = 134{,}75$ mm

dipakai panjang las $l = 140$ mm



Gambar 4.25 Panjang sambungan las

- Kasus gaya tarik yang disalurkan ke sebuah komponen struktur pelat dengan pengelasan sepanjang kedua sisi pada ujung pelat, dengan $l > w$:

  untuk $l \geq 2w$ $\quad U = 1{,}0$

  untuk $2w > l \geq 1{,}5w$ $\quad U = 0{,}87$

  untuk $1{,}5w > l \geq w$ $\quad U = 0{,}75$

  dengan: l = panjang pengelasan, mm

  w = lebar pelat (jarak antar sumbu pengelasan), mm

  Pada perhitungan,

  $l/w = 140/50 = 2{,}8$ dengan syarat diatas U=1,0

- Gaya tarik nominal las

  $\phi_f . N_{nw} = 4.\ 0{,}75 . A_{\text{netto las}} . (0{,}6\, f_u)$

  dengan:

  $\phi_f N_{nw}$ = gaya tarik nominal las terfaktor (N)

  $A_{\text{netto las}} = l . t_t . U$

  f_u = tegangan putus minimum bahan plat (MPa)

$\phi_f N_{nw} = 4.0{,}75.(140.2).1.(0{,}6.370)$

$= 186480$ N

$= 186{,}4800$ kN

$(\phi_f N_{nw} = 186{,}4800 \text{ kN}) > (N_u = 179{,}4840 \text{ kN})$ -aman-

Dengan cara yang sama dapat dihitung untuk semua perencanaan sambungan las rangka baja kuda-kuda, disajikan pada Tabel 4.10.

Tabel 4.10 Perencanaan Sambungan Las Kuda-Kuda

Kuda-Kuda	No. J	No. B	Profil	Jenis	N_u (kN)	t_f (mm)	f_{up} (MPa)	Mutu las	f_{uw} (MPa)	t_w (mm)	t_t (mm)	ϕR_{nw1} (N/mm)	ϕR_{nw2} (N/mm)	l_n (mm)	$l_n/4$ (mm)	l (mm)	w (mm)	l/w	U	ϕN_n (kN)	Ket
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]	[19]	[20]	[21]	[22]
K1	1	1	2L70.70.7	a	16,8800	7	370	E60	413,7	3	2	372,3300	333,0000	50,69	12,67	125	70	1,79	0,87	144,8550	aman
		15	2L50.50.5	b	14,2160	5	370	E60	413,7	3	2	372,3300	333,0000	42,69	10,67	125	50	2,50	1	166,5000	aman
	2	1	2L70.70.7	a	16,8800	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		2	2L70.70.7	a	104,3880	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		29	O76,3.3,2	vp	83,3200	3,2	370	E60	413,7	3	2	372,3300	333,0000	250,21	62,55	130	76,3	1,70	0,87	150,6492	aman
		30	2L45.45.5	d	98,4240	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3	2	2L70.70.7	a	104,3880	7	370	E60	413,7	3	2	372,3300	333,0000	313,48	78,37	125	70	1,79	0,87	144,8550	aman
		3	2L70.70.7	a	162,1840	7	370	E60	413,7	3	2	372,3300	333,0000	487,04	121,76	140	70	2,00	1	186,4800	aman
		31	2L45.45.5	v	52,7240	5	370	E60	413,7	3	2	372,3300	333,0000	158,33	39,58	125	45	2,78	1	166,5000	aman
		32	2L45.45.5	d	47,8200	5	370	E60	413,7	3	2	372,3300	333,0000	143,60	35,90	125	45	2,78	1	166,5000	aman
	4	3	2L70.70.7	a	162,1840	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		4	2L70.70.7	a	183,1520	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		33	O76,3.3,2	vp	29,6800	3,2	370	E60	413,7	3	2	372,3300	333,0000	89,13	22,28	125	76,3	1,64	0,87	144,8550	aman
		34	2L45.45.5	d	17,7880	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5	4	2L70.70.7	a	183,1520	7	370	E60	413,7	3	2	372,3300	333,0000	550,01	137,50	145	70	2,07	1	193,1400	aman
		5	2L70.70.7	a	187,2000	7	370	E60	413,7	3	2	372,3300	333,0000	562,16	140,54	145	70	2,07	1	193,1400	aman
		35	2L45.45.5	v	13,5720	5	370	E60	413,7	3	2	372,3300	333,0000	40,76	10,19	125	45	2,78	1	166,5000	aman
		36	2L45.45.5	d	5,9650	5	370	E60	413,7	3	2	372,3300	333,0000	17,91	4,48	125	45	2,78	1	166,5000	aman
	6	5	2L70.70.7	a	187,2000	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		6	2L70.70.7	a	178,0760	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		37	O76,3.3,2	vp	3,3410	3,2	370	E60	413,7	3	2	372,3300	333,0000	10,03	2,51	125	76,3	1,64	0,87	144,8550	aman
		38	2L45.45.5	d	10,5040	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	7	6	2L70.70.7	a	178,0760	7	370	E60	413,7	3	2	372,3300	333,0000	534,76	133,69	140	70	2,00	1	186,4800	aman
		7	2L70.70.7	a	162,2560	7	370	E60	413,7	3	2	372,3300	333,0000	487,26	121,81	140	70	2,00	1	186,4800	aman
		39	2L45.45.5	v	12,5160	5	370	E60	413,7	3	2	372,3300	333,0000	37,59	9,40	125	45	2,78	1	166,5000	aman
		40	2L45.45.5	d	18,0120	5	370	E60	413,7	3	2	372,3300	333,0000	54,09	13,52	125	45	2,78	1	166,5000	aman
	8	7	2L70.70.7	a	162,2560	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		8	2L70.70.7	a	162,4880	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		41	O76,3.3,2	vp	152,6440	3,2	370	E60	413,7	3	2	372,3300	333,0000	458,39	114,60	145	76,3	1,90	0,87	168,0318	aman
	9	15	2L50.50.5	b	14,2160	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		16	2L50.50.5	b	25,4040	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		29	O76,3.3,2	vp	83,3200	3,2	370	E60	413,7	3	2	372,3300	333,0000	250,21	62,55	130	76,3	1,70	0,87	150,6492	aman
	10	16	2L50.50.5	b	25,4040	5	370	E60	413,7	3	2	372,3300	333,0000	76,29	19,07	125	50	2,50	1	166,5000	aman
		17	2L50.50.5	b	105,4760	5	370	E60	413,7	3	2	372,3300	333,0000	316,74	79,19	125	50	2,50	1	166,5000	aman
		30	2L45.45.5	d	98,4240	5	370	E60	413,7	3	2	372,3300	333,0000	295,57	73,89	125	45	2,78	1	166,5000	aman
		31	2L45.45.5	v	52,7240	5	370	E60	413,7	3	2	372,3300	333,0000	158,33	39,58	125	45	2,78	1	166,5000	aman
	11	17	2L50.50.5	b	105,4760	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		18	2L50.50.5	b	157,8880	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		32	2L45.45.5	d	47,8200	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		33	O76,3.3,2	vp	29,6800	3,2	370	E60	413,7	3	2	372,3300	333,0000	89,13	22,28	125	76,3	1,64	0,87	144,8550	aman
	12	18	2L50.50.5	b	157,8880	5	370	E60	413,7	3	2	372,3300	333,0000	474,14	118,53	130	50	2,60	1	173,1600	aman
		19	2L50.50.5	b	176,4680	5	370	E60	413,7	3	2	372,3300	333,0000	529,93	132,48	140	50	2,80	1	186,4800	aman
		34	2L45.45.5	d	17,7880	5	370	E60	413,7	3	2	372,3300	333,0000	53,42	13,35	125	45	2,78	1	166,5000	aman
		35	2L45.45.5	v	13,5720	5	370	E60	413,7	3	2	372,3300	333,0000	40,76	10,19	125	45	2,78	1	166,5000	aman
	13	19	2L50.50.5	b	176,4680	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		20	2L50.50.5	b	179,4840	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		36	2L45.45.5	d	5,9650	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		37	O76,3.3,2	vp	3,3410	3,2	370	E60	413,7	3	2	372,3300	333,0000	10,03	2,51	125	76,3	1,64	0,87	144,8550	aman
	14	20	2L50.50.5	b	179,4840	5	370	E60	413,7	3	2	372,3300	333,0000	538,99	134,75	140	50	2,80	1	186,4800	aman
		21	2L50.50.5	b	170,0800	5	370	E60	413,7	3	2	372,3300	333,0000	510,75	127,69	135	50	2,70	1	179,8200	aman
		38	2L45.45.5	d	10,5040	5	370	E60	413,7	3	2	372,3300	333,0000	31,54	7,89	125	45	2,78	1	166,5000	aman
		39	2L45.45.5	v	12,5160	5	370	E60	413,7	3	2	372,3300	333,0000	37,59	9,40	125	45	2,78	1	166,5000	aman
	15	21	2L50.50.5	b	170,0800	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		22	2L50.50.5	b	163,3840	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		40	2L45.45.5	d	18,0120	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		41	O76,3.3,2	vp	152,6440	3,2	370	E60	413,7	3	2	372,3300	333,0000	458,39	114,60	145	76,3	1,90	0,87	168,0318	aman
		42	2L45.45.5	d	19,4440	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
K2	1	1	2L70.70.7	a	16,8320	7	370	E60	413,7	3	2	372,3300	333,0000	50,55	12,64	125	70	1,79	0,87	144,8550	aman
		15	2L50.50.5	b	14,1680	5	370	E60	413,7	3	2	372,3300	333,0000	42,55	10,64	125	50	2,50	1	166,5000	aman
	2	1	2L70.70.7	a	16,8320	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		2	2L70.70.7	a	99,2120	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		29	O76,3.3,2	vp	80,1200	3,2	370	E60	413,7	3	2	372,3300	333,0000	240,60	60,15	130	76,3	1,70	0,87	150,6492	aman
		30	2L45.45.5	d	94,1520	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3	2	2L70.70.7	a	99,2100	7	370	E60	413,7	3	2	372,3300	333,0000	297,93	74,48	130	70	1,86	0,87	150,6492	aman
		3	2L70.70.7	a	153,8900	7	370	E60	413,7	3	2	372,3300	333,0000	462,13	115,53	140	70	2,00	1	186,4800	aman
		31	2L45.45.5	v	50,3640	5	370	E60	413,7	3	2	372,3300	333,0000	151,24	37,81	125	45	2,78	1	166,5000	aman
		32	2L45.45.5	d	45,2240	5	370	E60	413,7	3	2	372,3300	333,0000	135,81	33,95	125	45	2,78	1	166,5000	aman
	4	3	2L70.70.7	a	153,8900	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		4	2L70.70.7	a	172,8680	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		33	O76,3.3,2	vp	27,8640	3,2	370	E60	413,7	3	2	372,3300	333,0000	83,68	20,92	125	76,3	1,64	0,87	144,8550	aman
		34	2L45.45.5	d	15,9640	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Tabel 4.10. Lanjutan.

Kuda-Kuda	No. J	No. B	Profil	Jenis	Nu (kN)	tf (mm)	fup (MPa)	Mutu las	fuw (MPa)	tw (mm)	tt (mm)	$\phi Rnw1$ (N/mm)	$\phi Rnw2$ (N/mm)	ln (mm)	$ln/4$ (mm)	l (mm)	w (mm)	l/w	U	ϕNn (kN)	Ket
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]	[19]	[20]	[21]	[22]
K2	5	4	2L70.70.7	a	172,8680	7	370	E60	413,7	3	2	372,3300	333,0000	519,12	129,78	140	70	2,00	1	186,4800	aman
		5	2L70.70.7	a	175,3800	7	370	E60	413,7	3	2	372,3300	333,0000	526,67	131,67	140	70	2,00	1	186,4800	aman
		35	2L45.45.5	v	11,5800	5	370	E60	413,7	3	2	372,3300	333,0000	34,77	8,69	125	45	2,78	1	166,5000	aman
		36	2L45.45.5	d	4,5440	5	370	E60	413,7	3	2	372,3300	333,0000	13,65	3,41	125	45	2,78	1	166,5000	aman
	6	5	2L70.70.7	a	175,4000	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		6	2L70.70.7	a	151,0120	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		37	O76.3.3.2	vp	77,8800	3,2	370	E60	413,7	3	2	372,3300	333,0000	233,87	58,47	130	76,3	1,70	0,87	150,6492	aman
		38	2L45.45.5	d	18,1920	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	7	6	2L70.70.7	a	151,0120	7	370	E60	413,7	3	2	372,3300	333,0000	453,49	113,37	140	70	2,00	1	186,4800	aman
		7	2L70.70.7	a	153,9040	7	370	E60	413,7	3	2	372,3300	333,0000	462,17	115,54	140	70	2,00	1	186,4800	aman
		39	2L45.45.5	v	12,4800	5	370	E60	413,7	3	2	372,3300	333,0000	37,48	9,37	125	45	2,78	1	166,5000	aman
		40	2L45.45.5	d	12,1680	5	370	E60	413,7	3	2	372,3300	333,0000	36,54	9,14	125	45	2,78	1	166,5000	aman
	8	7	2L70.70.7	a	153,8040	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		8	2L70.70.7	a	153,8960	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		41	O76.3.3.2	vp	10,1080	3,2	370	E60	413,7	3	2	372,3300	333,0000	30,35	7,59	125	76,3	1,64	0,87	144,8550	aman
	9	15	2L50.50.5	b	14,1680	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		16	2L50.50.5	b	23,4180	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		29	O76.3.3.2	vp	80,1200	3,2	370	E60	413,7	3	2	372,3300	333,0000	240,60	60,15	130	76,3	1,70	0,87	150,6492	aman
	10	16	2L50.50.5	b	23,4180	5	370	E60	413,7	3	2	372,3300	333,0000	70,32	17,58	125	50	2,50	1	166,5000	aman
		17	2L50.50.5	b	99,7440	5	370	E60	413,7	3	2	372,3300	333,0000	299,53	74,88	125	50	2,50	1	166,5000	aman
		30	2L45.45.5	d	94,1520	5	370	E60	413,7	3	2	372,3300	333,0000	282,74	70,68	125	45	2,78	1	166,5000	aman
		31	2L45.45.5	v	50,3640	5	370	E60	413,7	3	2	372,3300	333,0000	151,24	37,81	125	45	2,78	1	166,5000	aman
	11	17	2L50.50.5	b	99,7440	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		18	2L50.50.5	b	149,3240	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		32	2L45.45.5	d	45,2240	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		33	O76.3.3.2	vp	27,8640	3,2	370	E60	413,7	3	2	372,3300	333,0000	83,68	20,92	125	76,3	1,64	0,87	144,8550	aman
	12	18	2L50.50.5	b	149,3240	5	370	E60	413,7	3	2	372,3300	333,0000	448,42	112,11	130	50	2,60	1	173,1600	aman
		19	2L50.50.5	b	165,9360	5	370	E60	413,7	3	2	372,3300	333,0000	498,31	124,58	135	50	2,70	1	179,8200	aman
		34	2L45.45.5	d	15,9640	5	370	E60	413,7	3	2	372,3300	333,0000	47,94	11,98	125	45	2,78	1	166,5000	aman
		35	2L45.45.5	v	11,5800	5	370	E60	413,7	3	2	372,3300	333,0000	34,77	8,69	125	45	2,78	1	166,5000	aman
	13	19	2L50.50.5	b	165,9360	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		20	2L50.50.5	b	149,2280	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		36	2L45.45.5	d	4,5440	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		37	O76.3.3.2	vp	77,8800	3,2	370	E60	413,7	3	2	372,3300	333,0000	233,87	58,47	130	76,3	1,70	0,87	150,6492	aman
	14	20	2L50.50.5	b	149,2280	5	370	E60	413,7	3	2	372,3300	333,0000	448,13	112,03	130	50	2,60	1	173,1600	aman
		21	2L50.50.5	b	155,8120	5	370	E60	413,7	3	2	372,3300	333,0000	467,90	116,98	130	50	2,60	1	173,1600	aman
		38	2L45.45.5	d	18,1920	5	370	E60	413,7	3	2	372,3300	333,0000	54,63	13,66	125	45	2,78	1	166,5000	aman
		39	2L45.45.5	v	12,4800	5	370	E60	413,7	3	2	372,3300	333,0000	37,48	9,37	125	45	2,78	1	166,5000	aman
	15	21	2L50.50.5	b	155,8120	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		22	2L50.50.5	b	151,2280	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		40	2L45.45.5	d	12,1680	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		41	O76.3.3.2	vp	10,1080	3,2	370	E60	413,7	3	2	372,3300	333,0000	30,35	7,59	125	76,3	1,64	0,87	144,8550	aman
		42	2L45.45.5	d	13,1280	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
K3	1	1	2L70.70.7	a	16,2680	7	370	E60	413,7	3	2	372,3300	333,0000	48,85	12,21	125	70	1,79	0,87	144,8550	aman
		15	2L50.50.5	b	11,3860	5	370	E60	413,7	3	2	372,3300	333,0000	34,19	8,55	125	50	2,50	1	166,5000	aman
	2	1	2L70.70.7	a	16,2680	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		2	2L70.70.7	a	91,2520	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		29	O76.3.3.2	vp	74,9520	3,2	370	E60	413,7	3	2	372,3300	333,0000	225,08	56,27	130	76,3	1,70	0,87	150,6492	aman
		30	2L45.45.5	d	87,1280	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3	2	2L70.70.7	a	91,2520	7	370	E60	413,7	3	2	372,3300	333,0000	274,03	68,51	135	70	1,93	0,87	156,4434	aman
		3	2L70.70.7	a	140,8000	7	370	E60	413,7	3	2	372,3300	333,0000	422,82	105,71	135	70	1,93	0,87	156,4434	aman
		31	2L45.45.5	v	46,4120	5	370	E60	413,7	3	2	372,3300	333,0000	139,38	34,84	125	45	2,78	1	166,5000	aman
		32	2L45.45.5	d	41,1240	5	370	E60	413,7	3	2	372,3300	333,0000	123,50	30,87	125	45	2,78	1	166,5000	aman
	4	3	2L70.70.7	a	140,8000	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		4	2L70.70.7	a	148,2280	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		33	O76.3.3.2	vp	37,3160	3,2	370	E60	413,7	3	2	372,3300	333,0000	112,06	28,02	125	76,3	1,64	0,87	144,8550	aman
		34	2L45.45.5	d	46,1360	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5	4	2L70.70.7	a	148,2280	7	370	E60	413,7	3	2	372,3300	333,0000	445,13	111,28	140	70	2,00	1	186,4800	aman
		5	2L70.70.7	a	175,3640	7	370	E60	413,7	3	2	372,3300	333,0000	526,62	131,65	140	70	2,00	1	186,4800	aman
		35	2L45.45.5	v	29,4640	5	370	E60	413,7	3	2	372,3300	333,0000	88,48	22,12	125	45	2,78	1	166,5000	aman
		36	2L45.45.5	d	39,4520	5	370	E60	413,7	3	2	372,3300	333,0000	118,47	29,62	125	45	2,78	1	166,5000	aman
	6	5	2L70.70.7	a	175,3640	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		6	2L70.70.7	a	187,1560	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		37	O76.3.3.2	vp	20,6880	3,2	370	E60	413,7	3	2	372,3300	333,0000	62,13	15,53	125	76,3	1,64	0,87	144,8550	aman
		38	2L45.45.5	d	18,6040	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	7	6	2L70.70.7	a	187,1560	7	370	E60	413,7	3	2	372,3300	333,0000	562,03	140,51	150	70	2,14	1	199,8000	aman
		7	2L70.70.7	a	193,9400	7	370	E60	413,7	3	2	372,3300	333,0000	582,40	145,60	155	70	2,21	1	206,4600	aman
		39	2L45.45.5	v	10,9800	5	370	E60	413,7	3	2	372,3300	333,0000	32,97	8,24	125	45	2,78	1	166,5000	aman
		40	2L45.45.5	d	11,8880	5	370	E60	413,7	3	2	372,3300	333,0000	35,70	8,92	125	45	2,78	1	166,5000	aman
	8	7	2L70.70.7	a	193,9400	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		8	2L70.70.7	a	193,9320	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		41	O76.3.3.2	vp	10,0480	3,2	370	E60	413,7	3	2	372,3300	333,0000	30,17	7,54	125	76,3	1,64	0,87	144,8550	aman

Tabel 4.10. Lanjutan.

Kuda-Kuda	No. J	No. B	Profil	Jenis	N_u (kN)	t_f (mm)	f_{up} (MPa)	Mutu las	f_{uw} (MPa)	t_w (mm)	t_t (mm)	ϕR_{nw1} (N/mm)	ϕR_{nw2} (N/mm)	l_n (mm)	$l_n/4$ (mm)	l (mm)	w (mm)	l/w	U	ϕN_n (kN)	Ket
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]	[19]	[20]	[21]	[22]
K3	9	15	2L50.50.5	b	11,3860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		16	2L50.50.5	b	18,1040	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		29	O76,3.3,2	vp	74,9520	3,2	370	E60	413,7	3	2	372,3300	333,0000	225,08	56,27	130	76,3	1,70	0,87	150,6492	aman
	10	16	2L50.50.5	b	18,1040	5	370	E60	413,7	3	2	372,3300	333,0000	54,37	13,59	125	50	2,50	1	166,5000	aman
		17	2L50.50.5	b	88,8840	5	370	E60	413,7	3	2	372,3300	333,0000	266,92	66,73	125	50	2,50	1	166,5000	aman
		30	2L45.45.5	d	87,1280	5	370	E60	413,7	3	2	372,3300	333,0000	261,65	65,41	125	45	2,78	1	166,5000	aman
		31	2L45.45.5	v	46,4160	5	370	E60	413,7	3	2	372,3300	333,0000	139,39	34,85	125	45	2,78	1	166,5000	aman
	11	17	2L50.50.5	b	88,8840	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		18	2L50.50.5	b	119,2840	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		32	2L45.45.5	d	41,1240	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		33	O76,3.3,2	vp	37,3160	3,2	370	E60	413,7	3	2	372,3300	333,0000	112,06	28,02	125	76,3	1,64	0,87	144,8550	aman
	12	18	2L50.50.5	b	119,2840	5	370	E60	413,7	3	2	372,3300	333,0000	358,21	89,55	125	50	2,50	1	166,5000	aman
		19	2L50.50.5	b	151,3000	5	370	E60	413,7	3	2	372,3300	333,0000	454,35	113,59	130	50	2,60	1	173,1600	aman
		34	2L45.45.5	d	46,1360	5	370	E60	413,7	3	2	372,3300	333,0000	138,55	34,64	125	45	2,78	1	166,5000	aman
		35	2L45.45.5	v	29,4640	5	370	E60	413,7	3	2	372,3300	333,0000	88,48	22,12	125	45	2,78	1	166,5000	aman
	13	19	2L50.50.5	b	151,3400	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		20	2L50.50.5	b	178,5040	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		36	2L45.45.5	d	39,4520	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		37	O76,3.3,2	vp	20,6880	3,2	370	E60	413,7	3	2	372,3300	333,0000	62,13	15,53	125	76,3	1,64	0,87	144,8550	aman
	14	20	2L50.50.5	b	178,5040	5	370	E60	413,7	3	2	372,3300	333,0000	536,05	134,01	145	50	2,90	1	193,1400	aman
		21	2L50.50.5	b	190,2000	5	370	E60	413,7	3	2	372,3300	333,0000	571,17	142,79	155	50	3,10	1	206,4600	aman
		38	2L45.45.5	d	18,6040	5	370	E60	413,7	3	2	372,3300	333,0000	55,87	13,97	125	45	2,78	1	166,5000	aman
		39	2L45.45.5	v	10,9800	5	370	E60	413,7	3	2	372,3300	333,0000	32,97	8,24	125	45	2,78	1	166,5000	aman
	15	21	2L50.50.5	b	190,2000	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		22	2L50.50.5	b	188,2240	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		40	2L45.45.5	d	10,8880	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		41	O76,3.3,2	vp	10,0480	3,2	370	E60	413,7	3	2	372,3300	333,0000	30,17	7,54	125	76,3	1,64	0,87	144,8550	aman
		42	2L45.45.5	d	11,9860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
K4	1	1	2L70.70.7	a	15,0520	7	370	E60	413,7	3	2	372,3300	333,0000	45,20	11,30	125	70	1,79	0,87	144,8550	aman
		15	2L50.50.5	b	6,6720	5	370	E60	413,7	3	2	372,3300	333,0000	20,04	5,01	125	50	2,50	1	166,5000	aman
	2	1	2L70.70.7	a	15,0520	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		2	2L70.70.7	a	5,5320	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		29	O76,3.3,2	vp	24,5040	3,2	370	E60	413,7	3	2	372,3300	333,0000	73,59	18,40	125	76,3	1,64	0,87	144,8550	aman
		30	2L45.45.5	d	7,6400	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3	2	2L70.70.7	a	5,5320	7	370	E60	413,7	3	2	372,3300	333,0000	16,61	4,15	125	70	1,79	0,87	144,8550	aman
		3	2L70.70.7	a	4,1840	7	370	E60	413,7	3	2	372,3300	333,0000	12,56	3,14	125	70	1,79	0,87	144,8550	aman
		31	2L45.45.5	v	17,8920	5	370	E60	413,7	3	2	372,3300	333,0000	53,73	13,43	125	45	2,78	1	166,5000	aman
		32	2L45.45.5	d	2,1290	5	370	E60	413,7	3	2	372,3300	333,0000	6,39	1,60	125	45	2,78	1	166,5000	aman
	4	3	2L70.70.7	a	4,1840	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		4	2L70.70.7	a	0,8440	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		33	O76,3.3,2	vp	11,0640	3,2	370	E60	413,7	3	2	372,3300	333,0000	33,23	8,31	125	76,3	1,64	0,87	144,8550	aman
		34	2L45.45.5	d	3,7640	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5	4	2L70.70.7	a	0,8440	7	370	E60	413,7	3	2	372,3300	333,0000	2,53	0,63	125	70	1,79	0,87	144,8550	aman
		5	2L70.70.7	a	2,4900	7	370	E60	413,7	3	2	372,3300	333,0000	7,48	1,87	125	70	1,79	0,97	161,5050	aman
		35	2L45.45.5	v	10,4120	5	370	E60	413,7	3	2	372,3300	333,0000	31,27	7,82	125	45	2,78	1	166,5000	aman
		36	2L45.45.5	d	1,9560	5	370	E60	413,7	3	2	372,3300	333,0000	5,87	1,47	125	45	2,78	1	166,5000	aman
	6	5	2L70.70.7	a	2,4900	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		6	2L70.70.7	a	0,9140	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		37	O76,3.3,2	vp	10,4160	3,2	370	E60	413,7	3	2	372,3300	333,0000	31,28	7,82	125	76,3	1,64	0,87	144,8550	aman
		38	2L45.45.5	d	2,2440	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	7	6	2L70.70.7	a	0,9140	7	370	E60	413,7	3	2	372,3300	333,0000	2,74	0,69	125	70	1,79	0,87	144,8550	aman
		7	2L70.70.7	a	3,4800	7	370	E60	413,7	3	2	372,3300	333,0000	10,45	2,61	125	70	1,79	0,87	144,8550	aman
		39	2L45.45.5	v	5,2280	5	370	E60	413,7	3	2	372,3300	333,0000	15,70	3,92	125	45	2,78	1	166,5000	aman
		40	2L45.45.5	d	3,6280	5	370	E60	413,7	3	2	372,3300	333,0000	10,89	2,72	125	45	2,78	1	166,5000	aman
	8	7	2L70.70.7	a	3,4800	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		8	2L70.70.7	a	3,4800	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		41	O76,3.3,2	vp	9,3720	3,2	370	E60	413,7	3	2	372,3300	333,0000	28,14	7,04	125	76,3	1,64	0,87	144,8550	aman
	9	15	2L50.50.5	b	6,6720	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		16	2L50.50.5	b	12,4120	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		29	O76,3.3,2	vp	24,5040	3,2	370	E60	413,7	3	2	372,3300	333,0000	73,59	18,40	125	76,3	1,64	0,87	144,8550	aman
	10	16	2L50.50.5	b	12,4120	5	370	E60	413,7	3	2	372,3300	333,0000	37,27	9,32	125	50	2,50	1	166,5000	aman
		17	2L50.50.5	b	5,8720	5	370	E60	413,7	3	2	372,3300	333,0000	17,63	4,41	125	50	2,50	1	166,5000	aman
		30	2L45.45.5	d	7,6400	5	370	E60	413,7	3	2	372,3300	333,0000	22,94	5,74	125	45	2,78	1	166,5000	aman
		31	2L45.45.5	v	17,8920	5	370	E60	413,7	3	2	372,3300	333,0000	53,73	13,43	125	45	2,78	1	166,5000	aman
	11	17	2L50.50.5	b	5,8720	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		18	2L50.50.5	b	4,0240	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		32	2L45.45.5	d	2,1290	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		33	O76,3.3,2	vp	11,0640	3,2	370	E60	413,7	3	2	372,3300	333,0000	33,23	8,31	125	76,3	1,64	0,87	144,8550	aman
	12	18	2L50.50.5	b	4,0240	5	370	E60	413,7	3	2	372,3300	333,0000	12,08	3,02	125	50	2,50	1	166,5000	aman
		19	2L50.50.5	b	1,1590	5	370	E60	413,7	3	2	372,3300	333,0000	3,48	0,87	125	50	2,50	1	166,5000	aman
		34	2L45.45.5	d	3,7640	5	370	E60	413,7	3	2	372,3300	333,0000	11,30	2,83	125	45	2,78	1	166,5000	aman
		35	2L45.45.5	v	10,4120	5	370	E60	413,7	3	2	372,3300	333,0000	31,27	7,82	125	45	2,78	1	166,5000	aman

Tabel 4.10. Lanjutan.

Kuda-Kuda	No. J	No. B	Profil	Jenis	N_u (kN)	t_f (mm)	f_{up} (MPa)	Mutu las	f_{uw} (MPa)	t_w (mm)	t_t (mm)	ϕR_{nw1} (N/mm)	ϕR_{nw2} (N/mm)	l_n (mm)	$l_n/4$ (mm)	l (mm)	w (mm)	l/w	U	ϕN_n (kN)	Ket
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]	[19]	[20]	[21]	[22]
K4	13	19	2L50.50.5	b	1,1590	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		20	2L50.50.5	b	2,2040	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		36	2L45.45.5	d	1,9560	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		37	O76,3.3,2	vp	10,4160	3,2	370	E60	413,7	3	2	372,3300	333,0000	31,28	7,82	125	76,3	1,64	0,87	144,8550	aman
	14	20	2L50.50.5	b	2,2040	5	370	E60	413,7	3	2	372,3300	333,0000	6,62	1,65	125	50	2,50	1	166,5000	aman
		21	2L50.50.5	b	0,9910	5	370	E60	413,7	3	2	372,3300	333,0000	2,98	0,74	125	50	2,50	1	166,5000	aman
		38	2L45.45.5	d	2,2440	5	370	E60	413,7	3	2	372,3300	333,0000	6,74	1,68	125	45	2,78	1	166,5000	aman
		39	2L45.45.5	v	5,2280	5	370	E60	413,7	3	2	372,3300	333,0000	15,70	3,92	125	45	2,78	1	166,5000	aman
	15	21	2L50.50.5	b	0,9910	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		22	2L50.50.5	b	0,9200	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		40	2L45.45.5	d	3,6280	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		41	O76,3.3,2	vp	9,3720	3,2	370	E60	413,7	3	2	372,3300	333,0000	28,14	7,04	125	76,3	1,64	0,87	144,8550	aman
		42	2L45.45.5	d	3,6040	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Keterangan Tabel **4.10**:

[1] Kuda-kuda: K1, K2, K3, dan K4

[2] Nomor joint titik buhul

[3] Nomor batang yang disambung

[4] Profil batang yang disambung

[5] Jenis batang; a = batang atas, b = batang bawah, d = batang diagonal, v = batang vertikal
vp = batang vertikal pertemuan antar kuda-kuda

[6] N_u = gaya batang maksimum kombinasi faktor beban

[7] t_f = tebal profil

[8] f_{up} = tegangan putus tarik putus pelat/profil

[9] Mutu las

[10] f_{uw} = tegangan tarik putus logam las

[11] t_w = tebal kaki las

[12] t_t = tebal rencana las

[13] $\phi R_{nw1} = 0{,}75.t_t.(0{,}6f_{uw})$ (kuat las sudut, dengan f_{uw} = tegangan tarik putus logam las)

[14] $\phi R_{nw2} = 0{,}75.t_t.(0{,}6f_u)$ (kuat las sudut, dengan f_u = tegangan tarik putus pelat/profil)

[15] $l_n = N_u/\phi R_{nw}$ (panjang las yang dibutuhkan)

[16] $l_n/4$ = panjang las pada tiap sisi masing-masing profil

[17] l = panjang las terpakai pada tiap sisi masing-masing profil

[18] w = lebar pelat profil (jarak antar sumbu pengelasan)

[19] l/w = perbandingan panjang las terpakai dengan jarak antar sumbu pengelasan

[20] untuk $l \geq 2.w$ $U = 1{,}0$
untuk $2.w > l \geq 1{,}5w$ $U = 0{.}87$
untuk $1{,}5w > l \geq w$ $U = 0{,}75$

[21] $\phi N_n = 4.(0{,}75.U.l.t_t.(0{,}6.f_u))$ (kuat tarik las nominal terfaktor)

[22] $N_u \leq \phi N_n$

b. Perencanaan Sambungan Baut

Sebagai contoh perhitungan ditinjau pada perencanaan sambungan baut kuda-kuda K1 batang 20 b dengan plat buhul 13, sebagai berikut ini:

- Profil 2L 50.50.5 dengan:

  tegangan putus minimum baja profil, f_u profil = 370 MPa

  Gaya batang kombinasi faktor beban maksimum, N_u = 179,4840 kN

- Data-data baut yang digunakan untuk menyambung:

  mutu baut, $A.307$

  tegangan tarik putus baut, f_{ub} = 410 Mpa, diameter baut, d = 16 mm

- **Kekuatan satu baut**

  1. Kuat geser rencana baut

  $\phi_f.R_{ng} = \phi_f.r_1.f_u^b.A_b$

  dengan

  $\phi_f.R_{ng}$ = kuat geser rencana baut

  ϕ_f = 0,75 (faktor reduksi kekuatan untuk fraktur)

  r_1 = 0,4 (untuk baut dengan ulir pada bidang geser)

  f_u^b = 410 MPa (tegangan tarik putus baut)

  A_b = ¼.π.16^2 = 201,06 mm^2 (uas brutto penampang baut)

  $\phi_f.R_{ng}$ = 0,75.0,4.410.200,96

  = 24718,1 N = 24,7181 kN

  2. Kuat tarik rencana baut

  $\phi_f.R_{n,ta} = \phi f.0,75.f_u^b.A_b$

  $\phi_f.R_{n,ta}$ = 0,75.0,75.410.200,96

  = 46346,4 N = 46,3464 kN

  3. Kuat tumpu rencana baut

  $\phi_f.R_{n,tu} = 2,4.\phi_f.d_b.t_f.f_u$

  dengan

  $\phi_f.R_{n,tu}$ = Kuat tumpu rencana baut

  ϕ_f = 0,75 (faktor reduksi kekuatan untuk fraktur)

  d_b = 16 mm (diameter baut)

  t pelat buhul = 8 mm, $t_f < t$ pelat buhul, maka dipakai t_f

4. Beban titik $P4$

- Berat sendiri: $PK2 + PK4 = 1,16 + 1,00 = 2,16$ kN
- Berat penutup atap: $0,5 \cdot 2,197 \cdot 3,6 = 3,95$ kN
- Berat gording: $0,153 \cdot 3,6 \cdot 1,25 = 0,69$ kN
- Berat sagrod: $0,022 \cdot 1,953 \cdot 2 \cdot 1,25 = \underline{0,054 \text{ kN}} +$

$P4 = 6,424$ kN

5. Beban titik $P5$

- Berat sendiri: $PK2 = 1,16$ kN
- Berat penutup atap: $0,5 \cdot 1,099 \cdot 3,6 = 1,99$ kN
- Berat gording: $0,153 \cdot 3,6 \cdot 1,25 = 0,69$ kN
- Berat sagrod: $0,022 \cdot 0,855 \cdot 2 \cdot 1,25 = \underline{0,047 \text{ kN}} +$

$P5 = 4,289$ kN

6. Beban titik $P6$

- Berat sendiri: $PK2 = 1,16$ kN

$P6 = 1,16$ kN

7. Beban titik $P7$

- Berat sendiri: $PK2 = 1,16$ kN
- Berat penutup atap: $0,5 \cdot 2,197 \cdot 3,6 = 3,95$ kN
- Berat gording: $0,153 \cdot 3,6 \cdot 1,25 = 0,69$ kN
- Berat sagrod: $0,022 \cdot 2,197 \cdot 2 \cdot 1,25 = \underline{0,121 \text{ kN}} +$

$P5 = 5,921$ kN

8. Beban titik $P'1$

- Langit-langit (rusuk-rusuk kayu dan asbes) :

$= 0,11$ x Luas pembebanan $= 0,11 \times 3,6 \times 3,6 = 1,426$ kN

- Penggantung baja (d =3/4") $= 0,022 \times 5,541 = \underline{0,122 \text{ kN}} +$

$P'1 = 1,548$ kN

9. Beban titik $P'2$

- Langit-langit (rusuk-rusuk kayu dan asbes) :

$= 0,11$ x Luas pembebanan $= 0,11 \times 3,6 \times 5,4 = 2,138$ kN

- Penggantung baja (d =3/4") $= 0,022 \times 1,848 = \underline{0,041 \text{ kN}} +$

$P'2 = 2,179$ kN

10. Beban titik *P'*4

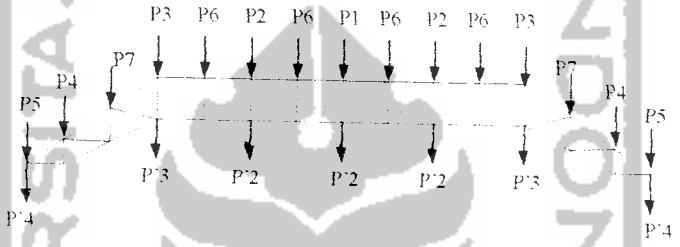
- Langit-langit (rusuk-rusuk kayu dan asbes) :

  = 0,11 x Luas pembebanan = 0,11 x 3,6 x 1,8 = 0,713 kN

- Penggantung baja (*d* =3/4") = 0,022 x 0 = 0,000 kN +

  *P'*4 = 0,713 kN

c. Perencanaan Beban Mati Kuda-Kuda K3



Gambar. 4.9 Perencanaan beban mati kuda-kuda K3

1. Beban titik P1

- Berat sendiri PK1 + PK3 = 1,19 + 1,10 = 2,29 kN
- Berat penutup atap: 0,5 . 2,197 . 3,6= 3,95 kN
- Berat gording: 0,153 . 3,6.1,25 = 0,69 kN
- Berat sagrod: 0,022 . 2,197.2.1,25 = 0,121 kN +

  P1 = 7,051 kN

2. Beban titik P2

- Berat sendiri: PK2 + PK3 = 1,16 + 1,1 = 2,26 kN
- Berat penutup atap: 0,5 . 2,197. 3,6 = 3,95 kN
- Berat gording: 0,153 . 3,6.1,25 = 0,69 kN
- Berat sagrod: 0,022 . 2,197.2.1,25 = 0,121 kN +

  P2 = 7,021 kN

3. Beban titik P3

- Berat sendiri: 2. P'K3 = 2. 2,28 = 4,56 kN
- Berat penutup atap: 0,5 . 2,197. 3,6 = 3,95 kN

- Berat gording: 0,153 . 3,6.1,25 = 0,69 kN
- Berat sagrod: 0,022 . 2,197.2.1,25 = 0,121 kN +

P3 = 9,321 kN

4. Beban titik P4

- Berat sendiri: PK3 + PK4 = 1,1 + 1,00 = 2,1 kN
- Berat penutup atap: 0,5 . 2,197. 3,6 = 3,95 kN
- Berat gording: 0,153 . 3,6.1,25 = 0,69 kN
- Berat sagrod: 0,022 . 1,953.2.1,25 = 0,054 kN +

P4 = 6,364 kN

5. Beban titik P5

- Berat sendiri: PK3 = 1,1 kN
- Berat penutup atap: 0,5 . 1,099. 3,6 = 1,99 kN
- Berat gording: 0,153 . 3,6.1,25 = 0,69 kN
- Berat sagrod: 0,022 . 0,855.2.1,25 = 0,047 kN +

P5 = 4,229 kN

6. Beban titik P6

- Berat sendiri: PK3 = 1,1 kN

P6 = 1,1 kN

7. Beban titik P7

- Berat sendiri: PK3 = 1,1 kN
- Berat penutup atap: 0,5 . 2,197. 3,6 = 3,95 kN
- Berat gording: 0,153 . 3,6.1,25 = 0,69 kN
- Berat sagrod: 0,022 . 2,197.2.1,25 = 0,121 kN +

P5 = 5,861 kN

8. Beban titik P'2

- Langit-langit (rusuk-rusuk kayu dan asbes) :

  = 0,11 x Luas pembebanan = 0,11 x 3,6 x 5,4 = 2,138 kN
- Penggantung baja (d =3/4") = 0,022 x 1,848 = 0,041 kN +

P'2 = 2,179 kN

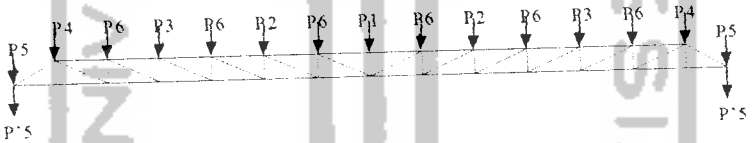
9 Beban titik P'3

- Langit-langit (rusuk-rusuk kayu dan asbes) :
  = 0,11 x Luas pembebanan = 0,11 x 5,4 x 5,4 = 3,2076 kN
- Penggantung baja (d =3/4") = 0,022 x 1,848 = 0,041 kN +
  P'3 = 3,2486 kN

10. Beban titik P'4

- Langit-langit (rusuk-rusuk kayu dan asbes) :
  = 0,11 x Luas pembebanan = 0,11 x 3,6 x 1,8 = 0,713 kN
- Penggantung baja (d =3/4") = 0,022 x 0 = 0,000 kN +
  P'4 = 0,713 kN

d. Perencanaan Beban Mati Kuda-Kuda K4



Gambar. 4.10 Perencanaan pembebanan mati kuda-kuda K4

1. Beban titik P1

- Berat sendiri PK1 + PK4 = 1,19 + 1,0 = 2,29 kN
- Berat penutup atap: 0,5 . 2,197 . 3,6= 3,95 kN
- Berat gording: 0,153 . 3,6.1,25 = 0,69 kN
- Berat sagrod: 0,022 . 1,953.2.1,25 = 0,054 kN +
  P1 = 6,454 kN

2. Beban titik P2

- Berat sendiri: PK2 + PK4 = 1,16 + 1,0 = 2,16 kN
- Berat penutup atap: 0,5 . 2,197. 3,6 = 3,95 kN
- Berat gording: 0,153 . 3,6.1,25 = 0,69 kN
- Berat sagrod: 0,022 . 1,953.2.1,25 = 0,054 kN +

P2 = 6,424 kN

3. Beban titik P3

- Berat sendiri: PK3 + PK4 = 1,1 + 1,0 = 2,1 kN
- Berat penutup atap: 0,5 . 2,197. 3,6 = 3,95 kN
- Berat gording: 0,153 . 3,6.1,25 = 0,69 kN
- Berat sagrod: 0,022 . 1,953.2.1,25 = 0,054 kN +

P3 = 6,364 kN

4. Beban titik P4

- Berat sendiri: 2. P'K4 = 2. 2,04 = 4,08 kN
- Berat penutup atap: 0,5 . 2,197. 3,6 = 3,95 kN
- Berat gording: 0,153 . 3,6.1,25 = 0,69 kN
- Berat sagrod: 0,022 . 1,953.2.1,25 = 0,054 kN +

P4 = 8,344 kN

5. Beban titik P5

- Berat sendiri: PK4 = 1,0 kN
- Berat penutup atap: 0,5 . 2,197. 3,6 = 3,95 kN
- Berat gording: 0,153 . 3,6.1,25 = 0,69 kN
- Berat sagrod: 0,022 . 1,953.2.1,25 = 0,047 kN +

P5 = 5,687kN

6. Beban titik P6

- Berat sendiri: PK4 = 1,0 kN

P6 = 1,0 kN

7. Beban titik P'5

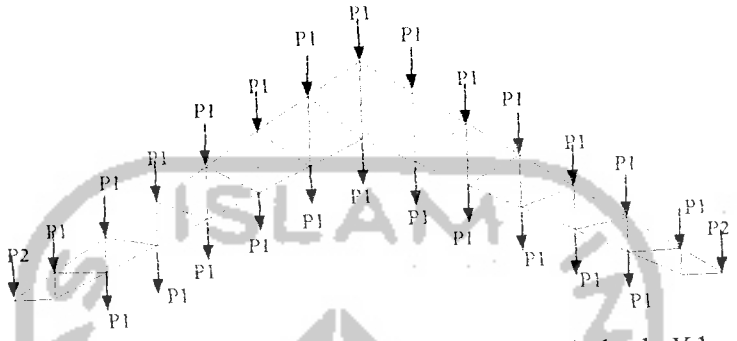
- Langit-langit (rusuk-rusuk kayu dan asbes) :

  = 0,11 x Luas pembebanan = 0,11 x 4,86 = 0,5346 kN
- Penggantung baja (d =3/4") = 0,022 x 0 = 0,000 kN +

P'5 = 0,5346 kN

3. Perencanaan Beban Hidup Kuda-Kuda

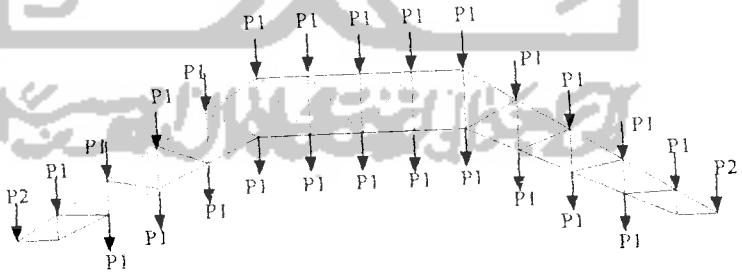
a. Perencanaan beban hidup kuda-kuda K1



Gambar. 4.11 Perencanaan beban hidup kuda-kuda K1

Beban hidup : P1 = 1 kN
P2 = 2 kN

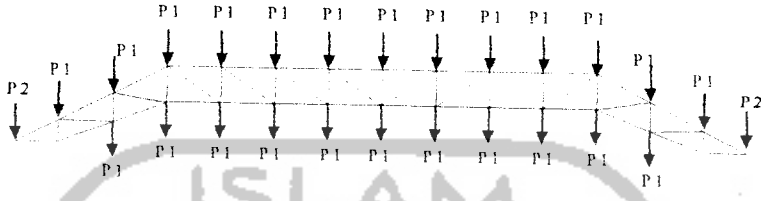
b. Perencanaan beban hidup kuda-kuda K2



Gambar.4.12 Perencanaan beban hidup kuda-kuda K2

Beban hidup: P1 = 1 kN
P2 = 2 kN

c. Perencanaan Beban Hidup Kuda-Kuda K3

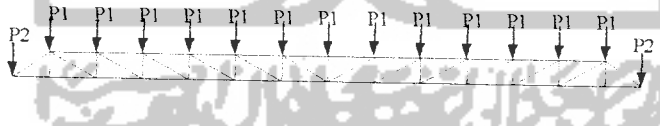


Gambar. 4.13 Perencanaan beban hidup kuda-kuda K3

Beban hidup: P1 = 1 kN

P2 = 2 kN

d. Perencanaan beban hidup kuda-kuda K4



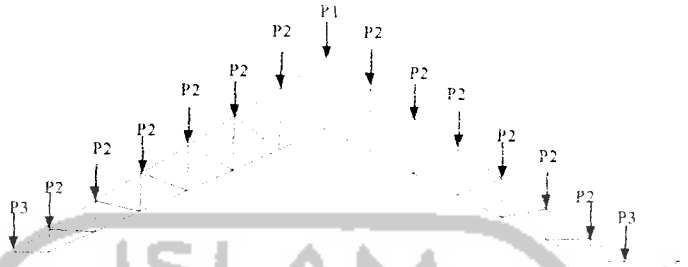
Gambar. 4.14 Perencanaan beban hidup kuda-kuda K4

Beban hidup: P1 = 1 kN

P2 = 2 kN

4. Perencanaan Beban Air Hujan Kuda-Kuda

a. Perencanaan beban air hujan kuda-kuda K1

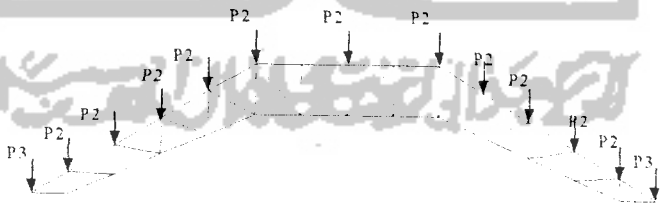


Gambar. 4.15 Perencanaan beban air hujan kuda-kuda K1

Beban air hujan :

- P1 = 0,01 x (40-0,8. 35) x (2,197 x 3,6 : 2) = 0,48 kN
- P2 = 0,01 x (40-0,8. 35) x (2,197 x 3,6) = 0,95 kN
- P3 = 0,01 x (40-0,8. 35) x (1,099 x 3,6) = 0,58 kN

b. Perencanaan beban air hujan kuda-kuda K2

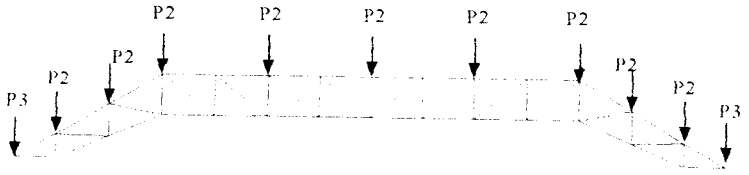


Gambar. 4.16 Perencanaan beban air hujan kuda-kuda K2

Beban air hujan :

- P2 = 0,01 x (40-0,8. 35) x (2,197 x 3,6) = 0,95 kN
- P3 = 0,01 x (40-0,8. 35) x (1,099 x 3,6) = 0,58 kN

c. Perencanaan beban air hujan kuda-kuda K3



Gambar. 4.17 Perencanaan beban air hujan kuda-kuda K3

Beban air hujan :

- P2 = 0,01 x (40-0,8. 35) x (2,197 x 3,6) = 0,95 kN
- P3 = 0,01 x (40-0,8. 35) x (1,099 x 3,6) = 0,58 kN

d. Perencanaan beban air hujan kuda-kuda K4

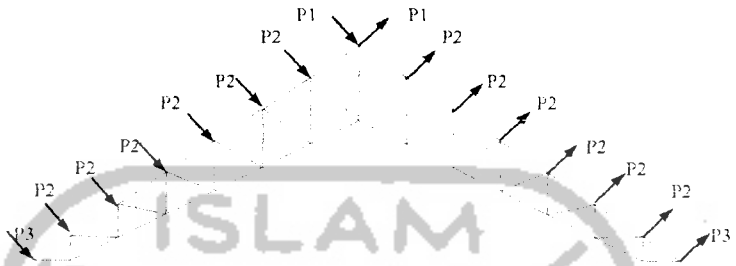
Gambar. 4.18 Perencanaan beban air hujan kuda-kuda K4

Beban air hujan :

- P1 = 0,01 x (40-0,8. 35) x (2,197 x 3,6) = 0,95 kN
- P3 = 0,01 x (40-0,8. 35) x (1,099 x 3,6) = 0,58 kN

5. Perencanaan Beban Angin Kuda-Kuda

a. Perencanaan beban angin kuda-kuda K1



Gambar. 4.19 Perencanaan beban angin kuda-kuda K1

Beban Angin:

- P1

Tiup angin = (0,02. 35 – 0,4) .0,6.(2,197 x 3,6 : 2) = 0,18 kN

$Wy = W.cos35^0 = 0,15$ kN

$Wx = W.sin35^0 = 0,10$ kN

Hisap angin = - 0,4 .0,6 . (2,197 x 3,6 : 2) = 0,24 kN

$Wy = W.cos35^0 = 0,19$ kN

$Wx = W.sin35^0 = 0,14$ kN

- P2

Tiup angin = (0,02. 35 – 0,4) .0,6.(2,197 x 3,6) = 1,42 kN

$Wy = W.cos35^0 = 1,17$ kN

$Wx = W.sin35^0 = 0,82$ kN

Hisap angin = - 0,4 .0,6 . (2,197 x 3,6) = 1,9 kN

$Wy = W.cos35^0 = 1,55$ kN

$Wx = W.sin35^0 = 1,09$ kN

- P3

Tiup angin = (0,02. 35 – 0,4) .0,6.(2,197 x 3,6) = 0,87 kN

$Wy = W.cos35^0 = 0,72$ kN

$Wx = W.sin35^0 = 0,50$ kN

Hisap angin = - 0,4 .0,6 . (1,099 x 3,6) = 1,16 kN

$Wy = W.cos35^0$ = 0,95 kN

$Wx = W.sin35^0$ = 0,67 kN

b. Perencanaan beban angin kuda-kuda K2

Gambar. 4.20 Perencanaan beban angin kuda-kuda K2

- P2

Tiup angin = (0,02. 35 – 0,4) .0,6.(2,197 x 3,6) = 1,42 kN

$Wy = W.cos35^0$ = 1,17 kN

$Wx = W.sin35^0$ = 0,82 kN

Hisap angin = - 0,4 .0,6 . (2,197 x 3,6) = 1,9 kN

$Wy = W.cos35^0$ = 1,55 kN

$Wx = W.sin35^0$ = 1,09 kN

- P3

Tiup angin = (0,02. 35 – 0,4) .0,6.(2,197 x 3,6) = 0,87 kN

$Wy = W.cos35^0$ = 0,72 kN

$Wx = W.sin35^0$ = 0,50 kN

Hisap angin = - 0,4 .0,6 . (1,099 x 3,6) = 1,16 kN

$Wy = W.cos35^0$ = 0,95 kN

$Wx = W.sin35^0$ = 0,67 kN

c. Perencanaan beban angin kuda-kuda K3

Gambar. 4.21 Perencanaan beban angin kuda-kuda K3

- P2

Tiup angin = (0,02. 35 – 0,4) .0,6.(2,197 x 3,6) = 1,42 kN

$Wy = W.cos35^0$ = 1,17 kN

$Wx = W.sin35^0$ = 0,82 kN

Hisap angin = - 0,4 .0,6 . (2,197 x 3,6) = 1,9 kN

$Wy = W.cos35^0$ = 1,55 kN

$Wx = W.sin35^0$ = 1,09 kN

- P3

Tiup angin = (0,02. 35 – 0,4) .0,6.(2,197 x 3,6) = 0,87 kN

$Wy = W.cos35^0$ = 0,72 kN

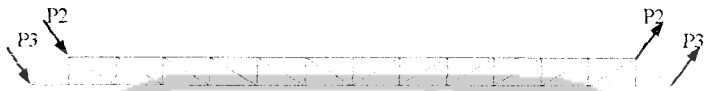
$Wx = W.sin35^0$ = 0,50 kN

Hisap angin = - 0,4 .0,6 . (1,099 x 3,6) = 1,16 kN

$Wy = W.cos35^0$ = 0,95 kN

$Wx = W.sin35^0$ = 0,67 kN

d. Perencanaan beban angin kuda-kuda K4



Gambar. 4.22 Perencanaan beban angin kuda-kuda K4

- P2

Tiup angin = (0,02. 35 – 0,4) .0,6.(2,197 x 3,6) = 1,42 kN

$Wy = W.cos35^0$ = 1,17 kN

$Wx = W.sin35^0$ = 0,82 kN

Hisap angin = - 0,4 .0,6 . (2,197 x 3,6) = 1,9 kN

$Wy = W.cos35^0$ = 1,55 kN

$Wx = W.sin35^0$ = 1,09 kN

- P3

Tiup angin = (0,02. 35 – 0,4) .0,6.(2,197 x 3,6) = 0,87 kN

$Wy = W.cos35^0$ = 0,72 kN

$Wx = W.sin35^0$ = 0,50 kN

Hisap angin = - 0,4 .0,6 . (1,099 x 3,6) = 1,16 kN

$Wy = W.cos350$ = 0,95 kN

$Wx = W.sin350$ = 0,67 kN

4.3.2 Analisis Struktur Kuda-Kuda

Analisis struktur kuda-kuda rangka baja menggunakan program aplikasi komputer SAP 90, dengan input data-data sebagai berikut ini:

1. Nomor joint dan element, sesuai bentuk dan ukuran rangka
2. Dukungan rangka baja dianggap sendi dan roll.
3. Luas profil baja yang dipakai.

t_f = 5 mm (tebal pelat profil)

f_u = 370 MPa (tegangan tarik putus pelat profil)

$\phi_f.R_n$ = 2,4.0,75.16.5.370

= 53280 N = 53,2800 kN

- Menghitung jumlah baut sambungan

Dari perhitungan diatas kuat rencana baut yang terkecil adalah kuat baut dalam geser, yaitu: $\phi_f.R_n$ = 24,7181 kN

jumlah baut, $n = N_u/\phi_f.R_n$ = 179,4840/24,7181 = 7,26

jumlah baut

- vertikal = $n/2$ = 3,63 jumlah baut terpasang, n_p = 4 baut
- horizontal = $n/2$ = 3,63 jumlah baut terpasang n_p = 4 baut

masing-masing sayap n_p = 2 baut

- **Cek kegagalan robekan pada lubang baut**

1. Pelelehan geser – retakan tarik

$\phi_f.T_{n1} = \phi(0,6.f_y.A_{vg} + f_u.A_{nt})$.

dengan

$\phi_f.T_{n1}$ = kekuatan nominal tarik pelat profil pelehan geser-retakan tarik

ϕ = 0,75

f_y = 240 MPa (tegangan leleh minimum)

$A_{vg} = (s'+(n_p-1).s).t_p$

dengan

s' = 30 mm (jarak lubang baut dengan tepi pelat profil)

s = 50 mm(jarak antar lubang baut)

d_p = 16 mm (diameter baut)

t_p = 5 mm (tebal profil)

n_p = 4 (jumlah baut pada daerah yang ditinjau)

A_{vg} = (30+(4-1).50).5

= 900 mm^2 (luas bruto pelelehan geser)

f_u = 370 MPa (tegangan tarik putus profil)

$A_{nt} = (b/2-(d_b+1)/2).t_f$

dengan

b = 50 mm (panjang kaki profil)

A_{nt} = (50/2-(16+1)/2).5

= 82,5 mm^2 (luas bersih retakan tarik)

ϕT_{n1} = 0,75(0,6.240.900 + 370.82,5)

= 120095 N = 120,095 kN (untuk satu profil)

ϕT_{n1} = 120,095.2 = 240,1875 kN (untuk dua profil) $\geq N_u$ =179,4840 kN -aman-

2. Retakan geser – pelehan tarik

$\phi_f T_{n2} = \phi (0{,}6 fu.Ans + fy.Atg)$.

dengan

$\phi f.Tn2$= kekuatan nominal tarik pelat profil retakan geser-pelehan tarik

ϕ = 0,75

fy = 240 MPa (tegangan leleh minimum)

$A_{ns} = (s' + (n_p\text{-}1).s - n_p.d_p).t_p$

= (30 + (4-1).50- 4.16).5

= 560 mm^2 (luas bersih retakan geser)

fu = 370 MPa (tegangan tarik putus profil)

$A_{tg} = (l_p/2).t$

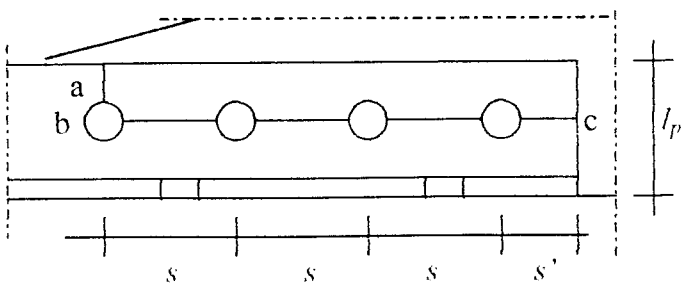
= (50/2).5

= 125 mm^2 (luas kotor pelehan geser)

ϕT_{n2} = 0,75(0,6.370.560 + 240.125)

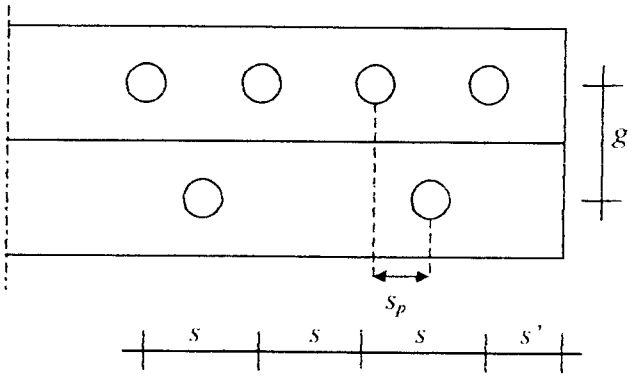
= 115740 N = 115,74 kN (untuk satu profil)

ϕT_{n2} = 115,74.2 = 231,4800 kN (untuk dua profil) $\geq N_u$=179,4840 kN -aman-



Gambar 4.26 Daerah yang diarsir dapat terjadi kegagalan robekan

- **Cek kuat tarik profil dengan luas netto profil**



Gambar 4.27 Profil siku dengan kaki-kaki yang diratakan menjadi satu bidang datar

$\phi T_{n3} = \phi . A_{netto} . f_u$

dengan,

$\phi = 0{,}75$

$A_{netto} = l_p - 2.(d_p + 1) + (s_p^2 / 4.g)$

$s_p = s/2 = 50/2 = 25$ mm

$g = g_a + g_b - t_f$

$= b/2 + b/2 + t_f$

$= 50/2 + 50/2 - 5$

$= 45$ mm

$A_{netto} = 2((2.50-5) - 2.(16+1) + (25^2/4.45)).5$

$= 644{,}7222$ mm^2

$\phi T_{n3} = 0{,}75.644{,}7222.370.10^{-3}$

$= 179{,}6976$ kN $\geq N_u = 179{,}4840$ kN -aman-

Dengan cara yang sama dapat dihitung perencanaan untuk semua sambungan baut titik buhul rangka baja seluruh kuda-kuda, yang disajikan pada Tabel 4.11.

Tabel 4.11 Perencanaan Sambungan Baut Kuda-Kuda

Kuda-Kuda	No J	No. B	Profil	je-nis	Nu	Ag	tp	fu profil	Perencanaan, mutu,diameter, jumlah, dan jarak baut											Cek p.geser-r.tarik			Cek r.geser-p.tarik			Cek An. profil		Ket
									Mutu Baut	fub	d	ϕVn geser	ϕTn tarik	ϕRn tump.	n	n/2	np	s	s'	Avg	Ant	ϕTn1	Ans	Atg	ϕTn2	An	ϕNn	
					(kN)	(mm2)	(mm)	(MPa)		(MPa)	(mm)	(kN)	(kN)	(kN)				(mm)	(mm)	(mm2)	(mm2)	(kN)	(mm2)	(mm2)	(kN)	(mm2)	(kN)	
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]	[19]	[20]	[21]	[22]	[23]	[24]	[25]	[26]	[26]	[27]	[28]
K1	1	1	2L70.70.7	a	16,8800	1880	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		15	2L50.50.5	b	14,2160	960	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	1	2L70.70.7	a	16,8800	1880	7	370	A 307	410	16	24,7181	46,3464	74,5920	0,7	0,3	2	50	30	560	185,5	223,9125	322	245	195,4260	1420,7	395,9851	aman
		2	2L70.70.7	a	104,3880	1880	7	370	A 307	410	16	24,7181	46,3464	74,5920	4,2	2,1	3	50	30	910	185,5	299,5125	553	245	272,3490	1420,722	395,9851	aman
		29	O76,3.3,2	vp	83,3200	734,9	3,2	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		30	2L45.45.5	d	98,4240	860	5	370	A 307	410	16	24,7181	46,3464	53,2800	4,0	-	4	50	30	900	70	233,2500	560	112,5	226,9800	549,0625	153,0352	aman
	3	2	2L70.70.7	a	104,3880	1880	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		3	2L70.70.7	a	162,1840	1880	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		31	2L45.45.5	v	52,7240	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		32	2L45.45.5	d	47,8200	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	4	3	2L70.70.7	a	162,1840	1880	7	370	A 307	410	16	24,7181	46,3464	74,5920	6,6	3,3	4	50	30	1260	185,5	375,1125	784	245	349,2720	1420,722	395,9851	aman
		4	2L70.70.7	a	183,1520	1880	7	370	A 307	410	16	24,7181	46,3464	74,5920	7,4	3,7	4	50	30	1260	185,5	375,1125	784	245	349,2720	1420,722	395,9851	aman
		33	O76,3.3,2	vp	29,6800	734,9	3,2	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		34	2L45.45.5	d	17,7880	860	5	370	A 307	410	16	24,7181	46,3464	53,2800	0,7	-	2	50	30	400	70	125,2500	230	112,5	117,0900	549,0625	153,0352	aman
	5	4	2L70.70.7	a	183,1520	1880	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		5	2L70.70.7	a	187,2000	1880	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		35	2L45.45.5	v	13,5720	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		36	2L45.45.5	d	5,9650	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	6	5	2L70.70.7	a	187,2000	1880	7	370	A 307	410	16	24,7181	46,3464	74,5920	7,6	3,8	4	50	30	1260	185,5	375,1125	784	245	349,2720	1420,722	395,9851	aman
		6	2L70.70.7	a	178,0760	1880	7	370	A 307	410	16	24,7181	46,3464	74,5920	7,2	3,6	4	50	30	1260	185,5	375,1125	784	245	349,2720	1420,722	395,9851	aman
		37	O76,3.3,2	vp	3,3410	860	3,2	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		38	2L45.45.5	d	10,5040	860	5	370	A 307	410	16	24,7181	46,3464	53,2800	0,4	-	2	50	30	400	70	125,2500	230	112,5	117,0900	549,0625	153,0352	aman
	7	6	2L70.70.7	a	178,0760	1880	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		7	2L70.70.7	a	162,2560	1880	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		39	2L45.45.5	v	12,5160	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		40	2L45.45.5	d	18,0120	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8	7	2L70.70.7	a	162,2560	1880	7	370	A 307	410	16	24,7181	46,3464	74,5920	6,6	3,3	4	50	30	1260	185,5	375,1125	784	245	349,2720	1420,722	395,9851	aman
		8	2L70.70.7	a	162,4880	1880	7	370	A 307	410	16	24,7181	46,3464	74,5920	6,6	3,3	4	50	30	1260	185,5	375,1125	784	245	349,2720	1420,722	395,9851	aman
		41	O76,3.3,2	vp	152,6440	734,9	3,2	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	9	15	2L50.50.5	b	14,2160	960	5	370	A 307	410	16	24,7181	46,3464	53,2800	0,6	0,3	2	50	30	400	82,5	132,1875	230	125	121,5900	644,7222	179,6976	aman
		16	2L50.50.5	b	25,4040	960	5	370	A 307	410	16	24,7181	46,3464	53,2800	1,0	0,5	2	50	30	400	82,5	132,1875	230	125	121,5900	644,7222	179,6976	aman
		29	O76,3.3,2	vp	83,3200	734,9	3,2	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10	16	2L50.50.5	b	25,4040	960	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		17	2L50.50.5	b	105,4760	960	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		30	2L45.45.5	d	98,4240	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		31	2L45.45.5	v	52,7240	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11	17	2L50.50.5	b	105,4760	960	5	370	A 307	410	16	24,7181	46,3464	53,2800	4,3	2,1	3	50	30	650	82,5	186,1875	395	125	176,5350	644,7222	179,6976	aman
		18	2L50.50.5	b	157,8880	960	5	370	A 307	410	16	24,7181	46,3464	53,2800	6,4	3,2	4	50	30	900	82,5	240,1875	560	125	231,4800	644,7222	179,6976	aman
		32	2L45.45.5	d	47,8200	860	5	370	A 307	410	16	24,7181	46,3464	53,2800	1,9	-	2	50	30	400	70	125,2500	230	112,5	117,0900	549,0625	153,0352	aman
		33	O76,3.3,2	vp	29,6800	734,9	3,2	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Tabel 4.11 Lanjutan

Kuda-Kuda	No. J	No. B	Profil	je-nis	*Nu* (kN)	*Ag* (mm2)	*tp* (mm)	*fu* profil (MPa)	Perencanaan, mutu,diameter, jumlah, dan jarak baut											Cek p.geser-r.tarik			Cek r.geser-p.tarik			Cek An. profil		Ket
									Mutu Baut	*fub* (MPa)	*d* (mm)	ϕVn geser (kN)	ϕTn tarik (kN)	ϕRn tump. (kN)	*n*	*n/2*	*np*	*s* (mm)	*s'* (mm)	*Avg* (mm2)	*Ant* (mm2)	$\phi Tn1$ (kN)	*Ans* (mm2)	*Atg* (mm2)	$\phi Tn2$ (kN)	*An* (mm2)	ϕNn (kN)	
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]	[19]	[20]	[21]	[22]	[23]	[24]	[25]	[26]	[26]	[27]	[28]
K1	12	18	2L50.50.5	b	157,8880	960	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		19	2L50.50.5	b	176,4680	960	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		34	2L45.45.5	d	17,7880	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		35	2L45.45.5	v	13,5720	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	13	19	2L50.50.5	b	176,4680	960	5	370	A.307	410	16	24,7181	46,3464	53,2800	7,1	3,6	4	50	30	900	82,5	240,1875	560	125	231,4800	644,7222	179,6976	aman
		20	2L50.50.5	b	179,4840	960	5	370	A.307	410	16	24,7181	46,3464	53,2800	7,3	3,6	4	50	30	900	82,5	240,1875	560	125	231,4800	644,7222	179,6976	aman
		36	2L45.45.5	d	5,9650	860	5	370	A.307	410	16	24,7181	46,3464	53,2800	0,2	-	2	50	30	400	70	125,2500	230	112,5	117,0900	549,0625	153,0352	aman
		37	O76,3.3,2	vp	3,3410	734,9	3,2	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	14	20	2L50.50.5	b	179,4840	960	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		21	2L50.50.5	b	170,0800	960	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		38	2L45.45.5	d	10,5040	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		39	2L45.45.5	v	12,5160	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	15	21	2L50.50.5	b	170,0800	960	5	370	A.307	410	16	24,7181	46,3464	53,2800	6,9	3,4	4	50	30	900	82,5	240,1875	560	125	231,4800	644,7222	179,6976	aman
		22	2L50.50.5	b	163,3840	960	5	370	A.307	410	16	24,7181	46,3464	53,2800	6,6	3,3	4	50	30	900	82,5	240,1875	560	125	231,4800	644,7222	179,6976	aman
		40	2L45.45.5	d	18,0120	860	5	370	A.307	410	16	24,7181	46,3464	53,2800	0,7	-	2	50	30	400	70	125,2500	230	112,5	117,0900	549,0625	153,0352	aman
		41	O76,3.3,2	vp	152,6440	734,9	3,2	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		42	2L45.45.5	d	19,4440	860	5	370	A.307	410	16	24,7181	46,3464	53,2800	0,8	-	2	50	30	400	70	125,2500	230	112,5	117,0900	549,0625	153,0352	aman
K2	1	1	2L70.70.7	a	16,8320	1880	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		15	2L50.50.5	b	14,1680	960	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	1	2L70.70.7	a	16,8320	1880	7	370	A.307	410	16	24,7181	46,3464	74,5920	0,7	0,3	2	50	30	380	185,5	185,0325	322	245	195,4260	1420,722	395,9851	aman
		2	2L70.70.7	a	99,2120	1880	7	370	A.307	410	16	24,7181	46,3464	74,5920	4,0	2,0	3	50	30	730	185,5	260,6325	553	245	272,3490	1420,722	395,9851	aman
		29	O76,3.3,2	vp	80,1200	734,9	3,2	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		30	2L45.45.5	d	94,1520	860	5	370	A.307	410	16	24,7181	46,3464	53,2800	3,8	-	4	50	30	780	70	207,3300	560	112,5	226,9800	549,0625	153,0352	aman
	3	2	2L70.70.7	a	99,2100	1880	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		3	2L70.70.7	a	153,8900	1880	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		31	2L45.45.5	v	50,3640	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		32	2L45.45.5	d	45,2240	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	4	3	2L70.70.7	a	153,8900	1880	7	370	A.307	410	16	24,7181	46,3464	74,5920	6,2	3,1	4	50	30	1080	185,5	336,2325	784	245	349,2720	1420,722	395,9851	aman
		4	2L70.70.7	a	172,8680	1880	7	370	A.307	410	16	24,7181	46,3464	74,5920	7,0	3,5	4	50	30	1080	185,5	336,2325	784	245	349,2720	1420,722	395,9851	aman
		33	O76,3.3,2	vp	27,8640	734,9	3,2	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		34	2L45.45.5	d	15,9640	860	5	370	A.307	410	16	24,7181	46,3464	53,2800	0,6	-	2	50	30	280	70	99,3300	230	112,5	117,0900	549,0625	153,0352	aman
	5	4	2L70.70.7	a	172,8680	1880	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		5	2L70.70.7	a	175,3800	1880	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		35	2L45.45.5	v	11,5800	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		36	2L45.45.5	d	4,5440	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	6	5	2L70.70.7	a	175,4000	1880	7	370	A.307	410	16	24,7181	46,3464	74,5920	7,1	3,5	4	50	30	1080	185,5	336,2325	784	245	349,2720	1420,722	395,9851	aman
		6	2L70.70.7	a	151,0120	1880	7	370	A.307	410	16	24,7181	46,3464	74,5920	6,1	3,1	4	50	30	1080	185,5	336,2325	784	245	349,2720	1420,722	395,9851	aman
		37	O76,3.3,2	vp	77,8800	860	3,2	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		38	2L45.45.5	d	18,1920	860	5	370	A.307	410	16	24,7181	46,3464	53,2800	0,7	-	2	50	30	280	70	99,3300	230	112,5	117,0900	549,0625	153,0352	aman
	7	6	2L70.70.7	a	151,0120	1880	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		7	2L70.70.7	a	153,9040	1880	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Tabel 4.11 Lanjutan

Kuda-Kuda	No. J	No. B	Profil	jenis	Nu	Ag	tp	fu profil	Perencanaan, mutu,diameter, jumlah, dan jarak baut											Cek p.geser-r.tarik			Cek r.geser-p.tarik			Cek An. profil		Ket
									Mutu Baut	fub	d	φVn geser	φTn tarik	φRn tump.	n	n/2	np	s	s'	Avg	Ant	φTn1	Ans	Atg	φTn2	An	φNn	
					(kN)	(mm2)	(mm)	(MPa)		(MPa)	(mm)	(kN)	(kN)	(kN)				(mm)	(mm)	(mm2)	(mm2)	(kN)	(mm2)	(mm2)	(kN)	(mm2)	(kN)	
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]	[19]	[20]	[21]	[22]	[23]	[24]	[25]	[26]	[26]	[27]	[28]
K2	7	39	2L45.45.5	v	12,4800	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		40	2L45.45.5	d	12,1680	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8	7	2L70.70.7	a	153,8040	1880	7	370	A.307	410	16	24,7181	46,3464	74,5920	6,2	3,1	4	50	30	1080	185,5	336,2325	784	245	349,2720	1420,722	395,9851	aman
		8	2L70.70.7	a	153,8960	1880	7	370	A.307	410	16	24,7181	46,3464	74,5920	6,2	3,1	4	50	30	1080	185,5	336,2325	784	245	349,2720	1420,722	395,9851	aman
		41	O76,3.3,2	vp	10,1080	734,9	3,2	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	9	15	2L50.50.5	b	14,1680	960	5	370	A.307	410	16	24,7181	46,3464	53,2800	0,6	0,3	2	50	30	280	82,5	106,2675	230	125	121,5900	644,7222	179,6976	aman
		16	2L50.50.5	b	23,4180	960	5	370	A.307	410	16	24,7181	46,3464	53,2800	0,9	0,5	2	50	30	280	82,5	106,2675	230	125	121,5900	644,7222	179,6976	aman
		29	O76,3.3,2	vp	80,1200	734,9	3,2	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10	16	2L50.50.5	b	23,4180	960	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		17	2L50.50.5	b	99,7440	960	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		30	2L45.45.5	d	94,1520	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		31	2L45.45.5	v	50,3640	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11	17	2L50.50.5	b	99,7440	960	5	370	A.307	410	16	24,7181	46,3464	53,2800	4,0	2,0	3	50	30	530	82,5	160,2675	395	125	176,5350	644,7222	179,6976	aman
		18	2L50.50.5	b	149,3240	960	5	370	A.307	410	16	24,7181	46,3464	53,2800	6,0	3,0	4	50	30	780	82,5	214,2675	560	125	231,4800	644,7222	179,6976	aman
		32	2L45.45.5	d	45,2240	860	5	370	A.307	410	16	24,7181	46,3464	53,2800	1,8	-	2	50	30	280	70	99,3300	230	112,5	117,0900	549,0625	153,0352	aman
		33	O76,3.3,2	vp	27,8640	734,9	3,2	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12	18	2L50.50.5	b	149,3240	960	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		19	2L50.50.5	b	165,9360	960	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		34	2L45.45.5	d	15,9640	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		35	2L45.45.5	v	11,5800	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	13	19	2L50.50.5	b	165,9360	960	5	370	A.307	410	16	24,7181	46,3464	53,2800	6,7	3,4	4	50	30	780	82,5	214,2675	560	125	231,4800	644,7222	179,6976	aman
		20	2L50.50.5	b	149,2280	960	5	370	A.307	410	16	24,7181	46,3464	53,2800	6,0	3,0	4	50	30	780	82,5	214,2675	560	125	231,4800	644,7222	179,6976	aman
		36	2L45.45.5	d	4,5440	860	5	370	A.307	410	16	24,7181	46,3464	53,2800	0,2	-	2	50	30	280	70	99,3300	230	112,5	117,0900	549,0625	153,0352	aman
		37	O76,3.3,2	vp	77,8800	734,9	3,2	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	14	20	2L50.50.5	b	149,2280	960	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		21	2L50.50.5	b	155,8120	960	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		38	2L45.45.5	d	18,1920	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		39	2L45.45.5	v	12,4800	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	15	21	2L50.50.5	b	155,8120	960	5	370	A.307	410	16	24,7181	46,3464	53,2800	6,3	3,2	4	50	30	780	82,5	214,2675	560	125	231,4800	644,7222	179,6976	aman
		22	2L50.50.5	b	151,2280	960	5	370	A.307	410	16	24,7181	46,3464	53,2800	6,1	3,1	4	50	30	780	82,5	214,2675	560	125	231,4800	644,7222	179,6976	aman
		40	2L45.45.5	d	12,1680	860	5	370	A.307	410	16	24,7181	46,3464	53,2800	0,5	-	2	50	30	280	70	99,3300	230	112,5	117,0900	549,0625	153,0352	aman
		41	O76,3.3,2	vp	10,1080	734,9	3,2	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		42	2L45.45.5	d	13,1280	860	5	370	A.307	410	16	24,7181	46,3464	53,2800	0,5	-	2	50	30	280	70	99,3300	230	112,5	117,0900	549,0625	153,0352	aman
K3	1	1	2L70.70.7	a	16,2680	1880	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		15	2L50.50.5	b	11,3860	960	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	1	2L70.70.7	a	16,2680	1880	7	370	A.307	410	16	24,7181	46,3464	74,5920	0,7	0,3	2	50	30	560	185,5	223,9125	322	245	195,4260	1420,722	395,9851	aman
		2	2L70.70.7	a	91,2520	1880	7	370	A.307	410	16	24,7181	46,3464	74,5920	3,7	1,8	2	50	30	560	185,5	223,9125	322	245	195,4260	1420,722	395,9851	aman
		29	O76,3.3,2	vp	74,9520	734,9	3,2	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		30	2L45.45.5	d	87,1280	860	5	370	A.307	410	16	24,7181	46,3464	53,2800	3,5	-	4	50	30	900	70	233,2500	560	112,5	226,9800	549,0625	153,0352	aman
	3	2	2L70.70.7	a	91,2520	1880	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		3	2L70.70.7	a	140,8000	1880	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Tabel 4.11 Lanjutan

Kuda-Kuda	No. J	No. B	Profil	jenis	Nu (kN)	Ag (mm2)	tp (mm)	fu profil (MPa)	Perencanaan, mutu,diameter, jumlah, dan jarak baut											Cek p.geser-l.tarik			Cek r.geser-p.tarik			Cek An. profil		Ket
									Mutu Baut	fub (MPa)	d (mm)	ϕVn geser (kN)	ϕTn tarik (kN)	ϕRn tump. (kN)	n	n/2	np	s (mm)	s' (mm)	Avg (mm2)	Ant (mm2)	ϕTn1 (kN)	Ans (mm2)	Atg (mm2)	ϕTn2 (kN)	An (mm2)	ϕNn (kN)	
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]	[19]	[20]	[21]	[22]	[23]	[24]	[25]	[26]	[26]	[27]	[28]
K3	3	31	2L45.45.5	v	46,4120	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		32	2L45.45.5	d	41,1240	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	4	3	2L70.70.7	a	140,8000	1880	7	370	A.307	410	16	24,7181	46,3464	74,5920	5,7	2,8	3	50	30	910	185,5	299,5125	553	245	272,3490	1420,722	395,9851	aman
		4	2L70.70.7	a	148,2280	1880	7	370	A.307	410	16	24,7181	46,3464	74,5920	6,0	3,0	4	50	30	1260	185,5	375,1125	784	245	349,2720	1420,722	395,9851	aman
		33	O76,3.3,2	vp	37,3160	734,9	3,2	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		34	2L45.45.5	d	46,1360	860	5	370	A.307	410	16	24,7181	46,3464	53,2800	1,9	-	2	50	30	400	70	125,2500	230	112,5	117,0900	549,0625	153,0352	aman
	5	4	2L70.70.7	a	148,2280	1880	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		5	2L70.70.7	a	175,3640	1880	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		35	2L45.45.5	v	29,4640	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		36	2L45.45.5	d	39,4520	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	6	5	2L70.70.7	a	175,3640	1880	7	370	A.307	410	16	24,7181	46,3464	74,5920	7,1	3,5	4	50	30	1260	185,5	375,1125	784	245	349,2720	1420,722	395,9851	aman
		6	2L70.70.7	a	187,1560	1880	7	370	A.307	410	16	24,7181	46,3464	74,5920	7,6	3,8	4	50	30	1260	185,5	375,1125	784	245	349,2720	1420,722	395,9851	aman
		37	O76,3.3,2	vp	20,6880	860	3,2	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		38	2L45.45.5	d	18,6040	860	5	370	A.307	410	16	24,7181	46,3464	53,2800	0,8	-	2	50	30	400	70	125,2500	230	112,5	117,0900	549,0625	153,0352	aman
	7	6	2L70.70.7	a	187,1560	1880	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		7	2L70.70.7	a	193,9400	1880	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		39	2L45.45.5	v	10,9800	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		40	2L45.45.5	d	11,8880	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8	7	2L70.70.7	a	193,9400	1880	7	370	A.307	410	16	24,7181	46,3464	74,5920	7,8	3,9	4	50	30	1260	185,5	375,1125	784	245	349,2720	1420,722	395,9851	aman
		8	2L70.70.7	a	193,9320	1880	7	370	A.307	410	16	24,7181	46,3464	74,5920	7,8	3,9	4	50	30	1260	185,5	375,1125	784	245	349,2720	1420,722	395,9851	aman
		41	O76,3.3,2	vp	10,0480	734,9	3,2	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	9	15	2L50.50.5	b	11,3860	960	5	370	A.307	410	16	24,7181	46,3464	53,2800	0,5	0,2	2	50	30	400	82,5	132,1875	230	125	121,5900	644,7222	179,6976	aman
		16	2L50.50.5	b	18,1040	960	5	370	A.307	410	16	24,7181	46,3464	53,2800	0,7	0,4	2	50	30	400	82,5	132,1875	230	125	121,5900	644,7222	179,6976	aman
		29	O76,3.3,2	vp	74,9520	734,9	3,2	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	10	16	2L50.50.5	b	18,1040	960	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		17	2L50.50.5	b	88,8840	960	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		30	2L45.45.5	d	87,1280	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		31	2L45.45.5	v	46,4160	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11	17	2L50.50.5	b	88,8840	960	5	370	A.307	410	16	24,7181	46,3464	53,2800	3,6	1,8	2	50	30	400	82,5	132,1875	230	125	121,5900	644,7222	179,6976	aman
		18	2L50.50.5	b	119,2840	960	5	370	A.307	410	16	24,7181	46,3464	53,2800	4,8	2,4	3	50	30	650	82,5	186,1875	395	125	176,5350	644,7222	179,6976	aman
		32	2L45.45.5	d	41,1240	860	5	370	A.307	410	16	24,7181	46,3464	53,2800	1,7	-	2	50	30	400	70	125,2500	230	112,5	117,0900	549,0625	153,0352	aman
		33	O76,3.3,2	vp	37,3160	734,9	3,2	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12	18	2L50.50.5	b	119,2840	960	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		19	2L50.50.5	b	151,3000	960	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		34	2L45.45.5	d	46,1360	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		35	2L45.45.5	v	29,4640	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	13	19	2L50.50.5	b	151,3400	960	5	370	A.307	410	16	24,7181	46,3464	53,2800	6,1	3,1	4	50	30	900	82,5	240,1875	560	125	231,4800	644,7222	179,6976	aman
		20	2L50.50.5	b	178,5040	960	5	370	A.307	410	16	24,7181	46,3464	53,2800	7,2	3,6	4	50	30	900	82,5	240,1875	560	125	231,4800	644,7222	179,6976	aman
		36	2L45.45.5	d	39,4520	860	5	370	A.307	410	16	24,7181	46,3464	53,2800	1,6	-	2	50	30	400	70	125,2500	230	112,5	117,0900	549,0625	153,0352	aman
		37	O76,3.3,2	vp	20,6880	734,9	3,2	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Tabel 4.11 Lanjutan

Kuda-Kuda	No. J	No. B	Profil	je-nis	Nu	Ag	tp	fu profil	Perencanaan, mutu,diameter, jumlah, dan jarak baut											Cek p.geser-r tarik			Cek r.geser-p.tarik			Cek An. profil		Ket
									Mutu Baut	fub	d	ϕVn geser	ϕTn tarik	ϕRn tump.	n	n/2	np	s	s'	Avg	Ant	ϕTn1	Ans	Atg	ϕTn2	An	ϕNn	
					(kN)	(mm2)	(mm,	(MPa)		(MPa)	(mm)	(kN)	(kN)	(kN)				(mm)	(mm)	(mm2)	(mm2)	(kN)	(mm2)	(mm2)	(kN)	(mm2)	(kN)	
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]	[19]	[20]	[21]	[22]	[23]	[24]	[25]	[26]	[26]	[27]	[28]
K3	14	21	2L50.50.5	b	190,2000	960	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		38	2L45.45.5	d	18,6040	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		39	2L45.45.5	v	10,9800	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	15	21	2L50.50.5	b	190,2000	960	5	370	A.307	410	16	24,7181	46,3464	53,2800	7,7	3,8	4	75	30	1275	82,5	321,1875	935	125	356,3550	688,125	191,7949	aman
		22	2L50.50.5	b	188,2240	960	5	370	A.307	410	16	24,7181	46,3464	53,2800	7,6	3,8	4	70	30	1200	82,5	304,9875	860	125	331,3800	678,0556	188,9883	aman
		40	2L45.45.5	d	10,8880	860	5	370	A.307	410	16	24,7181	46,3464	53,2800	0,4	-	2	50	30	400	70	125,2500	230	112,5	117,0900	549,0625	153,0352	aman
		41	O76,3.3,2	vp	10,0480	734,9	3,2	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		42	2L45.45.5	d	11,9860	860	5	370	A.307	410	16	24,7181	46,3464	53,2800	0,5	-	2	50	30	400	70	125,2500	230	112,5	117,0900	549,0625	153,0352	aman
K4	1	1	2L70.70.7	a	15,0520	1880	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		15	2L50.50.5	b	6,6720	960	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	1	2L70.70.7	a	15,0520	1880	7	370	A.307	410	16	24,7181	46,3464	74,5920	0,6	0,3	2	50	30	380	185,5	185,0325	322	245	195,4260	1420,722	395,9851	aman
		2	2L70.70.7	a	5,5320	1880	7	370	A.307	410	16	24,7181	46,3464	74,5920	0,2	0,1	2	50	30	380	185,5	185,0325	322	245	195,4260	1420,722	395,9851	aman
		29	O76,3.3,2	vp	24,5040	734,9	3,2	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		30	2L45.45.5	d	7,6400	860	5	370	A.307	410	16	24,7181	46,3464	53,2800	0,3	-	2	50	30	280	70	99,3300	230	112,5	117,0900	549,0625	153,0352	aman
	3	2	2L70.70.7	a	5,5320	1880	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		3	2L70.70.7	a	4,1840	1880	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		31	2L45.45.5	v	17,8920	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		32	2L45.45.5	d	2,1290	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	4	3	2L70.70.7	a	4,1840	1880	7	370	A.307	410	16	24,7181	46,3464	74,5920	0,2	0,1	2	50	30	380	185,5	185,0325	322	245	195,4260	1420,722	395,9851	aman
		4	2L70.70.7	a	0,8440	1880	7	370	A.307	410	16	24,7181	46,3464	74,5920	0,0	0,0	2	50	30	380	185,5	185,0325	322	245	195,4260	1420,722	395,9851	aman
		33	O76,3.3,2	vp	11,0640	734,9	3,2	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		34	2L45.45.5	d	3,7640	860	5	370	A.307	410	16	24,7181	46,3464	53,2800	0,2	-	2	50	30	280	70	99,3300	230	112,5	117,0900	549,0625	153,0352	aman
	5	4	2L70.70.7	a	0,8440	1880	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		5	2L70.70.7	a	2,4900	1880	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		35	2L45.45.5	v	10,4120	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		36	2L45.45.5	d	1,9560	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	6	5	2L70.70.7	a	2,4900	1880	7	370	A.307	410	16	24,7181	46,3464	74,5920	0,1	0,1	2	50	30	380	185,5	185,0325	322	245	195,4260	1420,722	395,9851	aman
		6	2L70.70.7	a	0,9140	1880	7	370	A.307	410	16	24,7181	46,3464	74,5920	0,0	0,0	2	50	30	380	185,5	185,0325	322	245	195,4260	1420,722	395,9851	aman
		37	O76,3.3,2	vp	10,4160	860	3,2	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		38	2L45.45.5	d	2,2440	860	5	370	A.307	410	16	24,7181	46,3464	53,2800	0,1	-	2	50	30	280	70	99,3300	230	112,5	117,0900	549,0625	153,0352	aman
	7	6	2L70.70.7	a	0,9140	1880	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		7	2L70.70.7	a	3,4800	1880	7	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		39	2L45.45.5	v	5,2280	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		40	2L45.45.5	d	3,6280	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	8	7	2L70.70.7	a	3,4800	1880	7	370	A.307	410	16	24,7181	46,3464	74,5920	0,1	0,1	2	50	30	380	185,5	185,0325	322	245	195,4260	1420,722	395,9851	aman
		8	2L70.70.7	a	3,4800	1880	7	370	A.307	410	16	24,7181	46,3464	74,5920	0,1	0,1	2	50	30	380	185,5	185,0325	322	245	195,4260	1420,722	395,9851	aman
		41	O76,3.3,2	vp	9,3720	734,9	3,2	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	9	15	2L50.50.5	b	6,6720	960	5	370	A.307	410	16	24,7181	46,3464	53,2800	0,3	0,1	2	50	30	280	82,5	106,2675	230	125	121,5900	644,7222	179,6976	aman
		16	2L50.50.5	b	12,4120	960	5	370	A.307	410	16	24,7181	46,3464	53,2800	0,5	0,3	2	50	30	280	82,5	106,2675	230	125	121,5900	644,7222	179,6976	aman
		29	O76,3.3,2	vp	24,5040	734,9	3,2	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Tabel 4.11 Lanjutan

Kuda-Kuda	No. J	No. B	Profil	je-nis	*Nu*	*Ag*	*tp*	*fu* profil	Perencanaan, mutu,diameter, jumlah, dan jarak baut											Cek p.geser-r.tarik			Cek r.geser-p.tarik			Cek An. profil		Ket
									Mutu Baut	*fub*	*d*	ϕVn geser	ϕTn tarik	ϕRn tump.	*n*	*n*/2	*np*	*s*	*s'*	*Avg*	*Ant*	$\phi Tn1$	*Ans*	*Atg*	$\phi Tn2$	*An*	ϕNn	
					(kN)	(mm2)	(mm)	(MPa)		(MPa)	(mm)	(kN)	(kN)	(kN)				(mm)	(mm)	(mm2)	(mm2)	(kN)	(mm2)	(mm2)	(kN)	(mm2)	(kN)	
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]	[19]	[20]	[21]	[22]	[23]	[24]	[25]	[26]	[26]	[27]	[28]
K4	10	16	2L50.50.5	b	12,4120	960	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		17	2L50.50.5	b	5,8720	960	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		30	2L45.45.5	d	7,6400	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		31	2L45.45.5	v	17,8920	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	11	17	2L50.50.5	b	5,8720	960	5	370	A.307	410	16	24,7181	46,3464	53,2800	0,2	0,1	2	50	30	280	82,5	106,2675	230	125	121,5900	644,7222	179,6976	aman
		18	2L50.50.5	b	4,0240	960	5	370	A.307	410	16	24,7181	46,3464	53,2800	0,2	0,1	2	50	30	280	82,5	106,2675	230	125	121,5900	644,7222	179,6976	aman
		32	2L45.45.5	d	2,1290	860	5	370	A.307	410	16	24,7181	46,3464	53,2800	0,1	-	2	50	30	280	70	99,3300	230	112,5	117,0900	549,0625	153,0352	aman
		33	O76.3.3,2	vp	11,0640	734,9	3,2	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12	18	2L50.50.5	b	4,0240	960	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		19	2L50.50.5	b	1,1590	960	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		34	2L45.45.5	d	3,7640	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		35	2L45.45.5	v	10,4120	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	13	19	2L50.50.5	b	1,1590	960	5	370	A.307	410	16	24,7181	46,3464	53,2800	0,0	0,0	2	50	30	280	82,5	106,2675	230	125	121,5900	644,7222	179,6976	aman
		20	2L50.50.5	b	2,2040	960	5	370	A.307	410	16	24,7181	46,3464	53,2800	0,1	0,0	2	50	30	280	82,5	106,2675	230	125	121,5900	644,7222	179,6976	aman
		36	2L45.45.5	d	1,9560	860	5	370	A.307	410	16	24,7181	46,3464	53,2800	0,1	-	2	50	30	280	70	99,3300	230	112,5	117,0900	549,0625	153,0352	aman
		37	O76.3.3,2	vp	10,4160	734,9	3,2	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	14	20	2L50.50.5	b	2,2040	960	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		21	2L50.50.5	b	0,9910	960	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		38	2L45.45.5	d	2,2440	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		39	2L45.45.5	v	5,2280	860	5	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	15	21	2L50.50.5	b	0,9910	960	5	370	A.307	410	16	24,7181	46,3464	53,2800	0,0	0,0	2	50	30	280	82,5	106,2675	230	125	121,5900	748,8889	208,7311	aman
		22	2L50.50.5	b	0,9200	960	5	370	A.307	410	16	24,7181	46,3464	53,2800	0,0	0,0	2	50	30	280	82,5	106,2675	230	125	121,5900	748,8889	208,7311	aman
		40	2L45.45.5	d	3,6280	860	5	370	A.307	410	16	24,7181	46,3464	53,2800	0,1	-	2	50	30	280	70	99,3300	230	112,5	117,0900	666,25	185,6979	aman
		41	O76.3.3,2	vp	9,3720	734,9	3,2	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		42	2L45.45.5	d	3,6040	860	5	370	A.307	410	16	24,7181	46,3464	53,2800	0,1	-	2	50	30	280	70	99,3300	230	112,5	117,0900	666,25	185,6979	aman

Keterangan **Tabel 4.11**:

[1] Kuda-kuda

[2] Nomor joint/titik buhul

[3] Nomor batang

[4] Profil batang

[5] jenis batang: a = batang atas, b = batang bawah, d = batang diagonal, v = batang verikal, vp = batang vertikal pertemuan

[6] *Nu* = gaya batang kombinasi faktor beban maksimum

[7] *Ag* = luas penampang kotor profil

[8] *tp* = tebal pelat profil

[9] *fu* profil = tegangan tarik putus profil

[10] Mutu baut

[11] *fub* = tegangan tarik putus baut

[12] *d* = diameter baut

[13] ϕVn geser = kuat geser satu baut

[14] ϕTn tarik = kuat tarik satu baut

[15] ϕRn tumpu = kuat tumpu satu baut

[16] $n = Nu/\phi Vn$ (jumlah baut nominal)

[17] *n*/2 = jumlah baut pada profil siku sayap horizontal dan sayap vertikal

[18] *np* = jumlah baut terpasang

[19] *s* = jarak antar pusat lubang baut

[20] *s'* = jarak dari pusat lubang baut ke tepi pelat sayap profil

[21] $Avg = (s' + (np-1)s)tp$ (luas bruto yang mengalami pelelehan geser)

[22] $Ant = (lp/2 - (d+1)/2).tp$ (luas bersih yang mengalami retakan tarik)

[23] $\phi Tn1 = 0,75.(0,6.fy.Avg + fu.Ant)$ (kekuatan nominal terfaktor pelelehan geser-retakan tarik)

[24] $Ans = (s' + (np-1).s - np.d).tp$ (luas bersih yang mengalami retakan geser)

[25] $Atg = (lp/2).tp$ (luas bruto yang mengalami pelelehan tarik)

[26] $\phi Tn2 = 0,75.(0,6.fu.Ans + fy.Atg)$ (kekuatan nomilal terfaktor retakan geser-pelelehan tarik)

[27] $Ant = Ag - n.d.t + \Sigma(sp\text{^}2/4g)$ (luas penampang netto profil)

[28] $\phi Nn = 0,75.Anetto.fup$ (kuat tarik nominal terfaktor profil dengan *Anetto*)