

BAB V

PENINJAUAN KOLOM

5.1 Dasar Peninjauan

Kolom merupakan struktur utama yang menerima beban bangunan dan beban lainnya, fungsi dari pada kolom sendiri adalah sebagai penerus beban ke pondasi. Struktur kolom sendiri menggunakan beton bertulang, karena kolom tegak lurus atau vertikal maka membutuhkan material yang tahan terhadap tekan dan tarik oleh karena itu digunakan beton bertulang. Dalam perencanaan kolom ini menggunakan mutu beton $f_c' = 30$ MPa dan mutu tulangan $f_y = 400$ MPa.



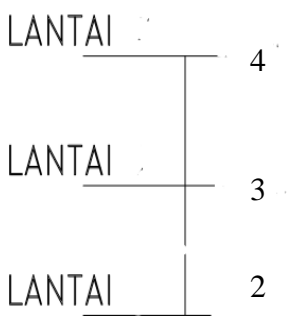
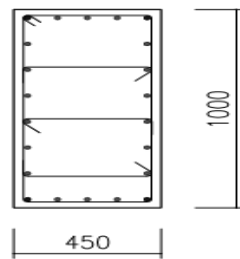
Gambar 5.1 Denah Kolom Lantai 2-4

5.2 Perhitungan Kolom

5.2.1 Kolom K2B

Data umum perencanaan:

- Mutu Beton (f_c') : 30 Mpa
- Mutu Baja (f_y) : 400 Mpa
- Tulangan pokok : D 22
- Tulangan Bagi : D 13
- Ukuran Rencana Kolom : 450 x 1000

| LANTAI | K2B |
|------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
|  |  |
| MUTU BETON (f_c') | 30 MPA |
| TULANGAN | 22 D22 |
| SENGKANG TUMPUAN X | 2,5D13-75 |
| SENGKANG LAPANGAN X | 2,5D13-75 |
| SENGKANG TUMPUAN Y | 1D13-75 |
| SENGKANG LAPANGAN Y | 1D13-75 |

Gambar 5.2 Detail Kolom K2B

❖ Kolom dengan dimensi 450 x 1000 dan tulangan pokok 22D22 maka,

$$\begin{aligned} A_s' = A_s &= 0,25 \times \pi \times D^2 \times 16 \\ &= 0,25 \times \pi \times 22^2 \times 16 = 1936 \text{ mm}^2 \end{aligned}$$

Dipakai tulangan = 22D22 ($A_s = 8362,9 \text{ mm}^2$)

$$\begin{aligned} d' &= t_s + (\frac{1}{2} \times D \text{ tul pokok}) + D \text{ tul sengkang} \\ &= 40 + (\frac{1}{2} \times 22) + 13 \\ &= 64 \leq 70 \text{ OK} \end{aligned}$$

$$\begin{aligned} d &= h - d' \\ &= 1000 - 64 \\ &= 936 \text{ mm} \end{aligned}$$

❖ Mencari Mu

$$\begin{aligned} 0,7225 \times b \times c \times f_c' &= A_s \times f_y \\ 0,7225 \times 450 \times c \times 30 &= 8362,9 \times 400 \\ 9753,75 &= 3345160 \\ c &= 342,961 \text{ mm} \end{aligned}$$

$$\begin{aligned} M_u &= A_s \times 0,8 \times f_y \times (d - 0,425 \times c) \\ &= 8362,9 \times 0,8 \times 400 \times (936 - 0,425 \times 342,961) \\ &= 2114787606 \text{ Nmm} \\ &= 2114,787 \text{ kNm} \end{aligned}$$

❖ Mencari Pu

(Pu) belum diketahui, oleh sebab itu perlu asumsi nilai (e) untuk mendapatkan nilai (Pu), (e)= 900 mm

$$\text{Jadi, } e = \frac{Mu}{Pu} \cdot 10^3$$

$$900 = \frac{2114,787 \cdot 10^3}{Pu}$$

$$Pu = 2349,763 \text{ kn}$$

Jumlah penulangan diperkirakan 2%

Ukuran kolom 450 mm x 1000 mm, d'= 64 mm

$$Po = 0,85 fc' (Ag - Ast) + fy \cdot Ast$$

$$Po = Ag \cdot (0,85 \cdot fc' (1-p) + fy \cdot p)$$

$$Po = Ag (0,85 \cdot 30 (1-2\%) + 400 \cdot 2\%)$$

$$Pn = 0,8 Po \rightarrow \text{Kolom Beugeul}$$

$$Pu/\Phi = 0,8 Ag (0,85 \cdot 30 (1-0,02) + 400 \cdot 0,02)$$

$$Pu = \Phi 0,8 Ag (0,85 \cdot 30 (1-0,02) + 400 \cdot 0,02)$$

$$2349,763 = 0,65 \cdot 0,8 Ag (0,85 \cdot 30 (1-0,02) + 400 \cdot 0,02)$$

$$Ag = \frac{2349,763}{0,65 \cdot 0,8 \cdot (0,85 \cdot 29,4 + 8)} = 136,974 \text{ mm}^2$$

Dicoba dengan tulangan 22D22 pada masing-masing sisi kolom (As = 8362,9 mm²)

$$\rho = \frac{8362,9}{1000 \times 450} = 0,018$$

❖ Pemeriksaan Pu Terhadap beban seimbang Pub

$$d = 450 - 64 = 386 \text{ mm}$$

$$C_b = \frac{500(d)}{500 + f_y} = \frac{500(386)}{500 + 400} = 214,444 \text{ mm}$$

$$\beta_1 = 0,85 \text{ (faktor reduksi)}$$

$$ab = \beta_1 \cdot C = 0,85 \cdot 214,444 = 182,277 \text{ mm}$$

$$\begin{aligned} \epsilon_s' &= \frac{214,444 - 64}{214,444} \cdot 0,003 < \frac{f_y}{E_s} \\ &= 0,0021 < \frac{400}{200000} \end{aligned}$$

10.5.2 SNI 03-2847-2002,
modulus elastisitas baja
tulangan non pratekan Es
dapat diambil sebesar
200.000 MPa

= 0,0021 > 0,002 jadi, tulangan mencapai luluh ketika beton

hancur

$$f_s' = E_s \cdot \epsilon_s' = 200000 \cdot 0,0021 = 420 \text{ MPa}$$

$$f_s' > f_y = 420 \text{ MPa} > 400 \text{ MPa}$$

$$\begin{aligned} P_{ub} &= 0,65 (0,85 \cdot F_c' \cdot ab \cdot b + A_s \cdot F_s' - A_s \cdot F_y) \\ &= 0,65 [(0,85 \cdot 30 \cdot 182,277 \cdot 450) + (8362,9 \cdot 420) \\ &\quad - (8362,9 \cdot 400)] (10)^{-4} \\ &= 4871642 \text{ N} \\ &= 4871,642 \text{ kN} \end{aligned}$$

$$\begin{aligned} \emptyset P_{nb} &= 0,65 (4871,642) > P_u \\ &= 3166,567 \text{ kN} > 2349,763 \text{ kN (aman)} \end{aligned}$$

❖ Memeriksa kekuatan penampang

$$P_n = \frac{A_s' f_y}{\frac{e}{(d-d')} + 0,5} + \frac{b h f_c'}{\frac{3he}{d^2} + 1,18}$$

$$= \frac{8362,9 \cdot 400}{\frac{900}{(936-64)}+0,5} + \frac{1000 \times 450 \times 30}{\frac{3 \times 1000 \times 900}{936^2}+1,18}$$

$$= 2183367,904 + 421894,243$$

$$= 2265125,705 \text{ N}$$

$$= 2265,125 \text{ kN}$$

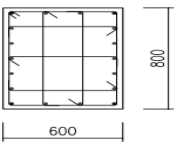
$$\phi P_{nb} = 0,65 (2265,125) > P_u$$

$$= 1472,331 \text{ kN} > 2349,763 \text{ kN (aman)}$$

5.2.2 Kolom K3A

Data umum perencanaan:

- Mutu Beton (f_c') : 30 Mpa
- Mutu Baja (f_y) : 400 Mpa
- Tulangan pokok : D 22
- Tulangan Bagi : D 13
- Ukuran Rencana Kolom : 600 x 800

| LANTAI | K3A |
|-----------------------|-------------------------------------------------------------------------------------|
| LANTAI 4 |  |
| LANTAI 3 | |
| LANTAI 2 | |
| MUTU BETON (f_c') | 30 MPA |
| TULANGAN | 18 D22 |
| SENGKANG TUMPUAN X | 2,5D13-100 |
| SENGKANG LAPANGAN X | 2,5D13-100 |
| SENGKANG TUMPUAN Y | 2D13-100 |
| SENGKANG LAPANGAN Y | 2D13-100 |

Gambar 5.3 Detail Kolom K3A

❖ Kolom dengan dimensi 600 x 800 dan tulangan pokok 18D22 maka,

$$\begin{aligned} A_s' = A_s &= 0,25 \times \pi \times D^2 \times 16 \\ &= 0,25 \times \pi \times 22^2 \times 16 = 1936 \text{ mm}^2 \end{aligned}$$

Dipakai tulangan = 18D22 ($A_s = 6842,4 \text{ mm}^2$)

$$\begin{aligned} d' &= t_s + (\frac{1}{2} \times D \text{ tul pokok}) + D \text{ tul sengkang} \\ &= 40 + (\frac{1}{2} \times 22) + 13 \\ &= 64 \leq 70 \text{ OK} \end{aligned}$$

$$\begin{aligned} d &= h - d' \\ &= 800 - 64 \\ &= 736 \text{ mm} \end{aligned}$$

❖ Mencari Mu

$$\begin{aligned} 0,7225 \times b \times c \times f_c' &= A_s \times f_y \\ 0,7225 \times 600 \times c \times 30 &= 6842,4 \times 400 \\ 13005 &= 2736960 \\ c &= 210,454 \text{ mm} \end{aligned}$$

$$\begin{aligned} M_u &= A_s \times 0,8 \times f_y \times (d - 0,425 \times c) \\ &= 6842,4 \times 0,8 \times 400 \times (736 - 0,425 \times 210,454) \\ &= 1415680627 \text{ Nmm} \\ &= 1415,680 \text{ kNm} \end{aligned}$$

❖ Mencari Pu

(Pu) belum diketahui, oleh sebab itu perlu asumsi nilai (e) untuk mendapatkan nilai (Pu), (e)= 900 mm

$$\text{Jadi, } e = \frac{Mu}{Pu} \cdot 10^3$$

$$900 = \frac{1415,680 \cdot 10^3}{Pu}$$

$$Pu = 1572,977 \text{ kn}$$

Jumlah penulangan diperkirakan 2%

Ukuran kolom 600 mm x 800 mm, d'= 64 mm

$$Po = 0,85 fc' (Ag - Ast) + fy \cdot Ast$$

$$Po = Ag \cdot (0,85 \cdot fc' (1-p) + fy \cdot p)$$

$$Po = Ag (0,85 \cdot 30 (1-2\%) + 400 \cdot 2\%)$$

$$Pn = 0,8 Po \rightarrow \text{Kolom Beugeul}$$

$$Pu/\Phi = 0,8 Ag (0,85 \cdot 30 (1-0,02) + 400 \cdot 0,02)$$

$$Pu = \Phi 0,8 Ag (0,85 \cdot 30 (1-0,02) + 400 \cdot 0,02)$$

$$1572,977 = 0,65 \cdot 0,8 Ag (0,85 \cdot 30 (1-0,02) + 400 \cdot 0,02)$$

$$Ag = \frac{1572,977}{0,65 \cdot 0,8 \cdot (0,85 \cdot 29,4 + 8)} = 91,693 \text{ mm}^2$$

Dicoba dengan tulangan 18D22 pada masing-masing sisi kolom (As = 6842,4 mm²)

$$\rho = \frac{6842,4}{600 \times 800} = 0,014$$

❖ Pemeriksaan Pu Terhadap beban seimbang Pub

$$d = 600 - 64 = 536 \text{ mm}$$

$$C_b = \frac{500(d)}{500 + f_y} = \frac{500(536)}{500 + 400} = 297,777 \text{ mm}$$

$$\beta_1 = 0,85 \text{ (faktor reduksi)}$$

$$ab = \beta_1 \cdot C = 0,85 \cdot 297,777 = 253,110 \text{ mm}$$

$$\begin{aligned} \epsilon_s' &= \frac{297,777 - 64}{297,777} \cdot 0,003 < \frac{f_y}{E_s} \\ &= 0,0023 < \frac{400}{200000} \end{aligned}$$

10.5.2 SNI 03-2847-2002,
modulus elastisitas baja
tulangan non pratekan Es
dapat diambil sebesar
200.000 MPa

= 0,0023 > 0,002 jadi, tulangan mencapai luluh ketika beton

hancur

$$f_s' = E_s \cdot \epsilon_s' = 200000 \cdot 0,0023 = 460 \text{ MPa}$$

$$f_s' > f_y = 460 \text{ MPa} > 400 \text{ MPa}$$

$$\begin{aligned} P_{ub} &= 0,65 (0,85 \cdot F_c' \cdot ab \cdot b + A_s \cdot F_s' - A_s \cdot F_y) \\ &= 0,65 [(0,85 \cdot 30 \cdot 253,110 \cdot 600) + (6842,4 \cdot 460) \\ &\quad - (6842,4 \cdot 400)] (10)^{-4} \\ &= 5664409,254 \text{ N} \\ &= 5664,409 \text{ kN} \end{aligned}$$

$$\begin{aligned} \emptyset P_{nb} &= 0,65 (5664,409) > P_u \\ &= 3681,865 \text{ kN} > 1572,977 \text{ kN (aman)} \end{aligned}$$

❖ Memeriksa kekuatan penampang

$$P_n = \frac{A_s' f_y}{\frac{e}{(d-d')} + 0,5} + \frac{b h f_c'}{\frac{3he}{d^2} + 1,18}$$

$$= \frac{6842,4 \cdot 400}{\frac{900}{(736-64)}+0,5} + \frac{600 \times 800 \times 30}{\frac{3 \times 800 \times 900}{736^2}+1,18}$$

$$= 1488055,922 + 2786660,058$$

$$= 4274715,98 \text{ N}$$

$$= 4274,715 \text{ kN}$$

$$\phi P_{nb} = 0,65 (4274,715) > P_u$$

$$= 2778,564 \text{ kN} > 1572,977 \text{ kN (aman)}$$

5.2.3 Kolom K4

Data umum perencanaan:

- Mutu Beton (f_c') : 30 Mpa
- Mutu Baja (f_y) : 400 Mpa
- Tulangan pokok : D 22
- Tulangan Bagi : D 13
- Ukuran Rencana Kolom : 450 x 600

| LANTAI | K 4 |
|-----------------------|------------|
| LANTAI 4 | |
| LANTAI 3 | |
| LANTAI 2 | |
| MUTU BETON (f_c') | 30 MPA |
| TULANGAN | 14 D22 |
| SENGKANG TUMPUAN X | 2,5D13-100 |
| SENGKANG LAPANGAN X | 2,5D13-100 |
| SENGKANG TUMPUAN Y | 2D13-100 |
| SENGKANG LAPANGAN Y | 2D13-100 |

Gambar 5.4 Detail Kolom K4

❖ Kolom dengan dimensi 450 x 600 dan tulangan pokok 14D22 maka,

$$\begin{aligned} A_s' = A_s &= 0,25 \times \pi \times D^2 \times 16 \\ &= 0,25 \times \pi \times 22^2 \times 16 = 1936 \text{ mm}^2 \end{aligned}$$

Dipakai tulangan = 14D22 ($A_s = 5321,8 \text{ mm}^2$)

$$\begin{aligned} d' &= t_s + (\frac{1}{2} \times D \text{ tul pokok}) + D \text{ tul sengkang} \\ &= 40 + (\frac{1}{2} \times 22) + 13 \\ &= 64 \leq 70 \text{ OK} \end{aligned}$$

$$\begin{aligned} d &= h - d' \\ &= 600 - 64 \\ &= 536 \text{ mm} \end{aligned}$$

❖ Mencari Mu

$$\begin{aligned} 0,7225 \times b \times c \times f_c' &= A_s \times f_y \\ 0,7225 \times 450 \times c \times 30 &= 5321,8 \times 400 \\ 9753,75 &= 2128720 \\ c &= 218,246 \text{ mm} \end{aligned}$$

$$\begin{aligned} M_u &= A_s \times 0,8 \times f_y \times (d - 0,425 \times c) \\ &= 5321,8 \times 0,8 \times 400 \times (536 - 0,425 \times 218,246) \\ &= 754836363,5 \text{ Nmm} \\ &= 754,836 \text{ kNm} \end{aligned}$$

❖ Mencari Pu

(Pu) belum diketahui, oleh sebab itu perlu asumsi nilai (e) untuk mendapatkan nilai (Pu), (e)= 900 mm

$$\text{Jadi, } e = \frac{Mu}{Pu} \cdot 10^3$$

$$900 = \frac{754,836 \cdot 10^3}{Pu}$$

$$Pu = 838,706 \text{ kn}$$

Jumlah penulangan diperkirakan 2%

Ukuran kolom 450 mm x 600 mm, d'= 64 mm

$$Po = 0,85 fc' (Ag - Ast) + fy \cdot Ast$$

$$Po = Ag \cdot (0,85 \cdot fc' (1-p) + fy \cdot p)$$

$$Po = Ag (0,85 \cdot 30 (1-2\%) + 400 \cdot 2\%)$$

$$Pn = 0,8 Po \rightarrow \text{Kolom Beugeul}$$

$$Pu/\Phi = 0,8 Ag (0,85 \cdot 30 (1-0,02) + 400 \cdot 0,02)$$

$$Pu = \Phi 0,8 Ag (0,85 \cdot 30 (1-0,02) + 400 \cdot 0,02)$$

$$838,706 = 0,65 \cdot 0,8 Ag (0,85 \cdot 30 (1-0,02) + 400 \cdot 0,02)$$

$$Ag = \frac{838,706}{0,65 \cdot 0,8 \cdot (0,85 \cdot 29,4 + 8)} = 48,890 \text{ mm}^2$$

Dicoba dengan tulangan 14D22 pada masing-masing sisi kolom (As = 5321,8 mm²)

$$\rho = \frac{5321,8}{450 \times 600} = 0,019$$

❖ Pemeriksaan Pu Terhadap beban seimbang Pub

$$d = 450 - 64 = 386 \text{ mm}$$

$$C_b = \frac{500(d)}{500 + f_y} = \frac{500(386)}{500 + 400} = 214,444 \text{ mm}$$

$$\beta_1 = 0,85 \text{ (faktor reduksi)}$$

$$ab = \beta_1 \cdot C = 0,85 \cdot 214,444 = 182,277 \text{ mm}$$

$$\begin{aligned} \epsilon_s' &= \frac{214,444 - 64}{214,444} \cdot 0,003 < \frac{f_y}{E_s} \\ &= 0,0021 < \frac{400}{200000} \end{aligned}$$

10.5.2 SNI 03-2847-2002,
modulus elastisitas baja
tulangan non pratekan Es
dapat diambil sebesar
200.000 MPa

= 0,0021 > 0,002 jadi, tulangan mencapai luluh ketika beton

hancur

$$f_s' = E_s \cdot \epsilon_s' = 200000 \cdot 0,0021 = 420 \text{ MPa}$$

$$f_s' > f_y = 420 \text{ MPa} > 400 \text{ MPa}$$

$$\begin{aligned} P_{ub} &= 0,65 (0,85 \cdot f_c' \cdot ab \cdot b + A_s \cdot f_s' - A_s \cdot F_y) \\ &= 0,65 [(0,85 \cdot 30 \cdot 182,277 \cdot 450) + (5321,8 \cdot 420) \\ &\quad - (5321,8 \cdot 400)] (10)^{-4} \\ &= 3594501,702 \text{ N} \\ &= 3594,501 \text{ kN} \end{aligned}$$

$$\begin{aligned} \emptyset P_{nb} &= 0,65 (3594,501) > P_u \\ &= 2336,425 \text{ kN} > 838,706 \text{ kN (aman)} \end{aligned}$$

❖ Memeriksa kekuatan penampang

$$P_n = \frac{A_s' f_y}{\frac{e}{(d-d')} + 0,5} + \frac{b h f_c'}{\frac{3he}{d^2} + 1,18}$$

$$= \frac{5321,8 \cdot 400}{\frac{900}{(536-64)}+0,5} + \frac{450 \times 600 \times 30}{\frac{3 \times 600 \times 900}{536^2}+1,18}$$

$$= 884468,169 + 1187895,139$$

$$= 2072363,308 \text{ N}$$

$$= 2072,363 \text{ kN}$$

$$\phi P_{nb} = 0,65 (2072,363) > P_u$$

$$= 1347,035 \text{ kN} > 838,706 \text{ kN (aman)}$$

5.2.4 Kolom K7

Data umum perencanaan:

- Mutu Beton (f_c') : 30 Mpa
- Mutu Baja (f_y) : 400 Mpa
- Tulangan pokok : D 22
- Tulangan Bagi : D 13
- Ukuran Rencana Kolom : 700 x 700

| LANTAI | K 7 |
|-----------------------|------------|
| LANTAI 4 | |
| LANTAI 3 | |
| LANTAI 2 | |
| MUTU BETON (f_c') | 30 MPA |
| TULANGAN | 16 D22 |
| SENGKANG TUMPUAN X | 2.5D13-125 |
| SENGKANG LAPANGAN X | 2.5D13-125 |
| SENGKANG TUMPUAN Y | 2.5D13-125 |
| SENGKANG LAPANGAN Y | 2.5D13-125 |

Gambar 5.5 Detail Kolom K7

❖ Kolom dengan dimensi 700 x 700 dan tulangan pokok 16D22 maka,

$$\begin{aligned} A_s' = A_s &= 0,25 \times \pi \times D^2 \times 16 \\ &= 0,25 \times \pi \times 22^2 \times 16 = 1936 \text{ mm}^2 \end{aligned}$$

Dipakai tulangan = 16D22 ($A_s = 6082 \text{ mm}^2$)

$$\begin{aligned} d' &= t_s + (\frac{1}{2} \times D \text{ tul pokok}) + D \text{ tul sengkang} \\ &= 40 + (\frac{1}{2} \times 22) + 13 \\ &= 64 \leq 70 \text{ OK} \end{aligned}$$

$$\begin{aligned} d &= h - d' \\ &= 700 - 64 \\ &= 636 \text{ mm} \end{aligned}$$

❖ Mencari Mu

$$0,7225 \times b \times c \times f_c' = A_s \times f_y$$

$$0,7225 \times 700 \times c \times 30 = 6082 \times 400$$

$$15172,5 \quad \quad \quad = 2432800$$

$$c \quad \quad \quad = 160,342 \text{ mm}$$

$$\begin{aligned} M_u &= A_s \times 0,8 \times f_y \times (d - 0,425 \times c) \\ &= 6082 \times 0,8 \times 400 \times (636 - 0,425 \times 160,342) \\ &= 1105181434 \text{ Nmm} \\ &= 1105,181 \text{ kNm} \end{aligned}$$

❖ Mencari Pu

(Pu) belum diketahui, oleh sebab itu perlu asumsi nilai (e) untuk mendapatkan nilai (Pu), (e)= 900 mm

$$\text{Jadi, } e = \frac{Mu}{Pu} \cdot 10^3$$

$$900 = \frac{1105,181 \cdot 10^3}{Pu}$$

$$Pu = 1227,978 \text{ kn}$$

Jumlah penulangan diperkirakan 2%

Ukuran kolom 700 mm x 700 mm, d'= 64 mm

$$Po = 0,85 f_c' (Ag - Ast) + f_y \cdot Ast$$

$$Po = Ag \cdot (0,85 \cdot f_c' (1-p) + f_y \cdot p)$$

$$Po = Ag (0,85 \cdot 30 (1-2\%) + 400 \cdot 2\%)$$

$$Pn = 0,8 Po \rightarrow \text{Kolom Beugeul}$$

$$Pu/\Phi = 0,8 Ag (0,85 \cdot 30 (1-0,02) + 400 \cdot 0,02)$$

$$Pu = \Phi 0,8 Ag (0,85 \cdot 30 (1-0,02) + 400 \cdot 0,02)$$

$$1227,978 = 0,65 \cdot 0,8 Ag (0,85 \cdot 30 (1-0,02) + 400 \cdot 0,02)$$

$$Ag = \frac{1227,978}{0,65 \cdot 0,8 \cdot (0,85 \cdot 29,4 + 8)} = 71,582 \text{ mm}^2$$

Dicoba dengan tulangan 16D22 pada masing-masing sisi kolom (As = 6082 mm²)

$$\rho = \frac{6082}{700 \times 700} = 0,012$$

❖ Pemeriksaan Pu Terhadap beban seimbang Pub

$$d = 700 - 64 = 636 \text{ mm}$$

$$C_b = \frac{500(d)}{500 + f_y} = \frac{500(636)}{500 + 400} = 353,333 \text{ mm}$$

$$\beta_1 = 0,85 \text{ (faktor reduksi)}$$

$$ab = \beta_1 \cdot C = 0,85 \cdot 353,333 = 300,333 \text{ mm}$$

$$\begin{aligned} \epsilon_s' &= \frac{353,333 - 64}{353,333} \cdot 0,003 < \frac{f_y}{E_s} \\ &= 0,0024 < \frac{400}{200000} \end{aligned}$$

10.5.2 SNI 03-2847-2002,
modulus elastisitas baja
tulangan non pratekan Es
dapat diambil sebesar
200.000 MPa

= 0,0024 > 0,002 jadi, tulangan mencapai luluh ketika beton

hancur

$$f_s' = E_s \cdot \epsilon_s' = 200000 \cdot 0,0024 = 480 \text{ MPa}$$

$$f_s' > f_y = 480 \text{ MPa} > 400 \text{ MPa}$$

$$\begin{aligned} P_{ub} &= 0,65 (0,85 \cdot f_c' \cdot ab \cdot b + A_s \cdot f_s' - A_s \cdot f_y) \\ &= 0,65 [(0,85 \cdot 30 \cdot 300,333 \cdot 700) + (6082 \cdot 480) \\ &\quad - (6082 \cdot 400)] (10)^{-4} \end{aligned}$$

$$= 6403730,353 \text{ N}$$

$$= 6403,730 \text{ kN}$$

$$\emptyset P_{nb} = 0,65 (6403,730) > P_u$$

$$= 4162,424 \text{ kN} > 1227,978 \text{ kN (aman)}$$

❖ Memeriksa kekuatan penampang

$$P_n = \frac{A_s' f_y}{\frac{e}{(d-d')} + 0,5} + \frac{b h f_c'}{\frac{3he}{d^2} + 1,18}$$

$$= \frac{6082 \cdot 400}{\frac{900}{(636-64)} + 0,5} + \frac{700 \times 700 \times 30}{\frac{3 \times 700 \times 900}{636^2} + 1,18}$$

$$= 1173323,44 + 2511755,138$$

$$= 3685078,578 \text{ N}$$

$$= 3685,078 \text{ kN}$$

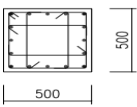
$$\phi P_{nb} = 0,65 (3685,078) > P_u$$

$$= 2395,300 \text{ kN} > 1227,978 \text{ kN (aman)}$$

5.2.5 Kolom K8

Data umum perencanaan:

- Mutu Beton (f_c') : 30 Mpa
- Mutu Baja (f_y) : 400 Mpa
- Tulangan pokok : D 22
- Tulangan Bagi : D 13
- Ukuran Rencana Kolom : 500 x 500

| LANTAI | K8 |
|-----------------------|-------------------------------------------------------------------------------------|
| LANTAI 4 |  |
| LANTAI 3 | |
| LANTAI 2 | |
| MUTU BETON (f_c') | 30 MPA |
| TULANGAN | 16 D22 |
| SENGKANG TUMPUAN X | 2D13-100 |
| SENGKANG LAPANGAN X | 2D13-100 |
| SENGKANG TUMPUAN Y | 2D13-100 |
| SENGKANG LAPANGAN Y | 2D13-100 |

Gambar 5.6 Detail Kolom K8

❖ Kolom dengan dimensi 500 x 500 dan tulangan pokok 16D22 maka,

$$\begin{aligned} A_s' = A_s &= 0,25 \times \pi \times D^2 \times 16 \\ &= 0,25 \times \pi \times 22^2 \times 16 = 1936 \text{ mm}^2 \end{aligned}$$

Dipakai tulangan = 16D22 ($A_s = 6082 \text{ mm}^2$)

$$\begin{aligned} d' &= t_s + (\frac{1}{2} \times D \text{ tul pokok}) + D \text{ tul sengkang} \\ &= 40 + (\frac{1}{2} \times 22) + 13 \\ &= 64 \leq 70 \text{ OK} \end{aligned}$$

$$\begin{aligned} d &= h - d' \\ &= 500 - 64 \\ &= 436 \text{ mm} \end{aligned}$$

❖ Mencari Mu

$$0,7225 \times b \times c \times f_c' = A_s \times f_y$$

$$0,7225 \times 500 \times c \times 30 = 6082 \times 400$$

$$10837,5 \quad \quad \quad = 2432800$$

$$c = 224,479 \text{ mm}$$

$$\begin{aligned} M_u &= A_s \times 0,8 \times f_y \times (d - 0,425 \times c) \\ &= 6082 \times 0,8 \times 400 \times (436 - 0,425 \times 224,479) \\ &= 662882386,2 \text{ Nmm} \\ &= 662,882 \text{ kNm} \end{aligned}$$

❖ Mencari Pu

(Pu) belum diketahui, oleh sebab itu perlu asumsi nilai (e) untuk mendapatkan nilai (Pu), (e)= 900 mm

$$\text{Jadi, } e = \frac{Mu}{Pu} \cdot 10^3$$

$$900 = \frac{662,882 \cdot 10^3}{Pu}$$

$$Pu = 736,535 \text{ kn}$$

Jumlah penulangan diperkirakan 2%

Ukuran kolom 500 mm x 500 mm, d'= 64 mm

$$Po = 0,85 \text{ fc}' (Ag - Ast) + fy \cdot Ast$$

$$Po = Ag \cdot (0,85 \cdot \text{fc}' (1-p) + fy \cdot p)$$

$$Po = Ag (0,85 \cdot 30 (1-2\%) + 400 \cdot 2\%)$$

$$Pn = 0,8 Po \rightarrow \text{Kolom Beugeul}$$

$$Pu/\Phi = 0,8 Ag (0,85 \cdot 30 (1-0,02) + 400 \cdot 0,02)$$

$$Pu = \Phi 0,8 Ag (0,85 \cdot 30 (1-0,02) + 400 \cdot 0,02)$$

$$736,535 = 0,65 \cdot 0,8 Ag (0,85 \cdot 30 (1-0,02) + 400 \cdot 0,02)$$

$$Ag = \frac{736,535}{0,65 \cdot 0,8 \cdot (0,85 \cdot 29,4 + 8)} = 42,934 \text{ mm}^2$$

Dicoba dengan tulangan 16D22 pada masing-masing sisi kolom (As = 6082 mm²)

$$\rho = \frac{6082}{500 \times 500} = 0,024$$

❖ Pemeriksaan Pu Terhadap beban seimbang Pub

$$d = 500 - 64 = 436 \text{ mm}$$

$$C_b = \frac{500(d)}{500 + f_y} = \frac{500(436)}{500 + 400} = 242,222 \text{ mm}$$

$$\beta_1 = 0,85 \text{ (faktor reduksi)}$$

$$ab = \beta_1 \cdot C = 0,85 \cdot 242,222 = 205,888 \text{ mm}$$

$$\epsilon_s' = \frac{242,222 - 64}{242,222} \cdot 0,003 < \frac{f_y}{E_s}$$

$$= 0,0022 < \frac{400}{200000}$$

10.5.2 SNI 03-2847-2002,
modulus elastisitas baja
tulangan non pratekan Es
dapat diambil sebesar
200.000 MPa

= 0,0022 > 0,002 jadi, tulangan mencapai luluh ketika beton

hancur

$$f_s' = E_s \cdot \epsilon_s' = 200000 \cdot 0,0022 = 440 \text{ MPa}$$

$$f_s' > f_y = 440 \text{ MPa} > 400 \text{ MPa}$$

$$P_{ub} = 0,65 (0,85 \cdot F_c' \cdot ab \cdot b + A_s \cdot F_s' - A_s \cdot F_y)$$

$$= 0,65 [(0,85 \cdot 30 \cdot 205,888 \cdot 500) + (6082 \cdot 440)$$

$$- (6082 \cdot 400)] (10)^{-4}$$

$$= 4382133,52 \text{ N}$$

$$= 4382,133 \text{ kN}$$

$$\emptyset P_{nb} = 0,65 (4382,133) > P_u$$

$$= 2848,386 \text{ kN} > 736,535 \text{ kN (aman)}$$

❖ Memeriksa kekuatan penampang

$$P_n = \frac{A_s' f_y}{\frac{e}{(d-d')} + 0,5} + \frac{b h f_c'}{\frac{3he}{d^2} + 1,18}$$

$$= \frac{6082.400}{\frac{900}{(436-64)}+0,5} + \frac{500 \times 500 \times 30}{\frac{3 \times 500 \times 900}{436^2}+1,18}$$

$$= 833334,806 + 905613,906$$

$$= 1738948,712 \text{ N}$$

$$= 1738,948 \text{ kN}$$

$$\emptyset P_{nb} = 0,65 (1738,948) > P_u$$

$$= 1130,316 \text{ kN} > 736,535 \text{ kN (aman)}$$