

BAB IV

ESTIMASI DIMENSI

4.1. Estimasi Dimensi

Sebelum menghitung struktur sebaiknya dilakukan estimasi awal dimensi elemen struktur. Estimasi awal berfungsi untuk menghindari penentuan dimensi elemen yang berulang-ulang. Selain itu estimasi awal dapat memberikan gambaran dimensi elemen yang dibutuhkan.

Estimasi dilakukan dengan menggunakan perhitungan awal sederhana yang bersifat pendekatan yang meliputi perencanaan tebal pelat, balok, dan kolom. Pada pemilihan ukuran elemen struktur ini harus diperhatikan syarat-syarat minimum dari elemen struktur yang akan ditinjau.

4.2. Estimasi Dimensi Balok

tinggi balok (h) = $l/10$ sampai $l/16$

lebar balok (b) = $h/2$ sampai $\frac{2}{3} h$

Hitungan tinggi minimum balok induk

a. Panjang bentang : $l = 8000$ mm

Tinggi minimum balok

$$\begin{aligned} &= \frac{L}{16} \times \left(0,4 + \frac{F_y}{700} \right) \\ &= \frac{8000}{16} \times \left(0,4 + \frac{400}{700} \right) \\ &= 485,7 \text{ mm} \end{aligned}$$

Tinggi maksimum balok

$$= 1/10 \times 8000$$

$$= 800 \text{ mm}$$

Dipakai $h = 650 \text{ mm}$

Lebar minimum balok

$$\begin{aligned} b &= \frac{1}{2} \cdot h \\ &= \frac{1}{2} \cdot 650 \\ &= 325 \end{aligned}$$

Lebar maksimum balok

$$\begin{aligned} b &= \frac{2}{3} \cdot h \\ &= \frac{2}{3} \cdot 650 \\ &= 433,33 \end{aligned}$$

Dipakai $b = 350 \text{ mm}$

Sehingga dipakai balok induk ukuran 350/650 (mm/mm)

b. Panjang bentang : $l = 6000 \text{ mm}$

Tinggi minimum balok

$$\begin{aligned} &= \frac{L}{16} \times \left(0,4 + \frac{F_y}{700} \right) \\ &= \frac{6000}{16} \times \left(0,4 + \frac{400}{700} \right) \\ &= 364,27 \text{ mm} \end{aligned}$$

Tinggi maksimum balok

$$= 1/10 \times 6000$$

$$= 600 \text{ mm}$$

Dipakai $h = 500 \text{ mm}$

Lebar minimum balok

$$\begin{aligned} b &= \frac{1}{2} \cdot h \\ &= \frac{1}{2} \cdot 500 \\ &= 250 \end{aligned}$$

Lebar maksimum balok

$$\begin{aligned} b &= \frac{2}{3} \cdot h \\ &= \frac{2}{3} \cdot 500 \\ &= 333,33 \end{aligned}$$

Dipakai $b = 250 \text{ mm}$

Sehingga dipakai balok induk ukuran 250/500 (mm/mm)

c. Panjang bentang : $l = 4000 \text{ mm}$

Tinggi minimum balok

$$\begin{aligned} &= \frac{L}{16} \times \left(0,4 + \frac{F_y}{700} \right) \\ &= \frac{4000}{16} \times \left(0,4 + \frac{400}{700} \right) \\ &= 242,85 \text{ mm} \end{aligned}$$

Tinggi maksimum balok

$$= 1/10 \times 4000$$

$$= 400 \text{ mm}$$

Dipakai $h = 400 \text{ mm}$

Lebar minimum balok

$$\begin{aligned} b &= \frac{1}{2} \cdot h \\ &= \frac{1}{2} \cdot 400 \\ &= 200 \end{aligned}$$

Lebar maksimum balok

$$\begin{aligned} b &= \frac{2}{3} \cdot h \\ &= \frac{2}{3} \cdot 500 \\ &= 266,66 \end{aligned}$$

Dipakai $b = 200 \text{ mm}$

Sehingga dipakai balok induk ukuran 200/400 (mm/mm)

d. Panjang bentang : $l = 3000 \text{ mm}$

Tinggi minimum balok

$$\begin{aligned} &= \frac{L}{16} \times \left(0,4 + \frac{F_y}{700} \right) \\ &= \frac{3000}{16} \times \left(0,4 + \frac{400}{700} \right) \\ &= 182,1375 \text{ mm} \end{aligned}$$

Tinggi maksimum balok

$$= 1/10 \times 3000$$

$$= 300 \text{ mm}$$

Dipakai $h = 300 \text{ mm}$

Lebar minimum balok

$$\begin{aligned} b &= \frac{1}{2} \cdot h \\ &= \frac{1}{2} \cdot 300 \\ &= 150 \end{aligned}$$

Lebar maksimum balok

$$\begin{aligned} b &= \frac{2}{3} \cdot h \\ &= \frac{2}{3} \cdot 300 \\ &= 200 \end{aligned}$$

Dipakai $b = 200 \text{ mm}$

Sehingga dipakai balok induk ukuran 200/300 (mm/mm)

Hitungan tinggi minimum balok lift

Panjang bentang : $l = 2250 \text{ mm}$

Tinggi minimum balok

$$\begin{aligned} &= \frac{L}{16} \times \left(0,4 + \frac{F_y}{700} \right) \\ &= \frac{2250}{16} \times \left(0,4 + \frac{400}{700} \right) \\ &= 136,60 \text{ mm} \end{aligned}$$

Tinggi maksimum balok

$$= 1/10 \times 2250$$

$$= 225 \text{ mm}$$

Dipakai $h = 225 \text{ mm}$

Lebar minimum balok

$$b = \frac{1}{2} \cdot h$$

$$= \frac{1}{2} \cdot 225$$

$$= 112,5$$

Lebar maksimum balok

$$b = \frac{2}{3} \cdot h$$

$$= \frac{2}{3} \cdot 225$$

$$= 150$$

Dipakai $b = 150 \text{ mm}$

Sehingga dipakai balok induk ukuran 225/150 (mm/mm)

Hitungan tinggi minimum balok anak

a. Panjang bentang : $l = 8000 \text{ mm}$

Tinggi minimum balok induk = Tinggi balok anak

$$= 1/16 \times 8000 = 500 \text{ mm}$$

Lebar minimum balok

$$b = \frac{1}{2} \cdot h$$

$$b = \frac{1}{2} \cdot 500 = 250 \text{ mm}$$

Dipakai balok anak dengan ukuran 250/500 (mm/mm)

b. Panjang bentang : $l = 6000 \text{ mm}$

Tinggi minimum balok induk = Tinggi balok anak

$$= 1/16 \times 6000 = 375 \text{ mm}$$

Lebar minimum balok

$$b = \frac{1}{2} \cdot h$$

$$b = \frac{1}{2} \cdot 375 = 187,5 \text{ mm}$$

Dipakai balok anak dengan ukuran 200/400 (mm/mm)

4.3. Estimasi Dimensi Kolom

Estimasi yang dilakukan pada kolom ini hanya pendekatan. Estimasi dilakukan hanya untuk memperhitungkan beban aksial, untuk bebannya diambil dari beban hidup dan beban mati yang membebani kolom. Estimasi dilakukan dengan mengambil kolom yang mendukung luasan pelat lantai yang terbesar.

Sesuai dengan SNI 1727-1989 uraian pembebanan adalah sebagai berikut :

1. Beban mati pada atap :

$$\text{Pelat atap (12 cm)} = 0,12 \cdot 24 = 2,88 \text{ kN/m}^2$$

$$\text{Finishing (spesi + water proofing)} = 0,5 \text{ kN/m}^2$$

$$\text{Plafon dan penggantung} = 0,18 \text{ kN/m}^2$$

$$\text{ME dan AC} = 0,3 \text{ kN/m}^2 +$$

$$q_{\text{mati}} = 3,86 \text{ kN/m}^2$$

2. Beban mati pada tiap lantai

Pelat lantai (12 cm)	=	0,12 . 24	=	2,88	kN/m^2
Pasir urug (3 cm)	=	0,03 . 18	=	0,36	kN/m^2
Spesi (2 cm)	=	0,02 . 0,21	=	0,0042	kN/m^2
Tegel (2 cm)	=	0,02 . 0,24	=	0,0048	kN/m^2
Plafon dan penggantung			=	0,18	kN/m^2
ME dan AC			=	0,3	kN/m^2
					+
			q_{mati}	= 4,209	kN/m^2

3. Beban Hidup

Beban hujan pada atap : $q_{\text{hujan}} = 0,03 \cdot 10 \text{ kN/m}^2 = 0,3 \text{ kN/m}^2$

Beban hidup pada atap : $q_{\text{hidup}} = 1 \text{ kN/m}^2$

Beban hidup pada tiap lantai : $q_{\text{hidup}} = 2,5 \text{ kN/m}^2$

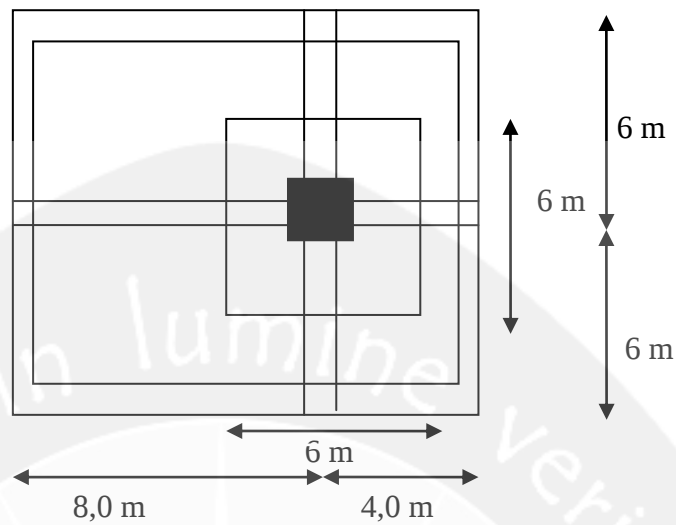
Diperoleh : $q_{dl} \text{ atap} = 3,86 \text{ kN/m}^2$

$q_{ll} \text{ atap} = 1,00 \text{ kN/m}^2$

$q_r \text{ atap} = 0,3 \text{ kN/m}^2$

$q_{dl} \text{ lantai} = 4,209 \text{ kN/m}^2$

$q_{ll} \text{ lantai} = 2,50 \text{ kN/m}^2$



Gambar 4.1. Luasan Lantai yang Didukung Kolom

4.3.1. Estimasi Beban Rencana Tiap Lantai

Lantai atap

Beban mati

$$\text{Pelat atap} = 6,0 \times 6,0 \times 3,86 = 138,96 \text{ kN}$$

$$\text{Balok induk (35/60)} = 0,35 \times (0,65 - 0,12) \times 24 \times 6 = 26,712 \text{ kN}$$

$$\text{Balok induk (25/50)} = 0,25 \times (0,5 - 0,12) \times 24 \times 6 = 13,68 \text{ kN}$$

$$\text{Balok anak (22/50)} = 2 \times 0,5 \times \{0,25 \times (0,5 - 0,12)\} \times 24 \times 6 = 13,68 \text{ kN}$$

$$\text{Balok anak (20/40)} = 0,5 \times \{0,2 \times (0,4 - 0,12)\} \times 24 \times 6 = 4,032 \text{ kN}$$

$$N_{dl} \text{ atap} = 197,064 \text{ kN}$$

$$\text{Beban hujan} = 6,0 \times 6,0 \times 0,3 = 10,8 \text{ kN}$$

Beban hidup

$$q_{ll} \text{ atap} = 1 \text{ kN/m}^2$$

$$N_{ll} \text{ atap} = (6,0 \times 6,0) \times 1 = 36 \text{ kN}$$

Lantai Dasar, 1 - 10

Beban mati

$$\text{Pelat lantai} = 6,0 \times 6,0 \times 4,209 = 151,524 \text{ kN}$$

$$\text{Balok induk (35/60)} = 0,35 \times (0,65-0,12) \times 24 \times 6 = 26,712 \text{ kN}$$

$$\text{Balok induk (25/50)} = 0,25 \times (0,5-0,12) \times 24 \times 6 = 13,68 \text{ kN}$$

$$\text{Balok anak (22/50)} = 2 \times 0,5 \times \{0,25 \times (0,5-0,12)\} \times 24 \times 6 = 13,68 \text{ kN}$$

$$\text{Balok anak (20/40)} = 0,5 \times \{0,2 \times (0,4-0,12)\} \times 24 \times 6 = 4,032 \text{ kN}$$

$$\text{Dinding } \frac{1}{2} \text{ bata} = (6,0 + 6,0) \times 4,0 \times 2,5 = 120 \text{ kN}$$

$$\begin{array}{r} \text{-----} + \\ N_{dl} \text{ lantai} = 329,628 \text{ kN} \end{array}$$

Beban hidup

$$q_{ll} \text{ lantai} = 2,5 \text{ kN/m}^2$$

$$N_{ll} \text{ lantai} = (6,0 \times 6,0) \times 2,5 = 90 \text{ kN}$$

Hitungan lantai 1 :

Beban mati

$$\text{Beban atap} = N_{dl} \text{ atap} = 197,064 \text{ kN}$$

$$\text{Beban lantai 1 - 10} = 10 \times N_{dl} \text{ lantai} = 10 \times 329,628 = 3296,28 \text{ kN}$$

$$\text{Berat kolom taksiran} = 10 \times 0,8 \times 0,8 \times 4 \times 24 = 614,4 \text{ kN}$$

$$\begin{array}{r} \text{-----} + \\ N_{dl} = 4107,744 \text{ kN} \\ = 4.107.744 \text{ N} \end{array}$$

Beban hidup

$$\text{Beban atap} = N_{ll} \text{ atap} = 36 \text{ kN}$$

$$\text{Beban lantai 1 - 10} = 10 \times N_{ll} \text{ lantai} = 10 \times 90 = 900 \text{ kN}$$

$$\begin{aligned}
 N_{II} &= 936 \text{ kN} \\
 &= 936.000 \text{ N}
 \end{aligned}$$

Data

$$F'_c = 25 \text{ Mpa}$$

$$F_y = 400 \text{ Mpa}$$

$$\phi = 0,65 \text{ (Kolom dengan pengikat sengkang)}$$

$$P_u = 1,2 N_{dl} + 1,6 N_{II}$$

$$P_u = 1,2 \cdot 4107744 + 1,6 \cdot 936.000$$

$$P_u = 6426892,8 \text{ N}$$

$$\phi P_n(\max) = 0,8 \phi [0,85 f'_c (A_g - A_{st}) + f_y A_{st}]$$

$$\phi P_n(\max) = 0,8 \times 0,65 [0,85 \times 25 (A_g - 0,02 A_g) + 400 \times 0,02 A_g]$$

$$= 0,52 \times [21,25 A_g - 0,42 A_g] + 8 A_g]$$

$$= 14,989 A_g$$

$$A_g = \frac{P_u}{14,989} = \frac{6426892,8}{14,989} = 428773,95 \text{ mm}^2$$

$$b = h = \sqrt{A_g} = 654,808 \text{ mm}$$

Hitungan lantai 2 :

Beban mati

$$\text{Beban atap} = N_{dl} \text{ atap} = 197,064 \text{ kN}$$

$$\text{Beban lantai 2 - 10} = 9 \times N_{dl} \text{ lantai} = 9 \times 329,628 = 2966,65 \text{ kN}$$

$$\text{Berat kolom taksiran} = 9 \times 0,8 \times 0,8 \times 4 \times 24 = 552,96 \text{ kN}$$

$$\begin{aligned}
 &+ \\
 N_{dl} &= 3716,674 \text{ kN}
 \end{aligned}$$

$$= 3.716.674 \quad \text{N}$$

Beban hidup

$$\text{Beban atap} = N_{ll} \text{ atap} = 36 \quad \text{kN}$$

$$\text{Beban lantai 2 - 10} = 9 \times N_{dl} \text{ lantai} = 9 \times 90 = 810 \quad \text{kN}$$

$$\begin{array}{r} \hline N_{ll} = 846 \quad \text{kN} \\ = 846.000 \quad \text{N} \end{array} +$$

Data

$$f'_c = 25 \text{ Mpa}$$

$$f_y = 400 \text{ Mpa}$$

$$\phi = 0,65 \text{ (Kolom dengan pengikat sengkang)}$$

$$P_u = 1,2 N_{dl} + 1,6 N_{ll}$$

$$P_u = 1,2 \cdot 3.716.674 + 1,6 \cdot 846.000$$

$$P_u = 5.813.608,8 \quad \text{N}$$

$$\phi P_n(\text{max}) = 0,8 \phi [0,85 f'_c (A_g - A_{st}) + f_y A_{st}]$$

$$\phi P_n(\text{max}) = 0,8 \times 0,65 [0,85 \times 25 (A_g - 0,02 A_g) + 400 \times 0,02 A_g]$$

$$= 0,52 \times [21,25 A_g - 0,42 A_g] + 8 A_g]$$

$$= 14,989 A_g$$

$$A_g = \frac{P_u}{14,989} = \frac{5.813.608,8}{14,989} = 387.858,3495 \text{ mm}^2$$

$$b = h = \sqrt{A_g} = 622,782 \text{ mm}$$

Hitungan lantai 3 :

Beban mati

$$\text{Beban atap} = N_{dl} \text{ atap} = 197,064 \quad \text{kN}$$

$$\text{Beban lantai 3 - 10} = 8 \times N_{dl} \text{ lantai} = 8 \times 329,628 = 2637,02 \text{ kN}$$

$$\text{Berat kolom taksiran} = 8 \times 0,8 \times 0,8 \times 4 \times 24 = 491,52 \text{ kN}$$

$$N_{dl} = 3325,604 \text{ kN}$$

$$= 3.325.604 \text{ N}$$

Beban hidup

$$\text{Beban atap} = N_{ll} \text{ atap} = 36 \text{ kN}$$

$$\text{Beban lantai 3 - 10} = 8 \times N_{dl} \text{ lantai} = 8 \times 90 = 720 \text{ kN}$$

$$N_{ll} = 756 \text{ kN}$$

$$= 756.000 \text{ N}$$

Data

$$f'_c = 25 \text{ Mpa}$$

$$f_y = 400 \text{ Mpa}$$

$$\phi = 0,65 \text{ (Kolom dengan pengikat sengkang)}$$

$$P_u = 1,2 N_{dl} + 1,6 N_{ll}$$

$$P_u = (1,2 \times 3.325.604) + (1,6 \times 756.000)$$

$$P_u = 5200324,8 \text{ N}$$

$$\phi P_n(\max) = 0,8 \phi [0,85 f'_c (A_g - A_{st}) + f_y A_{st}]$$

$$\phi P_n(\max) = 0,8 \times 0,65 [0,85 \times 25 (A_g - 0,02 A_g) + 400 \times 0,02 A_g]$$

$$= 0,52 \times [21,25 A_g - 0,42 A_g + 8 A_g]$$

$$= 14,989 A_g$$

$$A_g = \frac{P_u}{14,989} = \frac{5200324,8}{14,989} = 346942,7447 \text{ mm}^2$$

$$b = h = \sqrt{A_g} = 589,0184 \text{ mm}$$

Hitungan lantai 4 :

Beban mati

$$\begin{aligned}
 \text{Beban atap} &= N_{dl} \text{ atap} &= 197,064 &\text{ kN} \\
 \text{Beban lantai 4 - 10} &= 7 \times N_{dl} \text{ lantai} = 7 \times 329,628 &= 2307,39 &\text{ kN} \\
 \text{Berat kolom taksiran} &= 7 \times 0,8 \times 0,8 \times 4 \times 24 &= 430,08 &\text{ kN} \\
 &&\hline
 N_{dl} &= 2934,534 &\text{ kN} \\
 &= 2.934.534 &\text{ N}
 \end{aligned}$$

Beban hidup

$$\begin{aligned}
 \text{Beban atap} &= N_{ll} \text{ atap} &= 36 &\text{ kN} \\
 \text{Beban lantai 4 - 10} &= 7 \times N_{dl} \text{ lantai} = 7 \times 90 &= 630 &\text{ kN} \\
 &&\hline
 N_{ll} &= 666 &\text{ kN} \\
 &= 666.000 &\text{ N}
 \end{aligned}$$

Data

$$f'_c = 25 \text{ Mpa}$$

$$f_y = 400 \text{ Mpa}$$

$$\phi = 0,65 \text{ (Kolom dengan pengikat sengkang)}$$

$$P_u = 1,2 N_{dl} + 1,6 N_{ll}$$

$$P_u = (1,2 \times 2.934.534) + (1,6 \times 666.000)$$

$$P_u = 4587040,8 \text{ N}$$

$$\phi P_n(\max) = 0,8 \phi [0,85 f'_c (A_g - A_{st}) + f_y A_{st}]$$

$$\phi P_n(\max) = 0,8 \times 0,65 [0,85 \times 25 (A_g - 0,02 A_g) + 400 \times 0,02 A_g]$$

$$= 0,52 \times [21,25 \times A_g - 0,42 \times A_g] + 8 \times A_g]$$

$$= 14,989 \times A_g$$

$$A_g = \frac{P_u}{14,989} = \frac{4587040,8}{14,989} = 306027,1399 \text{ mm}^2$$

$$b = h = \sqrt{A_g} = 553,1971 \text{ mm}$$

Hitungan lantai 5 :

Beban mati

Beban atap	$= N_{dl} \text{ atap}$	$= 197,064 \text{ kN}$
Beban lantai 5 - 10	$= 6 \times N_{dl} \text{ lantai} = 6 \times 329,628$	$= 1977,76 \text{ kN}$
Berat kolom taksiran	$= 6 \times 0,8 \times 0,8 \times 4 \times 24$	$= 368,64 \text{ kN}$
		$N_{dl} = 2543,464 \text{ kN}$
		$= 2.543.464 \text{ N}$

Beban hidup

Beban atap	$= N_{ll} \text{ atap}$	$= 36 \text{ kN}$
Beban lantai 5 - 10	$= 6 \times N_{dl} \text{ lantai} = 6 \times 90$	$= 540 \text{ kN}$
		$N_{ll} = 576 \text{ kN}$
		$= 576.000 \text{ N}$

Data

$$F'_c = 25 \text{ Mpa}$$

$$F_y = 400 \text{ Mpa}$$

$$\emptyset = 0,65 \text{ (Kolom dengan pengikat sengkang)}$$

$$P_u = 1,2 N_{dl} + 1,6 N_{ll}$$

$$P_u = (1,2 \times 2.543.464) + (1,6 \times 576.000)$$

$$P_u = 3.973.756,8 \text{ N}$$

$$\phi P_n(\max) = 0,8 \phi [0,85 f'_c (A_g - A_{st}) + f_y A_{st}]$$

$$\phi P_n(\max) = 0,8 \times 0,65 [0,85 \times 25 (A_g - 0,02 A_g) + 400 \times 0,02 A_g]$$

$$= 0,52 \times [21,25 A_g - 0,42 A_g] + 8 A_g$$

$$= 14,989 A_g$$

$$A_g = \frac{P_u}{14,989} = \frac{3.973.756,8}{14,989} = 265111,5418 \text{ mm}^2$$

$$b = h = \sqrt{A_g} = 514,88 \text{ mm}$$

Hitungan lantai 6 :

Beban mati

$$\text{Beban atap} = N_{dl} \text{ atap} = 197,064 \text{ kN}$$

$$\text{Beban lantai 6 - 10} = 5 \times N_{dl} \text{ lantai} = 5 \times 329,628 = 1648,14 \text{ kN}$$

$$\text{Berat kolom taksiran} = 5 \times 0,8 \times 0,8 \times 4 \times 24 = 307,2 \text{ kN}$$

$$\underline{N_{dl} = 2152,404 \text{ kN}} +$$

$$= 2.152.404 \text{ N}$$

Beban hidup

$$\text{Beban atap} = N_{ll} \text{ atap} = 36 \text{ kN}$$

$$\text{Beban lantai 6 - 10} = 5 \times N_{dl} \text{ lantai} = 5 \times 90 = 450 \text{ kN}$$

$$\underline{N_{ll} = 486 \text{ kN}} +$$

$$= 486.000 \text{ N}$$

Data

$$f'_c = 25 \text{ Mpa}$$

$$F_y = 400 \text{ Mpa}$$

$$\phi = 0,65 \text{ (Kolom dengan pengikat sengkang)}$$

$$P_u = 1,2 N_{dl} + 1,6 N_{ll}$$

$$P_u = (1,2 \times 2.152.404) + (1,6 \times 486.000)$$

$$P_u = 3.360.484,8 \text{ N}$$

$$\phi P_n(\max) = 0,8 \phi [0,85 f'_c (A_g - A_{st}) + f_y A_{st}]$$

$$\phi P_n(\max) = 0,8 \times 0,65 [0,85 \times 25 (A_g - 0,02 A_g) + 400 \times 0,02 A_g]$$

$$= 0,52 \times [21,25 A_g - 0,42 A_g] + 8 A_g]$$

$$= 14,989 A_g$$

$$A_g = \frac{P_u}{14,989} = \frac{3.360.484,8}{14,989} = 224196,7309 \text{ mm}^2$$

$$b = h = \sqrt{A_g} = 473,49 \text{ mm}$$

Hitungan lantai 7 :

Beban mati

$$\text{Beban atap} = N_{dl} \text{ atap} = 197,064 \text{ kN}$$

$$\text{Beban lantai 7 - 10} = 4 \times N_{dl} \text{ lantai} = 4 \times 329,628 = 1318,51 \text{ kN}$$

$$\text{Berat kolom taksiran} = 4 \times 0,8 \times 0,8 \times 4 \times 24 = 245,76 \text{ kN}$$

$$N_{dl} = 1761,334 \text{ kN}$$

$$= 1.761.334 \text{ N}$$

Beban hidup

$$\text{Beban atap} = N_{ll} \text{ atap} = 36 \text{ kN}$$

$$\text{Beban lantai 7 - 10} = 4 \times N_{ll} \text{ lantai} = 4 \times 90 = 360 \text{ kN}$$

$$\begin{aligned}
 N_{ll} &= 396 \text{ kN} \\
 &= 396.000 \text{ N}
 \end{aligned}$$

Data

$$F'_c = 25 \text{ Mpa}$$

$$F_y = 400 \text{ Mpa}$$

$$\phi = 0,65 \text{ (Kolom dengan pengikat sengkang)}$$

$$P_u = 1,2 N_{dl} + 1,6 N_{ll}$$

$$P_u = (1,2 \times 1.761.334) + (1,6 \times 396.000)$$

$$P_u = 2.747.200,8 \text{ N}$$

$$\phi P_n(\max) = 0,8 \phi [0,85 f'_c (A_g - A_{st}) + f_y A_{st}]$$

$$\phi P_n(\max) = 0,8 \times 0,65 [0,85 \times 25 (A_g - 0,02 A_g) + 400 \times 0,02 A_g]$$

$$= 0,52 \times [21,25 A_g - 0,42 A_g] + 8 A_g]$$

$$= 14,989 A_g$$

$$A_g = \frac{P_u}{14,989} = \frac{2.747.200,8}{14,989} = 183281,1262 \text{ mm}^2$$

$$b = h = \sqrt{A_g} = 428,11 \text{ mm}$$

Hitungan lantai 8 :

Beban mati

$$\text{Beban atap} = N_{dl} \text{ atap} = 197,064 \text{ kN}$$

$$\text{Beban lantai 8 - 10} = 3 \times N_{dl} \text{ lantai} = 3 \times 329,628 = 988,84 \text{ kN}$$

$$\text{Berat kolom taksiran} = 3 \times 0,8 \times 0,8 \times 4 \times 24 = 184,32 \text{ kN}$$

$$\begin{aligned}
 &+ \\
 N_{dl} &= 1370,224 \text{ kN}
 \end{aligned}$$

$$= 1.370.224 \quad \text{N}$$

Beban hidup

$$\text{Beban atap} = N_{ll} \text{ atap} = 36 \quad \text{kN}$$

$$\text{Beban lantai 8 - 10} = 3 \times N_{dl} \text{ lantai} = 3 \times 90 = 270 \quad \text{kN}$$

$$\begin{array}{r} \hline N_{ll} = 306 \quad \text{kN} \\ + \\ = 306.000 \quad \text{N} \end{array}$$

Data

$$f'_c = 25 \text{ Mpa}$$

$$f_y = 400 \text{ Mpa}$$

$$\phi = 0,65 \text{ (Kolom dengan pengikat sengkang)}$$

$$P_u = 1,2 N_{dl} + 1,6 N_{ll}$$

$$P_u = (1,2 \times 1.370.224) + (1,6 \times 306.000)$$

$$P_u = 2.133.868,8 \quad \text{N}$$

$$\phi P_n(\text{max}) = 0,8 \phi [0,85 f'_c (A_g - A_{st}) + f_y A_{st}]$$

$$\phi P_n(\text{max}) = 0,8 \times 0,65 [0,85 \times 25 (A_g - 0,02 A_g) + 400 \times 0,02 A_g]$$

$$= 0,52 \times [21,25 A_g - 0,42 A_g] + 8 A_g]$$

$$= 14,989 A_g$$

$$A_g = \frac{P_u}{14,989} = \frac{2.133.868,8}{14,989} = 142362,319 \text{ mm}^2$$

$$b = h = \sqrt{A_g} = 377,30 \text{ mm}$$

Hitungan lantai 9 :

Beban mati

$$\text{Beban atap} = N_{dl} \text{ atap} = 197,064 \quad \text{kN}$$

$$\text{Beban lantai 9 - 10} = 2 \times N_{dl} \text{ lantai} = 2 \times 329,628 = 659,25 \text{ kN}$$

$$\text{Berat kolom taksiran} = 2 \times 0,8 \times 0,8 \times 4 \times 24 = 122,88 \text{ kN}$$

$$N_{dl} = 979,194 \text{ kN}$$

$$= 979.194 \text{ N}$$

Beban hidup

$$\text{Beban atap} = N_{ll} \text{ atap} = 36 \text{ kN}$$

$$\text{Beban lantai 9 - 10} = 2 \times N_{dl} \text{ lantai} = 2 \times 90 = 180 \text{ kN}$$

$$N_{ll} = 216 \text{ kN}$$

$$= 216.000 \text{ N}$$

Data

$$f'_c = 25 \text{ Mpa}$$

$$f_y = 400 \text{ Mpa}$$

$$\phi = 0,65 \text{ (Kolom dengan pengikat sengkang)}$$

$$P_u = 1,2 N_{dl} + 1,6 N_{ll}$$

$$P_u = (1,2 \times 979.194) + (1,6 \times 216.000)$$

$$P_u = 1.152.632,8 \text{ N}$$

$$\phi P_n(\max) = 0,8 \phi [0,85 f'_c (A_g - A_{st}) + f_y A_{st}]$$

$$\phi P_n(\max) = 0,8 \times 0,65 [0,85 \times 25 (A_g - 0,02 A_g) + 400 \times 0,02 A_g]$$

$$= 0,52 \times [21,25 A_g - 0,42 A_g] + 8 A_g]$$

$$= 14,989 A_g$$

$$A_g = \frac{P_u}{14,989} = \frac{1.152.632,8}{14,989} = 101449,9166 \text{ mm}^2$$

$$b = h = \sqrt{A_g} = 318,51 \text{ mm}$$

Hitungan lantai 10 :

Beban mati

$$\text{Beban atap} = N_{dl} \text{ atap} = 197,064 \text{ kN}$$

$$\text{Beban lantai 10 - 10} = 1 \times N_{dl} \text{ lantai} = 1 \times 329,628 = 329,62 \text{ kN}$$

$$\text{Berat kolom taksiran} = 1 \times 0,8 \times 0,8 \times 4 \times 24 = 61,44 \text{ kN}$$

$$N_{dl} = 588,132 \text{ kN}$$

$$= 588.132 \text{ N}$$

Beban hidup

$$\text{Beban atap} = N_{ll} \text{ atap} = 36 \text{ kN}$$

$$\text{Beban lantai 10 - 10} = 1 \times N_{dl} \text{ lantai} = 1 \times 90 = 90 \text{ kN}$$

$$N_{ll} = 126 \text{ kN}$$

$$= 126.000 \text{ N}$$

Data

$$f'_c = 25 \text{ Mpa}$$

$$f_y = 400 \text{ Mpa}$$

$$\phi = 0,65 \text{ (Kolom dengan pengikat sengkang)}$$

$$P_u = 1,2 N_{dl} + 1,6 N_{ll}$$

$$P_u = (1,2 \times 588.132) + (1,6 \times 126.000)$$

$$P_u = 907.358,4 \text{ N}$$

$$\phi P_n(\max) = 0,8 \phi [0,85 f'_c (A_g - A_{st}) + f_y A_{st}]$$

$$\phi P_n(\max) = 0,8 \times 0,65 [0,85 \times 25 (A_g - 0,02 A_g) + 400 \times 0,02 A_g]$$

$$= 0,52 \times [21,25xAg - 0,42x.Ag) + 8.Ag]$$

$$= 14,989.Ag$$

$$A_g = \frac{P_u}{14,989} = \frac{907.358,4}{14,989} = 60534,95 \text{ mm}^2$$

$$b = h = \sqrt{A_g} = 246,03 \text{ mm}$$

Hitungan lantai atap :

Beban mati

Beban atap	$= N_{dl} \text{ atap}$	$= 197,064 \text{ kN}$	
			+
	N_{dl}	$= 197,064 \text{ kN}$	
		$= 197.064 \text{ N}$	

Beban hidup

Beban atap	$= N_{ll} \text{ atap}$	$= 36 \text{ kN}$	
			+
	N_{ll}	$= 36 \text{ kN}$	
		$= 36000 \text{ N}$	

Beban hujan

N_r	$= 10,08 \text{ kN}$
N_r	$= 10080 \text{ kN}$

$$P_u = 1,2 N_{dl} + 1,6 N_{ll} + 0,5 N_r$$

$$P_u = 1,2 \cdot 197.064 + 1,6 \cdot 36000 + 0,5 \cdot 10080$$

$$P_u = 299.166,8 \text{ N}$$

$$\phi P_n(\max) = 0,8 \phi [0,85 f'_c (A_g - A_{st}) + f_y A_{st}]$$

$$\phi P_n(\max) = 0,8 \times 0,65 [0,85 \times 25 (A_g - 0,02.A_g) + 400 \times 0,02A_g]$$

$$= 0,52 \times [21,25xAg - 0,42x.Ag) + 8.Ag]$$

$$= 14,989.Ag$$

$$A_g = \frac{P_u}{14,989} = \frac{299.166,8}{14,989} = 19955,75 \text{ mm}^2$$

$$b = h = \sqrt{A_g} = 141,26 \text{ mm}$$

Tabel 4.1. Estimasi Dimensi Kolom Tiap Lantai

Lantai	N_{dl} (N)	N_{ll} (N)	P_u (N)	h (mm)	Dipakai (mm)
Atap lift	197.064	36000	299.166,8	141,26	400x400
10 Atap	588.132	126.000	907.166,8	246,03	500x500
9	979.194	216.000	1.152.632,8	318,51	500x500
8	1.370.224	306.000	2.133.868,8	377,3	600x600
7	1.761.334	396.000	2.747.200,8	428,11	600x600
6	2.152.404	486.000	3.360.484,8	473,49	600x600
5	2.543.464	576.000	3.973.756,8	514,88	600x600
4	2.934.534	666.000	4.587.040,8	553,1971	700x700
3	3.325.604	756.000	5.200.324,8	589,01	700x700
2	3.716.674	846.000	5.813.608,8	622,78	700x700
1	4.107.744	936.000	6.426.892,8	654,080	700x700