$A_{1\varnothing} = ¼.\ \pi.\ D^2 = ¼.\ \pi.\ 8^2 = 50{,}265\ mm^2$

Jarak antar tulangan : $s \le \frac{A_{\theta 1}.b}{As_{perlu}} \le \frac{50{,}265.1000}{227{,}13} \le 221{,}3$ mm

$s \le 2h \le 2.100 \le 200$

$s \le 250$

Dipakai tulangan pokok : P8 – 120 mm

$As_{ada} = \frac{A_{1\theta}.1000}{s} = \frac{50{,}265.1000}{120} = 418{,}875\ mm^2 > As_{ada} = 227{,}13\ mm^2$

Kontrol Kapasitas Momen (Mn) :

$a = \frac{As_{ada}.fy}{0{,}85.f'c.b} = \frac{418{,}875.240}{0{,}85.22{,}5.1000} = 5{,}256$ mm

$Mn = As_{ada}.fy.\ (d - \frac{a}{2}) = 418{,}875.240\ (75 - \frac{5{,}265}{2})$

$= 7{,}276$ KNm $\ge \frac{Mu}{\phi} = 3{,}03$ KNm **.....OK!**

4.2.2.3. Perencanaan Tulangan Bagi Pelat Atap

$As_{bagi} = 0{,}002.\ b.\ h = 0{,}002.\ 1000.\ 100 = 200\ mm^2$

Digunakan tulangan polos ∅6 mm, sehingga luas tampang 1 tulangan bagi :

$A_{1\varnothing} = ¼.\ \pi.\ D^2 = ¼.\ \pi.\ 8^2 = 50{,}24\ mm^2$

Jarak antar tulangan pokok : $s \le \frac{A_{\theta 1}.b}{As_{bagi}} \le \frac{50{,}24.1000}{200} \le 251{,}2$ mm

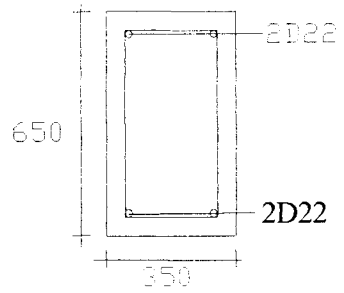
Dipakai tulangan bagi : P8 – 200 mm

Tabel 4.8 Perencanaan pelat atap

	Mulx	Mutx	Muly	Muty
fc' (Mpa)	22.5	22.5	22.5	22.5
fy (Mpa)	240	240	240	240
ly (m)	7.2	7.2	7.2	7.2
lx (m)	3.6	3.6	3.6	3.6
ly/lx	2.0	2.0	2.0	2.0
C	62	62	35	35
qu (kNm)	5.344	5.344	5.344	5.344
Mu (KNm)	4.294	4.294	2.424	2.424
Mu/ϕ (KNm)	5.368	5.368	3.030	3.030
d (mm)	75	75	65	75
m	12.549	12.549	12.549	12.549
Rn (MPa)	0.954	0.954	0.717	0.539
ρ_{min}	0.00583	0.00583	0.00583	0.00583
ρb	0.04838	0.04838	0.04838	0.04838
ρ_{maks}	0.03629	0.03629	0.03629	0.03629
ρ_{aktual}	0.00408	0.00408	0.00305	0.00228
$1.33.\rho_{aktual}$	0.00543	0.00543	0.00405	0.00303
ρ_{pakai}	0.00543	0.00543	0.00405	0.00303
As ada (mm2)	407.020	407.020	263.250	227.250
dtul.pokok (mm)	8	8	8	8
A1d.pokok (mm2)	50.286	50.286	50.286	50.286
s (mm)	123.546	123.546	191.019	221.279
s pakai (mm)	120	120	120	120
As aktual (mm2)	419.048	419.048	419.048	419.048
a (mm)	5.259	5.259	5.259	5.259
Mn (KNm)	7.278	7.278	6.273	7.278
Tul. Pokok	P8-120	P8-120	P8-120	P8-120
Kontrol	AMAN	AMAN	AMAN	AMAN
As bagi (mm2)		200		200
dtul.bagi (mm)		8		8
A1d.bagi (mm2)		50.286		50.286
x (mm)		251.429		251.429
xpakai (mm)		200		200
Tul. Bagi		P8-200		P8-200

$As_{min} = \rho_{min}.b.d = 0{,}0035.350.589 = 721{,}525\ mm^2$

Dipakai 2D22 dengan $As_{ada} = 760{,}57\ mm^2$



Gambar 4.21 tulangan balok lapangan

$$s = \frac{b - 2.Pb - 2.\phi\ sengkang - n.\phi\ tul}{(n-1)} = \frac{350 - 2.40 - 2.10 - 2.22}{(2-1)} = 206\ mm$$

Kontrol

$$a = \frac{As_{ada}.fy}{0{,}85.fc'.b} = \frac{760{,}57.400}{0{,}85.22{,}5.350} = 45{,}45\ mm$$

$$Mn = As_{ada}.fy.(d - {}^{a}/_{2}) = 760{,}57.400.(589 - {}^{45{,}45}/_{2})$$

$$= 172{,}277\ kNm > {}^{Mu}/_{\phi} = 107{,}84\ kNm$$

G. Tulangan Tumpuan daerah B

Dipakai dimensi rencana 350/650

fc' = 22,5 Mpa fy = 400 Mpa

Mu = 531,2 kNm

Mu akibat distribusi momen 20% = 531,2 - (0,2. 531,2) = 424,962 kNm

$$\frac{Mu}{\phi} = \frac{424{,}962}{0{,}8} = 531{,}2\ kNm$$

$$\rho_b = \frac{0{,}85.fc'}{fy}\beta_1\left(\frac{600}{600 + fy}\right) = 0{,}0244$$

tul desak pakai (n buah)	-	2	-
As' ada (mm)	-	760.571	-
As perlu total (mm2)	-	2645.6360	-
tul. tarik perlu (n buah)	-	6.9570	-
tul tarik pakai (n buah)	-	7	-
As ada (mm2)	-	2662	-
Kontrol	-		-
r' ada	-	0.00369	-
r ada	-	0.01291	-
(rada - r'ada)	-	0.0092	-
fs' (MPa)	-	326.2025	-
fs' pakai (MPa)	-	326.2025	-
a (mm2)	-	122.0092931	-
Mn1 (kNm)	-	431.214	-
Mn2 (kNm)	-	130.997	-
Mn	-	562.211	-
s (mm)	-	35	-
Kontrol	-	AMAN	-
Mkap	505.959	702.763	413.409

Kesimpulan

Perencanaan	Tul. Rangkap
Tul. Atas n buah	7
Tul. Bawah n buah	4
ρ1 (ρ - ρ')	0.0055
fs' (MPa)	143.6708
fs' pakai (MPa)	143.6708
a (mm2)	142.7493237
Mn1 (kNm)	438.044
Mn2 (kNm)	115.391
Mn	553.435
Kontrol	**AMAN**
Mkap	691.793

4. Penulangan vertikal

$$Vc,v = \frac{Asc'}{Asc} Vj,h \left(0,6 + {}^{Nu,k}/_{Ag.f'c} \right)$$

$$Vc,v = 1.2102982 \left(0,6 + {}^{3779,5012}/_{600.600.22,5} \right)$$

$= 99388$ N $= 99,388$ kN

Vj,v = d/hc. Vj,h = 539/600. 2102,982 = 1301,08 kN

Vs,v = Vj,v – Vc,v = 1301,08 – 99,388 = 1201,692 kN

Aj,v = Vs,v / fy =1201,692 /400 = 3004,23 mm^2

pakai 8 D22 dengan As = 3042,288 mm^2 > 3004,23 mm^2

Mx (KNm)	265.7201
My (KNm)	349.0082
t kolom (mm)	0.6
d (mm)	619.00
m (m)	1.4435
Bx	7
By	2.8
x (m)	1.219
y (m)	1.219
f'c (MPa)	22.5
qu max (KN/m2)	173.3035102
qu min (KN/m2)	79.21244388
qu1 (KN/m2)	124.7962051
qu2 (KN/m2)	127.719749
qu terjadi (KN/m2)	126.257977
Vu (KN)	802.2481102
Vu/ϕ (KN)	**1337.080184**
βc	1.0
bo (mm)	4876
Vc1 (KN)	85900.7302
Vc2 (KN)	57267.1534
Vc pakai(KN)	**57267.1534**
Kontrol	**AMAN**

Kuat tumpuan pondasi	
luas pondasi/A2 (m2)	19.6000
luas Kolom/A3 (m2)	0.3600
(A2/A3)^0,5	7.3786
jika lebih besar dari 2, dipakai nilai 2	
ϕPn (KN)	9639.0
Kuat tumpuan kolom	
ϕPn (KN)	4819.5
Kontrol ϕPn kolom <= ϕPN pondasi	
AMAN	
Tul Lentur sisi Panjang arah X	

qux (KN/m2)	173.3035
L (m)	7.00
h kolom (m)	0.60
l1 (m)	3.20
Mu1 (KNm)	887.3140
tebal pelat/h (mm)	700
Pb (mm)	70
d (mm)	619.00
f'c (MPa)	22.5
fy (MPa)	400
β1	0.85
m	20.9150
Rn (MPa)	2.3158
ρ_b	0.02438
ρ_{min}	0.00350
ρ_{maks}	0.01829
ρ	0.00619
1,33.ρ	0.00823
ρpakai	0.00613
As pertu (mm2)	3794.4700
dtul.pokok (mm)	22
A1d.pokok (mm2)	379.9400
jrk tul. pokok/s (mm)	100.1299
jrk tul. pakai/s (mm)	90
tul pokok pakai	**P22 - 90**
As aktual (mm2)	4221.5556
a (mm)	88.2940
Mn (kNm)	970.7096
Kontrol	**AMAN**
dtul.susut (mm)	12
A1d.susut (mm2)	113.0400
As susut (mm2)	1238.0000
jrk tul. susut/s (mm)	91.3086
jrk tul. pakai/s (mm)	90
tul pokok pakai	**P12 - 90**