# PERATAAN BEBAN PADA PORTAL

PELAT LANTAI tebal pelat 0.12 m

| | | | |
|---|---|---|---|
| 1. Berat sendiri pelat | : 0.12x2400 | 288 | kg/m2 |
| 2. Berat Ubin (tebal 10mm) | : 0.01x2400 | 24 | kg/m2 |
| 3. Berat spesi (tebal 20mm) | : 0.02x2400 | 48 | kg/m2 |
| 3. Berat dinding | : 250 | 250 | kg/m2 |
| 4. Beban hidup untuk sekolah | | 250 | kg/m2 |

**WL (total beban hidup)** 250 kg/m2
Faktor Reduksi Beban Hidup 0.9 (PPIUG hal 21Gedung Sekolah)
**WL =** **225** kg/m2

**WD (t** n 610 kg/m2
**Total** **610** kg/m2

| no | trapesium | H | L | WL | qekLive | WD | qekDead |
|---|---|---|---|---|---|---|---|
| 1 | | 1.8 | 4.05 | 225 | 298.3333 | 610 | 808.8148 |
| 2 | | 1.3 | 3.6 | 225 | 241.6435 | 610 | 655.1224 |
| 3 | | 1.05 | 3.6 | 225 | 209.4531 | 610 | 567.8507 |
| 4 | | | | 225 | | 0 | |
| 5 | | | | 225 | | 0 | |
| 6 | | | | | | | |
| 7 | | | | | | | |

| no | segitiga | H | WL | qekLive | WD | qekDead |
|---|---|---|---|---|---|---|
| 1 | | 1.8 | 225 | 270 | 610 | 732 |
| 2 | | | | | | |
| 3 | | | | | | |

| no | doble segitiga | L | WL | qekLive | WD | qekDead |
|---|---|---|---|---|---|---|
| 1 | | 7.2 | 225 | 202.5 | 610 | 549 |
| 2 | | | | | | |
| 3 | | | | | | |

| no | segitiga cntileve | L | WL | qekLive | WD | qekDead |
|---|---|---|---|---|---|---|
| 1 | | 2.6 | 225 | 146.25 | 610 | 396.5 |

A. PELAT LANTAI

Pelat Tipe A

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Lx = | 3 | $\frac{Ly}{Lx}=$ | 1.4 | fy = | 320 | $\rho_{min}=\frac{1,4}{fy}=$ | 0.004375 |
| Ly = | 4.2 | | | fć = | 30 | | |
| Wu= | 8.24 | kN/m2 | | β1= | 0.85 | $\rho_b=\frac{\beta 1\cdot 0.85\cdot f'c}{fy}\cdot\frac{600}{600+fy}=$ | 0.0442 |
| x = | 42 | Mlx = | 3.11472 | dx= | 90 | | |
| x = | 18 | Mly = | 1.33488 | b = | 1000 | $\rho_{max}=0,75\cdot\rho_b=$ | 0.0331 |
| x = | 72 | Mtx = | -5.33952 | dy= | 80 | | |
| x = | 55 | Mty = | -4.0788 | | | | |

Luas tulangan arah x akibat momen lapangan arah x

$Mn=\frac{Mlx}{0,8}=$ 3893400 $\rho=\frac{1}{m}\left\{1-\sqrt{1-\frac{2\cdot m\cdot Rn}{fy}}\right\}=$ 0.0015165

$Rn=\frac{Mn}{b\cdot d^2}=$ 0.480667 ρ<ρmin maka dipakai ρmin

$m=\frac{fy}{0,85\cdot f'c}=$ 12.54902 $As\cdot lx=\rho_{min}\cdot b\cdot d=$ 393.75 dipasang 6ø10 - 160

Luas tulangan arah y akibat momen lapangan arah y

$Mn=\frac{Mly}{0,8}=$ 1668600 $\rho=\frac{1}{m}\left\{1-\sqrt{1-\frac{2\cdot m\cdot Rn}{fy}}\right\}=$ #DIV/0!

$Rn=\frac{Mn}{b\cdot d^2}=$ 0.260719 ρ<ρmin maka dipakai ρmin

$m=\frac{fy}{0,85\cdot f'c}=$ #DIV/0! $As\cdot lx=\rho_{min}\cdot b\cdot d=$ 0 dipasang 6ø10 - 160

Luas tulangan arah x akibat momen lapangan arah x

$Mn=\frac{Mlx}{0,8}=$ #VALUE! $\rho=\frac{1}{m}\left\{1-\sqrt{1-\frac{2\cdot m\cdot Rn}{fy}}\right\}=$ #DIV/0!

$Rn=\frac{Mn}{b\cdot d^2}=$ #VALUE! ρ<ρmin maka dipakai ρmin

$m=\frac{fy}{0,85\cdot f'c}=$ #DIV/0! $As\cdot lx=\rho_{min}\cdot b\cdot d=$ 0 dipasang 6ø10 - 160

Luas tulangan arah x akibat momen lapangan arah x

$Mn=\frac{Mly}{0,8}=$ #VALUE! $\rho=\frac{1}{m}\left\{1-\sqrt{1-\frac{2\cdot m\cdot Rn}{fy}}\right\}=$ #DIV/0!

$Rn=\frac{Mn}{b\cdot d^2}=$ #VALUE! ρ<ρmin maka dipakai ρmin

$m=\frac{fy}{0,85\cdot f'c}=$ #DIV/0! $As\cdot lx=\rho_{min}\cdot b\cdot d=$ 0 dipasang 6ø10 - 160

**TABEL PERHITUNGAN PELAT LANTAI DAN PELAT ATAP 2 ARAH**

| Nama Pelat | PL 1 | PL 2 | PL 3 | PA 4 | PA 5 | PA 6 |
|---|---|---|---|---|---|---|
| Tipe Pelat | I-2 | I-2 | I-2 | I-2 | I-2 | I-2 |
| Lx (m) | 3 | 4 | 2.5 | 3 | 4 | 2.5 |
| Ly (m) | 4.2 | 4.2 | 4.2 | 4.2 | 4.2 | 4.2 |
| Ly/Lx | 1.4 | 1.05 | 1.68 | 1.4 | 1.05 | 1.68 |
| Wu (kN/m2) | 8.24 | 8.24 | 8.24 | 5.772 | 5.772 | 5.772 |
| X (lx) | 42 | 27.25 | 50.6 | 42 | 27.25 | 50.6 |
| X (ly) | 18 | 24.25 | 15 | 18 | 24.25 | 15 |
| X (tx) | 72 | 54 | 79.2 | 72 | 54 | 79.2 |
| X (ty) | 55 | 51.75 | 54 | 55 | 51.75 | 54 |
| Mlx (kNm) | 3.11472 | 3.59264 | 2.6059 | 2.181816 | 2.516592 | 1.825395 |
| Mly (kNm) | 1.33488 | 3.19712 | 0.7725 | 0.935064 | 2.239536 | 0.541125 |
| Mtx (kNm) | -5.33952 | -7.11936 | -4.0788 | -3.740256 | -4.987008 | -2.85714 |
| Mty (kNm) | -4.0788 | -6.82272 | -2.781 | -2.85714 | -4.779216 | -1.94805 |
| fy (Mpa) | 320 | 320 | 320 | 320 | 320 | 320 |
| f'c (Mpa) | 30 | 30 | 30 | 30 | 30 | 30 |
| ρmin | 0.004375 | 0.004375 | 0.004375 | 0.004375 | 0.004375 | 0.004375 |
| β1 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 | 0.85 |
| ρb | 0.044175 | 0.044175 | 0.044175 | 0.044175 | 0.044175 | 0.044175 |
| ρmax | 0.033131 | 0.033131 | 0.033131 | 0.033131 | 0.033131 | 0.033131 |
| dx (mm) | 90 | 90 | 90 | 70 | 70 | 70 |
| dy (mm) | 80 | 80 | 80 | 60 | 60 | 60 |
| Mn {lx} (Nmm) | 3893400 | 4490800 | 3257375 | 2727270 | 3145740 | 2281744 |
| Mn {ly} (Nmm) | 1668600 | 3996400 | 965625 | 1168830 | 2799420 | 676406.3 |
| Mn {tx} (Nmm) | 6674400 | 8899200 | 5098500 | 4675320 | 6233760 | 3571425 |
| Mn {ty} (Nmm) | 5098500 | 8528400 | 3476250 | 3571425 | 5974020 | 2435063 |
| Rn {lx} (N/mm2) | 0.480667 | 0.55442 | 0.402145 | 0.556586 | 0.641988 | 0.465662 |
| Rn {ly} (N/mm2) | 0.260719 | 0.624438 | 0.150879 | 0.324675 | 0.777617 | 0.187891 |
| Rn {tx} (N/mm2) | 0.824 | 1.098667 | 0.629444 | 0.954147 | 1.272196 | 0.728862 |
| Rn {ty} (N/mm2) | 0.796641 | 1.332563 | 0.543164 | 0.992063 | 1.65945 | 0.676406 |
| m | 12.54902 | 12.54902 | 12.54902 | 12.54902 | 12.54902 | 12.54902 |
| ρ {lx} | 0.001517 | 0.001752 | 0.001267 | 0.001759 | 0.002032 | 0.001469 |
| ρ {ly} | 0.000819 | 0.001976 | 0.000473 | 0.001021 | 0.002468 | 0.000589 |
| ρ {tx} | 0.002618 | 0.003511 | 0.001992 | 0.00304 | 0.00408 | 0.002311 |
| ρ {ty} | 0.00253 | 0.004279 | 0.001716 | 0.003163 | 0.005366 | 0.002143 |
| Aslx (mm2) | 393.75 | 393.75 | 393.75 | 306.25 | 306.25 | 306.25 |
| Asly (mm2) | 350 | 350 | 350 | 262.5 | 262.5 | 262.5 |
| Astx (mm2) | 393.75 | 393.75 | 393.75 | 306.25 | 306.25 | 306.25 |
| Asty (mm2) | 350 | 350 | 350 | 262.5 | 262.5 | 262.5 |
| As Φ10 | 78.57143 | 78.57143 | 78.57143 | 78.57143 | 78.57143 | 78.57143 |
| Jarak {lx} | 180 | 180 | 180 | 250 | 250 | 250 |
| Jarak {ly} | 200 | 200 | 200 | 280 | 280 | 280 |
| Jarak {tx} | 180 | 180 | 180 | 250 | 250 | 250 |
| Jarak {ty} | 200 | 200 | 200 | 280 | 280 | 280 |
| Ast (lx) | 436.5079 | 436.5079 | 436.5079 | 314.2857 | 314.2857 | 314.2857 |
| Ast (ly) | 392.8571 | 392.8571 | 392.8571 | 280.6122 | 280.6122 | 280.6122 |
| Ast (tx) | 436.5079 | 436.5079 | 436.5079 | 314.2857 | 314.2857 | 314.2857 |
| Ast (ty) | 392.8571 | 392.8571 | 392.8571 | 280.6122 | 280.6122 | 280.6122 |

**TABEL PERHITUNGAN PELAT LANTAI DAN PELAT ATAP 1 ARAH**

| Nama Pelat | PL 7 | PA 8 |
|---|---|---|
| Tipe Pelat | I-2 | I-2 |
| Lx (m) | 1.5 | 1.8 |
| Ly (m) | 4.2 | 4.2 |
| Ly/Lx | 2.8 | 2.333333 |
| Wu (kN/m2) | 8.24 | 5.772 |
| Ml (kNm) | 2.3175 | 2.33766 |
| Mt (kNm) | 0.7725 | 0.77922 |
| dx (mm) | 90 | 70 |
| Mn {lx} (Nmm) | 2896875 | 2922075 |
| Mn {tx} (Nmm) | 965625 | 974025 |
| al (mm) | 1.271 | 1.282 |
| at (mm) | 0.422 | 0.425 |
| Asl (mm2) | 101.2828 | 102.1594 |
| Ast (mm2) | 33.62813 | 33.86719 |
| ρl | 0.001125 | 0.001459 |
| ρt | 0.000374 | 0.000484 |
| ρ min | 0.004375 | 0.004375 |
| Aslx (mm2) | 393.75 | 306.25 |
| n {lx} | 5.015924 | 3.901274 |
| n {tx} | 0.428384 | 0.431429 |
| n {lx} use | 6 | 4 |
| n {tx} use | 2 | 2 |
| As Φ10 | 78.57143 | 78.57143 |
| As nΦ10 {lx} | 471.4286 | 314.2857 |
| As nΦ10 {tx} | 157.1429 | 157.1429 |
| Jarak {lx} | 166.6667 | 250 |
| Jarak {tx} | 500 | 500 |
| Jarak {lx} use | 160 | 250 |
| Jarak {tx} use | 500 | 500 |
| As bagi {ty} | 235.2 | 196 |
| n bagi | 2.996178 | 2.496815 |
| n bagi use | 4 | 4 |
| s bagi (mm) | 250 | 250 |

**TABEL PERHITUNGAN PENULANGAN BALOK TIPE 1-1**

| Letak Tulangan | TA,TA',LBC,LCD | TB - TD | TC | LAB - LDA' |
|---|---|---|---|---|
| Mu (Nmm) | 7403500 | 11845600 | 10768700 | 8641150 |
| Φ | 0.8 | 0.8 | 0.8 | 0.8 |
| Mn (Nmm) | 9254375 | 14807000 | 13460875 | 10801437.5 |
| b (mm) | 200 | 200 | 200 | 200 |
| d (mm) | 246 | 246 | 246 | 246 |
| Rn | 0.764622166039 | 1.223395 | 1.112175 | 0.89244477 |
| m | 12.55 | 12.55 | 12.55 | 12.55 |
| ρ | 0.002426387427 | 0.00392 | 0.003555 | 0.00283948 |
| ρmin | 0.004375 | 0.004375 | 0.004375 | 0.004375 |
| Ast ($mm^2$) | 215.25 | 215.25 | 215.25 | 215.25 |
| As' ($mm^2$) | 107.625 | 107.625 | 107.625 | 107.625 |
| n | 1.903227861633 | 1.903228 | 1.903228 | 1.90322786 |
| n use | 2 | 2 | 2 | 2 |
| cek tulangan | | | | |
| a (mm) | 13.50588235294 | 13.50588 | 13.50588 | 13.5058824 |
| Mn 1 Nmm | 16479337.41176 | 16479337 | 16479337 | 16479337 |
| tulangan | tunggal | tunggal | tunggal | tunggal |
| Ø tulangan | 12 | 12 | 12 | 12 |
| Ast (mm2) | 226.194671 | 226.1947 | 226.1947 | 226.194671 |

**Perhitungan Balok**

**Data :**

| | | | | | | |
|---|---|---|---|---|---|---|
| * | Nama Balok | | | | BRWF2 | |
| * | Dimensi Balok | | h : | | 400 | mm |
| | | | b : | | 200 | mm |
| * | Selimut Beton | | : | | 40 | mm |
| * | Kualitas beton | | | K | 225 | |
| * | fy | | : | | 400 | |
| * | f'c ( 0.083*K Beton ) | | : | | 18 | |
| * | Diameter : | Tulangan | : | | 19 | mm |
| | | Sengkang | : | | 10 | mm |
| * | d | | : | | 340.5 | mm |
| * | ρ | min | *(1.4/fy)* | | 0.0035 | |
| | | | *( √fc )/4fy* | | 0.002652 | |
| | ρ | min pakai ( terkecil ) | | | 0.002652 | |
| * | ρ | balance | | | 0.195075 | |
| | | *(0.85*f'c*β)/40*[600/(600+fy)]* | | | | |
| * | ρ | max | | | 0.146306 | |
| | | *0.75*ρbalance* | | | | |

**Penulangan Tumpuan**

| | | | | | | |
|---|---|---|---|---|---|---|
| * | Mu | 110 | kNm | | | |
| * | Mn | 129.4117647059 | kNm | | | |
| | *(Mu/0.85)* | | | | | |
| * | Rn | 5.580967985919 | N/mm2 | | | |
| | *Mn/(bd^2)* | | | | | |
| * | m | 26.14379084967 | | | | |
| | *fy/(0.85*fc"')* | | | | | |
| * | ρ | 0.018357730831 | ρmin < ρ < ρmax | | ρmin | 0.002652 |
| | *1/m-[1-(√1-(2*Rn*m)/fy)]* | | | | ρmax | 0.146306 |
| * | ρ | 0.018358 | | | | |
| | Pakai | | | | | |
| * | As | 1250.1798 | mm2 | | | |
| | *ρ*b*d* | | | | | |
| * | n Tulangan | 4.407584286074 | | 19 | | |
| * | n Pakai | 5 | | 19 | | |

**Penulangan Lapangan**

| | | | | | | |
|---|---|---|---|---|---|---|
| * | Mu | 50 | kNm | | | |
| * | Mn | 58.82352941176 | kNm | | | |
| | *(Mu/0.85)* | | | | | |
| * | Rn | 2.536803629963 | N/mm2 | | | |
| | *Mn/(bd^2)* | | | | | |
| * | m | 26.14379084967 | | | | |
| | *fy/(0.85*fc"')* | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| * | ρ | 0.006978626417 | ρmin < ρ < ρmax | | | ρmin | 0.002652 |
| | *1/m-[1-(√1-(2*Rn*m)/fy)]* | | | | | ρmax | 0.146306 |
| * | ρ | 0.00697863 | | | | | |
| | Pakai | | | | | | |
| * | As | 475.244703 | mm2 | | | | |
| | ρ*b*d | | | | | | |
| * | n Tulangan | 1.67550386351 | D | 19 | | | |
| * | n Pakai | 2 | D | 19 | | | |

**Penulangan Sengkang**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| * | Tu | 8.2 | kNm | | | | |
| * | Vu | 50 | kN | fy | 240 | Mpa | |
| * | Vn | 83.33333333333 | kN | D Tul | 10 | mm | |
| | Vu/0.6 | | | A Tul | 50.28571 | mm2 | |
| * | Vc | 48.1539717988 | kN | | | | |
| | *1/6*√fc'*b*d* | | | | | | |

Cek kemampuan penampang :

| | | | | | | |
|---|---|---|---|---|---|---|
| * | Σx²y | 16000000 | mm3 | | | |
| * | *φ 1/24*√fc'*Σx²y* | 1.697056274848 | kNm | < | | 8.2 |

Bila < tulangan torsi diperlukan

| | | | | | | |
|---|---|---|---|---|---|---|
| * | *0.6*5/6*√fc'*b*d >Vu* | 144.4619153964 | kN | > | Vu : | 50 |

Jika > dari Vu maka memakai tulangan geser minimum

Jika < dari Vu maka memakai tulangan geser

| | | | | | |
|---|---|---|---|---|---|
| | Tulangan geser | | | Geser minimum | |
| | | | | S = d/2 : | 170.25 |
| * | Vu | 50 | kN | S pakai | 100 |
| * | φVc | 36.1154788491 | kN | | |
| | Vu ≤ φVc | Yes | Pakai tulangan geser minimum | | |
| | | No | Hitung Vs | | |
| * | Vs | 30.55118781756 | kN | | |
| | *(Vu/0.75)-Vc* | | | | |

| | | | | |
|---|---|---|---|---|
| * | Vs | < | *0.75*2/3*√fc'*b*d* | |
| | 30.5511878176 | < | 144.4619153964 | |

Kalau tidak penampang harus diperbesar

| | | | | | |
|---|---|---|---|---|---|
| * | S | 1008.802488131 | | | |
| * | S pakai | 120 | Diameter | 10 | |

**Perhitungan Torsi**

| | | | |
|---|---|---|---|
| * | Tu : | 8.2 | kNm |
| * | Tn : | 13.66666666667 | kNm |
| | *Tu/0.6* | | |
| * | fy : | 400 | |
| * | x : | 200 | |
| * | y : | 400 | |
| * | Ct | 0.00425625 | |

$(b*d)/(\Sigma x^2 y)$

* Vc | 23.941965444 | kN

$\frac{1/6*\sqrt{fc'}*b*d}{\sqrt{(1+(2.5*Ct*Tu/Vu)^2)}}$

* Vs perlu | 59.39136788934

$(Vu/0.6)-Vc$

* Vs perlu < $0.6*2/3*\sqrt{fc'}*b*d$

59.3913678893 < 144.4619153964

Jika tidak penampang diperbesar

* Av/s | 0.436059969819

$Vs\ perlu/(fy*d)$

* $\Sigma x^2 y$ | 16000000 | mm3

* Tc

$\frac{1/15*\sqrt{fc'}*\Sigma x^2 y}{\sqrt{(1+(0.4Vu/(CtTu)))}}$ | 3.926482332815 | kNm

* Besar torsi yang dapat dipikul sengkang

4 Tc : | 15.70592933126 | kNm

* Ts perlu < Ts max

Tn-Tc < 15.70592933126

9.74018433385 < 15.70592933126

Bila tidak ubah penampang

* x1 : | 110

* y1 : | 310

* $\alpha t$ : | 1.59 < 1.5

$0.66+0.33*(y1/x1)$

Bila tidak memenuhi syarat pakai 1.5

* $\alpha t$ : | 1.44

* At/s : | 0.82649277841

$\frac{Ts\ perlu}{\alpha t*x1*y1*fy}$

* Luas tulangan untuk memikul torsi

$Av+2At$ : 2.089045526639 > $b/(3*fy)$

2.089045526639 > 0.166667

Bila tidak pakai | 0.166666666667

* Yang dipakai | 1

* Tulangan yang dipakai : | 10 | mm

* As : | 78.57142857143 | mm2

* S perlu | 157.1428571429 | mm

* Spasi maksimum :

$1/3*\sqrt{fc'}*b*d < Vs < 2/3*\sqrt{fc'}*b*d$

96.3079435976 < 59.39136788934

Bila < Smax $s<1/2d$ 170.25

Bila > Smax $s<1/4d<300mm$ 85.125

* Syarat penulangan momen torsi untuk sengkang tertutup

Smax : 105 < 300

$(x1+y1)/4$

* S pakai (mm) | 100 | Diameter | 10

* Perhitungan tulangan torsi

* Al : 694.2539338645 mm2

$\frac{2At}{S}(x1+y1)$

* Syarat Al min

$$\frac{2.8*Tu}{fy*(Tu+1/3V/Ct)} - \frac{2At}{S} \times (X1+Y1)$$

= 0.94752228049 - 1.65298555682 x 420

= -693.306411584

* Al pakai : 694

* n Tulangan : 2.446738856711 19

3 Diameter 19

**Kesimpulan**

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | Dimensi Balok | h : | | 400 | mm | |
| | | b : | | 200 | mm | |
| 2 | Selimut Beton | | | 40 | mm | |
| 3 | Tulangan | Tumpuan | Lapangan | Diameter | | |
| | Atas | 5 | 2 | 19 | | |
| | Bawah | 2 | 5 | 19 | | |
| 4 | Sengkang | 1/4 l | 10 | - | 100 | |
| | | 1/2 l | 10 | - | 120 | |
| 5 | Torsi | 4 | Diameter | 16 | | |

( Kalau ada )

Dipasang disisi kiri dan kanan balok

kN

mm
mm

**BALOK ATAP 1-1 DAN 8-8**

| | |
|---|---|
| Lebar (m) | 0.2 |
| Tinggi (m) | 0.3 |
| Wpelat (kg/m2) | 321 |
| Tebal pelat | 0.1 |
| h trapesium | 0.9 |

Perhitungan Beban

| | |
|---|---|
| W balok | 96 |
| W listplang | 38.4 |
| W pelat | 271.21224 |
| WD (kg/m2) | 405.61224 |
| WL (kg/m2) | 101.38776 |
| WU (kg/m2) | 648.9551 |

Perhitungan Momen

| | |
|---|---|
| MtA = MtA' (kgm) | 715.473 |
| MtB = MtD (kgm) | 1144.7568 |
| MtC (kgm) | 1040.688 |
| MlAB = MlDA' (kgm) | 817.68343 |
| MlBC = MlCD (kgm) | 715.473 |

Perhitungan Tulangan

| | |
|---|---|
| P (mm) | 40 |
| ΦD (mm) | 12 |
| ΦS (mm) | 8 |
| deff (mm) | 246 |
| ρmax | 0.03313 |
| ρmin | 0.004375 |

Perhitungan Gaya Geser

| | |
|---|---|
| VB ki = VB ka (kg) | 1567.2266 |
| VA=VB ka=VD ki=VA' (kg) | 1362.8057 |

Perhitungan Tulangan Geser

| | |
|---|---|
| VC (N) | 44913.25 |
| 1/2 Φ VC (N) | 16842.469 |
| Φ VC (N) | 33684.937 |

Perhitungan tulangan utama

| Letak Tulangan | TA,TA',LBC,LCD | TB - TD | TC | LAB - LDA' |
|---|---|---|---|---|
| Mu (Nmm) | 7154730 | 11447568 | 10406880 | 8176834.3 |
| Φ | 0.8 | 0.8 | 0.8 | 0.8 |
| Mn (Nmm) | 8943412.5 | 14309460 | 13008600 | 10221043 |
| b (mm) | 200 | 200 | 200 | 200 |
| d (mm) | 246 | 246 | 246 | 246 |
| Rn | 0.738929580607 | 1.1822873 | 1.0748067 | 0.8444909 |
| m | 12.55 | 12.55 | 12.55 | 12.55 |
| ρ | 0.002343620742 | 0.0037845 | 0.0034327 | 0.0026842 |
| ρmin | 0.004375 | 0.004375 | 0.004375 | 0.004375 |
| Ast ($mm^2$) | 215.25 | 215.25 | 215.25 | 215.25 |
| As' ($mm^2$) | 107.625 | 107.625 | 107.625 | 107.625 |
| n | 1.903227861633 | 1.9032279 | 1.9032279 | 1.9032279 |
| n use | 2 | 2 | 2 | 2 |
| cek tulangan | | | | |
| a (mm) | 13.50588235294 | 13.505882 | 13.505882 | 13.505882 |
| Mn 1 Nmm | 16479337.41176 | 16479337 | 16479337 | 16479337 |
| tulangan | tunggal | tunggal | tunggal | tunggal |
| Ø tulangan | 12 | 12 | 12 | 12 |
| Ast (mm2) | 226.194671 | 226.19467 | 226.19467 | 226.19467 |

Tulangan penahan geser

| Letak Tulangan | TBki;TBka | TA,Tbka,TC,Tdki,TA' |
|---|---|---|
| Vu (N) | 15672.26571429 | 13628.057 |
| Tulangan | 0 | 0 |
| Sengkang Praktis | | |
| δmax | 123 | 123 |
| Φ sengkang | Φ8 | Φ8 |
| Jarak (mm) | 120 | 120 |

# TABEL PENULANGAN BALOK LANTAI

**TYPE 1-1 (BALOK INDUK)**

**Tulangan Lentur ;**

| | |
|---|---|
| f'c | 20 |
| fy | 320 |
| h (mm) | 400 |
| b (mm) | 300 |
| D sengkang | 8 |
| p | 20 |
| D Tul Utama | 14 |
| ρ min | 0.004375 |
| ρ max | 0.0221 |

| | Mu (Nmm) | Mu/Φ (Nmm) | d (mm) | d' (mm) | Rn (N/mm2) | m |
|---|---|---|---|---|---|---|
| Tumpuan | 2.84E+07 | 3.55E+07 | 365 | 35 | 0.8882217 | 18.82353 |
| lapangan | 1.94E+07 | 2.43E+07 | 365 | 35 | 0.606743 | 18.82353 |

| ρ | 4/3 ρ | As (mm2) | Tulangan terpasang | As Terpasang (mm2) |
|---|---|---|---|---|
| 0.00285226 | 0.003803 | 416.43012965123 | 4 Φ14 | 615.44 |
| 0.00193117 | 0.0025749 | 479.0625 | 4 Φ14 | 615.44 |

**Cek kapasitas Penampang Terhadap Lentur**

| | a (mm) | Mn (Nmm) | Φ Mn (Nmm) | Φ Mn> Mu (Nmm) |
|---|---|---|---|---|
| Tumpuan | 38.615843 | 68080874.479937 | 54464699.58 | ok |
| lapangan | 38.615843 | 68080874.479937 | 54464699.58 | ok |

**Tulangan Geser :**

| | Vu (N) | Vn (N) | Vc (N) | Vs (N) | Keterangan | D Sengkang ( mm) | Av (mm2) | S (mm) | S max (mm) |
|---|---|---|---|---|---|---|---|---|---|
| Tumpuan | 4.95E+04 | 6.61E+04 | 81616.4812 | -1.56E+04 | Tul Sengkang Min | 8 | 100.48 | 7.54E+02 | 182.5 |
| lapangan | 2.16E+04 | 2.88E+04 | 8705.75799 | 2.01E+04 | Tul Sengkang Min | 8 | 100.48 | 7.30E+02 | 182.5 |

| Tul Sengkang |
| --- |
| Φ 8 -160 |
| Φ 8 -170 |

**Perhitungan Balok**

**Data :**

| | | | | | | |
|---|---|---|---|---|---|---|
| * | Nama Balok | | | | BR | |
| * | Dimensi Balok | | h : | | 450 | mm |
| | | | b : | | 300 | mm |
| * | Selimut Beton | | : | | 40 | mm |
| * | Kualitas beton | | | K | 225 | |
| * | fy | | : | | 400 | |
| * | f'c ( 0.083*K Beton ) | | : | | 18 | |
| * | Diameter : | Tulangan | : | | 19 | mm |
| | | Sengkang | : | | 10 | mm |
| * | d | | : | | 379.75 | mm |
| * | ρ | min | *(1.4/fy)* | | 0.0035 | |
| | | | *( √fc )/4fy* | | 0.002652 | |
| | ρ | min pakai ( terkecil ) | | | 0.002652 | |
| * | ρ | balance | | | 0.019508 | |
| | | *(0.85*f'c*β)/fy*[600/(600+fy)]* | | | | |
| * | ρ | max | | | 0.014631 | |
| | | *0.75*ρbalance* | | | | |

**Penulangan Tumpuan**

| | | | | | | |
|---|---|---|---|---|---|---|
| * | Mu | 120 | kNm | | | |
| * | Mn | 141.176470588 | kNm | | | |
| | (Mu/0.85) | | | | | |
| * | Rn | 3.26321358674 | N/mm2 | | | |
| | Mn/(bd^2) | | | | | |
| * | m | 26.1437908497 | | | | |
| | fy/(0.85*fc"') | | | | | |
| * | ρ | 0.00928497106 | *ρmin < ρ < ρmax* | | ρmin | 0.002652 |
| | *1/m-[1-(√1-(2*Rn*m)/fy)]* | | | | ρmax | 0.014631 |
| * | ρ | 0.00928497 | | | | |
| | Pakai | | | | | |
| * | As | 1057.79020725 | mm2 | | | |
| | *ρ*b*d* | | | | | |
| * | n Tulangan | 3.72930317338 | | 19 | | |
| * | n Pakai | 6 | | 19 | | |

**Penulangan Lapangan**

| | | | | | | |
|---|---|---|---|---|---|---|
| * | Mu | 116.5 | kNm | | | |
| * | Mn | 137.058823529 | kNm | | | |
| | *(Mu/0.85)* | | | | | |
| * | Rn | 3.16803652379 | N/mm2 | | | |
| | *Mn/(bd^2)* | | | | | |
| * | m | 26.1437908497 | | | | |
| | *fy/(0.85*fc"')* | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| * | ρ | 0.00897244008 | ρmin < ρ < ρmax | | | ρmin | 0.002652 |
| | *1/m-[1-(√1-(2*Rn*m)/fy)]* | | | | | ρmax | 0.014631 |
| * | ρ | 0.006917152 | | | | | |
| | Pakai | | | | | | |
| * | As | 788.0365416 | mm2 | | | | |
| | *ρ*b*d* | | | | | | |
| * | n Tulangan | 2.77827035568 | D | 19 | | | |
| * | n Pakai | 6 | D | 19 | | | |

**Penulangan Sengkang**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| * | Tu | 5 | kNm | | | | |
| * | Vu | 73.1 | kN | fy | 240 | Mpa | |
| * | Vn | 121.833333333 | kN | D Tul | 10 | mm | |
| | *Vu/0.6* | | | A Tul | 78.57143 | mm2 | |
| * | Vc | 80.5571400467 | kN | | | | |
| | *1/6*√fc'*b*d* | | | | | | |

Cek kemampuan penampang :

| | | | | | | |
|---|---|---|---|---|---|---|
| * | $\Sigma x^2y$ | 40500000 | mm3 | | | |
| * | *φ 1/24*√fc'*$\Sigma x^2y$* | 4.295673695708 | kNm | < | 5 | |

Bila < tulangan torsi diperlukan

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| * | *0.6*5/6*√fc'*b*d >Vu* | 241.67142014 | kN | > | Vu : | 73.1 | |

Jika > dari Vu maka memakai tulangan geser minimum

Jika < dari Vu maka memakai tulangan geser

| | | | | | |
|---|---|---|---|---|---|
| Tulangan geser | | | | Geser minimum | |
| | | | | S = d/2 : | 189.875 |
| * Vu | 73.1 | kN | | S pakai | 100 |
| * φVc | 60.417855035 | kN | | | |
| Vu ≤ φVc | Yes | Pakai tulangan geser minimum | | | |
| | No | Hitung Vs | | | |
| * Vs | 37.0488116317 | kN | | | |
| *(Vu/0.75)-Vc* | | | | | |

| | | | | |
|---|---|---|---|---|
| * | Vs | < | 0.75*2/3*√fc'*b*d | |
| | 37.0488116317 | < | 241.67142014 | |

Kalau tidak penampang harus diperbesar

| | | | | | |
|---|---|---|---|---|---|
| * | S | 927.770648671 | | | |
| * | S pakai | 120 | Diameter | 10 | |

**Perhitungan Torsi**

| | | | |
|---|---|---|---|
| * | Tu : | 5 | kNm |
| * | Tn : | 8.33333333333 | kNm |
| | *Tu/0.6* | | |
| * | fy : | 400 | |
| * | x : | 300 | |
| * | y : | 450 | |
| * | Ct | 0.00281296296 | |

*(b*d)/(Σx²y)*

* Vc | 72.5954108731 | kN

*1/6*√fc'*b*d*

*√(1+(2.5*Ct*Tu/Vu)²)*

* Vs perlu | 49.2379224602

*(Vu/0.6)-Vc*

* Vs perlu < 0.6*2/3*√fc'*b*d

49.2379224602 < 241.67142014

Jika tidak penampang diperbesar

* Av/s | 0.32414695497

*Vs perlu/(fy*d)*

* Σx²y | 40500000 | mm3

* Tc

*1/15*√fc'*Σx²y* | 4.96548637983 | kNm

*√(1+(0.4Vu/(CtTu )))*

* Besar torsi yang dapat dipikul sengkang ( Ts max )

4 Tc : | 19.8619455193 | kNm

* Ts perlu < Ts max

*Tn-Tc* < 19.86194551931

3.36784695351 < 19.86194551931

Bila tidak ubah penampang

* x1 : | 210

* y1 : | 360

* αt : | 1.22571428571 < 1.5

*0.66+0.33*(y1/x1)*

Bila tidak memenuhi syarat pakai 1.5

* αt : | 1.036218487

* At/s : | 0.17912985487

*Ts perlu*

*αt*x1*y1*fy*

* Luas tulangan untuk memikul torsi

*Av+2At :* 0.68240666471 > *b/(3*fy)*

0.68240666471 > 0.25

Bila tidak pakai | 0.25

* Yang dipakai | 3.479722123

* Tulangan yang dipakai : | 10 | mm

* As : | 78.5714285714 | mm2

* S perlu | 45.1595994129 | mm

* Spasi maksimum :

*1/3*√fc'*b*d < Vs*

161.114280093 < 49.23792246025

Bila < Smax *s<1/2d* 189.875

Bila > Smax *s<1/4d<300mm* 94.9375

* Syarat penulangan momen torsi untuk sengkang tertutup

Smax : 142.5 < 300

*(x1+y1)/4*

| | | | | | | |
|---|---|---|---|---|---|---|
| * | S pakai (mm) | 100 | | Diameter | | 10 |
| * | Perhitungan tulangan torsi | | | | | |
| * | Al : | 204.208034552 | mm2 | | | |
| | *2At/S ( x1+y1 )* | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| * | Syarat Al min | | | | | |
| | *2.8*Tu* / *fy*(Tu+1/3V/Ct)* | - | *2At* / *S* | x | *( X1+Y1 )* | |
| = | 0.76853948827 | - | 0.358259709741 | x | 570 | |
| = | -203.439495064 | | | | | |
| * | Al pakai : | 2275 | | | | |
| * | n Tulangan : | 8.0206497104 | | 19 | | |
| | | 6 | Diameter | | 19 | |

**Kesimpulan**

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | Dimensi Balok | h : | | 450 | mm | |
| | | b : | | 300 | mm | |
| 2 | Selimut Beton | | | 40 | mm | |
| 3 | Tulangan | Tumpuan | | Lapangan | Diameter | |
| | Atas | 6 | | 6 | 19 | |
| | Bawah | 6 | | 6 | 19 | |
| 4 | Sengkang | 1/4 l | | 10 | - | 100 |
| | | 1/2 l | | 10 | - | 200 |
| 5 | Torsi | | Diameter | | 19 | |
| | ( Kalau ada ) | | | | | |

kN

mm
mm

**Beban Pelat**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Beban Mati** | | | | | | |
| * | Beban plat | 0.15 | x | 2400 | = | 360 | kg/m2 |
| * | Beban tegel | 0 | x | 24 | = | 0 | kg/m2 |
| * | Beban spesi | 0 | x | 21 | = | 0 | kg/m2 |
| * | Baban plafon | 1 | x | 11 | = | 11 | kg/m2 |
| * | Beban penggantung | 1 | x | 7 | = | 7 | kg/m2 |
| * | Tandon Air | 1 | x | 2000 | = | 2000 | kg/m2 |
| * | Beban M&E | 1 | x | 48 | = | 48 | kg/m2 |
| | **Beban Total** | | | | | **2426** | kg/m2 |
| | | | | | | | |
| | **Beban Mati Atap** | | | | | | |
| * | Beban plat | 0.1 | x | 2400 | = | 240 | kg/m2 |
| * | Beban M&E | 1 | x | 48 | = | 48 | kg/m2 |
| * | Baban plafon | 0 | x | 11 | = | 0 | kg/m2 |
| * | Beban penggantung | 0 | x | 7 | = | 0 | kg/m2 |
| | **Beban Total** | | | | | **288** | kg/m2 |

| Respon spektrum | |
|---|---|
| | |
| 0 | 0.38 |
| 0.2 | 0.95 |
| 1 | 0.95 |
| 1.2 | 0.79166667 |
| 1.4 | 0.67857143 |
| 1.6 | 0.59375 |
| 1.8 | 0.52777778 |
| 2 | 0.475 |
| 2.2 | 0.43181818 |
| 2.4 | 0.39583333 |
| 2.6 | 0.36538462 |
| 2.8 | 0.33928571 |
| 3 | 0.31666667 |
| | |

Beban pada balok

| No | Jenis persegi | W | x(m) | y(m) | Lt(m) | ht(m) | Ls (m) | hs (m) | Qt (kg/m2) | Qs (kg/m2) | Qt (kN/m2) | Qs (kN/m2) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 423 | 3.60 | 4.05 | 4.05 | 1.80 | 3.60 | 1.80 | 560.87 | 507.60 | 5.50 | 4.98 |
| 2 | 2 | 423 | 3.00 | 7.20 | 7.20 | 1.50 | 3.00 | 1.50 | 597.78 | 423.00 | 5.86 | 4.15 |
| 3 | 4 | 423 | 1.80 | 2.70 | 2.70 | 0.90 | 1.80 | 0.90 | 324.30 | 253.80 | 3.18 | 2.49 |
| 4 | 6 | 423 | 1.95 | 3.60 | 3.60 | 0.98 | 1.95 | 0.98 | 372.09 | 274.95 | 3.65 | 2.70 |
| 5 | 7 | 423 | 3.60 | 8.10 | 8.10 | 1.80 | 3.60 | 1.80 | 711.27 | 507.60 | 6.98 | 4.98 |
| 6 | 2 atap | 288 | 3.00 | 7.20 | 7.20 | 1.50 | 3.00 | 1.50 | 407.00 | 288.00 | 3.99 | 2.83 |
| 7 | 4 atap | 288 | 1.80 | 4.00 | 4.00 | 0.90 | 1.80 | 0.90 | 241.70 | 172.80 | 2.37 | 1.70 |

| No | Jenis Bujur sangkar | W | x(m) | y(m) | Ls(m) | hs(m) | Qs (kg/m2) | Qs (kN/m2) |
|---|---|---|---|---|---|---|---|---|
| 1 | 3 | 441 | 3.60 | 3.60 | 3.60 | 1.80 | 529.20 | 5.19 |
| 2 | 3 atap | 2426 | 3.60 | 3.60 | 3.60 | 1.80 | 2911.20 | 28.56 |
| 3 | 5 | 423 | 4.50 | 4.50 | 4.50 | 2.25 | 634.50 | 6.22 |
| 4 | 5 atap | 288 | 4.50 | 4.50 | 4.50 | 2.25 | 432.00 | 4.24 |

**Beban Hidup**

| | | | |
|---|---|---|---|
| * | Untuk pelat | 250 | kg/m2 |
| * | Untuk atap | 100 | kg/m2 |
| * | Beban air hujan | 20 | kg/m2 |
| | **Beban untuk plat** | **250** | kg/m2 |
| | **Beban untuk  atap** | **120** | kg/m2 |

Beban pada balok

| No | Jenis persegi | W | x(m) | y(m) | Lt(m) | ht(m) | Ls (m) | hs (m) | Qt (kg/m2) | Qs (kg/m2) | Qt (kN/m2) | Qs (kN/m2) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 250 | 3.60 | 4.05 | 4.05 | 1.80 | 3.60 | 1.80 | 331.48 | 300.00 | 3.25 | 2.94 |
| 2 | 2 | 250 | 3.00 | 7.20 | 7.20 | 1.50 | 3.00 | 1.50 | 353.30 | 250.00 | 3.47 | 2.45 |
| 3 | 4 | 250 | 1.80 | 2.70 | 2.70 | 0.90 | 1.80 | 0.90 | 191.67 | 150.00 | 1.88 | 1.47 |
| 4 | 6 | 250 | 1.95 | 3.60 | 3.60 | 0.98 | 1.95 | 0.98 | 219.91 | 162.50 | 2.16 | 1.59 |
| 5 | 7 | 250 | 3.60 | 8.10 | 8.10 | 1.80 | 3.60 | 1.80 | 420.37 | 300.00 | 4.12 | 2.94 |
| 6 | 2 atap | 120 | 3.00 | 7.20 | 7.20 | 1.50 | 3.00 | 1.50 | 169.58 | 120.00 | 1.66 | 1.18 |
| 7 | 4 atap | 120 | 1.80 | 4.00 | 4.00 | 0.90 | 1.80 | 0.90 | 100.71 | 72.00 | 0.99 | 0.71 |

| No | Jenis Bujur sangkar | W | x(m) | y(m) | Ls(m) | hs(m) | Qs (kg/m2) | Qs (kN/m2) |
|---|---|---|---|---|---|---|---|---|
| 1 | 3 | 250 | 3.6 | 3.6 | 3.6 | 1.8 | 300.00 | 2.94 |
| 2 | 3 atap | 120 | 3.6 | 3.6 | 3.6 | 1.8 | 144.00 | 1.41 |
| 3 | 5 | 250 | 4.50 | 4.50 | 4.50 | 2.25 | 375.00 | 3.68 |
| 4 | 5 atap | 120 | 4.50 | 4.50 | 4.50 | 2.25 | 180.00 | 1.77 |

# BALOK PORTAL UTAMA

Data Perencanan

| | | | |
|---|---|---|---|
| fc' | 18 | | jika fc' >30, maka beta dihitung |
| fy | 400 | | beta ' |
| Beta' | 0.85 | | |

Dimensi Balok

| | | | |
|---|---|---|---|
| lebar | 300 | mm | |
| tinggi | 600 | mm | |
| deking | 40 | mm | konstruksi tidak langsung berhubungan dengan tanal |
| D. tlg Long | 19 | mm | |
| D. tlg Stirrup | 10 | mm | |
| dx | 540.5 | mm | |

| | | |
|---|---|---|
| rho min | 0.00350 | yang dipakai nilai yang terbesar |
| | 0.00265 | |
| rho balanc | 0.020 | $\rho b=(0.85.fc'.\beta/fy)(600/(600+fy))$ |
| rho maks | 0.015 | $\rho mak=0.75\ \rho b$ |

| | | |
|---|---|---|
| m | 26.144 | |
| MU | 270000000 | Nmm |
| MN | 337500000 | |
| Rn | 3.850890112 | |
| rho perlu | 0.011294856 | |

Kontrol kondisi rho perlu

| rho min | < | rho perlu | < | rho maks | |
|---|---|---|---|---|---|
| 0.00350 | < | 0.011295 | < | 0.015 | OK !!! |

| | | |
|---|---|---|
| As | 1831.460966 | |
| Jumlah Tulangan | 6.462801 | |

| no. | Tipe Balok | b | h | deking | Dl | Dt | dx | m | Mu |
|---|---|---|---|---|---|---|---|---|---|
| | | mm | mm | mm | mm | mm | mm | | Nmm |
| 1 | | 300 | 400 | 40 | 10 | 19 | 341 | 26.144 | |
| 2 | | | | | | | | | |
| 3 | | | | | | | | | |
| 4 | | | | | | | | | |
| 5 | | | | | | | | | |
| 6 | | | | | | | | | |
| 7 | | | | | | | | | |
| 8 | | | | | | | | | |

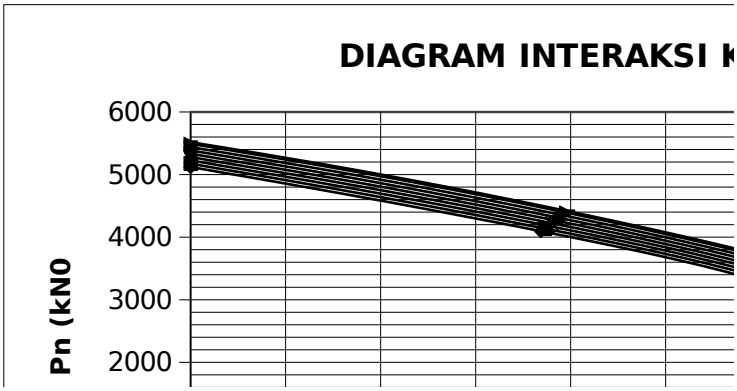
h dan cuaca

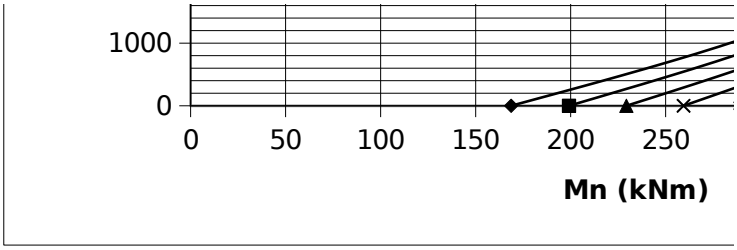
| Mn | Rn |
| --- | --- |
| Nmm | |
| 0 | 0 |

Diagram Interaksi Kolom

8670 c2 - 920 As c + 246000 As = 0

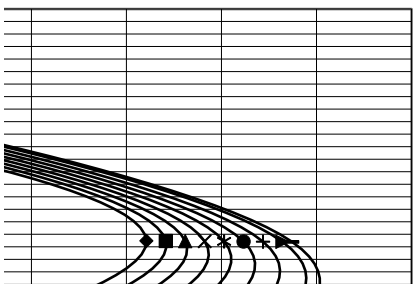
| | | | | | | |
|---|---|---|---|---|---|---|
| ρ (%) | 1 | 1.1 | 1.2 | 1.3 | 1.4 | 1.5 |
| b | 400 | 400 | 400 | 400 | 400 | 400 |
| h | 450 | 450 | 450 | 450 | 450 | 450 |
| Ast (mm2) | 1800 | 1980 | 2160 | 2340 | 2520 | 2700 |
| As=As' | 900 | 990 | 1080 | 1170 | 1260 | 1350 |
| f'c (MPa) | 30 | 30 | 30 | 30 | 30 | 30 |
| fy (Mpa) | 320 | 320 | 320 | 320 | 320 | 320 |
| P0 (N) | 5120100 | 5173110 | 5226120 | 5279130 | 5332140 | 5385150 |
| kN | 5120.1 | 5173.11 | 5226.12 | 5279.13 | 5332.14 | 5385.15 |
| Pnmax (KN) | 4096.08 | 4138.488 | 4180.896 | 4223.304 | 4265.712 | 4308.12 |
| | | | | | | |
| c b | 267.3913 | 267.3913 | 267.3913 | 267.3913 | 267.3913 | 267.3913 |
| εs=εy | 0.0016 | 0.0016 | 0.0016 | 0.0016 | 0.0016 | 0.0016 |
| ab | 227.28261 | 227.2826 | 227.2826 | 227.28261 | 227.2826 | 227.2826 |
| ε's | 0.0025512 | 0.002551 | 0.002551 | 0.0025512 | 0.002551 | 0.002551 |
| | | | | | | |
| Pnb(N) | 2295332.6 | 2293038 | 2290743 | 2288447.6 | 2286153 | 2283858 |
| kN | 2295.3326 | 2293.038 | 2290.743 | 2288.4476 | 2286.153 | 2283.858 |
| Mnb(Nmm) | 360475177 | 3.71E+08 | 3.81E+08 | 391169452 | 4.01E+08 | 4.12E+08 |
| kNm | 360.47518 | 370.7066 | 380.938 | 391.16945 | 401.4009 | 411.6323 |
| e(mm) | 157.04703 | 161.6662 | 166.2946 | 170.93223 | 175.5792 | 180.2355 |
| c1 (kalkulator) | 47.750865 | 52.52595 | 57.30104 | 62.076125 | 66.85121 | 71.6263 |
| a | 40.588235 | 44.64706 | 48.70588 | 52.764706 | 56.82353 | 60.88235 |
| ko~ εs | 0.0227587 | 0.020417 | 0.018466 | 0.0168144 | 0.015399 | 0.014172 |
| ko~ ε's | 0.000487 | 0.000715 | 0.000906 | 0.0010669 | 0.001205 | 0.001325 |
| M0(Nmm) | 168686931 | 1.99E+08 | 2.29E+08 | 259441713 | 2.89E+08 | 3.19E+08 |
| KNm | 168.68693 | 199.1066 | 229.3582 | 259.44171 | 289.3572 | 319.1047 |
| | | | | | | |
| M | 0 | 0 | 0 | 0 | 0 | 0 |
| | 184.3236 | 186.232 | 188.1403 | 190.04868 | 191.957 | 193.8654 |
| | 360.47518 | 370.7066 | 380.938 | 391.16945 | 401.4009 | 411.6323 |
| | 168.68693 | 199.1066 | 229.3582 | 259.44171 | 289.3572 | 319.1047 |
| | | | | | | |
| P | 5120.1 | 5173.11 | 5226.12 | 5279.13 | 5332.14 | 5385.15 |
| | 4096.08 | 4138.488 | 4180.896 | 4223.304 | 4265.712 | 4308.12 |
| | 2295.3326 | 2293.038 | 2290.743 | 2288.4476 | 2286.153 | 2283.858 |
| | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 |

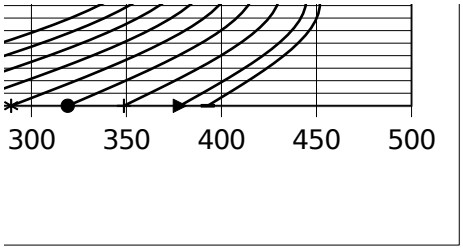



1000
0
0
50
100
150
200
250
Mn (kNm)

| | | | | | | |
|---|---|---|---|---|---|---|
| 1.6 | 1.7 | 1.75 | 1.9 | 2 | 5.5 | 6 |
| 400 | 400 | 400 | 400 | 400 | 400 | 400 |
| 450 | 450 | 450 | 450 | 450 | 450 | 450 |
| 2880 | 3060 | 3150 | 3420 | 3600 | 9900 | 10800 |
| 1440 | 1530 | 1575 | 1710 | 1800 | 4950 | 5400 |
| 30 | 30 | 30 | 30 | 30 | 30 | 30 |
| 320 | 320 | 320 | 320 | 320 | 320 | 320 |
| 5438160 | 5491170 | 5517675 | 5597190 | 5650200 | 7505550 | 7770600 |
| 5438.16 | 5491.17 | 5517.675 | 5597.19 | 5650.2 | 7505.55 | 7770.6 |
| 4350.528 | 4392.936 | 4414.14 | 4477.752 | 4520.16 | 6004.44 | 6216.48 |
| | | | | | | |
| 267.3913 | 267.3913 | 267.3913 | 267.3913 | 267.3913 | 267.3913 | 267.3913 |
| 0.0016 | 0.0016 | 0.0016 | 0.0016 | 0.0016 | 0.0016 | 0.0016 |
| 227.2826 | 227.2826 | 227.2826 | 227.2826 | 227.2826 | 227.2826 | 227.2826 |
| 0.002551 | 0.002551 | 0.002551 | 0.002551 | 0.002551 | 0.002551 | 0.002551 |
| | | | | | | |
| 2281563 | 2279268 | 2278120 | 2274678 | 2272383 | 2192058 | 2180583 |
| 2281.563 | 2279.268 | 2278.12 | 2274.678 | 2272.383 | 2192.058 | 2180.583 |
| 4.22E+08 | 4.32E+08 | 4.37E+08 | 4.53E+08 | 4.63E+08 | 8.21E+08 | 8.72E+08 |
| 421.8637 | 432.0952 | 437.2109 | 452.558 | 462.7894 | 820.8893 | 872.0464 |
| 184.9012 | 189.5763 | 191.9174 | 198.9548 | 203.6582 | 374.4835 | 399.9144 |
| 76.40138 | 81.17647 | 83.56401 | 191.0035 | 212.226 | 233.45 | 254.6713 |
| 64.94118 | 69 | 71.02941 | 162.353 | 180.3921 | 198.4325 | 216.4706 |
| 0.013099 | 0.012152 | 0.011719 | 0.00344 | 0.002796 | 0.002269 | 0.00183 |
| 0.001429 | 0.001522 | 0.001564 | 0.002372 | 0.002435 | 0.002486 | 0.002529 |
| 3.49E+08 | 3.78E+08 | 3.93E+08 | 7.21E+08 | 7.77E+08 | 1.32E+09 | 1.43E+09 |
| 348.6842 | 378.0956 | 392.7383 | 721.295 | 776.901 | 1315.385 | 1429.851 |
| | | | | | | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 195.7738 | 197.6821 | 198.6363 | 201.4988 | 203.4072 | 270.1998 | 279.7416 |
| 421.8637 | 432.0952 | 437.2109 | 452.558 | 462.7894 | 820.8893 | 872.0464 |
| 348.6842 | 378.0956 | 392.7383 | 721.295 | 776.901 | 1315.385 | 1429.851 |
| | | | | | | |
| 5438.16 | 5491.17 | 5517.675 | 5597.19 | 5650.2 | 7505.55 | 7770.6 |
| 4350.528 | 4392.936 | 4414.14 | 4477.752 | 4520.16 | 6004.44 | 6216.48 |
| 2281.563 | 2279.268 | 2278.12 | 2274.678 | 2272.383 | 2192.058 | 2180.583 |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | |
| 7 | 8 | 9 | 10 | 11 | tidak memenuhi | |

**KOLOM**




300
350
400
450
500

## TABEL PERHITUNGAN PENULANGAN KOLOM

| Nama kolom | k1 | k2 | k3 | k4 | k5 |
|---|---|---|---|---|---|
| b (mm) | 400 | 400 | 400 | 400 | 400 |
| h (mm) | 400 | 450 | 400 | 450 | 400 |
| Ik ($mm^4$) | 2.13E+09 | 3.04E+09 | 2.13E+09 | 3.04E+09 | 2.13E+09 |
| Ib ($mm^4$) | 3.04E+09 | 3.04E+09 | 3.04E+09 | 3.04E+09 | 3.04E+09 |
| Ec (Mpa) | 25742.96 | 25742.96 | 25742.96 | 25742.96 | 25742.96 |
| D lantai ($kN/m^2$) | 3.93 | 3.93 | 3.93 | 3.93 | 3.21 |
| L lantai ($kN/m^2$) | 1.5 | 1.5 | 1.5 | 1.5 | 0.9 |
| Bd | 0.662732 | 0.662732 | 0.662732 | 0.662732 | 0.727891 |
| Eik ($Nmm^2$) | 1.32E+13 | 1.88E+13 | 1.32E+13 | 1.88E+13 | 1.27E+13 |
| Eik ($kNm^2$) | 13211.59 | 18811.03 | 13211.59 | 18811.03 | 12713.37 |
| Eib ($Nmm^2$) | 9.41E+12 | 9.41E+12 | 9.41E+12 | 9.41E+12 | 9.05E+12 |
| Eib ($kNm^2$) | 9405.514 | 9405.514 | 9405.514 | 9405.514 | 9050.83 |
| ψA | 0.758519 | 2.454545 | 0.624295 | 0.981818 | 0.48623 |
| ψB | 0 | 0 | 0 | 0 | 0.758519 |
| k | 0.61 | 0.66 | 0.6 | 0.626 | 0.70625 |
| Batas kelangsingan | | | | | |
| r (m) | 0.12 | 0.135 | 0.12 | 0.135 | 0.12 |
| λu (m) | 4.8 | 4.775 | 4.8 | 4.775 | 3.8 |
| M1 | -3.9721 | 9.1049 | 7.3934 | -10.1509 | 3.7352 |
| M2 | 9.7336 | -16.5689 | -13.0688 | 22.2793 | -14.7793 |
| (k x λu)/r | 24.4 | 23.34444 | 24 | 22.14185 | 22.36458 |
| 34-12(M1/M2) | 38.89698 | 40.59421 | 40.78875 | 39.46744 | 37.03278 |
| (k x λu)/r ≤ 34-12(M1/M2) maka pembesaran momen dapat diabaikan | | | | | |
| Perencanaan Tulangan | | | | | |
| Mu (kNm) | 85.3304 | 99.4338 | 114.3076 | 94.9318 | 49.1254 |
| Pu (kN) | 345.33 | 442.166 | 140.898 | 361.41 | 127.478 |
| Ag ($mm^2$) | 160000 | 180000 | 160000 | 180000 | 160000 |
| e (mm) | 247.0981 | 224.8789 | 811.2791 | 262.6707 | 385.3637 |
| Pu/(0,85*f'c*Ag*Ø) | 0.130215 | 0.148204 | 0.043167 | 0.121136 | 0.039056 |
| Ø use | 0.65 | 0.65 | 0.8 | 0.65 | 0.8 |
| Pu/(0,85*f'c*Ag*Ø)  x (e/h) | 0.08044 | 0.074062 | 0.087552 | 0.070709 | 0.037627 |
| ρ | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Ast ($mm^2$) | 1600 | 1800 | 1600 | 1800 | 1600 |
| As | 800 | 900 | 800 | 900 | 800 |
| Tulangan Ø 20 | 3 | 3 | 3 | 3 | 3 |
| As terpasang ($mm^2$) | 942 | 942 | 942 | 942 | 942 |

| k6 | k7 |
|---|---|
| 400 | 400 |
| 450 | 450 |
| 3.04E+09 | 3.04E+09 |
| 3.04E+09 | 3.04E+09 |
| 25742.96 | 25742.96 |
| 3.21 | 3.21 |
| 0.9 | 0.9 |
| 0.727891 | 0.727891 |
| 1.81E+13 | 1.81E+13 |
| 18101.66 | 18101.66 |
| 9.05E+12 | 9.05E+12 |
| 9050.83 | 9050.83 |
| 1.8 | 0.75 |
| 2.454545 | 0.981818 |
| 0.85 | 0.75036 |

| | |
|---|---|
| 0.135 | 0.135 |
| 3.775 | 3.775 |
| -15.7205 | 13.0132 |
| 55.5072 | -76.729 |
| 23.76852 | 20.98229 |
| 37.39859 | 36.03519 |

| | |
|---|---|
| | |
| 122.9175 | 106.3165 |
| 208.546 | 163.904 |
| 180000 | 180000 |
| 589.4023 | 648.651 |
| 0.056794 | 0.044636 |
| 0.8 | 0.8 |
| 0.074387 | 0.064341 |
| 0.01 | 0.01 |
| 1800 | 1800 |
| 900 | 900 |
| 3 | 3 |
| 942 | 942 |

**Perhitungan Kolom Dengan Daktilitas Terbatas**

**Data :**

| | | | | | | |
|---|---|---|---|---|---|---|
| * Nama Kolom | | | | | C3 | |
| * Dimensi Kolom | | h : | | | 300 | mm |
| | | b : | | | 300 | mm |
| * Selimut Beton | | : | | | 40 | mm |
| * Kualitas beton | | | | K | 225 | Mpa |
| * fy | | : | | | 400 | Mpa |
| * f'c ( 0.083*K Beton ) | | : | | | 18 | Mpa |
| * Diameter : | Tulangan | : | | | 16 | mm |
| | Sengkang | : | | | 10 | mm |
| * d' | | : | | | 58 | mm |
| * d | | : | | | 242 | mm |
| * d'/h | | : | | | 0.19333333 | |
| * Nu : | 320 | kN | | | | |
| * Mu | 35 | kNm | | B | | |
| * Vu | 15 | kN | | | | |
| * Ag | 900 | cm2 | | | 90000 | mm2 |

**Perhitungan tulangan kolom**

| | | | | |
|---|---|---|---|---|
| * $\phi$.Ag.0.85.fc' | 8950.5 | untuk $\phi$ | | 0.65 |
| | 11016 | untuk $\phi$ | | 0.8 |
| * $\phi$.Ag.0.5.fc'.h | 206550 | untuk $\phi$ | | 0.85 |
| * $\frac{Nu}{\phi.Ag.0.85.fc'}$ | 0.357521926 | untuk $\phi$ | | 0.65 |
| * $\frac{Nu}{\phi.Ag.0.85.fc'}$ | 0.290486565 | untuk $\phi$ | | 0.8 |
| * $\frac{Mu}{\phi.Ag.0.5.fc'.h}$ | 0.169450496 | | | |
| * r : | 2.125 | % | | |
| ( Iterasi Kolom CUR IV ) | | | | |
| * $\beta$ : | 0.8 | | | |
| ( Iterasi Kolom CUR IV ) | | | | |
| * $\rho$ | 0.017 | | | |
| *r*$\beta$* | | | | |
| * As | 1234.2 | mm2 | | |
| $\rho$*b*d* | | | | |
| * Atul | 201.1428571 | mm2 | | |
| *1/4*22/7*D2* | | | | |
| * n Tul | 6.1359375 | D | | 16 |
| * n Pakai | 8 | D | | 16 |

**Perhitungan tulangan geser**

| | | | |
|---|---|---|---|
| * Diameter sengkang : | 10 | mm | |
| * fy sengkang | 240 | Mpa | |
| * Vc | 51.33595231 | kN | |
| *1/6*$\sqrt{}$fc'*b*d* | | | |
| * Vn | 23.07692308 | kN | |
| *Vu/0.6* | | | |
| * Vn | < | Vc | |
| 23.0769230769231 | < | 240 | |
| Memakai tulangan geser min | | | |
| * S min : | 121 | | |

*d/2*

* S pasang 100 mm

**Kesimpulan**

* Dimensi kolom h : 300 mm

b : 300 mm

* Selimut beton 40 mm

* Tulangan 8 D 16

* Sengkang

| | | | | | |
|---|---|---|---|---|---|
| Tumpuan | 10 | - | 100 | mm | 1/4 l |
| Lapangan | 10 | - | 120 | mm | 1/2 l |

| Pondasi pada kolom | k1 | k2 | k3 | k4 |
|---|---|---|---|---|
| Dimensi kolom | 40/40 | 40/45 | 40/40 | 40/45 |
| σ t (kN/m2) | 300 | 300 | 300 | 300 |
| γ t (kN/m3) | 16 | 16 | 16 | 16 |
| γ b (kN/m3) | 24 | 24 | 24 | 24 |
| Kedalaman pondasi (m) | 2 | 2 | 2 | 2 |
| t (m) | 0.4 | 0.4 | 0.4 | 0.4 |
| p (mm) | 70 | 70 | 70 | 70 |
| D tulangan utama | 22 | 22 | 22 | 22 |
| Df (m) | 1.6 | 1.6 | 1.6 | 1.6 |
| Mu (kNm) | 85.3304 | 99.4338 | 114.3076 | 94.1254 |
| Pu (kN) | 345.33 | 442.166 | 140.898 | 361.41 |
| Berat tanah q1 (kN/m2) | 25.6 | 25.6 | 25.6 | 25.6 |
| Berat pondasi q2 (kN/m2) | 9.6 | 9.6 | 9.6 | 9.6 |
| σijin (kN/m2) | 264.8 | 264.8 | 264.8 | 264.8 |
| PD (mm) | 217.646 | 281.841 | 82.871 | 226.515 |
| PL (mm) | 45.12 | 64.973 | 25.106 | 45.992 |
| PE (mm) | 39.034 | 11.781 | 16.347 | 43.6 |
| MD (kNm) | 3.907 | 5.0529 | 4.782 | 15.2212 |
| ML (kNm) | 3.1533 | 1.9009 | 1.0344 | 2.5086 |
| ME (kNm) | 82.1918 | 91.4694 | 107.5348 | 85.4162 |
| P total (kN) | 301.8 | 358.595 | 124.324 | 316.107 |
| M total (kNm) | 89.2521 | 98.4232 | 113.3512 | 103.146 |
| Dicoba lebar pondasi B | 1.8 | 1.7 | 6 | 2 |
| σmax terjadi (kN/m2) | 184.9713 | 244.2806 | 6.602089 | 156.3863 |
| σmax terjadi < σ ijin | ok | ok | ok | ok |
| σmin terjadi (kN/m2) | 1.325 | 3.882007 | 0.3048 | 1.66725 |
| σmin terjadi > 0 | ok | ok | ok | ok |

## PLATE FOUNDATION

**Data**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| * | Name foundation | | : | F1 | | | | |
| * | Dimension foundation | x | : | 1 | m | : | 1000 | mm |
| | | y | : | 1 | m | : | 1000 | mm |
| * | fc' | | : | 18 | Mpa | | | |
| * | Reinforcement bar | D | : | 16 | mm | | | |
| | | fy | : | 400 | Mpa | | | |
| * | Dimension column | x | : | 350 | mm | : | | 0.35 |
| | | y | : | 350 | mm | : | | 0.35 |
| * | Plate thichness | | : | 300 | mm | | | |
| * | Concrete decking | | : | 40 | mm | | | |
| * | d | | : | 236 | mm | : | 0.236 | m |
| * | Vu ( axial force ) | | : | 580 | kN | | | |
| * | Mu ( moment force ) | | : | 20 | kN | | | |

**Soil's up lift force**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| * | qC | | : | 10 | kg/cm2 | : | | 981 |
| * | σt | | : | 580 | kN/m2 | < | | 981 |
| | | | | | | ( OK ) | | |

**qu**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| * | Vu/(x*y) | | : | 580 | kN/m2 | | | |
| * | Mu*6/(x*y2) | | : | 120 | kN/m2 | | | |
| * | qu 1 | | : | 700 | kN/m2 | | | |
| * | qu 2 | | : | 460 | kN/m2 | | | |
| * | x at force area | | : | 1 | m | : | 1000 | mm |
| * | y at force area | | : | 0.089 | m | : | 89 | mm |
| * | qu1-qu2 | | : | 240 | kN/m2 | | | |
| * | q3' | | : | 218.64 | kN/m2 | | | |
| * | q3 | | : | 678.64 | kN/m2 | | | |
| * | qu at force area | | : | 689.32 | kN/m2 | | | |
| * | qu ( average ) | | : | 580 | kN/m2 | | | |

**Shear checking**

**I One way**

**x direction**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| * | Volume at force area | | : | 89000 | mm2 | : | 0.089 | m2 |
| * | Vu at force area | | : | 62.3 | kN | | | |
| * | ϕ Vc | | : | 100.12632 | kN | > | | 62.3 |
| | 0.6*1/6*√fc'*b*d | | | | | ( OK ) | | |

**y direction**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| * | Volume at force area | | : | 0.089 | m2 | : | 89000 | mm2 |
| * | Vu at force area | | : | 61.34948 | kN | | | |
| * | ϕ Vc | | : | 100.12632 | kN | > | | 61.3495 |
| | 0.6*1/6*√fc'*b*d | | | | | ( OK ) | | |

**II Pons**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| * | ax | | : | 0.586 | m | : | 586 | mm |
| * | ay | | : | 0.586 | m | : | 586 | mm |
| * | Aa | | : | 0.343396 | m2 | | | |
| * | Aplate | | : | 1 | m2 | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| * | A force area | | | : | 0.656604 | m2 | | |
| * | bo | | | : | 2.344 | m | : | 2344 mm |
| * | βc | | | : | 1 | | | |
| * | λs | | | : | 40 | | | |
| | 40 for interior column | | | | | | | |
| | 30 for exterior column | | | | | | | |
| | 20 for corner column | | | | | | | |
| * | Vu at force area | | | : | 380.83032 | kN | | |
| * | Vc 1 | | | : | 14081.766 | kN | | |
| | (2+4/βc)*√fc'*bo*d | | | | | | | |
| * | Vc2 | | | : | 1178.8205 | kN | | |
| | [(λs*d/bo)+2)]1/12*√fc'*bo*d | | | | | | | |
| * | Vc3 | | | : | 9387.8438 | kN | | |
| | 4*√fc'*bo*d | | | | | | | |
| * | Vc | | | : | 1178.82 | kN | | |
| | The smallest among | | | | | | | |
| | Vc1,Vc2,Vc3 | | | | | | | |
| * | ϕ Vc | | | : | 707.292 | kN | > | 380.83 |
| | | | | | | | ( OK ) | |

**Reinforcement desain**

**x direction**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| * | qu | | | : | 700 | kN | | |
| * | l | | | : | 0.5 | m | | |
| * | Mu | | | : | 87.5 | kNm | | |
| * | Mu/bd2 | | | : | 1571.0284 | | | |
| * | ρ | | | : | 0.00524 | | | |
| | CUR 4 | | | | | | | |
| * | As | | | : | 1236.64 | mm2 | | |
| | ρ*b*d | | | | | | | |
| * | Atul | | | : | 201.14286 | mm2 | | |
| * | Reinforcement | D | 16 | - | 162.6527 | mm | | |
| * | Use | D | 16 | - | 150 | mm | | |

**y direction**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| * | qu | qu1 | | : | 580 | kN/m2 | | |
| | | qu2 | | : | 700 | kN/m2 | | |
| * | l | | | : | 0.5 | m | | |
| * | Mu | | | : | 82.5 | kNm | | |
| * | Mu/bd2 | | | : | 1481.2554 | | | |
| * | ρ | | | : | 0.00375 | | | |
| | CUR 4 | | | | | | | |
| * | As | | | : | 885 | mm | | |
| | ρ*b*d | | | | | | | |
| * | Reinforcement | D | 16 | - | 227.2801 | mm | | |
| * | Use | D | 16 | - | 150 | mm | | |

**Resume**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| * | Dimension plate | x | = | | 1 | m | | |
| | | y | = | | 1 | m | | |
| | | t | = | | 0.3 | m | | |
| * | Concrete decking | | = | | 40 | mm | | |
| * | Reinforcement bar | x | = | D | 16 | - | 150 | |

y = D 16 - 150

m
m

kN/m2
kN/m2

kN

kN

kN

mm

mm

**PILE FOUNDATION**

**Data**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| * | Concrete quality | | K | | 500 | | | | |
| * | fc' pile foundation | | : | | 40 | Mpa | | | |
| * | fc' poer | | : | | 18 | Mpa | | | |
| * | fy | | : | | 400 | Mpa | | | |
| * | Pile dimension | | | | 20 | x | | 20 | cm |
| * | P | | : | | 550 | kN | : | 56065.24 | kg |
| * | M | | : | | 50 | kNm | : | 5096.84 | kgm |
| * | Poer dimension | x | : | | 0.8 | m | | | |
| | | y | : | | 1.2 | m | | | |
| | | t | : | | 0.5 | m | : | 500 | mm |
| * | Selimut beton poer | | : | | 50 | mm | | | |
| * | Dimensi kolom | x | : | | 400 | mm | | | |
| | | y | : | | 400 | mm | | | |
| * | Diameter tulangan poer | | : | | 22 | mm | | | |
| * | d | | : | | 417 | mm | : | 0.417 | m |
| * | qC ( conus resistant ) | | : | | 55 | kg/cm2 | | | |
| * | JHP | | : | | 550 | kg/cm2 | | | |

**Kekuatan bahan tiang pancang**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| * | Ab | | : | | 400 | cm2 | | | |
| * | Ak | | : | | 80 | cm | | | |
| * | Qall | | : | 16133.33 | kg | | | | |
| | qC*Ab/3+JHP*Ak/5 | | | | | | | | |
| * | Beban Poer | | : | | 3180 | kg | | | |
| * | Pu | | : | 59245.24 | kg | : | 581.1958 | kN | |
| * | Banyak tiang pancang | | : | | 8 | buah | | | |
| * | Pt | | : | 7405.655 | kg | : | 72.64948 | kN | |
| * | Jarak antar tiang | x | : | | 1.5 | m | | | |
| | | y | : | | 1.5 | m | | | |
| * | Jumlah tiang | x | : | | 4 | buah | | | |
| | | y | : | | 2 | buah | | | |
| * | Beban akibat momen | | : | 849.4733 | kg | | | | |
| * | Beban gabungan | P1 | : | 8255.128 | kg | : | 80.98281 | kN | |
| | | P2 | : | 6556.182 | kg | : | 64.31614 | kN | |
| * | P terbesar | | : | 39000 | kg | : | 382.59 | kN | |
| * | Cek fc' tiang pancang | | : | 9.75 | Mpa | | < | | 13.2 |
| | | | | | | | ( OK ) | | |
| * | Cek daya dukung tiang | | : | 16133.33 | kg | | > | | 39000 |
| | | | | | | | ( OK ) | | |

**Penulangan poer**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| * | Dimensi poer | x | : | | 0.8 | m | | | |
| | | y | : | | 1.2 | m | | | |
| | | t | : | | 0.5 | m | | | |
| * | Selimut beton poer | | : | | 50 | mm | | | |
| * | ax | | : | | 817 | mm | : | 0.817 | m |
| * | ay | | : | | 817 | mm | : | 0.817 | m |
| * | bo | | : | | 3268 | mm | : | 3.268 | m |

**Geser pada ujung kolom**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| * | $\phi$ Vc | | : | 20685.18 | kN | | > | | 550 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 0.6*4*√fc'*bo*d | | | | | | ( OK ) | |
| | **Geser pada ujung tiang** | | | | | | | |
| * | 2 Pu | | : | 118490.5 | kg | : | 1162.392 | kN |
| * | Mu | | : | 59245.5 | kgm | : | 581.1984 | kNm |
| * | Mu/bd2 | | : | 2785.294 | | | | |
| * | ρ | | | 0.0099 | | | | |
| | CUR 4 | | | | | | | |
| * | As | | : | 0.004954 | m2 | : | 49.5396 | cm2 |
| | ρ*b*d | | | | | | | |
| * | As for | 1.2 | : | 41.283 | cm2 | : | 4128.3 | mm2 |
| * | D tulangan poer | | : | 22 | mm | | | |
| * | Atul | | : | 380.2857 | mm2 | | | |
| * | S | | : | 92.11678 | mm | | | |
| | **Geser Lentur** | | | | | | | |
| * | ϕ Vc | | : | 212.3017 | kN | | | |
| | 0.6*1/6*√fc'*b*d | | | | | | | |
| * | Vu | | : | 1162.392 | kN | | > | 212.3017 |
| | > perlu tulangan geser | | | | | | | |
| | < tidak perlu tulangan geser | | | | | | | |
| | **Tulangan geser** | | | | | | | |
| * | S | | : | 100 | mm | | | |
| * | Av | | : | 380.2857 | mm2 | | | |
| * | d | | : | 417 | mm | | | |
| * | ϕ Vs | | : | 761.1799 | kN | | | |
| | 0.6*2*Av*fy*d/s | | | | | | | |
| * | ϕ (Vc+ Vs) | | : | 973.4816 | kN | | > | 1162.392 |
| | | | | | | | ( OK ) | |
| **Resume** | | | | | | | | |
| * | Jumlah tiang pancang | | : | 8 | | | | |
| * | Kualitas tiang pancang | | K | 500 | | | | |
| * | Dimensi tiang pancang | | : | 20 | x | | 20 | cm |
| * | Dimensi poer | x | : | 0.8 | m | | | |
| | | y | : | 1.2 | m | | | |
| | | t | : | 0.5 | m | | | |
| * | Selimut beton poer | | : | 50 | mm | | | |
| * | Tulangan poer | | : | 22 | mm | | | |
| * | fc' poer | | : | 18 | Mpa | | | |
| * | fy poer | | : | 400 | Mpa | | | |
| * | Tulangan poer | D | 22 | - | 100 | mm | | |

| | |
|---|---|
| k | 225 |
| fc' | 18.675 |

kg

kN

kN

kN