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LAMPIRAN 1

(Retak Awal dan Lendutan pada PP-1)

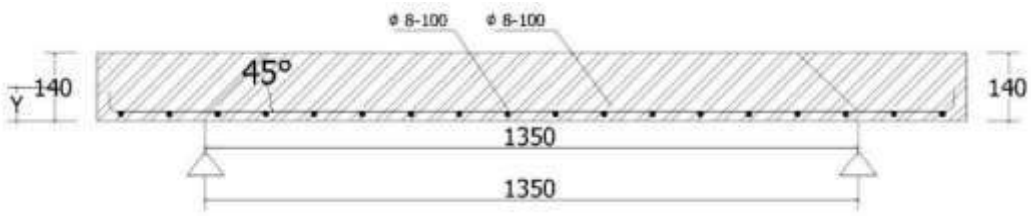
Lebar Pelat (L)	=	2600	mm			
Panjang Pelat (b)	=	1350	mm			
Tebal Pelat (h)	=	140	mm			
Diameter (ds)	=	7,8	mm			
Jarak antar Tulangan	=	100	mm			
Fy	=	402,4	Mpa			
Es	=	200000	Mpa			
Mutu beton (fc)	=	25	Mpa			
Modulus Elastisitas Beton (Ec)	=	21299,16	Mpa			
Selimut Beton (d')	=	20	Mm			
Berat Sendiri	=	1164,405	Kg/m3	=	3,254	kN/m2
Pelat Beban	=	1217,52	Kg/m3	=	3,403	kN/m2
Pasir	=	559,66	Kg/m3	=	1,564	kN/m2
Pasir + Pelat Beban	=	4,967	kN/m2			
Poisson Ratio (v)	=	0,2				
Jumlah Tulangan (ns)	=	24	buah			

Secara analitis beban retak awal dapat dihitung dengan cara berikut ini :

f_r = 0,62 x $\sqrt{f'c}$

= 3,100 Mpa

Titik berat penampang :



Gambar 1. Titik Berat Penampang PP-1

N = $\frac{Es}{Ec}$

= $\frac{200000}{21299,16}$

= 9,390

Y = $\frac{b\ .h\left(\frac{1}{2}h\right)+(n-1).ns.\frac{1}{4}.\pi.ds^2.d'}{b.h+(n-1).ns.\frac{1}{4}.\pi.ds'}$

= $\frac{13422435,17}{198621,7584}$

= 67,578 mm

Momen Inersia Penampang

I solid = $\frac{1}{12}$. b.h^3 + b.h. ($\frac{1}{2}$. h –y)^2

= 308700000 + 1108809,81

= 309808809.8 mm^4

I tulangan = (n-1).ns. $\frac{1}{64}$.π.ds^4 + (n-1).ns. $\frac{1}{64}$.π.ds^2 .(y-d')^2

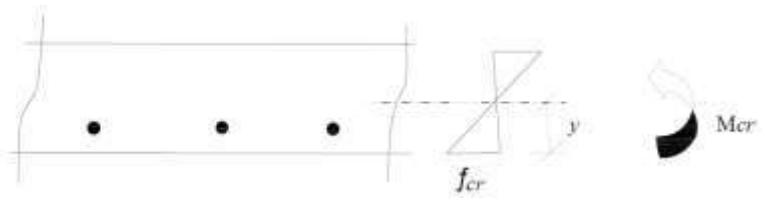
= 36586,73621 + 21780328,2

= 21816914,89 mm^4

I netto = 309808809.8 mm^4 + 21816914,89 mm^4

= 331625724,7 mm^4

Momen Retak



Gambar 2. Momen Retak

Mcr = $\frac{fr}{y}$. I netto

= $\frac{3{,}310}{67{,}578}$ x 331625724,7

= 15,213 kNm

Beban Retak

∑ M = M beban + M berat sendiri

Mcr = P.($\frac{1}{2}$. l) + $\frac{1}{8}$. q . l^2

Pcr = $\frac{2.Mcr - \frac{1}{8}.q.l^2}{\frac{1}{2}.l}$

= $\frac{27{,}675}{1{,}3}$

= 21,289 kN

Lendutan akibat berat sendiri pelat

δq = $\frac{5.q.l^4}{384.EI}$ (1 – v^2)

= $\frac{743{,}583}{2712{,}326}$. 0,96

= 0,263 mm

Lendutan saat beban retak awal.

δcr = δq + $\frac{P.L^3}{48.EI}$ (1 – v^2)

$$= \quad 0{,}23 + \frac{374{,}171}{339{,}041}\ 0{,}96$$

$$= \quad 1{,}323 \text{ mm}$$

LAMPIRAN 2

(Retak Awal dan Lendutan PB-2)

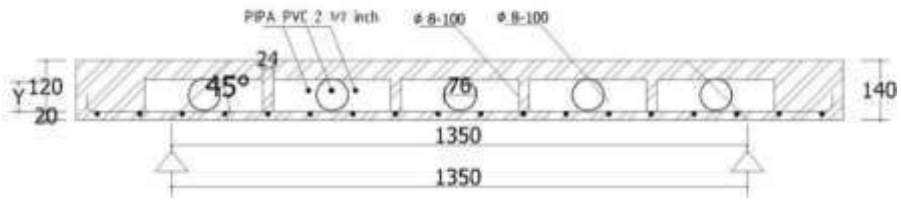
Lebar Pelat (L)	=	2600	mm			
Panjang Pelat (b)	=	1350	mm			
Tebal Pelat (h)	=	140	mm			
Diameter (ds)	=	7,8	mm			
Jarak antar Tulangan	=	100	mm			
Fy	=	402,4	Mpa			
Es	=	200000	Mpa			
Mutu beton (fc)	=	25	Mpa			
Modulus Elastisitas Beton (Ec)	=	21299,16	Mpa			
Selimut Beton (d')	=	20	Mm			
Berat Sendiri	=	1003,173	Kg/m3	=	2,804	kN/m2
Pelat Beban	=	1217,52	Kg/m3	=	3,403	kN/m2
Pasir	=	559,66	Kg/m3	=	1,564	kN/m2
Pasir + Pelat Beban	=	4,967	kN/m2			
Poisson Ratio (v)	=	0,2				
Jumlah Tulangan (ns)	=	24	buah			
Jumlah pvc bentang pendek(nk)	=	4	buah			
Jumlah pvc bentang pendek(nk)	=	8	buah			

Secara analitis beban retak awal dapat dihitung dengan cara berikut ini :

f_r = 0,62 x $\sqrt{f'c}$

= 3,310 Mpa

Titik berat penampang :



Gambar 3. Titik Berat Penampang PB-2

n = $\frac{Es}{Ec}$

= $\frac{200000}{21299,16}$

= 9,390

Y = $\frac{b\ .h\left(\frac{1}{2}h\right)+(n-1).ns.\frac{1}{4}.\pi.ds^2.d'}{b.h+(n-1).ns.\frac{1}{4}.\pi.ds'}$

= $\frac{12152226,43}{180475,92}$

= 67,334 mm

Momen Inersia Penampang

I solid = $\frac{1}{12}$. b.h^3 + b.h. ($\frac{1}{2}$. h –y)^2

= 308700000 + 1342988,15

= 310042988,2 mm^4

I tulangan = (n-1).ns. $\frac{1}{64}$.π.ds^4 + (n-1).ns. $\frac{1}{64}$.π.ds^2 .(y-d')^2

= 36586,73621 + 21557929,6

= 21594516,35 mm^4

I Rongga

Ix = nk . $\frac{1}{64}$. π dk^4 + nk . $\frac{1}{4}$. π dk^2 (83,5 –y)^2

= 6550647,94 + 4742027,64

= 11292675,58

Iy = nk . $\frac{1}{64}$. π dk^4 + nk . $\frac{1}{4}$. π dk^2 (83,5 –y)^2

= 13101295,88 + 9484055,28

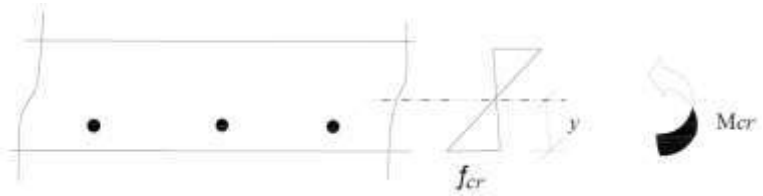
= 22585351,15

I netto = Isolid + I tulangan – I rongga

= 310042988,2 + 21594516,3 – 33878026,73

= 297759477,77 mm^4

Momen Retak



Gambar 4. Momen Retak

Mcr = $\frac{fr}{y}$. I netto

= $\frac{3,310}{67,578}$ x 297759477,8

= 13,709 kNm

Beban Retak

∑ M = M beban + M berat sendiri

Mcr = P.($\frac{1}{2}$. l) + $\frac{1}{8}$. q . l^2

Pcr = $\frac{2.Mcr - \frac{1}{8}.q.l^2}{\frac{1}{2}.l}$

$$= \frac{25{,}048}{1{,}3}$$

$$= 19{,}268 \text{ kN}$$

Lendutan akibat berat sendiri pelat

$$\delta q = \frac{5.q.l^4}{384.EI} (1 - v^2)$$

$$= \frac{640{,}621}{2435{,}338} . 0{,}96$$

$$= 0{,}253 \text{ mm}$$

Lendutan saat beban retak awal.

$$\delta cr = \delta q + \frac{P.L^3}{48.EI} (1 - v^2)$$

$$= 0{,}23 + \frac{338{,}647}{304{,}417} 0{,}96$$

$$= 1{,}320 \text{ mm}$$

LAMPIRAN 3

(Retak Awal dan Lendutan PB-3)

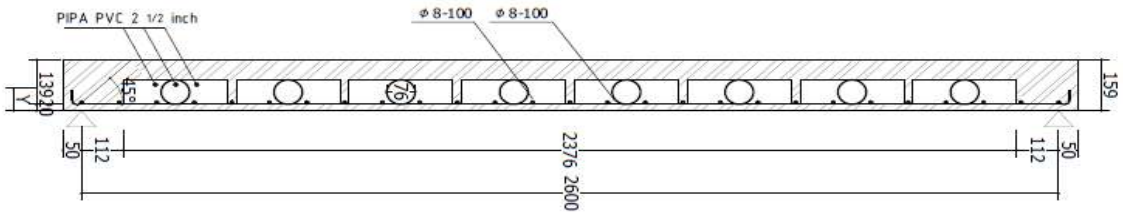
Lebar Pelat (L)	=	2600	mm			
Panjang Pelat (b)	=	1350	mm			
Tebal Pelat (h)	=	159	mm			
Diameter (ds)	=	7,8	mm			
Jarak antar Tulangan	=	100	mm			
Fy	=	402,4	Mpa			
Es	=	200000	Mpa			
Mutu beton (fc)	=	25	Mpa			
Modulus Elastisitas Beton (Ec)	=	21299,16	Mpa			
Selimut Beton (d')	=	20	Mm			
Berat Sendiri	=	1162,880	Kg/m3	=	3,250	kN/m2
Pelat Beban	=	1217,52	Kg/m3	=	3,403	kN/m2
Pasir	=	559,66	Kg/m3	=	1,564	kN/m2
Pasir + Pelat Beban	=	4,967	kN/m2			
Poisson Ratio (v)	=	0,2				
Jumlah Tulangan (ns)	=	24	buah			
Jumlah pvc bentang pendek(nk)	=	4	buah			
Jumlah pvc bentang pendek(nk)	=	8	buah			

Secara analitis beban retak awal dapat dihitung dengan cara berikut ini :

f_r = 0,62 x $\sqrt{f'c}$

= 3,310 Mpa

Titik berat penampang :



Gambar 5. Titik Berat Penampang PB-3

n = $\frac{Es}{Ec}$

= $\frac{200000}{21299,16}$

= 9,390

Y = $\frac{b\ .h\left(\frac{1}{2}h\right)+(n-1).ns.\frac{1}{4}.\pi.ds^2.d'}{b.h+(n-1).ns.\frac{1}{4}.\pi.ds'}$

= $\frac{16020768,03}{207475,92}$

= 77,217 mm

Momen Inersia Penampang

I solid = $\frac{1}{12}$. b.h^3 + b.h. ($\frac{1}{2}$. h –y)^2

= 460800000 + 1672359,918

= 462472359,9 mm^4

I tulangan = (n-1).ns. $\frac{1}{64}$.π.ds^4 + (n-1).ns. $\frac{1}{64}$.π.ds^2 .(y-d')^2

= 36586,73621 + 31228229,6

= 31536686,42 mm^4

I Rongga

Ix = nk . $\frac{1}{64}$. π dk^4 + nk . $\frac{1}{4}$. π dk^2 (83,5 –y)^2

= 6550647,94 + 716216,89

= 7266864,82

Iy = nk . $\frac{1}{64}$. π dk^4 + nk . $\frac{1}{4}$. π dk^2 (83,5 –y)^2

= 13101295,88 + 716216,89

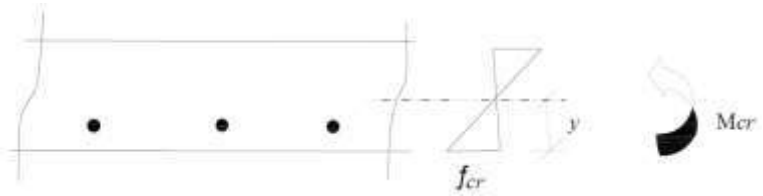
= 14533729,65

I netto = Isolid + I tulangan – I rongga

= 462472359,9+ 31536686,42 – 21800594,47

= 472208451,86 mm^4

Momen Retak



Gambar 6. Momen Retak

Mcr = $\frac{fr}{y}$. I netto

= $\frac{3,310}{77,217}$ x 472208451,9

= 18,957 kNm

Beban Retak

∑ M = M beban + M berat sendiri

Mcr = P.($\frac{1}{2}$. l) + $\frac{1}{8}$. q . l^2

Pcr = $\frac{2.Mcr - \frac{1}{8}.q.l^2}{\frac{1}{2}.l}$

$$= \frac{35,159}{1,3}$$

= 27,045 kN

Lendutan akibat berat sendiri pelat

$$\delta q = \frac{5.q.l^4}{384.EI} (1 - v^2)$$

$$= \frac{745,223}{3862,135} . 0,96$$

= 0,185 mm

Lendutan saat beban retak awal.

$$\delta cr = \delta q + \frac{P.L^3}{48.EI} (1 - v^2)$$

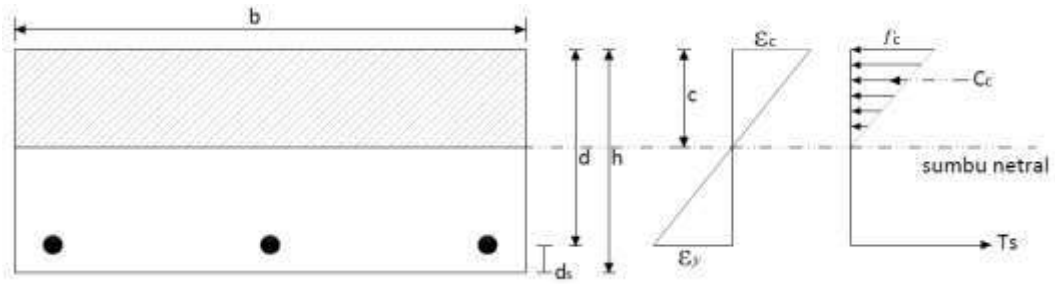
$$= 0,185 + \frac{475,348}{482,767} 0,96$$

= 1,130 mm

LAMPIRAN 4

(Beban Leleh pada PP-1)

Lebar Pelat (L)	=	2600	mm			
Panjang Pelat (b)	=	1350	mm			
Tebal Pelat (h)	=	140	mm			
Diameter (ds)	=	7,8	mm			
Jarak antar Tulangan	=	100	mm			
Fy	=	402,4	Mpa			
Es	=	200000	Mpa			
Mutu beton (fc)	=	25	Mpa			
Modulus Elastisitas Beton (Ec)	=	21299,16	Mpa			
Selimut Beton (d')	=	20	Mm			
Berat Sendiri	=	1164,405	Kg/m3	=	3,254	kN/m2
Pelat Beban	=	1217,52	Kg/m3	=	3,403	kN/m2
Pasir	=	559,66	Kg/m3	=	1,564	kN/m2
Pasir + Pelat Beban	=	4,967	kN/m2			
Poisson Ratio (v)	=	0,2				
Jumlah Tulangan (ns)	=	24	buah			



Gambar 7. Diaagram Penampang Retak Awal

Dengan anggapan tulangan baja mengalami kondisi leleh pertama, ketika εy = $\frac{fy}{Es}$ tegangan Tarik baja (fy) beton tarik diabaikan. Distribusi tegangan beton

dianggap masih berbentuk segitiga, dimana tegangan beton (fc = εc . Es) tetapi harus dicek fc ≤ fc', konstribusi beton bagian tarik diabaikan.

As = n x ¼ . π. d^2

= 10 x 0,3 x 3,143 x 60,840

= 478,029 mm^2

$\varepsilon y = \frac{fy}{Es}$

$= \frac{402,4}{200000}$

= 0,002012

$\frac{\varepsilon c}{\varepsilon y} = \frac{c}{d-c}$

$\frac{\varepsilon c}{0,002012} = \frac{c}{116-c}$

$\varepsilon c = \frac{0,002012.c}{116-c}$

fc = εc . Ec

$fc = \frac{0,002012.c}{116-c}$. 4700. 5,3395

$= \frac{23641\ x\ c^2}{116-c}$

Gaya tarik baja

Ts = As x fy

= 478,029 x 402,400

= 192358,6971 N

Berdasarkan syarat kesimbangan Cc = Ts, didapat persamaan sebagai berikut :

$\frac{23641\ x\ c^2}{116-c}$ = 192358,697

c = 25,629 mm

Kontrol :

fc = $\frac{47{,}282\ x\ c}{116-c}$

= 13,394 < 25……ok

Momen yang terjadi :

Cc = $\frac{23641\ x\ 656{,}84}{116-25{,}629}$

Ec = $\frac{0{,}002\ x\ 25{,}629}{116-25{,}629}$

= 0,001

yc = 2/3 x c

= 17,086 mm

yt = d – c

= 90,471 mm

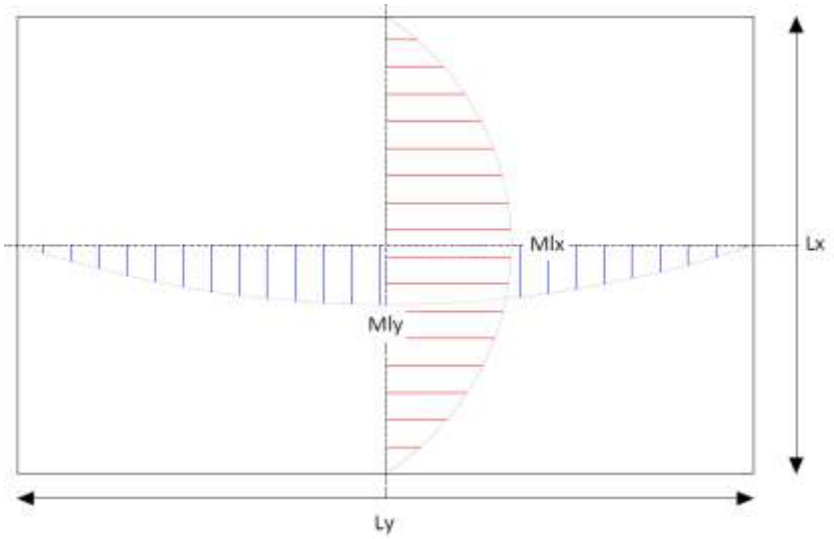
M = (Cc x yc) + (Ts x yt)

= 20335530,234

= 20,336 kN

Perbandingan bentang panjang dan bentang pendek (ly/lx)

= 1,92 < 2 (termasuk pelat dua arah)



Gambar 8. Lendutan pada Penampang Pelat

Metode analitis kekuatan lentur pelat dua arah dengan menggunakan metode koefisien momen dari table koefisien momen didapatkan koefisien Clx = 97 dan Cly = 38.

Momen lapangan arah sumbu x Mlx = Clx x 0,001 x q X lx^2 sedangkan Momen lapangan arah sumbu y Mly = Cly x 0,001 x q X ly^2.

Momen lapangan = Mn

Momen lapangan arah sumbu x :

Mlx = 97 x 0,001 x q(beban mati + beban hidup) x 1,823

20,336 = 97 x 0,001 x q(3,254 + beban hidup) x 1,823

Beban hidup = 111,777 kN/m^2

Beban hidup pelat pejal (PP-1) adalah sebesar :

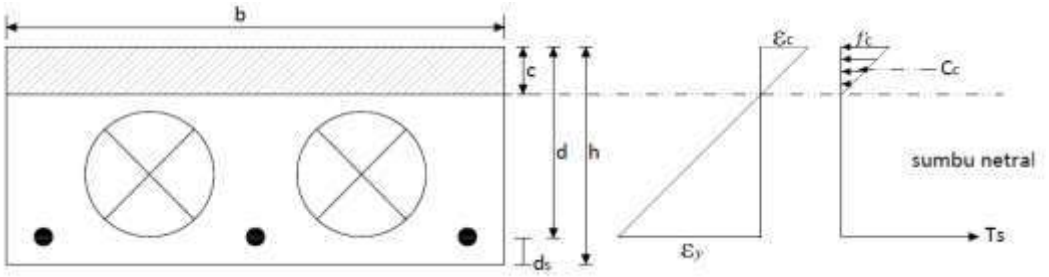
Beban hidup = 111,777 x 1,35 x 2,6

= 392,337 kN

LAMPIRAN 5

(Beban Leleh pada Pelat Berongga PB-2)

Lebar Pelat (L)	=	2600	mm			
Panjang Pelat (b)	=	1350	mm			
Tebal Pelat (h)	=	140	mm			
Diameter (ds)	=	7,8	mm			
Jarak antar Tulangan	=	100	mm			
Fy	=	402,4	Mpa			
Es	=	200000	Mpa			
Mutu beton (fc)	=	25	Mpa			
Modulus Elastisitas Beton (Ec)	=	21299,16	Mpa			
Selimut Beton (d')	=	20	Mm			
Berat Sendiri	=	1003,173	Kg/m3	=	2,804	kN/m2
Pelat Beban	=	1217,52	Kg/m3	=	3,403	kN/m2
Pasir	=	559,66	Kg/m3	=	1,564	kN/m2
Pasir + Pelat Beban	=	4,967	kN/m2			
Berat Jenis beton	=	2333,33	Kg/m3	=	22,89	kN/m3



b = 1000 mm

Gambar 9. Diagram Penampang Retak Awal pada PB-2

pada pelat berongga PB-2 letak garis netral dianggap masih berada diatas rongga sehingga perhitungan secara analitis beban pada saat leleh dianggap

sama dengan pelat pejal PP-1, $\varepsilon y = \frac{fy}{Es}$ tegangan Tarik baja (fy) beton tarik diabaikan. Distribusi tegangan beton dianggap masih berbentuk segitiga, dimana tegangan beton (fc = εc . Es) tetapi harus dicek fc ≤ fc', konstribusi beton bagian tarik diabaikan.

As = n x ¼ . π. d^2

= 10 x 0,3 x 3,143 x 57,912

= 455,0236 mm^2

Tinggi efektif tulangan :

d = h – ts – 0,5 x diameter

= 140 – 20 – 3,805

= 116 mm

$\varepsilon y = \frac{fy}{Es}$

$= \frac{402,4}{200000}$

= 0,002012

$\frac{\varepsilon c}{\varepsilon y} = \frac{c}{d-c}$

$\frac{\varepsilon c}{0,002012} = \frac{c}{116-c}$

$\varepsilon c = \frac{0,002012.c}{116-c}$

fc = εc . Ec

$fc = \frac{0,002012.c}{116-c}$. 4700. 5

$= \frac{47,282\ .c}{116-c}$

Gaya tekan beton

Cc = 0,5 x fc x c x b

= 0,5 x fc x c x 1000

= $\frac{23641\ x.c^2}{116-c}$

Gaya Tarik baja

Ts = As x fy

= 455,024 x 402,400

= 183101,5139 N

Berdasarkan syarat kesimbangan Cc = Ts, didapat persamaan sebagai berikut :

$\frac{23641\ x\ c^2}{116-c}$ = 183101,5139

23641 x c^2 = 21275480,406 – 183101,514 c

23641 x c^2 + 183101,514 c - 21275480,406 = 0

Maka diperoleh nilai c = 25,629 mm

Kontrol :

fc = $\frac{47,282\ x\ c}{116-c}$

= 13,380 < 25…….ok

Cc = $\frac{23641\ x\ 656,84}{116-25,629}$

= 171460,202 N

Ec = $\frac{0,002\ x\ 25,629}{116-25,629}$

= 0,001

Ec = $\frac{0,002\ x\ 25,629}{116-25,629}$

yc = 2/3 x c

= 17,086 mm

yt = d – c

= 90,566 mm

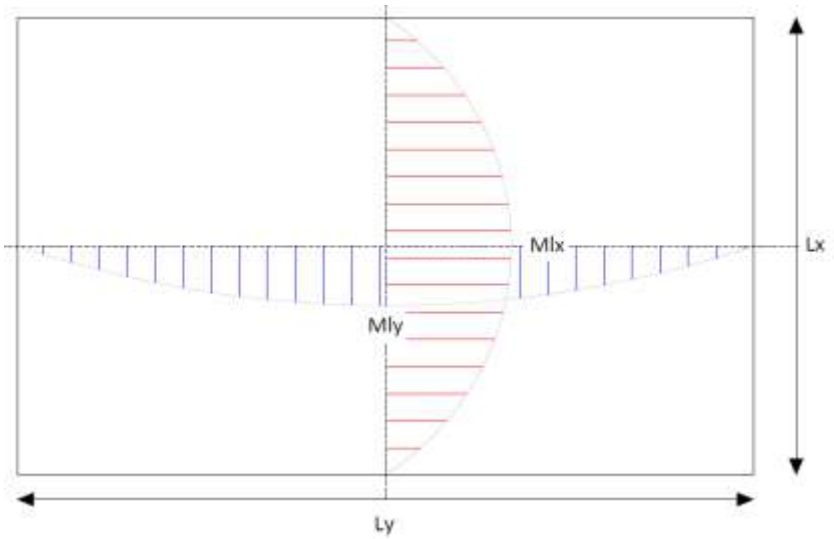
M = (Cc x yc) + (Ts x yt)

= 19512341,875

= 19,512 kN

Perbandingan bentang panjang dan bentang pendek (ly/lx)

= 1,92 < 2 (termasuk pelat dua arah)



Gambar 10. Lendutan pada Penampang Pelat

Metode analitis kekuatan lentur pelat dua arah dengan menggunakan metode koefisien momen dari table koefisien momen didapatkan koefisien Clx = 97 dan Cly = 38.

Momen lapangan arah sumbu x Mlx = Clx x 0,001 x q X lx^2 sedangkan Momen lapangan arah sumbu y Mly = Cly x 0,001 x q X ly^2.

Momen lapangan = Mn

Momen lapangan arah sumbu x :

Mlx = 97 x 0,001 x q(beban mati + beban hidup) x 1,823

19,512 = 97 x 0,001 x (2,804 + beban hidup) x 1,823

Beban hidup = 107,571 kN/m^2

Momen lapangan arah sumbu y :

Mly = 38 x 0,001 x q(beban mati + beban hidup) x 6,76

19,512 = 38 x 0,001 x (2,804 + beban hidup) x 6,76

Beban hidup = 73,115 kN/m^2

Beban hidup pelat berongga (PB-2) adalah sebesar :

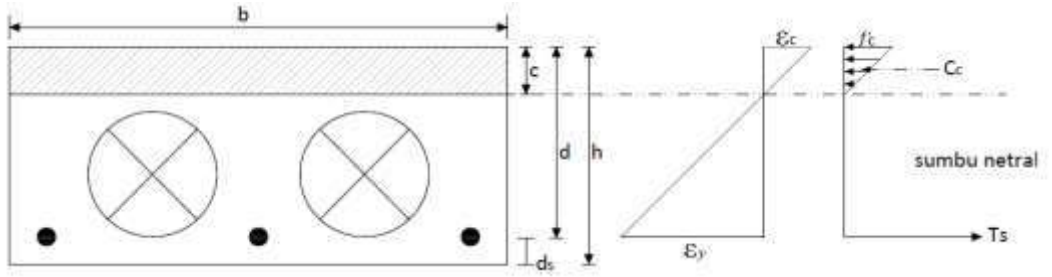
Beban hidup = 107,571 x 1,35 x 2,6

= 377,575 kN

LAMPIRAN 6

(Beban Leleh pada Pelat Berongga PB-3)

Lebar Pelat (L)	=	2600	mm			
Panjang Pelat (b)	=	1350	mm			
Tebal Pelat (h)	=	140	mm			
Diameter (ds)	=	7,8	mm			
Jarak antar Tulangan	=	100	mm			
Fy	=	402,4	Mpa			
Es	=	200000	Mpa			
Mutu beton (fc)	=	25	Mpa			
Modulus Elastisitas Beton (Ec)	=	21299,16	Mpa			
Selimut Beton (d')	=	20	Mm			
Berat Sendiri	=	1162,880	Kg/m3	=	3,250	kN/m2
Pelat Beban	=	1217,52	Kg/m3	=	3,403	kN/m2
Pasir	=	559,66	Kg/m3	=	1,564	kN/m2
Pasir + Pelat Beban	=	4,967	kN/m2			
Berat Jenis beton	=	2333,33	Kg/m3	=	22,89	kN/m3



b = 1000 mm

Gambar 11. Diaagram Penampang Retak Awal

pada pelat berongga PB-3 letak garis netral dianggap masih berada diatas rongga sehingga perhitungan secara analitis beban pada saat leleh dianggap

sama dengan pelat pejal PP-1, $\varepsilon y = \frac{fy}{Es}$ tegangan Tarik baja (fy) beton tarik diabaikan. Distribusi tegangan beton dianggap masih berbentuk segitiga, dimana tegangan beton (fc = εc . Es) tetapi harus dicek fc ≤ fc', konstribusi beton bagian tarik diabaikan.

As = n x ¼ . π. d^2

= 10 x 0,3 x 3,143 x 57,912

= 455,0236 mm^2

Tinggi efektif tulangan :

d = h – ts – 0,5 x diameter

= 15,95 – 20 – 3,805

= 136 mm

$\varepsilon y = \frac{fy}{Es}$

$= \frac{402,4}{200000}$

= 0,002012

$\frac{\varepsilon c}{\varepsilon y} = \frac{c}{d-c}$

$\frac{\varepsilon c}{0,002012} = \frac{c}{136-c}$

$\varepsilon c = \frac{0,002012.c}{136-c}$

fc = εc . Ec

$fc = \frac{0,002012.c}{136-c}$. 4700. 5

$= \frac{47,282.c}{136-c}$

Gaya tekan beton

Cc = 0,5 x fc x c x b

= 0,5 x fc x c x 1000

= $\frac{23641\ x.c^2}{136-c}$

Gaya Tarik baja

Ts = As x fy

= 455,024 x 402,400

= 183101,5139 N

Berdasarkan syarat kesimbangan Cc = Ts, didapat persamaan sebagai berikut :

$\frac{25246{,}109\ x\ c^2}{136-c}$ = 183101,5139

25246,109 x c^2 = 24937510 – 183101,514 c

Maka diperoleh nilai c = 27,896 mm

Kontrol :

fc = $\frac{47{,}282\ x\ c}{136-c}$

= 12,179 < 25……ok

Cc = $\frac{23641\ x\ 778{,}20}{136-27{,}896}$

= 169876,987 N

Ec = $\frac{0{,}002\ x\ 27{,}896}{136-27{,}896}$

= 0,001

yc = 2/3 x c

= 18,598 mm

yt = d – c

= 108,299 mm

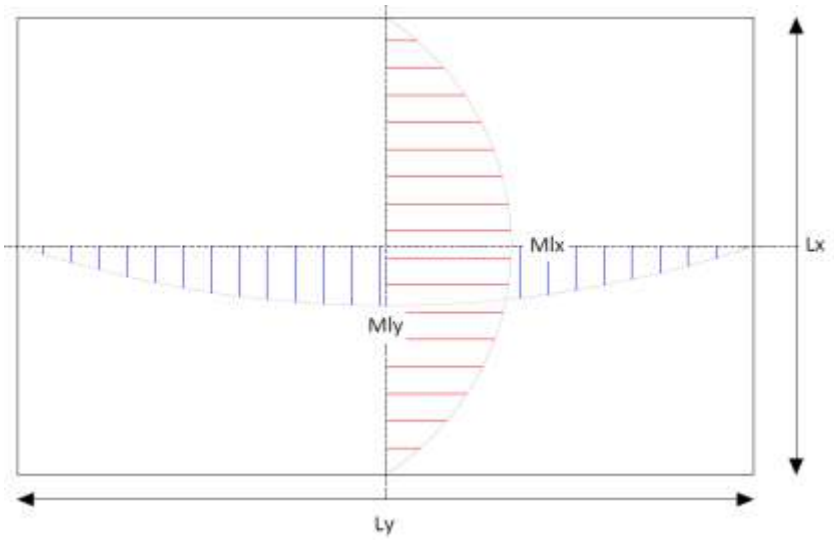
M = (Cc x yc) + (Ts x yt)

= 22988951,350

= 22,989 kN

Perbandingan bentang panjang dan bentang pendek (ly/lx)

= 1,92 < 2 (termasuk pelat dua arah)



Gambar 12. Lendutan pada Penampang Pelat

Metode analitis kekuatan lentur pelat dua arah dengan menggunakan metode koefisien momen dari table koefisien momen didapatkan koefisien Clx = 97 dan Cly = 38.

Momen lapangan arah sumbu x Mlx = Clx x 0,001 x q X lx^2 sedangkan Momen lapangan arah sumbu y Mly = Cly x 0,001 x q X ly^2.

Momen lapangan = Mn

Momen lapangan arah sumbu x :

Mlx = 97 x 0,001 x q(beban mati + beban hidup) x 1,823

22,989 = 97 x 0,001 x (3,262 + beban hidup) x 1,823

Beban hidup = 126,779 kN/m^2

Momen lapangan arah sumbu y :

Mly = 38 x 0,001 x q(beban mati + beban hidup) x 6,76

22,989 = 38 x 0,001 x (3,262 + beban hidup) x 6,76

Beban hidup = 86,231 kN/m^2

Beban hidup pelat berongga (PB-3) adalah sebesar :

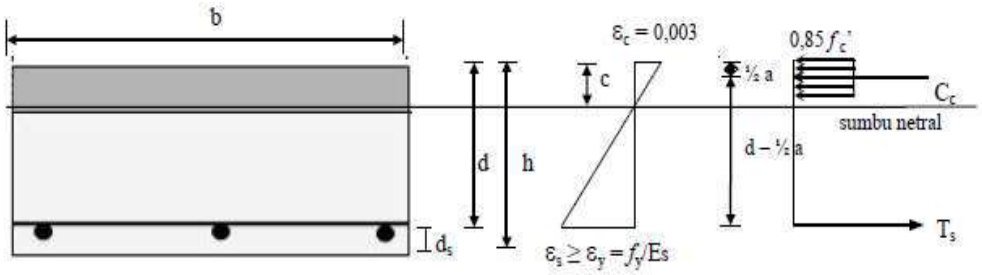
Beban hidup = 126,779 x 1,35 x 2,6

= 444,995 kN

LAMPIRAN 7

(Beban Maksimum pada Pelat PP-1)

Lebar Pelat (L)	=	2600	mm			
Panjang Pelat (b)	=	1350	mm			
Tebal Pelat (h)	=	140	mm			
Diameter (ds)	=	7,8	mm			
Jarak antar Tulangan	=	100	mm			
Fy	=	402,4	Mpa			
Es	=	200000	Mpa			
Mutu beton (fc)	=	25	Mpa			
Modulus Elastisitas Beton (Ec)	=	21299,16	Mpa			
Selimut Beton (d')	=	20	Mm			
Berat Sendiri	=	1164,405	Kg/m3	=	3,254	kN/m2
Pelat Beban	=	1217,52	Kg/m3	=	3,403	kN/m2
Pasir	=	559,66	Kg/m3	=	1,564	kN/m2
Pasir + Pelat Beban	=	4,967	kN/m2			
Poisson Ratio (v)	=	0,2				
Jumlah Tulangan (ns)	=	24	buah			



b = 1000 mm

Gambar 13. Diaagram Penampang Beban Maksimum

Dengan anggapan tulangan baja sudah leleh, maka fs = fy

As = n x ¼ . π. d^2

= 478,03 mm^2

Gaya tekan beton :

Cc = fc x a x b

= 28,510 x (0,85 . c) x 1000

= 21250.c N

Gaya tarik baja

Ts = As x fy

= 478,029 x 402,400

= 192358,70 N

Berdasarkan syarat kesimbangan Cc = Ts, didapat persamaan sebagai berikut :

Ts = Cc

192358,70 = 21250.c

c = 9,052 mm

a’ = 7,694 mm

Kontrol regangan baja

$\frac{\varepsilon c}{c} = \frac{\varepsilon s}{d-c}$

$\frac{0,003}{9,05} = \frac{\varepsilon s}{116,195-9,052}$

$\varepsilon s = 0,0355$

Dibandingkan dengan regangan leleh baja :

$\varepsilon y = \frac{fy}{Es}$

= $\frac{402,4}{200000}$

= 0,002

Karena asumsi awal bahwa tulangan baja sudah leleh (underreinforced) terbukti dimana $\varepsilon s > \varepsilon y$ maka gaya tekan beton :

Cc = 21250 x 9,052

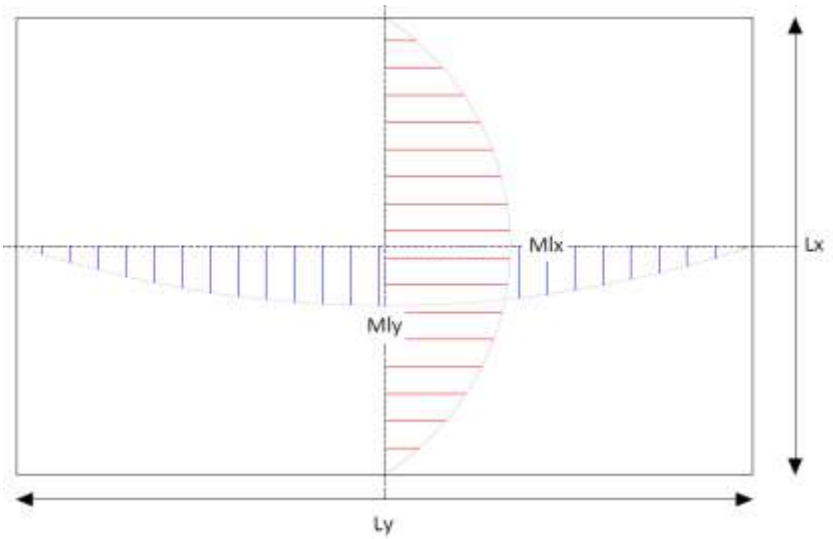
= 192,359 kN

Mn = Cc x (d – 0,5.a) x 27427,5

= 21,593 kN

Perbandingan bentang panjang dan bentang pendek (ly/lx)

= 1,92 < 2 (termasuk pelat dua arah)



Gambar 14. Lendutan pada Penampang Pelat

Metode analitis kekuatan lentur pelat dua arah dengan menggunakan metode koefisien momen dari table koefisien momen didapatkan koefisien Clx = 97 dan Cly = 38.

Momen lapangan arah sumbu x Mlx = Clx x 0,001 x q X lx^2 sedangkan Momen lapangan arah sumbu y Mly = Cly x 0,001 x q X ly^2.

Momen lapangan = Mn

Momen lapangan arah sumbu y :

Mly = 97 x 0,001 x q(beban mati + beban hidup) x 1,823

21,593 = 97 x 0,001 x q(3,254 + beban hidup) x 1,823

Beban hidup = 81,381 kN/m^2

Beban hidup pelat pejal (PP-1) adalah sebesar :

Beban hidup = 81,381 x 1,35 x 2,6

= 286,9 kN

Momen lapangan arah sumbu x :

Mlx = 38 x 0,001 x q(beban mati + beban hidup) x 1,823

21,593 = 97 x 0,001 x q(3,254 + beban hidup) x 1,823

Beban hidup = 117,92 kN/m^2

Beban hidup pelat pejal (PP-1) adalah sebesar :

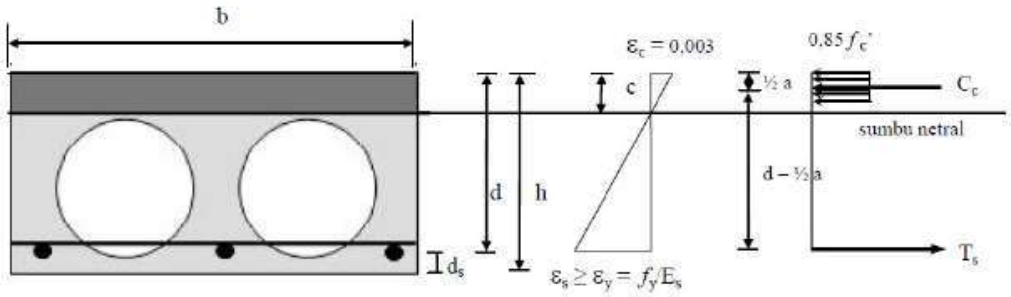
Beban hidup = 117,92 x 1,35 x 2,6

= 413,89 kN

LAMPIRAN 8

(Beban Maksimum pada Pelat Berongga PB-2)

Lebar Pelat (L)	=	2600	mm			
Panjang Pelat (b)	=	1350	mm			
Tebal Pelat (h)	=	140	mm			
Diameter (ds)	=	7,8	mm			
Jarak antar Tulangan	=	100	mm			
Fy	=	402,4	Mpa			
Es	=	200000	Mpa			
Mutu beton (fc)	=	25	Mpa			
Modulus Elastisitas Beton (Ec)	=	21299,16	Mpa			
Selimut Beton (d')	=	20	Mm			
Berat Sendiri	=	1003,173	Kg/m3	=	2,804	kN/m2
Pelat Beban	=	1217,52	Kg/m3	=	3,403	kN/m2
Pasir	=	559,66	Kg/m3	=	1,564	kN/m2
Pasir + Pelat Beban	=	4,967	kN/m2			
Berat Jenis beton	=	2333,33	Kg/m3	=	22,89	kN/m3



b = 1000 mm

Gambar 15. Diagram Penampang Beban Maksimum

Dengan anggapan tulangan baja sudah leleh, maka fs = fy

As = n x ¼ . π. d^2

= 478,03 mm^2

Gaya tekan beton :

Cc = fc x a x b

= 25 x (0,9 . c) x 1000

= 21250.c N

Gaya tarik baja

Ts = As x fy

= 472,029 x 402,400

= 192358,70 N

Berdasarkan syarat kesimbangan Cc = Ts, didapat persamaan sebagai berikut :

Ts = Cc

192358,70 = 21250.c

c = 9,052 mm

a’ = 7,694 mm

Kontrol regangan baja

$\frac{\varepsilon c}{c} = \frac{\varepsilon s}{d-c}$

$\frac{0,003}{9,05} = \frac{\varepsilon s}{116,195-9,0522}$

Ɛs = 0,0355

Dibandingkan dengan regangan leleh baja :

$\varepsilon y = \frac{fy}{Es}$

$= \frac{402,4}{200000}$

$= 0,002$

Karena asumsi awal bahwa tulangan baja sudah leleh (underreinforced) terbukti dimana $\varepsilon s > \varepsilon y$ maka gaya tekan beton :

Cc = 21250 x 9,0522

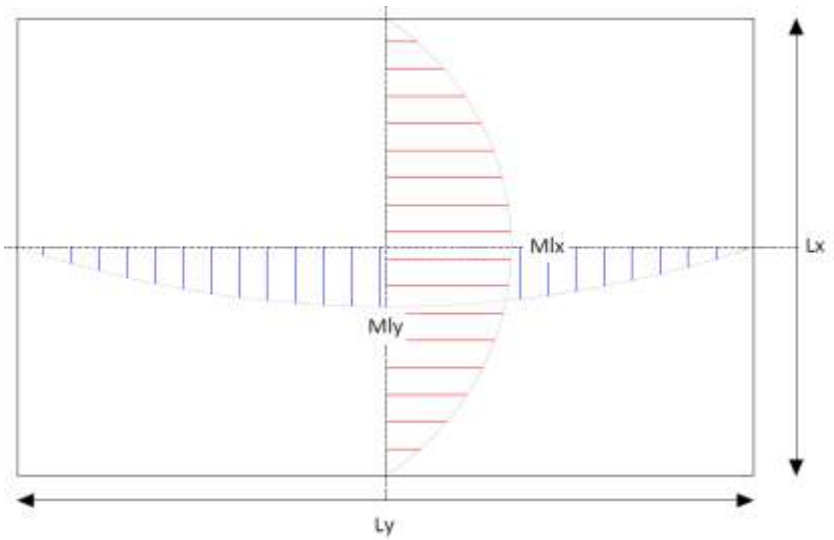
= 192,359 kN

Mn = Cc x (d – 0,5.a) x 192,359

= 21,593 kN

Perbandingan bentang panjang dan bentang pendek (ly/lx)

= 1,92 < 2 (termasuk pelat dua arah)



Gambar 16. Lendutan pada Penampang Pelat

Metode analitis kekuatan lentur pelat dua arah dengan menggunakan metode koefisien momen dari table koefisien momen didapatkan koefisien Clx = 97 dan Cly = 38.

Momen lapangan arah sumbu x Mlx = Clx x 0,001 x q X lx^2 sedangkan Momen lapangan arah sumbu y Mly = Cly x 0,001 x q X ly^2.

Momen lapangan = Mn

Momen lapangan arah sumbu y :

Mly = 97 x 0,001 x q(beban mati + beban hidup) x 1,823

21,593 = 97 x 0,001 x q(3,254 + beban hidup) x 1,823

Beban hidup = 81,832 kN/m^2

Beban hidup pelat pejal (PP-1) adalah sebesar :

Beban hidup = 81,832 x 1,35 x 2,6

= 297,1 kN

Momen lapangan arah sumbu x :

Mlx = 38 x 0,001 x q(beban mati + beban hidup) x 1,823

21,593 = 38 x 0,001 x q(3,254 + beban hidup) x 1,823

Beban hidup = 118,368 kN/m^2

Beban hidup pelat pejal (PP-1) adalah sebesar :

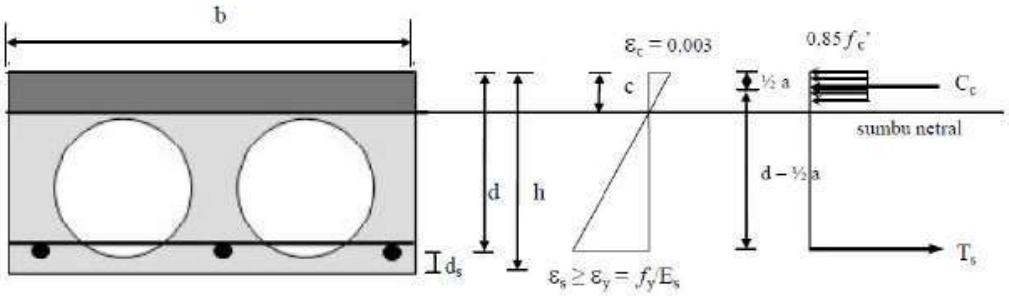
Beban hidup = 118,368 x 1,35 x 2,6

= 415,47 kN

LAMPIRAN 9

(Beban Maksimum pada Pelat Berongga PB-3)

Lebar Pelat (L)	=	2600	mm			
Panjang Pelat (b)	=	1350	mm			
Tebal Pelat (h)	=	140	mm			
Diameter (ds)	=	7,8	mm			
Jarak antar Tulangan	=	100	mm			
Fy	=	402,4	Mpa			
Es	=	200000	Mpa			
Mutu beton (fc)	=	25	Mpa			
Modulus Elastisitas Beton (Ec)	=	21299,16	Mpa			
Selimut Beton (d')	=	20	Mm			
Berat Sendiri	=	1162,880	Kg/m3	=	3,250	kN/m2
Pelat Beban	=	1217,52	Kg/m3	=	3,403	kN/m2
Pasir	=	559,66	Kg/m3	=	1,564	kN/m2
Pasir + Pelat Beban	=	4,967	kN/m2			
Berat Jenis beton	=	2333,33	Kg/m3	=	22,89	kN/m3



b = 1000 mm

Gambar 17. Diagram Penampang Beban Maksimum

Dengan anggapan tulangan baja sudah leleh, maka fs = fy

As = n x ¼ . π. d^2

= 478,03 mm^2

Gaya tekan beton :

Cc = fc x a x b

= 25 x (0,9 . c) x 1000

= 21250.c N

Gaya tarik baja

Ts = As x fy

= 478,029 x 402,400

= 192358,70 N

Berdasarkan syarat kesimbangan Cc = Ts, didapat persamaan sebagai berikut :

Ts = Cc

192358,70 = 21250.c

c = 27,896 mm

a’ = 7,694 mm

Kontrol regangan baja

$\frac{\varepsilon c}{c} = \frac{\varepsilon s}{d-c}$

$\frac{0,003}{9,05} = \frac{\varepsilon s}{136,1-9,0522}$

$\varepsilon s = 0,0409$

Dibandingkan dengan regangan leleh baja :

$\varepsilon y = \frac{fy}{Es}$

$= \frac{402,4}{200000}$

= 0,002

Karena asumsi awal bahwa tulangan baja sudah leleh (underreinforced) terbukti dimana $\varepsilon s > \varepsilon y$ maka gaya tekan beton :

Cc = 21250 x 9,0522

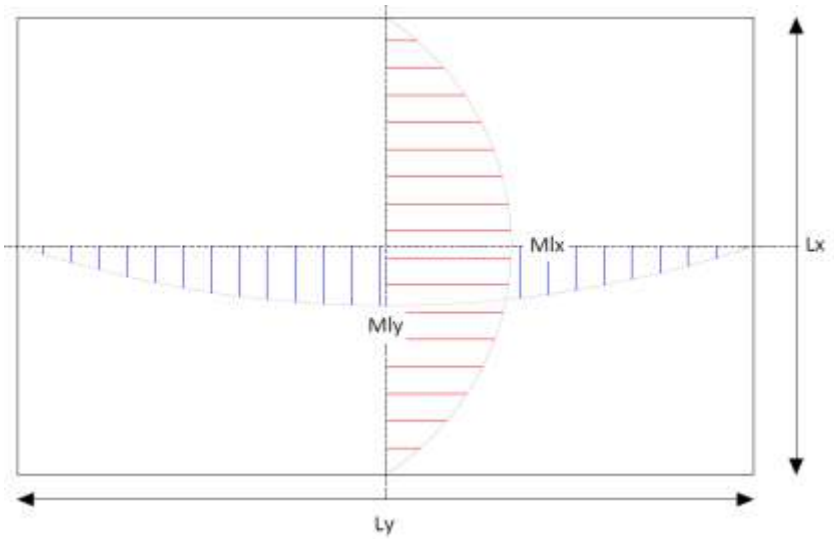
= 192,359 kN

Mn = Cc x (d – 0,5.a) x 192,359

= 25,44 kN

Perbandingan bentang panjang dan bentang pendek (ly/lx)

= 1,92 < 2 (termasuk pelat dua arah)



Gambar 18. Lendutan pada Penampang Pelat

Metode analitis kekuatan lentur pelat dua arah dengan menggunakan metode koefisien momen dari table koefisien momen didapatkan koefisien Clx = 97 dan Cly = 38.

Momen lapangan arah sumbu x Mlx = Clx x 0,001 x q X lx^2 sedangkan Momen lapangan arah sumbu y Mly = Cly x 0,001 x q X ly^2.

Momen lapangan = Mn

Momen lapangan arah sumbu y :

Mly = 97 x 0,001 x q(beban mati + beban hidup) x 1,823

25,44 = 97 x 0,001 x q(3,254 + beban hidup) x 1,823

Beban hidup = 96,45 kN/m^2

Beban hidup pelat pejal (PP-1) adalah sebesar :

Beban hidup = 96,45 x 1,35 x 2,6

= 350 kN

Momen lapangan arah sumbu x :

Mlx = 38 x 0,001 x q(beban mati + beban hidup) x 1,823

25,44 = 97 x 0,001 x q(3,254 + beban hidup) x 1,823

Beban hidup = 139,499 kN/m^2

Beban hidup pelat pejal (PP-1) adalah sebesar :

Beban hidup = 139,499 x 1,35 x 2,6

= 489,643 kN

LAMPIRAN 10

(Metode Navier Lendutan pada PP-1)

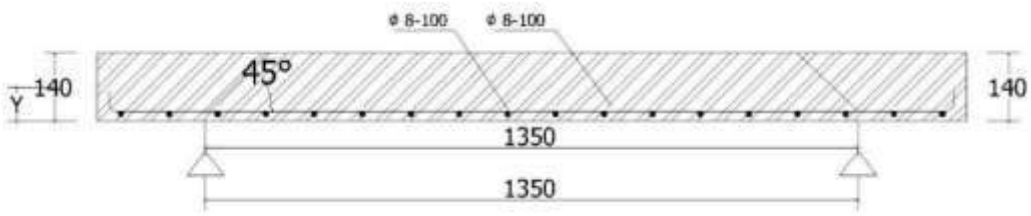
Lebar Pelat (L)	=	2600	mm			
Panjang Pelat (b)	=	1350	mm			
Tebal Pelat (h)	=	140	mm			
Diameter (ds)	=	7,8	mm			
Jarak antar Tulangan	=	100	mm			
Fy	=	402,4	Mpa			
Es	=	200000	Mpa			
Mutu beton (fc)	=	25	Mpa			
Modulus Elastisitas Beton (Ec)	=	21299,16	Mpa			
Selimut Beton (d')	=	20	Mm			
Berat Sendiri	=	1164,405	Kg/m3	=	3,254	kN/m2
Pelat Beban	=	1217,52	Kg/m3	=	3,403	kN/m2
Pasir	=	559,66	Kg/m3	=	1,564	kN/m2
Pasir + Pelat Beban	=	4,967	kN/m2			
Poisson Ratio (v)	=	0,2				
Jumlah Tulangan (ns)	=	24	buah			

Secara analitis beban retak awal dapat dihitung dengan cara berikut ini :

f_r = 0,7 x $\sqrt{f'c}$

= 3,5 Mpa

Titik berat penampang :



Gambar 19. Titik Berat Penampang Pelat PP-1

N = $\frac{Es}{Ec}$

= $\frac{200000}{21299,16}$

= 9,390

Y = $\frac{b\ .h\left(\frac{1}{2}h\right)+(n-1).ns.\frac{1}{4}.\pi.ds^2.d'}{b.h+(n-1).ns.\frac{1}{4}.\pi.ds'}$

= $\frac{13422435,17}{198621,7584}$

= 68,722 mm

Momen Inersia Penampang

I solid = $\frac{1}{12}$. b.h^3 + b.h. ($\frac{1}{2}$. h –y)^2

= 594533333,3 + 594064,57

= 595127397,9 mm^4

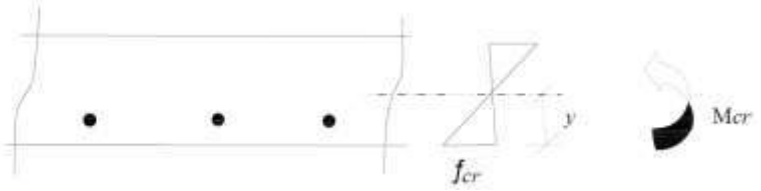
I tulangan = (n-1).ns. $\frac{1}{64}$.π.ds^4 + (n-1).ns. $\frac{1}{64}$.π.ds^2 .(y-d')^2

= 34545,177 + 22656715,133

= 22691260,310 mm^4

I netto = 617818658,211 mm4

Momen Retak



Gambar 20. Momen retak

Mcr = $\frac{fr}{y}$. I netto

= $\frac{3,313,5}{68,722}$ x 617818658,211

= 31,465 kNm

Beban Retak

∑ M = M beban + M berat sendiri

Mcr = P.($\frac{1}{2}$. I) + $\frac{1}{8}$. q . I^2

Pcr = $\frac{2.Mcr - \frac{1}{8}.q.l^2}{\frac{1}{2}.l}$

= $\frac{29,741}{1,3}$

= 22,878 kN

Po = 6,518 kN/m2

Faktor Daktalitas Navier

D = $\frac{E\ .\ h^3}{12(\ 1-v^2)}$

= $\frac{21299,160\ x\ 2744000}{12(\ 1-0,040)}$

= 5073,342 kNm

Perhitungan lendutan ditengah bentang :

w = $\frac{16_{po}}{\pi^6.D}\ \sum_{m=1}^{\infty}\sum_{n=1}^{\infty}\frac{\sin\frac{m\ .\pi\ .x}{a}\ \ \sin\frac{n\ .\pi\ .x}{b}}{m\ .\ n\ \left[\left\{\left(\frac{m}{a}\right)^2+\left(\frac{n}{b}\right)^2\right\}\right]^2}$

x = 0,675 a = 1

y = 1,3 b = 3

Tabel 1. perhitungan lendutan pelat ditengah bentang :

		$16.\ po / \pi^6$	$\sin (m.\ \pi.x / a)$	$\sin (n.\ \pi.x / a)$	$m.n((m/a)^2 + (n/b)^2)^2$	w
m = 1	n = 1	0,000021	1	1	0,697	3,06189E-05
m = 1	n = 3	0,000021	1	-1	5,640	-3,78178E-06
m = 1	n = 5	0,000021	1	1	21,235	1,00449E-06
m = 3	n = 1	0,000021	-1	1	15,259	-1,39789E-07
m = 3	n = 3	0,000021	-1	-1	56,427	3,78011E-07
m = 3	n = 5	0,000021	-1	1	129,548	-1,64649E-07
m = 5	n = 1	0,000021	1	1	69,327	3,07672E-07
m = 5	n = 3	0,000021	1	-1	225,732	-9,44923E-08
m = 5	n = 5	0,000021	1	1	435,392	4,89902E-08
						2,69192E-05

Jadi lendutan di tengah bentang pelat PP-1 adalah sebesar 0,0269 mm

LAMPIRAN 11

(Metode Navier Lendutan PB-2)

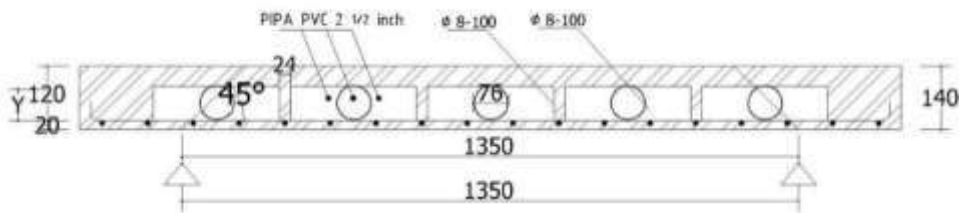
Lebar Pelat (L)	=	2600	mm			
Panjang Pelat (b)	=	1350	mm			
Tebal Pelat (h)	=	140	mm			
Diameter (ds)	=	7,8	mm			
Jarak antar Tulangan	=	100	mm			
Fy	=	402,4	Mpa			
Es	=	200000	Mpa			
Mutu beton (fc)	=	25	Mpa			
Modulus Elastisitas Beton (Ec)	=	21299,16	Mpa			
Selimut Beton (d')	=	20	Mm			
Berat Sendiri	=	1003,173	Kg/m3	=	2,804	kN/m2
Pelat Beban	=	1217,52	Kg/m3	=	3,403	kN/m2
Pasir	=	559,66	Kg/m3	=	1,564	kN/m2
Pasir + Pelat Beban	=	4,967	kN/m2			
Poisson Ratio (v)	=	0,2				
Jumlah Tulangan (ns)	=	24	buah			
Jumlah pvc bentang pendek(nk)	=	4	buah			
Jumlah pvc bentang pendek(nk)	=	8	buah			

Secara analitis beban retak awal dapat dihitung dengan cara berikut ini :

f_r = 0,7 x $\sqrt{f'c}$

= 3,5 Mpa

Titik berat penampang :



GAmbar 21. Titik Berat Penampang Pelat Berongga PB-2

N = $\frac{Es}{Ec}$

= $\frac{200000}{21299,16}$

= 9,390

Y = $\frac{b\ .h\left(\frac{1}{2}h\right)+(n-1).ns.\frac{1}{4}.\pi.ds^2.d'}{b.h+(n-1).ns.\frac{1}{4}.\pi.ds'}$

= 68,443 mm

Momen Inersia Penampang

I solid = $\frac{1}{12}$. b.h^3 + b.h. ($\frac{1}{2}$. h –y)^2

= 308700000 + 458089

= 309158088,8 mm^4

I tulangan = (n-1).ns. $\frac{1}{64}$.π.ds^4 + (n-1).ns. $\frac{1}{64}$.π.ds^2 .(y-d')^2

= 19345,299 + 12542700,395

= 12562045,694 mm^4

I Rongga

I rongga = nk . $\frac{1}{64}$. π dk^4 + nk . $\frac{1}{4}$. π dk^2 (83,5 –y)^2

= 8191605,714 + 54998,360

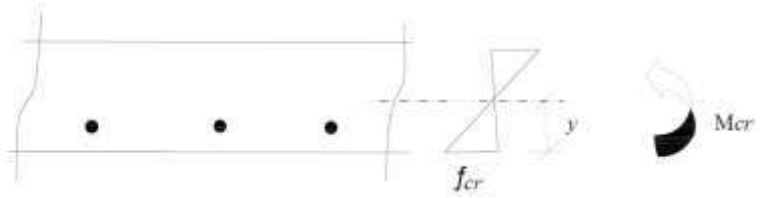
= 8246604,074 mm4

I netto = Isolid + I tulangan – I rongga

= 309158088,8 mm^4 + 12562045,694 mm^4 - 8246604,074 mm4

= 313473530,452 mm^4

Momen Retak



Gambar 22. Momen Retak

Mcr = $\frac{fr}{y}$. I netto

= $\frac{3,5}{68,443}$ x 313473530,452

= 16,030 kNm

Beban Retak

∑ M = M beban + M berat sendiri

Mcr = P.($\frac{1}{2}$. l) + $\frac{1}{8}$. q . l^2

Pcr = $\frac{2.Mcr - \frac{1}{8}.q.l^2}{\frac{1}{2}.l}$

= 20,700 kN

Po = 5,897 kN/m2

Faktor Daktalitas Navier

D = $\frac{E \,.\, h^3}{12(\,1-v^2)}$

= $\frac{21299{,}160\ x\ 2744000}{12(\,1-0{,}040)}$

= 5073,342 kNm

Perhitungan lendutan ditengah bentang :

w = $\frac{16_{po}}{\pi^6.D}\ \sum_{m=1}^{\infty}\sum_{n=1}^{\infty}\frac{\sin\frac{m\,.\pi\,.x}{a}\ \sin\frac{n\,.\pi\,.x}{b}}{m\ .\ n\ \left[\left\{\left(\frac{m}{a}\right\}^2+\left\{\frac{n}{b}\right\}^2\right)\right]^2}$

x = 0,675 a = 1

y = 1,3 b = 3

Tabel 2. perhitungan lendutan pelat ditengah bentang :

		16. po / π^6	sin (m. π.x / a)	sin (n. π.x / a)	$m.n((m/a)^2 + (n/b)^2)^2$	w
m = 1	n = 1	0,000019	1	1	0,697	2,7704E-05
m = 1	n = 3	0,000019	1	-1	5,640	-3,422E-06
m = 1	n = 5	0,000019	1	1	21,235	9,0886E-06
m = 3	n = 1	0,000019	-1	1	15,259	-1,265E-07
m = 3	n = 3	0,000019	-1	-1	56,427	3,4202E-07
m = 3	n = 5	0,000019	-1	1	129,548	-1,49E-07
m = 5	n = 1	0,000019	1	1	69,327	2,7838E-07
m = 5	n = 3	0,000019	1	-1	225,732	-8,55E-08
m = 5	n = 5	0,000019	1	1	435,392	4,4326E-08
						2,4357E-05

Jadi lendutan di tengah bentang pelat PP-1 adalah sebesar 0,0243 mm

LAMPIRAN 12

(Metode Navier Lendutan PB-3)

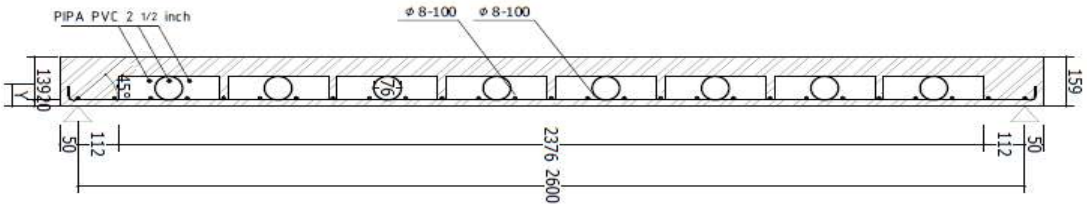
Lebar Pelat (L)	=	2600	mm			
Panjang Pelat (b)	=	1350	mm			
Tebal Pelat (h)	=	140	mm			
Diameter (ds)	=	7,8	mm			
Jarak antar Tulangan	=	100	mm			
Fy	=	402,4	Mpa			
Es	=	200000	Mpa			
Mutu beton (fc)	=	25	Mpa			
Modulus Elastisitas Beton (Ec)	=	21299,16	Mpa			
Selimut Beton (d')	=	20	Mm			
Berat Sendiri	=	1162,880	Kg/m3	=	3,250	kN/m2
Pelat Beban	=	1217,52	Kg/m3	=	3,403	kN/m2
Pasir	=	559,66	Kg/m3	=	1,564	kN/m2
Pasir + Pelat Beban	=	4,967	kN/m2			
Poisson Ratio (v)	=	0,2				
Jumlah Tulangan (ns)	=	24	buah			
Jumlah pvc bentang pendek(nk)	=	4	buah			
Jumlah pvc bentang pendek(nk)	=	8	buah			

Secara analitis beban retak awal dapat dihitung dengan cara berikut ini :

f_r = 0,7 x $\sqrt{f'c}$

= 3,5 Mpa

Titik berat penampang :



Gambar 23. Penampang pada Pelat Berongga PB-3

N = $\frac{Es}{Ec}$

= $\frac{200000}{21299,16}$

= 9,390

Y = $\frac{b\ .h\left(\frac{1}{2}h\right)+(n-1).ns.\frac{1}{4}.\pi.ds^2.d'}{b.h+(n-1).ns.\frac{1}{4}.\pi.ds'}$

= 82,558 mm

Momen Inersia Penampang

I solid = $\frac{1}{12}$. b.h^3 + b.h. ($\frac{1}{2}$. h –y)^2

= 870930450 + 3942778,89

= 874873228,9 mm^4

I tulangan = (n-1).ns. $\frac{1}{64}$.π.ds^4 + (n-1).ns. $\frac{1}{64}$.π.ds^2 .(y-d')^2

= 34545,177 + 37387295,863

= 37421841,040 mm^4

I Rongga

I rongga = nk . $\frac{1}{64}$. π dk^4 + nk . $\frac{1}{4}$. π dk^2 (83,5 –y)^2

= 8191605,714 + 216418,204

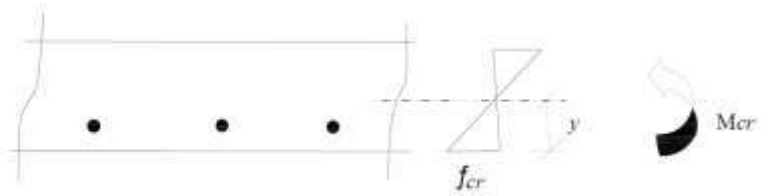
= 8408023,918 mm4

I netto = Isolid + I tulangan – I rongga

= 874873228,9 mm^4 + 37421841,040 mm^4 - 8408023,918 mm4

= 903887046,013 mm^4

Momen Retak



Gambar 24. Momen Retak

Mcr = $\frac{fr}{y}$. I netto

= $\frac{3,500}{82,588}$ x 903887046,013 mm^4

= 38,306 kNm

Beban Retak

∑ M = M beban + M berat sendiri

Mcr = P.($\frac{1}{2}$. l) + $\frac{1}{8}$. q . l^2

Pcr = $\frac{2.Mcr - \frac{1}{8}.q.l^2}{\frac{1}{2}.l}$

= $\frac{37,464}{1,3}$

= 28,818 kN

Po = 8,210 kN/m2

Faktor Daktalitas Navier

D = $\frac{E\ .\ h^3}{12(\ 1-v^2)}$

$$= \frac{21299{,}160\ x\ 4019679}{12(\ 1-0{,}040)}$$

= 7431,926 kNm

Perhitungan lendutan ditengah bentang :

$$w = \frac{16_{po}}{\pi^6.D} \sum_{m=1}^{\infty} \sum_{n=1}^{\infty} \frac{\sin\frac{m\ .\pi\ .x}{a}\ \sin\frac{n\ .\pi\ .x}{b}}{m\ .\ n\ \left[\left\{\left\{\frac{m}{a}\right\}^2+\left\{\frac{n}{b}\right\}^2\right\}\right]^2}$$

x = 0,675 a = 1

y = 1,3 b = 3

Tabel 3. perhitungan lendutan pelat ditengah bentang :

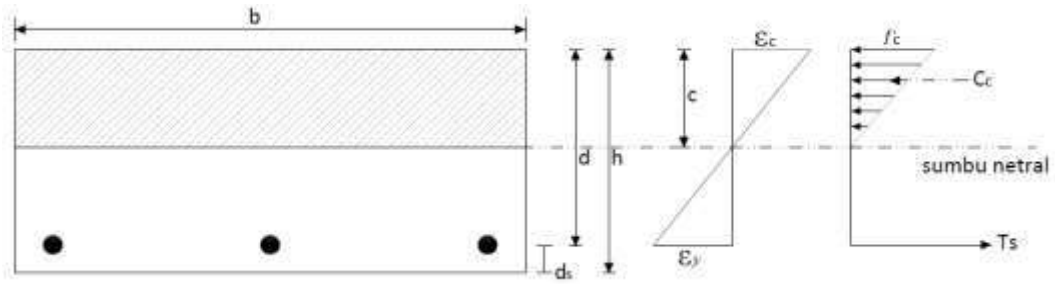
		$16.\ po / \pi^6$	$\sin (m.\ \pi.x / a)$	$\sin (n.\ \pi.x / a)$	$m.n((m/a)^2 + (n/b)^2)^2$	w
m = 1	n = 1	0,000018	1	1	0,697	2.6329E-05
m = 1	n = 3	0,000018	1	-1	5,640	-3,252E-06
m = 1	n = 5	0,000018	1	1	21,235	8.6374E-07
m = 3	n = 1	0,000018	-1	1	15,259	-1,202E-07
m = 3	n = 3	0,000018	-1	-1	56,427	3,2504E-06
m = 3	n = 5	0,000018	-1	1	129,548	-1,416E-07
m = 5	n = 1	0,000018	1	1	69,327	2.6456E-07
m = 5	n = 3	0,000018	1	-1	225,732	-8.125E-07
m = 5	n = 5	0,000018	1	1	435,392	4,2126E-08
						2,3147E-05

Jadi lendutan di tengah bentang pelat PP-1 adalah sebesar 0,023 mm

LAMPIRAN 13

(Lebar Retak pada PP-1)

Lebar Pelat (L)	=	2600	mm			
Panjang Pelat (b)	=	1350	mm			
Tebal Pelat (h)	=	140	mm			
Diameter (ds)	=	7,8	mm			
Jarak antar Tulangan	=	100	mm			
Fy	=	402,4	Mpa			
Es	=	200000	Mpa			
Mutu beton (fc)	=	25	Mpa			
Modulus Elastisitas Beton (Ec)	=	21299,16	Mpa			
Selimut Beton (d')	=	20	Mm			
Berat Sendiri	=	1164,405	Kg/m3	=	3,254	kN/m2
Pelat Beban	=	1217,52	Kg/m3	=	3,403	kN/m2
Pasir	=	559,66	Kg/m3	=	1,564	kN/m2
Pasir + Pelat Beban	=	4,967	kN/m2			
Poisson Ratio (v)	=	0,2				
Jumlah Tulangan (ns)	=	24	buah			



Gambar 7. Diaagram Penampang Retak Awal

Dengan anggapan tulangan baja mengalami kondisi leleh pertama, ketika εy = $\frac{fy}{Es}$ tegangan Tarik baja (fy) beton tarik diabaikan. Distribusi tegangan beton

dianggap masih berbentuk segitiga, dimana tegangan beton (fc = εc . Es) tetapi harus dicek fc ≤ fc', konstribusi beton bagian tarik diabaikan.

As = n x ¼ . π. d^2

= 10 x 0,3 x 3,143 x 60,840

= 478,029 mm^2

$\varepsilon y = \frac{fy}{Es}$

$= \frac{402,4}{200000}$

= 0,002012

$\frac{\varepsilon c}{\varepsilon y} = \frac{c}{d-c}$

$\frac{\varepsilon c}{0,002012} = \frac{c}{116-c}$

$\varepsilon c = \frac{0,002012.c}{116-c}$

fc = εc . Ec

$fc = \frac{0,002012.c}{116-c}$. 4700. 5,3395

$= \frac{23641\ x\ c^2}{116-c}$

Gaya tarik baja

Ts = As x fy

= 478,029 x 402,400

= 192358,6971 N

Berdasarkan syarat kesimbangan Cc = Ts, didapat persamaan sebagai berikut :

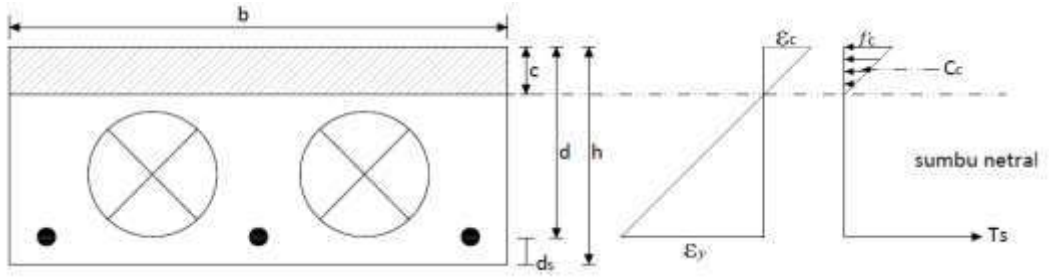
$\frac{23641\ x\ c^2}{116-c}$ = 192358,697

c	=	25,629 mm
w_{maks}	=	k1 x fs x (dc x A)
fs	=	0,6 x fy
	=	0,6 x 402,4
	=	241,44 Mpa
dc	=	(0,5 x 8) + 20
	=	24 mm
A	=	Luas persegi tarik : Jumlah tulangan
	=	12390,193 m2
w_{maks}	=	0,177 < 0,4 mm….OK

LAMPIRAN 14

(Lebar Retak pada Pelat Berongga PB-2)

Lebar Pelat (L)	=	2600	mm			
Panjang Pelat (b)	=	1350	mm			
Tebal Pelat (h)	=	140	mm			
Diameter (ds)	=	7,8	mm			
Jarak antar Tulangan	=	100	mm			
Fy	=	402,4	Mpa			
Es	=	200000	Mpa			
Mutu beton (fc)	=	25	Mpa			
Modulus Elastisitas Beton (Ec)	=	21299,16	Mpa			
Selimut Beton (d')	=	20	Mm			
Berat Sendiri	=	1003,173	Kg/m3	=	2,804	kN/m2
Pelat Beban	=	1217,52	Kg/m3	=	3,403	kN/m2
Pasir	=	559,66	Kg/m3	=	1,564	kN/m2
Pasir + Pelat Beban	=	4,967	kN/m2			
Berat Jenis beton	=	2333,33	Kg/m3	=	22,89	kN/m3



b = 1000 mm

Gambar 9. Diagram Penampang Retak Awal pada PB-2

pada pelat berongga PB-2 letak garis netral dianggap masih berada diatas rongga sehingga perhitungan secara analitis beban pada saat leleh dianggap

sama dengan pelat pejal PP-1, $\varepsilon y = \frac{fy}{Es}$ tegangan Tarik baja (fy) beton tarik diabaikan. Distribusi tegangan beton dianggap masih berbentuk segitiga, dimana tegangan beton (fc = εc . Es) tetapi harus dicek fc ≤ fc', konstribusi beton bagian tarik diabaikan.

As = n x ¼ . π. d^2

= 10 x 0,3 x 3,143 x 57,912

= 455,0236 mm^2

Tinggi efektif tulangan :

d = h – ts – 0,5 x diameter

= 140 – 20 – 3,805

= 116 mm

$\varepsilon y = \frac{fy}{Es}$

$= \frac{402,4}{200000}$

= 0,002012

$\frac{\varepsilon c}{\varepsilon y} = \frac{c}{d-c}$

$\frac{\varepsilon c}{0,002012} = \frac{c}{116-c}$

$\varepsilon c = \frac{0,002012.c}{116-c}$

fc = εc . Ec

$fc = \frac{0,002012.c}{116-c}$. 4700. 5

$= \frac{47,282\ .c}{116-c}$

Gaya tekan beton

Cc = 0,5 x fc x c x b

= 0,5 x fc x c x 1000

= $\frac{23641\ x.c^2}{116-c}$

Gaya Tarik baja

Ts = As x fy

= 455,024 x 402,400

= 183101,5139 N

Berdasarkan syarat kesimbangan Cc = Ts, didapat persamaan sebagai berikut :

$\frac{23641\ x\ c^2}{116-c}$ = 183101,5139

23641 x c^2 = 21275480,406 – 183101,514 c

23641 x c^2 + 183101,514 c - 21275480,406 = 0

Maka diperoleh nilai c = 25,629 mm

w_{maks} = k1 x fs x (dc x A)

k1 = 0,000011

fs = 0,6 x fy

= 0,6 x 402,4

= 241,44 Mpa

dc = (0,5 x 8) + 20

= 24 mm

A = Luas persegi tarik : Jumlah tulangan

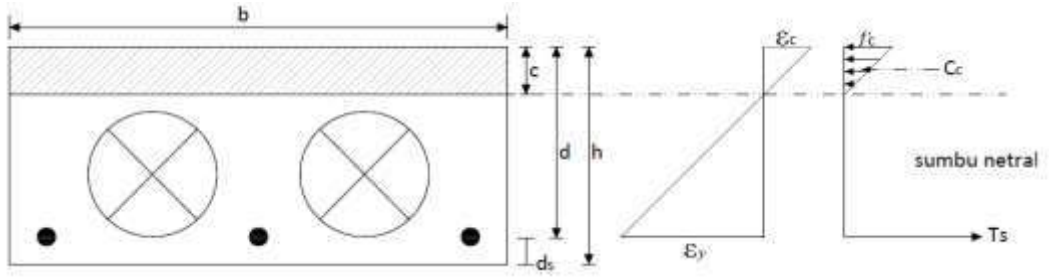
= 1382,4801 m2

w_{maks} = 0,334 < 0,4 mm….OK

LAMPIRAN 15

(Lebar Retak pada Pelat Berongga PB-3)

Lebar Pelat (L)	=	2600	mm			
Panjang Pelat (b)	=	1350	mm			
Tebal Pelat (h)	=	140	mm			
Diameter (ds)	=	7,8	mm			
Jarak antar Tulangan	=	100	mm			
Fy	=	402,4	Mpa			
Es	=	200000	Mpa			
Mutu beton (fc)	=	25	Mpa			
Modulus Elastisitas Beton (Ec)	=	21299,16	Mpa			
Selimut Beton (d')	=	20	Mm			
Berat Sendiri	=	1162,880	Kg/m3	=	3,250	kN/m2
Pelat Beban	=	1217,52	Kg/m3	=	3,403	kN/m2
Pasir	=	559,66	Kg/m3	=	1,564	kN/m2
Pasir + Pelat Beban	=	4,967	kN/m2			
Berat Jenis beton	=	2333,33	Kg/m3	=	22,89	kN/m3



b = 1000 mm

Gambar 11. Diaagram Penampang Retak Awal

pada pelat berongga PB-3 letak garis netral dianggap masih berada diatas rongga sehingga perhitungan secara analitis beban pada saat leleh dianggap

sama dengan pelat pejal PP-1, $\varepsilon y = \frac{fy}{Es}$ tegangan Tarik baja (fy) beton tarik diabaikan. Distribusi tegangan beton dianggap masih berbentuk segitiga, dimana tegangan beton (fc = εc . Es) tetapi harus dicek fc ≤ fc', konstribusi beton bagian tarik diabaikan.

As = n x ¼ . π. d^2

= 10 x 0,3 x 3,143 x 57,912

= 455,0236 mm^2

Tinggi efektif tulangan :

d = h – ts – 0,5 x diameter

= 15,95 – 20 – 3,805

= 136 mm

$\varepsilon y = \frac{fy}{Es}$

$= \frac{402,4}{200000}$

= 0,002012

$\frac{\varepsilon c}{\varepsilon y} = \frac{c}{d-c}$

$\frac{\varepsilon c}{0,002012} = \frac{c}{136-c}$

$\varepsilon c = \frac{0,002012.c}{136-c}$

fc = εc . Ec

$fc = \frac{0,002012.c}{136-c}$. 4700. 5

$= \frac{47,282.c}{136-c}$

Gaya tekan beton

Cc = 0,5 x fc x c x b

= 0,5 x fc x c x 1000

= $\frac{23641\ x.c^2}{136-c}$

Gaya Tarik baja

Ts = As x fy

= 455,024 x 402,400

= 183101,5139 N

Berdasarkan syarat kesimbangan Cc = Ts, didapat persamaan sebagai berikut :

$\frac{25246{,}109\ x\ c^2}{136-c}$ = 183101,5139

25246,109 x c^2 = 24937510 – 183101,514 c

Maka diperoleh nilai c = 27,896 mm

w_{maks} = k1 x fs x (dc x A)

k1 = 0,000011

fs = 0,6 x fy

= 0,6 x 402,4

= 241,44 Mpa

dc = (0,5 x 8) + 20

= 24 mm

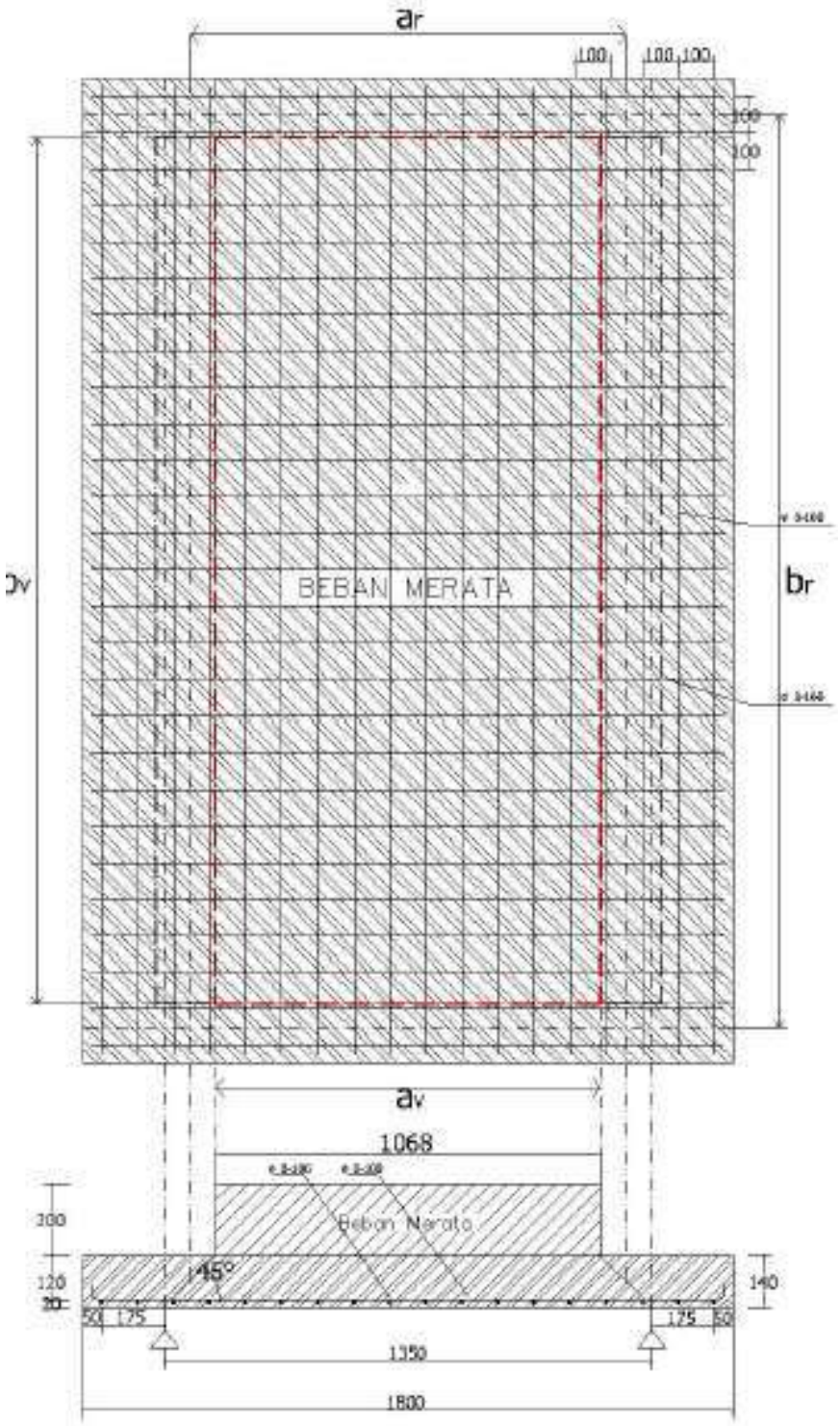
A = Luas persegi tarik : Jumlah tulangan

= 14311,238 m2

w_{maks} = 0,186 < 0,4 mm….OK

LAMPIRAN 16

(Geser PP-1)



Gmabr 25. Penampang Geser Pelat PP-1

Lebar Pelat (L)	=	2600	mm				
Panjang Pelat (b)	=	1350	mm				
Tebal Pelat (h)	=	140	mm				
Diameter (ds)	=	7,8	mm				
Jarak antar Tulangan	=	100	mm				
Fy	=	402,4	Mpa				
Es	=	200000	Mpa				
Mutu beton (fc)	=	28,51	Mpa				
Modulus Elastisitas Beton (Ec)	=	21299,16	Mpa				
Selimut Beton (d')	=	20	Mm				
Berat Sendiri	=	1164,405	Kg/m3	=	3,254	kN/m2	

Tinggi efektif tulangan :

d = h – ts – 0,5.d

= 140 - 2 – 3,9

= 116 mm

ar = lx - $\frac{d}{2}$ x 2

= 1350 – 116/2 x 2

= 1233,9 mm

br = ly - $\frac{d}{2}$ x 2

= 2600 - 116/2 x 2

= 2483,9 mm

βc = $\frac{ly}{lx}$

= $\frac{2600}{1350}$

= 1,93 mm

bo = 2 x (ar + br)

= 2 x (1233,9 + 2484)

= 7435,6 mm

Dalam SK-SNI 2847 tahun 2019 pasal 12.12.2.1 perhitungan kemampuan pelat dua arah non prategang dalam menahan gaya geser diambil nilai terkecil dari :

1. Vc = $0{,}17 \times \left(1 + \frac{2}{\beta} \right) \times \lambda \times \sqrt{fc} \times bo \times d$

= 1597007,194 N

= 1597,007 kN

2. Vc = $0{,}083 \times \left(2 + \frac{\alpha . d}{b0}\right) \times \lambda \times \sqrt{fc} \times bo \times d$

= 1003900,128 N

= 1003,900 kN

3. Vc = $0{,}33 \times \lambda \times \sqrt{fc} \times bo \times d$

= 1520790,425 N

= 1520,790 kN\

Diambil nilai terkeci (Vc) = 410,642 kN

Analisa eksperimen

Beban maksimum PP-1 = 410,642 kN

Beban maksimum PP-1 per meter persegi 116,992 kN/m2

Daerah beban area :

av = lx – (2 x d)

= 1350 – (2 x 116)

= 1117,8 mm

= 1,118 m

bv = ly – (2 x d)

= 2600 – (2 x 116)

= 2367,8 mm

Beban area geser :

Pvu = Pmaks x av x bv

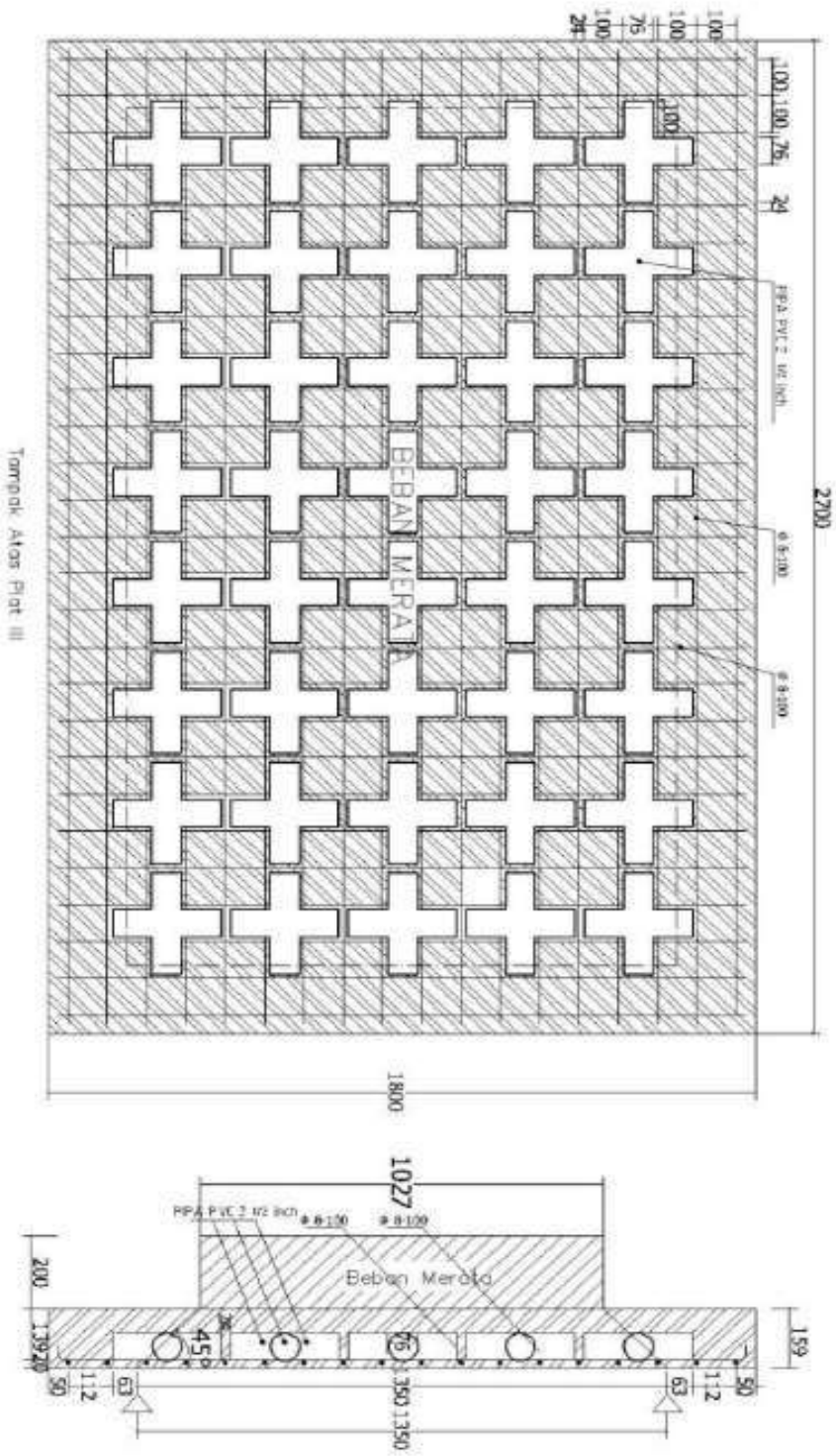
= 116,992 x 1,118 x 2,368

= 309,646 kN

Pvu < Vc……Maka tidak terjadi geser

LAMPIRAN 17

(Geser PB-2)



Gambar 26. Penampang Geser Pelat Berongga PB-2

Lebar Pelat (L)	=	2600	mm			
Panjang Pelat (b)	=	1350	mm			
Tebal Pelat (h)	=	140	mm			
Diameter (ds)	=	7,8	mm			
Jarak antar Tulangan	=	100	mm			
Fy	=	402,4	Mpa			
Es	=	200000	Mpa			
Mutu beton (fc)	=	28,51	Mpa			
Modulus Elastisitas Beton (Ec)	=	21299,16	Mpa			
Selimut Beton (d')	=	20	Mm			
Berat Sendiri	=	1003,173	Kg/m3	=	2,804	kN/m2

Tinggi efektif tulangan :

d = h – ts – 0,5.d

= 140 - 2 – 3,9

= 116 mm

ar = lx – 75 x 2

= 1350 – 150

= 1200 mm

br = ly - 250 x 2

= 2600 - 500

= 2100 mm

βc = $\frac{ly}{lx}$

= $\frac{2600}{1350}$

= 1,93 mm

bo = 2 x (ar + br)

= 2 x (1200 + 2100)

= 6600 mm

Dalam SK-SNI 2847 tahun 2019 pasal 12.12.2.1 perhitungan kemampuan pelat dua arah non prategang dalam menahan gaya geser diambil nilai terkecil dari :

1. Vc = $0{,}17 \times \left(1 + \frac{2}{\beta}\right) \times \lambda \times \sqrt{fc} \times bo \times d$

= 1417538,259 N

= 117,538 kN

2. Vc = $0{,}083 \times \left(2 + \frac{\alpha.d}{b0}\right) \times \lambda \times \sqrt{fc} \times bo \times d$

= 917930,325 N

= 917,930 kN

3. Vc = $0{,}33 \times \lambda \times \sqrt{fc} \times bo \times d$

= 1349886,6 N

= 1349,887 kN

Diambil nilai terkeci (Vc) = 917,930 kN

Luas penampang geser berdasarkan Aldejohann dan Schnellenbach

A solid = b x d

= 1350 x 116

= 156735 mm2

Arah y

A solid = b x d

= 2600 x 116

= 301860 mm2

Arah x

A Pb-2 = A solid – A rongga

= 156735 – 145589,4

= 11145,6 mm2

Arah y

A Pb-2 = A solid – A rongga

= 301860 – 256348,8

= 45511,2 mm2

Arah x

Vc = Vc' x $\frac{A\ PB-2}{\text{A solid}}$

= 917,930 x $\frac{11145,6}{156735}$

= 138,396 kN

Untuk membandingkan kondisi geser dilapangan diambil nilai Vc terbesar 138,396 kN.

Analisa eksperimen

Beban maksimum PB-2 = 335,18 kN

Beban maksimum PP-1 per meter persegi 95,49 kN/m2

Daerah beban area :

av = ar – (2 x (d-ts-db/2))

= 1200 – 116,2

= 1083,8 mm

= 1,084 m

bv = br – (2 x (d-ts-db/2))

= 1983,8 mm

= 1,984 m

Beban area geser :

Pvu = Pmaks x av x bv

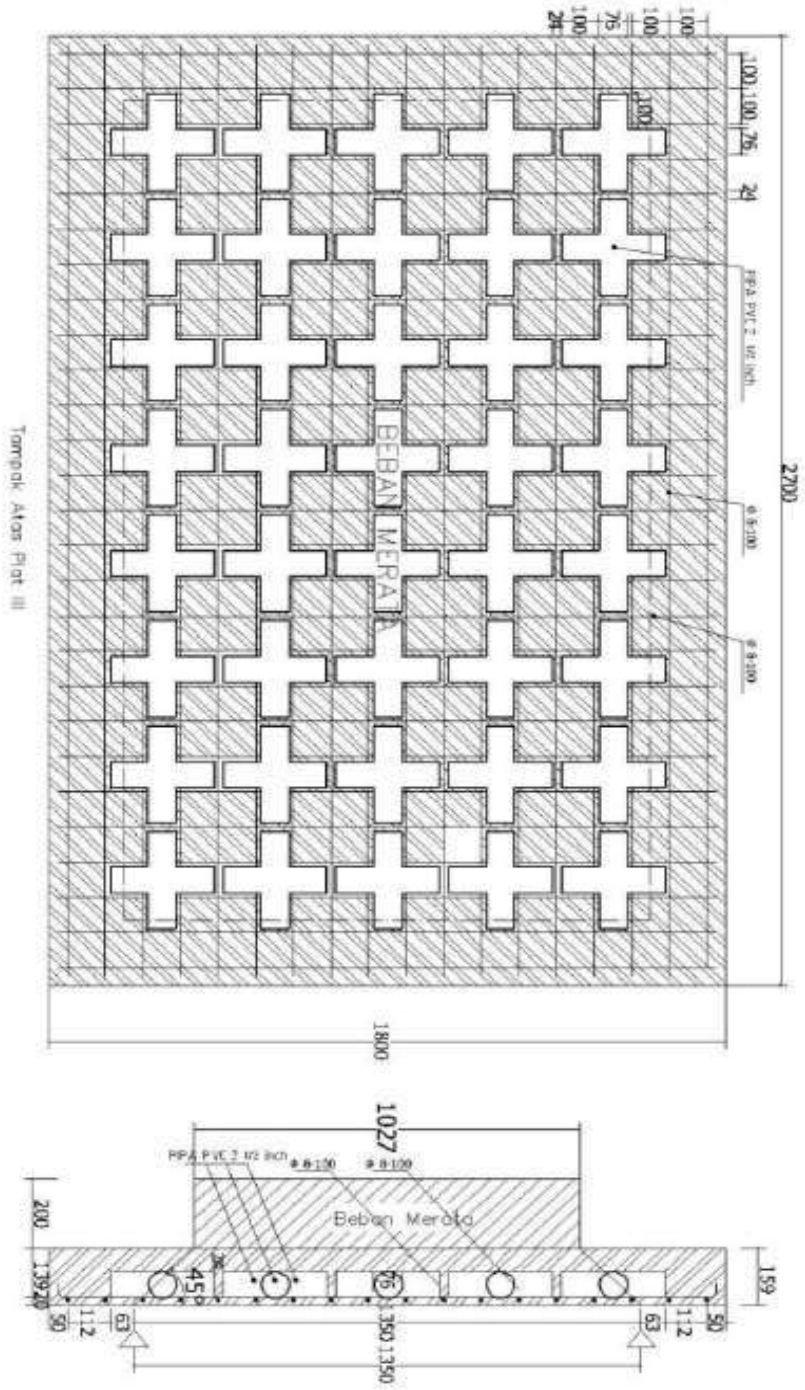
= 95,493 x av x bv

= 205,314 kN

Pvu > Vc…….Maka terjadi gagal geser

LAMPIRAN 18

(Geser pada PB-3)



Gambar 27. Penampang Geser Pelat Berongga PB-3

Lebar Pelat (L)	=	2600	mm				
Panjang Pelat (b)	=	1350	mm				
Tebal Pelat (h)	=	140	mm				
Diameter (ds)	=	7,8	mm				
Jarak antar Tulangan	=	100	mm				
Fy	=	402,4	Mpa				
Es	=	200000	Mpa				
Mutu beton (fc)	=	28,51	Mpa				
Modulus Elastisitas Beton (Ec)	=	21299,16	Mpa				
Selimut Beton (d')	=	20	Mm				
Berat Sendiri	=	1162,880	Kg/m3	=	3,250	kN/m2	

Tinggi efektif tulangan :

d = h – ts – 0,5.d

= 159,5 - 20 – 3,9

= 136 mm

ar = lx – 75 x 2

= 1350 – 150

= 1200 mm

br = ly - 250 x 2

= 2600 - 500

= 2100 mm

βc = $\frac{ly}{lx}$

= $\frac{2600}{1350}$

= 1,93 mm

bo = 2 x (ar + br)

= 2 x (1200 + 2100)

= 6600 mm

Dalam SK-SNI 2847 tahun 2019 pasal 12.12.2.1 perhitungan kemampuan pelat dua arah non prategang dalam menahan gaya geser diambil nilai terkecil dari :

1. Vc = 0,17 x (1 + $\frac{2}{\beta}$) x λ x √fc x bo x d

= 1661730,897 N

= 1661,731 kN

2. Vc = 0,083 x (2+ $\frac{\alpha.d}{b0}$) x λ x √fc x bo x d

= 1124300,757 N

= 1124,301 kN

3. Vc = 0,33 x λ x √fc x bo x d

= 1582425,205 N

= 1582,425 kN

Diambil nilai terkecil (Vc) = 1124,301 kN

Luas penampang geser berdasarkan Aldejohann dan Schnellenbach

Arah x

A solid = b x d

= 1350 x 136

= 183735 mm2

Arah y

A solid = b x d

= 2600 x 136

= 353860 mm2

Arah x

A Pb-2 = A solid – A rongga

= 183735 – 170669,4

= 13065,6 mm2

Arah y

A Pb-2 = A solid – A rongga

= 353860 – 300508,8

= 53351,2 mm2

Arah x

Vc = Vc' x $\frac{A\ PB-2}{\text{A solid}}$

= 1124,301 x $\frac{13065,6}{183735}$

= 79,950 kN

Arah y

Vc = Vc' x $\frac{A\ PB-2}{\text{A solid}}$

= 1124,301 x $\frac{53351,2}{353860}$

= 169,510 kN

Untuk membandingkan kondisi geser dilapangan diambil nilai Vc terbesar 169,510 kN.

Analisa eksperimen

Beban maksimum PB-2 = 396,257 kN

Beban maksimum PP-1 per meter persegi 112,89 kN/m2

Daerah beban area :

av = ar – (2 x (d-ts-db/2))

= 1200 – 156,2

= 1043,8 mm

= 1,044 m

bv = br – (2 x (d-ts-db/2))

= 1943,8 mm

= 1,944 m

Beban area geser :

Pvu = Pmaks x av x bv

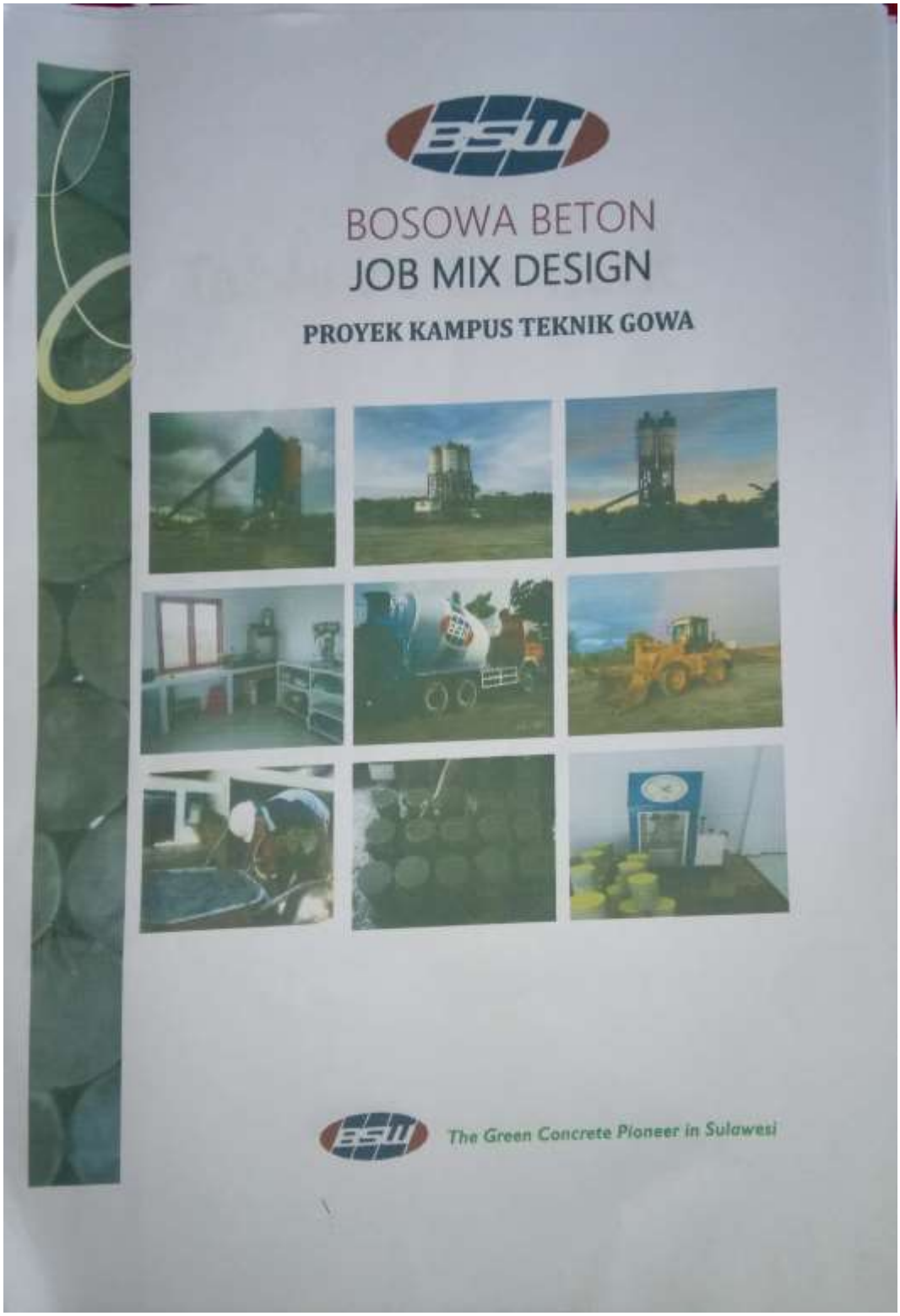
= 112,894 x 1,044 x 1,944

= 229,055 kN

Pvu > Vc…….Maka terjadi gagal geser

LAMPIRAN 19

(Job Mix Formula)



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2. Material Analysis
3. Broshure and certificate

BOSOWA BETON	PT. BOSOWA BETON INDONESIA FORMULIR	
JOB MIX DESIGN	No. Dokumen	SMT-FM-QAC-001.14
	Revisi	00
	Tgl Efektif	

Date : 31 JANUARI 2019
Project : KAMPUS TEKNIK UNHAS
Costumer :

GRADE (Kg/cm²)	K 350 + FA 30%	K 350
METHODE	MANUAL	MANUAL
NOMINAL SLUMP (Cm)	10±2	10±2
WATER CEMENT RATIO	0.39	0.44
CEMENT OPC CONTENT (Kg/m³)	334	420
FLY ASH CONTENT (Kg/m³)	143	0
NOMINAL WATER (Lt/m³)	185	185
ADMIXTURE 1 : RETARDER (Lt/m3)	1.5	1.9
ADMIXTURE 2 : SUPERPLAST (Lt/m3)	2	2
COARSE AGGREGATE 10-20 mm (Kg/m³)	890	920
FINE AGGREGATE (Kg/m³)	770	840

Note :
The above mixes will comply with all the current requirements of SNI 03-2834 provided all aspects of sampling preparation and testing.

Disetujui	Dibuat
Rully Seno S	Muhammad Sultan
Head Div QC	Head Dept QC

The Green Concrete Pioneer in Sulawesi

MATERIAL ANALYSIS

1. 10-20 Bili Bili Stone
2. 20-30 Bili Bili Stone
3. Bili Bili sand

The Green Concrete Pioneer in Sulawesi

BOSOWA / PT. BOSOWA BETON	DOC N0. : BBI WS 065c - 02	ISSUE N0. 1
	DATE :	PAGE 1 OF 1
	WORKSHEET	
QC DEPARTMENT	9,5 / 19 SPLIT CONDITION ANALYSIS	

REF : The last version of BBI WI 042 , 043 , 044 , 087

SAMPLE IDENTIFICATION

Sample number		Date Received	2-Jan-20
Sample Source	BILI BILI	Date Tested	3-Jan-20
Sent by		Tested by	ICSANG
Type of test	REGULER	Checked by	MUHAMMAD SULTAN
Testing Location	MAKASSAR LAB		

TEST RESULT

Item	Reference	Result
Colloid Content , %	AS 1141 - 12 , BBI WI 044	0.74
Fineness Modulus	ASTM C 136 , AS 1141.11,BBI WI 044	6.94
Water absorption , %	ASTM C 127 , BBI WI 042	0.91
Moisture Content , %	ASTM C 566 , BBI 087	0.8
Specific Gravity	ASTM C 127 , BBI 042	2.62

SIEVE ANALYSIS

Reference : ASTM C 33-93 , ASTM C 136 , AS 1141 - 11 , BBI WI 044

Sieve Aperture (mm)	Retained Mass (gram)	% Retained	% Passing
25	0	0	100
19	76	5.07	94.93
12.5	780	52.00	48.00
9.5	1360	90.67	9.33
4.75	1480	98.67	1.33
PAN	1500		

PT. BOSOWA BETON QC DEPARTMENT	DOC NO : BBI WS 085c - 02 DATE :	ISSUE NO. 1 PAGE 1 OF 1
	WORKSHEET 12,5 / 25 SPLIT CONDITION ANALYSIS	

REF : The last version of BBI WI 042 , 043 , 044 , 087

SAMPLE IDENTIFICATION

Sample number		Date Received	2-Jan-20
Sample Source	BILI BILI	Date Tested	3-Jan-20
Sent by		Tested by	ICSANG
Type of test	REGULER	Checked by	MUHAMMAD SULTAN
Testing Location	MAKASSAR LAB		

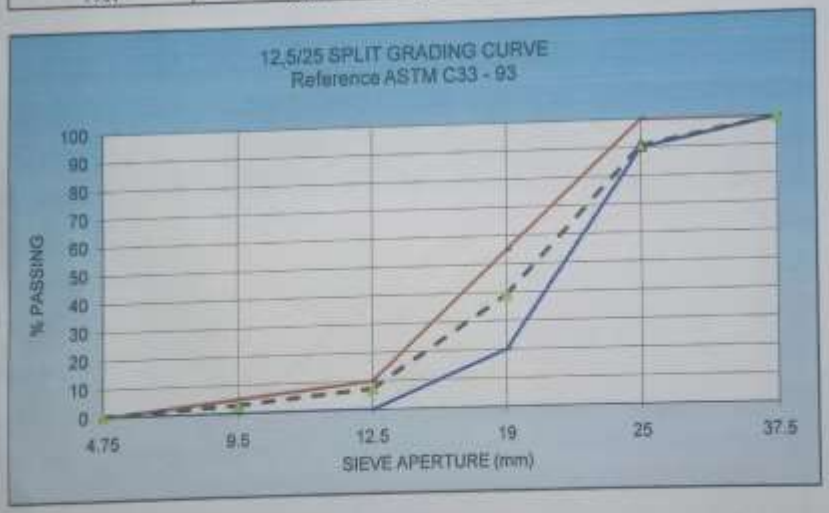
TEST RESULT

Item	Reference	Result
Colloid Content , %	AS 1141 - 12 , BBI WI 044	0.82
Fineness Modulus	ASTM C 136 , AS 1141.11,BBI WI 044	7.57
Water absorption , %	ASTM C 127 , BBI WI 042	0.62
Moisture Content , %	ASTM C 566 , BBI 067	0.20
Specific Gravity	ASTM C 127 , BBI 042	2.63

SIEVE ANALYSIS

Reference : ASTM C 33-93 , ASTM C 136 , AS 1141 - 11 , BBI WI 044

Sieve Aperture (mm)	Retained Mass (gram)	% Retained	% Passing
37.5	0	0	100
25	140	9.33	90.67
19	912	60.80	39.20
12.5	1390	92.67	7.33
9.5	1455	97.00	3.00
4.75	1494	99.60	0.40
PAN	1500	100	0



BOSOWA / PT. BOSOWA BETON / QC DEPARTMENT	DOC NO. : BBI WS 068-02	ISSUE NO. 1
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	SAND CONDITION ANALYSIS	

REF : The last version of BBI WI 043 , 044 , 045 , 087

SAMPLE IDENTIFICATION

Sample number		Date Received	2-Jan-20
Sample Source	BILI BILI	Date Tested	3-Jan-20
Sent by		Tested by	ICSANG
Type of test	REGULER	Checked by	MUHAMMAD SULTAN
Testing Location	MAKASSAR LAB		

TEST RESULT

Item	Reference	Result
Colloid Content , %	AS 1141 - 12 , BBI WI 043	4.40
Fineness Modulus	ASTM C 136 , AS 1141.11,BBI WI 044	2.66
Water absorption , %	ASTM C 127 , BBI WI 045	3.02
Moisture Content , %	ASTM C 566 , BBI 087	4.00
Specific Gravity	ASTM C 127 , BBI 045	2.58

SIEVE ANALYSIS

Reference : ASTM C 33-93 , ASTM C 136 , AS 1141 - 11 , BBI WI 044

Sieve Aperture (mm)	Retained Mass (gram)	% Retained	% Passing
9.5	0	0.00	100.00
4.75	0	0.00	100.00
2.36	57	6.70	93.30
1.18	303	30.30	69.70
0.6	542	54.20	45.80
0.3	816	81.60	18.40
0.15	955	95.50	4.50
PAN	1000	100.00	0.00

BROCHURE AND CERTIFICATE

1. Admixture Type D & F
2. Sertificat Cement

The Green Concrete Pioneer in Sulawesi

Celchem o8RS

Water Reducing and Retarding

Description

Celchem o8 Series is Polyhydroxy Carbon Salts . Celchem o8 series improves workability and retarding.

Recommended For

Used as a genaral purpose admixture when the placing placing condition.
For high quality concrete are more demanding such as :

- Ready mix concrete plant
- Durability improvement and unit quantity
- Pump Concrete
- High mechanical strength are required

Advantage

- Increased setting time in hot weather
- Increase strength
- Erosion of concrete and iron rods doesn't occur as a non-chloride
- Long lasting control of slump loss

General Properties

Form	Liquid
Color	Ligh Brown
Specific Gravity	1.16 +-0.02
Shelf Live	Minimum 1 year if stored in original unopened container
Storage	Dry, cool, shaded place
Packaging	Bulk Delivery

Dosage

Celchem o8 series is normally used at rate 0.2-0.6 kg per 100 kg of cement. Dosages may also be used depending on the concrete mix design.

Precautions

- Avoids contact with skin and eyes
- Wear protective gloves and eye protection during work
- If skin contact occurs, wash skin thoroughly
- If in eyes, hold eyes open, flood with warm water and seek medical attention without delay

Celchem 75 RS

High Range Water Reducing

Description

It is based on selected naphatalene sulphonated, which acts optimally on the various constituents of Portland cement. The use of Chelchem 75 RS helps in the production of plastic concrete. Celchem 75 RS meets the requirements of ASTM C494 f or types A and F admixtures.

Recommended For

Celchem 75 RS is especially suitable for concrete used in the construction of precast elements which quires excellent workability and high early and final strengths, such as:

- production of load bearing precast elements (e.g. bridge girders, piles concrete).
- structures constructed u sing travelling forms and slip forms.
- insitu casting of structural elements.

Advantage

- Very High Workability – Short placement time, save time and labour.
- High Water Reducing – High impermeability and strength, Improve durability
- High Early Strength – Early demoulding, Shorter steam curing
- Low Shringkage and Creep – Better dimensional stability

General Properties

Form	Liquid
Color	Dark Brown
Specific Gravity	1.17 +-0.02
Shelf Live	Minimum 1 year if stored in original unopened container
Storage	Dry, cool, shaded place
Packaging	Bulk Delivery

Dosage

Celchem 75 series is normally used at rate 0.4-1.5 kg per 100 kg of cement. Dosages may also be used depending on the concrete mix design.

Precautions

- Avoids contact with skin and eyes
- Wear protective gloves and eye protection during work
- If skin contact occurs, wash skin thoroughly
- If in eyes, hold eyes open, flood with warm water and seek medical attention without delay

SEMEN BOSOWA
Laboratorium Pengujian

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Telp. 0-800-1-805014 Fax 0411 373234
Barugo, Maros Sulsel Indonesia 90561

SERTIFIKAT MUTU

Nomor :	113-2019	Nama produk :	OPC
Tanggal :	24 Desember 2019	NRP :	104-019-171369
Masa produksi :	November 2019	Standar persyaratan:	SNI 2049:2015

Komposisi Kimia

	Hasil	Persyaratan
MgO, %	1,47	Maksimum 6,0
SO_3 %	2,27	Maksimum 3,5
Hilang pijar, %	4,63	Maksimum 5,0
Bagian tak larut, %	1,31	Maksimum 3,0
Alkali, %	0,25	Maksimum 0,60*

Sifat Fisika

	Hasil	Persyaratan
Kehalusan, Blaine m^2/kg	350	Minimum 280
Autoclave expansion %	0,03	Maksimum 0,80
Waktu pengikatan, Vicat test menit		
- Initial set	144	Minimum 45
- Final set	255	Maksimum 375
Kuat tekan kg/cm^2		
- 3 hari	182	Minimum 135
- 7 hari	252	Minimum 215
- 28 hari	376	Minimum 300
False set, final penetration, %	85,69	Minimum 50*
Kandungan udara, % volume	3,88	Maksimum 12*

Catatan :
- Berat jenis semen 3,10.
- *Persyaratan fisika tambahan ini berlaku hanya jika secara khusus diminta.

Disetujui oleh,

Andi Asman Setiawan
QA & QC Department Head

Hasil pengujian di atas hanya berlaku pada sampel yang telah dianalisa.
Sertifikat mutu ini tidak boleh digandakan tanpa persetujuan tertulis dari QA & QC Department Head.

LAMPIRAN 20

(Material Properties PVC)

Tabel 14. Material Properties PVC

Property	Unit	Value
Specific gravity	g/cm^3	1,40
Coefficient of linear expansion	$mm/m.^oC$	8×10^{-2}
Thermal conductivity	$W/m.^oC$	0,15
Modulus of elasticity	N/mm^2	3000
Surface resistance	Ohm	$> 10^{12}$
Tensile strength	N/mm^2	50-80
Elongation @ break	%	20-40

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