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## ANALISIS KAPASITAS LENTUR BALOK INDUK 400 X 600

### TULANGAN LONGITUDINAL (TUMPUAN)

Tinggi Penampang	: h	=	600	mm
Lebar Penampang	: b	=	400	mm
Selimut Beton	: d'	=	35	mm
Tinggi Efektif Penampang	: d	=	565	mm
Tinggi Efektif Penampang	: d1	=	515	mm
Kuat negatif Beton	: fc'	=	29,05	Mpa
Tegangan Leleh Baja Tulangan	: fy	=	420	Mpa
Modulus Elastisitas Beton	: Ec	= [ 4700 √ fc' ]	25332,0844	Mpa
Modulus Elastisitas Baja	: Es	=	200000	Mpa
Faktor Blok Tegangan	: β	=	0,85	
Diameter Tulangan	: D	=	22,00	mm
Banyak Tulangan Positif (+)	: n <sub>positif</sub>	=	8,00	
Banyak Tulangan negatif (-)	: n <sub>negatif</sub>	=	6,00	
Faktor Reduksi	: ϕ	=	0,9	
<b>Rasio Tulangan</b>				
Rasio Tulangan Balanced	: ρ <sub>b</sub>	= [ β.0.85.fc'/fy[600/[600+fy]] ]	=	0,0294
<b>Tulangan Positif</b>				
Luas Tul. Positif Terpasang	: A <sub>S</sub> <sub>Positif</sub>	= [ n Asd ]	=	3041,061689 mm <sup>2</sup>
Tinggi Blok Tegangan	: a	= [ A <sub>S</sub> Positif fy / 0.85 fc' b ]	=	129,32 mm
Tinggi Garis Netral	: c	= 0,85.fc'.a.b	=	1277245,91 mm
Rasio Tulangan Aktual	: ρ <sub>ak</sub>	= A <sub>S</sub> /b.d	=	0,0135
<b>Tulangan Mengalami Keruntuhan Tarik</b>				
Momen Nominal negatif	: M <sub>n</sub> <sub>positif</sub>	= 0,85.fc.a.b.d(1-(0,59.ρ.fy/fc'))	=	638,81 kN.m
	ϕM <sub>n</sub> <sub>positif</sub>	= 0,9.M <sub>n</sub> <sub>positif</sub>	=	574,93 kN.m
<b>Tulangan Negatif</b>				
Luas Tul. Positif Terpasang	: A <sub>S</sub> <sub>Positif</sub>	= [ n Asd ]	=	2280,796267 mm <sup>2</sup>
Tinggi Blok Tegangan	: a	= [ A <sub>S</sub> Positif fy / 0.85 fc' b ]	=	96,99 mm
Tinggi Garis Netral	: c	= 0,85.fc'.a.b	=	957934,43 mm
Rasio Tulangan Aktual	: ρ <sub>ak</sub>	= A <sub>S</sub> /b.d	=	0,0101
<b>Tulangan Mengalami Keruntuhan Tarik</b>				
Momen Nominal negatif	: M <sub>n</sub> <sub>negatif</sub>	= 0,85.fc.a.b.d(1-(0,59.ρ.fy/fc'))	=	494,64 kN.m
	ϕM <sub>n</sub> <sub>negatif</sub>	= 0,9.M <sub>n</sub> <sub>negatif</sub>	=	445,18 kN.m

## ANALISIS KAPASITAS LENTUR BALOK INDUK 400 X 600

### TULANGAN LONGITUDINAL (LAPANGAN)

Tinggi Penampang	: h	=	600	mm
Lebar Penampang	: b	=	400	mm
Selimut Beton	: d'	=	35	mm
Tinggi Efektif Penampang	: d	=	565	mm
Tinggi Efektif Penampang	: d1	=	515	mm
Kuat negatif Beton	: fc'	=	29,05	Mpa
Tegangan Leleh Baja Tulangan	: fy	=	420	Mpa
Modulus Elastisitas Beton	: Ec	= [ 4700 √ fc' ]	25332,0844	Mpa
Modulus Elastisitas Baja	: Es	=	200000	Mpa
Faktor Blok Tegangan	: β	=	0,85	
Diameter Tulangan	: D	=	22,00	mm
Banyak Tulangan Positif (+)	: n <sub>positif</sub>	=	6,00	
Banyak Tulangan negatif (-)	: n <sub>negatif</sub>	=	6,00	
Faktor Reduksi	: ϕ	=	0,9	
<b>Rasio Tulangan</b>				
Rasio Tulangan Balanced	: ρ <sub>b</sub>	= [ β.0.85.fc'/fy[600/[600+fy]] ]	0,0294	mm <sup>2</sup>
<b>Tulangan Positif</b>				
Luas Tul. Positif Terpasang	: A <sub>S</sub> <sub>Positif</sub>	= [ n Asd ]	2280,796267	mm <sup>2</sup>
Tinggi Blok Tegangan	: a	= [ A <sub>S</sub> Positif fy / 0.85 fc' b ]	96,99	mm
Tinggi Garis Netral	: c	= 0,85.fc'.a.b	957934,43	mm
Rasio Tulangan Aktual	: ρ <sub>ak</sub>	= A <sub>S</sub> /b.d	0,0101	
cek	<b>Tulangan Mengalami Keruntuhan Tarik</b>			
Momen Nominal negatif	: M <sub>n</sub> <sub>positif</sub>	= 0,85.fc.a.b.d(1-(0,59.ρ.fy/fc'))	494,64	kN.m
	ϕM <sub>n</sub> <sub>positif</sub>	=	445,18	kN.m
<b>Tulangan Negatif</b>				
Luas Tul. Positif Terpasang	: A <sub>S</sub> <sub>Positif</sub>	= [ n Asd ]	2280,796267	mm <sup>2</sup>
Tinggi Blok Tegangan	: a	= [ A <sub>S</sub> Positif fy / 0.85 fc' b ]	96,99	mm
Tinggi Garis Netral	: c	= 0,85.fc'.a.b	957934,43	mm
Rasio Tulangan Aktual	: ρ <sub>ak</sub>	= A <sub>S</sub> /b.d	0,0101	
cek	<b>Tulangan Mengalami Keruntuhan Tarik</b>			
Momen Nominal negatif	: M <sub>n</sub> <sub>negatif</sub>	= 0,85.fc.a.b.d(1-(0,59.ρ.fy/fc'))	494,64	kN.m
	ϕM <sub>n</sub> <sub>negatif</sub>	=	445,18	kN.m

## ANALISIS KAPASITAS LENTUR BALOK ANAK 300 X 600

### TULANGAN LONGITUDINAL (TUMPUAN)

Tinggi Penampang	: h	=	600	mm
Lebar Penampang	: b	=	300	mm
Selimut Beton	: d'	=	35	mm
Tinggi Efektif Penampang	: d	=	565	mm
Tinggi Efektif Penampang	: d1	=	515	mm
Kuat negatif Beton	: fc'	=	29,05	Mpa
Tegangan Leleh Baja Tulangan	: fy	=	420	Mpa
Modulus Elastisitas Beton	: Ec	= [ 4700 √ fc' ]	25332,0844	Mpa
Modulus Elastisitas Baja	: Es	=	200000	Mpa
Faktor Blok Tegangan	: β	=	0,85	
Diameter Tulangan	: D	=	22,00	mm
Banyak Tulangan Positif (+)	: n <sub>positif</sub>	=	5,00	
Banyak Tulangan negatif (-)	: n <sub>negatif</sub>	=	3,00	
Faktor Reduksi	: ϕ	=	0,9	
<b>Rasio Tulangan</b>				
Rasio Tulangan Balanced	: ρ <sub>b</sub>	= [β.0.85.fc'/fy[600/[600+fy]]]	=	0,0294
<b>Tulangan Positif</b>				
Luas Tul. Positif Terpasang	: A <sub>S</sub> <sub>Positif</sub>	= [ n Asd ]	=	1900,663555 mm <sup>2</sup>
Tinggi Blok Tegangan	: a	= [ A <sub>S</sub> Positif fy / 0.85 fc' b ]	=	107,76 mm
Tinggi Garis Netral	: c	= 0,85.fc'.a.b	=	798278,69 mm
Rasio Tulangan Aktual	: ρ <sub>ak</sub>	= A <sub>S</sub> /b.d	=	0,0112
cek	<b>Tulangan Mengalami Keruntuhan Tarik</b>			
Momen Nominal negatif	: M <sub>n</sub> <sub>positif</sub>	= 0,85.fc.a.b.d(1-(0,59.ρ.fy/fc'))	=	407,89 kN.m
	ϕM <sub>n</sub> <sub>positif</sub>	=	367,10	kN.m
<b>Tulangan Negatif</b>				
Luas Tul. Positif Terpasang	: A <sub>S</sub> <sub>Positif</sub>	= [ n Asd ]	=	1140,398133 mm <sup>2</sup>
Tinggi Blok Tegangan	: a	= [ A <sub>S</sub> Positif fy / 0.85 fc' b ]	=	64,66 mm
Tinggi Garis Netral	: c	= 0,85.fc'.a.b	=	478967,22 mm
Rasio Tulangan Aktual	: ρ <sub>ak</sub>	= A <sub>S</sub> /b.d	=	0,0067
cek	<b>Tulangan Mengalami Keruntuhan Tarik</b>			
Momen Nominal negatif	: M <sub>n</sub> <sub>negatif</sub>	= 0,85.fc.a.b.d(1-(0,59.ρ.fy/fc'))	=	255,09 kN.m
	ϕM <sub>n</sub> <sub>negatif</sub>	=	229,58	kN.m

## ANALISIS KAPASITAS LENTUR BALOK ANAK 300 X 600

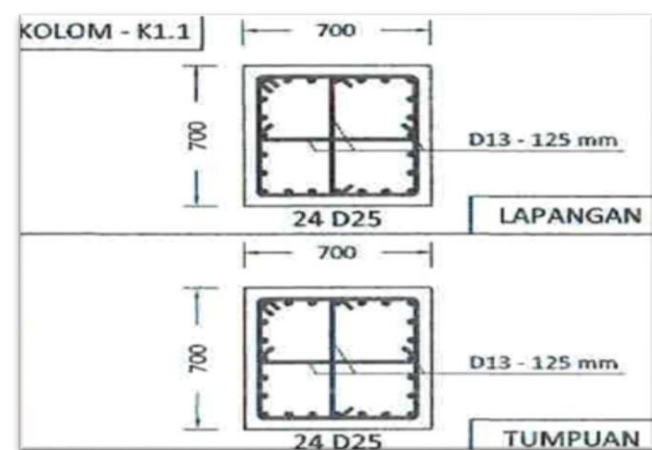
### TULANGAN LONGITUDINAL (LAPANGAN)

Tinggi Penampang	: h	=	600	mm
Lebar Penampang	: b	=	300	mm
Selimut Beton	: d'	=	35	mm
Tinggi Efektif Penampang	: d	=	565	mm
Tinggi Efektif Penampang	: d1	=	515	mm
Kuat negatif Beton	: fc'	=	29,05	Mpa
Tegangan Leleh Baja Tulangan	: fy	=	420	Mpa
Modulus Elastisitas Beton	: Ec	= [ 4700 √ fc' ]	25332,0844	Mpa
Modulus Elastisitas Baja	: Es	=	200000	Mpa
Faktor Blok Tegangan	: β	=	0,85	
Diameter Tulangan	: D	=	22,00	mm
Banyak Tulangan Positif (+)	: n <sub>positif</sub>	=	3,00	
Banyak Tulangan negatif (-)	: n <sub>negatif</sub>	=	3,00	
Faktor Reduksi	: ø	=	0,9	
<b>Rasio Tulangan</b>				
Rasio Tulangan Balanced	: ρ <sub>b</sub>	= [β.0.85.fc'/fy[600/[600+fy]]]	=	0,0294 mm <sup>2</sup>
<b>Tulangan Positif</b>				
Luas Tul. Positif Terpasang	: A <sub>S</sub> <sub>Positif</sub>	= [ n Asd ]	=	1140,398133 mm <sup>2</sup>
Tinggi Blok Tegangan	: a	= [ AsPositif fy / 0.85 fc' b ]	=	64,66 mm
Tinggi Garis Netral	: c	= 0,85.fc'.a.b	=	478967,22 mm
Rasio Tulangan Aktual	: ρ <sub>ak</sub>	= As/b.d	=	0,0067
cek	<b>Tulangan Mengalami Keruntuhan Tarik</b>			
Momen Nominal negatif	: M <sub>n</sub> <sub>positif</sub>	= 0,85.fc.a.b.d(1-(0,59.ρ.fy/fc'))	=	255,09 kN.m
	øM <sub>n</sub> <sub>positif</sub>	= 0,9.M <sub>n</sub> <sub>positif</sub>	=	229,58 kN.m
<b>Tulangan Negatif</b>				
Luas Tul. Positif Terpasang	: A <sub>S</sub> <sub>Positif</sub>	= [ n Asd ]	=	1140,398133 mm <sup>2</sup>
Tinggi Blok Tegangan	: a	= [ AsPositif fy / 0.85 fc' b ]	=	64,66 mm
Tinggi Garis Netral	: c	= 0,85.fc'.a.b	=	478967,22 mm
Rasio Tulangan Aktual	: ρ <sub>ak</sub>	= As/b.d	=	0,0067
cek	<b>Tulangan Mengalami Keruntuhan Tarik</b>			
Momen Nominal negatif	: M <sub>n</sub> <sub>negatif</sub>	= 0,85.fc.a.b.d(1-(0,59.ρ.fy/fc'))	=	255,09 kN.m
	øM <sub>n</sub> <sub>negatif</sub>	= 0,9.M <sub>n</sub> <sub>negatif</sub>	=	229,58 kN.m

**PERHITUNGAN AKSIAL KOLOM LANTAI 1**

**Data Kolom**

b	700	mm	
h	700	mm	
fc'	29,05	Mpa	
d'	40	mm	
d	660	mm	
fy	420	Mpa	
D	25	mm	(Dia. Tulangan)
n	24	buah	(Jumlah Tulangan)
Ast	11780,97	mm <sup>2</sup>	
Ag	490000	mm <sup>2</sup>	
as'	5890,485	mm <sup>2</sup>	
as	5890,485	mm <sup>2</sup>	
φ	0,65		



**Kapasitas Maksimum (Po) dari Kolom**

$$P_0 = 0,85 \times f_c' \times (A_g - A_{st}) + A_{st} \times F_y$$

$$P_0 = 16756430,8 \text{ N}$$

$$P_0 = 16756,431 \text{ Kn}$$

**Kekuatan Nominal Maksimum Penampang Kolom**

$$P_n (\text{max}) = 0,8 \times P_0$$

$$P_n (\text{max}) = 13405,14464 \text{ Kn}$$

**Eksentrisitas Minimum**

$$e_{\text{min}} = 0,1 \times h$$

$$e_{\text{min}} = 70 \text{ mm}$$

$$e_{\text{min}} = 938,3601247 \text{ Kn.m}$$

**Kuat Rencana Kolom**

$$\phi P_{n\text{max}} = \phi \times P_n (\text{max})$$

$$\phi P_{n\text{max}} = 8713,344015 \text{ Kn}$$

**Garis netral pada kondisi Seimbang**

$$c_b = (700) / (700 + f_y) \times d$$

$$c_b = 412,5 \text{ mm}$$

$$a_b = 0,85 \times c_b$$

$$a_b = 350,625 \text{ mm}$$

$$F_s' = E_s \times e's$$

$$F_s' = 700 \times ((c - d') / c)$$

$$F_s' = 632,1212121 \text{ Mpa}$$

$$f_s' \geq f_y$$

$$f_s' = f_y = 420 \text{ Mpa}$$

**Kapasitas Penampang pada Kondisi Seimbang (balance)**

$$P_{nb} = 0,85 \times f_c' \times a_b \times b + A_s' \times f_s' - A_s \times f_y$$

$$P_{nb} = 0,85 \times 29,05 \times (0,85 \times 700 \times 320) / (700 + 420) \times 420$$

$$P_{nb} = 6060465,469 \text{ N}$$

$$P_{nb} = 6060,465469 \text{ Kn}$$

$$\phi P_{nb} = 3939,302555$$

$$M_{nb} = 0,85 \times f_c' \times a_b \times b \times (y - a_b / 2) + A_s' \times f_s' \times (y - d') + A_s \times f_y \times (d - y)$$

$$M_{nb} = 2592569856 \text{ Kn.mm}$$

$$M_{nb} = 2592,569856 \text{ Kn.m}$$

$$\phi M_{nb} = 2074,055884 \text{ Kn.m}$$

**Eksentrisitas pada kondisi seimbang**

$$e_b = M_{nb} / P_{nb}$$

$$e_b = 0,4278 \text{ m}$$

$$e_b = 427,7839 \text{ mm}$$

**Kapasitas Penampang pada Momen Murni**

$$M_n = \frac{A_s \times f_y \times (d - (0,59 \times A_s \times f_y) / (f_c' \times b))}{\phi}$$

$$M_n = 1455256524,05 \text{ N}$$

$$M_n = 1455,26 \text{ Kn.m}$$

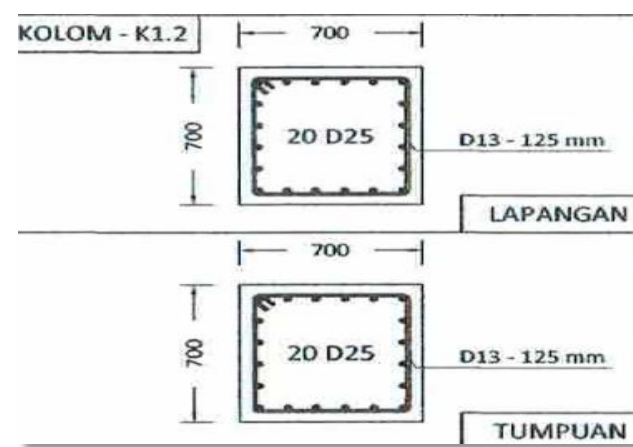
$$\phi M_n = 0,8 \times M_n$$

$$\phi M_n = 1164,21 \text{ Kn.m}$$

**PERHITUNGAN AKSIAL KOLOM LANTAI 2**

**Data Kolom**

b	700	mm	
h	700	mm	
fc'	29,05	Mpa	
d'	40	mm	
d	660	mm	
fy	420	Mpa	
D	25	mm	(Dia. Tulangan)
n	20	buah	(Jumlah Tulangan)
Ast	9817,475	mm <sup>2</sup>	
Ag	490000	mm <sup>2</sup>	
as'	4908,738	mm <sup>2</sup>	
as	4908,738	mm <sup>2</sup>	
φ	0,65		



**Kapasitas Maksimum (Po) dari Kolom**

$$P_0 = 0,85 \times f_c' \times (A_g - A_{st}) + A_{st} \times F_y$$

$$P_0 = 15980246,5 \text{ N}$$

$$P_0 = 15980,246 \text{ Kn}$$

**Kekuatan Nominal Maksimum Penampang Kolom**

$$P_n (\text{max}) = 0,8 \times P_0$$

$$P_n (\text{max}) = 12784,1972 \text{ Kn}$$

**Eksentrisitas Minimum**

$$e_{\text{min}} = 0,1 \times h$$

$$e_{\text{min}} = 70 \text{ mm}$$

$$e_{\text{min}} = 894,8938039 \text{ Kn.m}$$

**Kuat Rencana Kolom**

$$\phi P_{n\text{max}} = \phi \times P_n (\text{max})$$

$$\phi P_{n\text{max}} = 8309,728179 \text{ Kn}$$

**Garis netral pada kondisi Seimbang**

$$c_b = \frac{700}{(700 + f_y) \times d}$$

$$c_b = 412,5 \text{ mm}$$

$$a_b = 0,85 \times c_b$$

$$a_b = 350,625 \text{ mm}$$

$$F_s' = E_s \times e's$$

$$F_s' = \frac{700 \times ((c - d')/c)}{c}$$

$$F_s' = 632,1212121 \text{ Mpa}$$

$$f_s' \geq f_y$$

$$f_s' = f_y = 420 \text{ Mpa}$$

**Kapasitas Penampang pada Kondisi Seimbang (balance)**

$$P_{nb} = 0,85 \times f_c' \times a_b \times b + A_s' \times f_s' - A_s \times f_y$$

$$P_{nb} = 0,85 \times 11,24 \times (0,85 \times 700 \times 330) / (700 + 420) \times 420$$

$$P_{nb} = 6060465,469 \text{ N}$$

$$P_{nb} = 6060,465469 \text{ Kn}$$

$$\phi P_{nb} = 3939,302555$$

$$M_{nb} = 0,85 \times f_c' \times a_b \times b \times (y - a_b/2) + A_s' \times f_s' \times (y - d') + A_s \times f_y \times (d - y)$$

$$M_{nb} = 2336922807 \text{ Kn.mm}$$

$$M_{nb} = 2336,922807 \text{ Kn.m}$$

$$\phi M_{nb} = 1869,538245 \text{ Kn.m}$$

**Eksentrisitas pada kondisi seimbang**

$$e_b = M_{nb} / P_{nb}$$

$$e_b = 0,3856 \text{ m}$$

$$e_b = 385,6012 \text{ mm}$$

**Kapasitas Penampang pada Momen Murni**

$$M_n = \frac{A_s \times f_y \times (d - (0,59 \times A_s \times f_y) / (f_c' \times b))}{f_c' \times b}$$

$$M_n = 1237378480,87 \text{ N}$$

$$M_n = 1237,38 \text{ Kn.m}$$

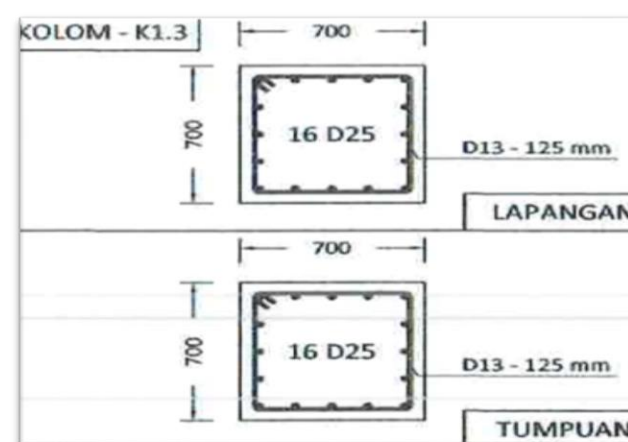
$$\phi M_n = 0,8 \times M_n$$

$$\phi M_n = 989,90 \text{ Kn.m}$$

**PERHITUNGAN AKSIAL KOLOM LANTAI 3**

**Data Kolom**

b	700	mm	
h	700	mm	
fc'	29,05	Mpa	
d'	40	mm	
d	660	mm	
fy	420	Mpa	
D	25	mm	(Dia. Tulangan)
n	16	buah	(Jumlah Tulangan)
Ast	7853,98	mm <sup>2</sup>	
Ag	490000	mm <sup>2</sup>	
as'	3926,99	mm <sup>2</sup>	
as	3926,99	mm <sup>2</sup>	
φ	0,65		



**Kapasitas Maksimum (Po) dari Kolom**

$$P_0 = 0,85 \times f_{c'} \times (A_g - A_{st}) + A_{st} \times F_y$$

$$P_0 = 15204062,2 \text{ N}$$

$$P_0 = 15204,062 \text{ Kn}$$

**Kekuatan Nominal Maksimum Penampang Kolom**

$$P_n (\text{max}) = 0,8 \times P_0$$

$$= 12163,24976 \text{ Kn}$$

**Eksentrisitas Minimum**

$$e_{\text{min}} = 0,1 \times h$$

$$= 70 \text{ mm}$$

$$= 851,4274831 \text{ Kn.m}$$

**Kuat Rencana Kolom**

$$\phi P_{n\text{max}} = \phi \times P_n (\text{max})$$

$$= 7906,112343 \text{ Kn}$$

**Garis netral pada kondisi Seimbang**

$$c_b = \frac{700}{(700 + f_y) \times d}$$

$$= 412,5 \text{ mm}$$

$$a_b = 0,85 \times c_b$$

$$= 350,625 \text{ mm}$$

$$f_s' = E_s \times e's$$

$$= \frac{700 \times ((c - d')/c)}{}$$

$$= 632,1212121 \text{ Mpa}$$

$$f_s' \geq f_y = 420 \text{ Mpa}$$

**Kapasitas Penampang pada Kondisi Seimbang (balance)**

$$P_{nb} = 0,85 \times f_{c'} \times a_b \times b + A_s' \times f_s' - A_s \times f_y$$

$$= 0,85 \times 29,05 \times (0,85 \times 600 \times 351) / (600 + 400) \times 400$$

$$= 6060465,469 \text{ N}$$

$$= 6060,465469 \text{ Kn}$$

$$\phi P_{nb} = 3939,302555$$

$$M_{nb} = 0,85 \times f_{c'} \times a_b \times b \times (y - a_b/2) + A_s' \times f_s' \times (y - d') + A_s \times f_y \times (d - y)$$

$$= 2081275758 \text{ Kn.mm}$$

$$= 2081,275758 \text{ Kn.m}$$

$$\phi M_{nb} = 1665,020606 \text{ Kn.m}$$

**Eksentrisitas pada kondisi seimbang**

$$e_b = M_{nb} / P_{nb}$$

$$= 0,3434 \text{ m}$$

$$= 343,4185 \text{ mm}$$

**Kapasitas Penampang pada Momen Murni**

$$M_n = \frac{A_s \times f_y \times (d - (0,59 \times A_s \times f_y) / (f_{c'} \times b))}{}$$

$$= 1009634553,36 \text{ N}$$

$$= 1009,63 \text{ Kn.m}$$

$$\phi M_n = 0,8 \times M_n$$

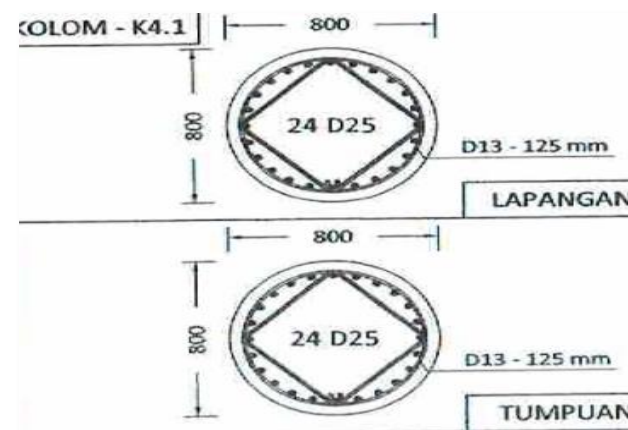
$$= 807,71 \text{ Kn.m}$$



**PERHITUNGAN AKSIAL KOLOM SPIRAL LANTAI 1**

**Data Kolom**

b	800	mm	
h	800	mm	
fc'	29,05	Mpa	
d'	40	mm	
d	760	mm	
fy	420	Mpa	
D	25	mm	(Dia. Tulangan)
n	24	buah	(Jumlah Tulangan)
Ast	11780,97	mm <sup>2</sup>	
Ag	640000	mm <sup>2</sup>	
as'	5890,485	mm <sup>2</sup>	
as	5890,485	mm <sup>2</sup>	
φ	0,65		



**Kapasitas Maksimum (Po) dari Kolom**

$$P_0 = 0,85 \times f_{c'} \times (A_g - A_{st}) + A_{st} \times F_y$$

$$P_0 = 20460305,8 \text{ N}$$

$$P_0 = 20460,306 \text{ Kn}$$

**Kekuatan Nominal Maksimum Penampang Kolom**

$$P_n (\text{max}) = 0,8 \times P_0$$

$$P_n (\text{max}) = 16368,24464 \text{ Kn}$$

**Eksentrisitas Minimum**

$$e_{\text{min}} = 0,1 \times h$$

$$e_{\text{min}} = 80 \text{ mm}$$

$$e_{\text{min}} = 1309,459571 \text{ Kn.m}$$

**Kuat Rencana Kolom**

$$\phi P_{n\text{max}} = \phi \times P_n (\text{max})$$

$$\phi P_{n\text{max}} = 10639,35902 \text{ Kn}$$

**Garis netral pada kondisi Seimbang**

$$C_b = \frac{800}{(800 + f_y) \times d}$$

$$C_b = 498,3606557 \text{ mm}$$

$$a_b = 0,85 \times C_b$$

$$a_b = 423,6065574 \text{ mm}$$

$$F_s' = E_s \times e's$$

$$F_s' = \frac{800 \times ((c-d)^2 / c)}{735,7894737} \text{ Mpa}$$

$$F_s' = 735,7894737 \text{ Mpa}$$

$$f_s' \geq f_y = 420 \text{ Mpa}$$

$$f_s' = f_y = 420 \text{ Mpa}$$

**Kapasitas Penampang pada Kondisi Seimbang (balance)**

$$P_{nb} = 0,85 \times f_{c'} \times a_b \times b + A_s' \times f_s' - A_s \times f_y$$

$$P_{nb} = 0,85 \times 11,24 \times (0,85 \times 600 \times 351) / (600 + 400) \times 400$$

$$P_{nb} = 8367923,934 \text{ N}$$

$$P_{nb} = 8367,923934 \text{ Kn}$$

$$\phi P_{nb} = 5439,150557$$

$$M_{nb} = 0,85 \times f_{c'} \times a_b \times b \times (y - a_b/2) + A_s' \times f_s' \times (y - d') + A_s \times f_y \times (d - y)$$

$$M_{nb} = 3356098513 \text{ Kn.mm}$$

$$M_{nb} = 3356,098513 \text{ Kn.m}$$

$$\phi M_{nb} = 2684,87881 \text{ Kn.m}$$

**Eksentrisitas pada kondisi seimbang**

$$e_b = M_{nb} / P_{nb}$$

$$e_b = 0,4011 \text{ m}$$

$$e_b = 401,0670 \text{ mm}$$

**Kapasitas Penampang pada Momen Murni**

$$M_n = \frac{A_s \times f_y \times (d - (0,59 \times A_s \times f_y) / (f_{c'} \times b))}{1724855133,79}$$

$$M_n = 1724855133,79 \text{ N}$$

$$M_n = 1724,86 \text{ Kn.m}$$

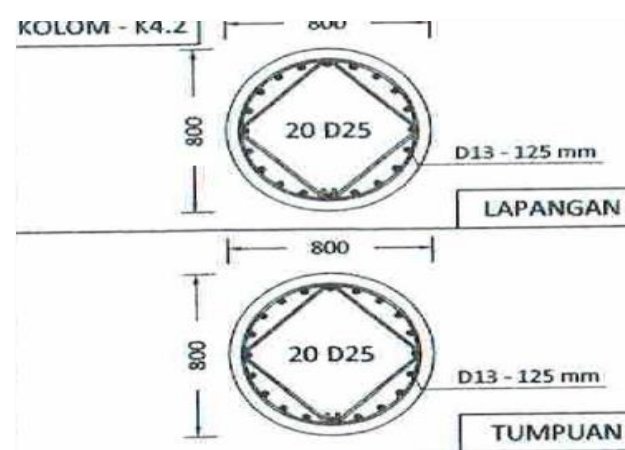
$$\phi M_n = 0,8 \times M_n$$

$$\phi M_n = 1379,88 \text{ Kn.m}$$

**PERHITUNGAN AKSIAL KOLOM SPIRAL LANTAI 2**

**Data Kolom**

b	800	mm	
h	800	mm	
fc'	29,05	Mpa	
d'	40	mm	
d	760	mm	
fy	420	Mpa	
D	25	mm	(Dia. Tulangan)
n	20	buah	(Jumlah Tulangan)
Ast	9817,475	mm <sup>2</sup>	
Ag	640000	mm <sup>2</sup>	
as'	4908,738	mm <sup>2</sup>	
as	4908,738	mm <sup>2</sup>	
φ	0,65		



**Kapasitas Maksimum (Po) dari Kolom**

$$P_0 = 0,85 \times f_c' \times (A_g - A_{st}) + A_{st} \times f_y$$

$$P_0 = 19684121,5 \text{ N}$$

$$P_0 = 19684,121 \text{ Kn}$$

**Kekuatan Nominal Maksimum Penampang Kolom**

$$P_n (\text{max}) = 0,8 \times P_0$$

$$P_n (\text{max}) = 15747,2972 \text{ Kn}$$

**Eksentrisitas Minimum**

$$e_{\text{min}} = 0,1 \times h$$

$$e_{\text{min}} = 80 \text{ mm}$$

$$e_{\text{min}} = 1259,783776 \text{ Kn.m}$$

**Kuat Rencana Kolom**

$$\phi P_{n\text{max}} = \phi \times P_n (\text{max})$$

$$\phi P_{n\text{max}} = 10235,74318 \text{ Kn}$$

**Garis netral pada kondisi Seimbang**

$$c_b = \frac{800}{(800 + f_y) \times d}$$

$$c_b = 498,3606557 \text{ mm}$$

$$a_b = 0,85 \times c_b$$

$$a_b = 423,6065574 \text{ mm}$$

$$f_s' = E_s \times e's$$

$$f_s' = \frac{800 \times ((c - d')/c)}{1}$$

$$f_s' = 735,7894737 \text{ Mpa}$$

$$f_s' \geq f_y = 420 \text{ Mpa}$$

**Kapasitas Penampang pada Kondisi Seimbang (balance)**

$$P_{nb} = 0,85 \times f_c' \times a_b \times b + A_s' \times f_s' - A_s \times f_y$$

$$P_{nb} = 0,85 \times 11,24 \times (0,85 \times 600 \times 351) / (600 + 400) \times 400$$

$$P_{nb} = 8367923,934 \text{ N}$$

$$P_{nb} = 8367,923934 \text{ Kn}$$

$$\phi P_{nb} = 5439,150557$$

$$M_{nb} = 0,85 \times f_c' \times a_b \times b \times (y - a_b/2) + A_s' \times f_s' \times (y - d') + A_s \times f_y \times (d - y)$$

$$M_{nb} = 3059218069 \text{ Kn.mm}$$

$$M_{nb} = 3059,218069 \text{ Kn.m}$$

$$\phi M_{nb} = 2447,374455 \text{ Kn.m}$$

**Eksentrisitas pada kondisi seimbang**

$$e_b = M_{nb} / P_{nb}$$

$$e_b = 0,3656 \text{ m}$$

$$e_b = 365,5887 \text{ mm}$$

**Kapasitas Penampang pada Momen Murni**

$$M_n = \frac{A_s \times f_y \times (d - (0,59 \times A_s \times f_y) / (f_c' \times b))}{1}$$

$$M_n = 1458960900,14 \text{ N}$$

$$M_n = 1458,96 \text{ Kn.m}$$

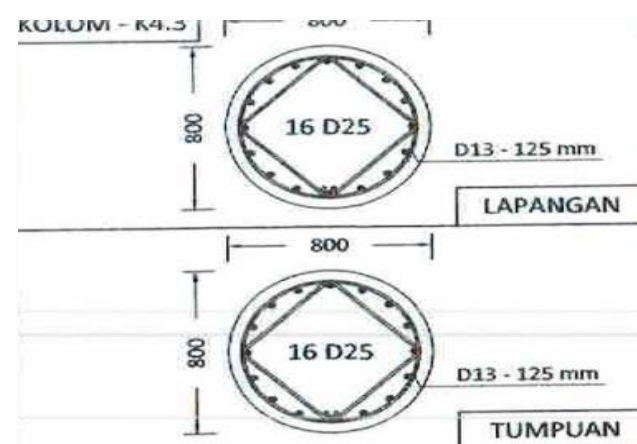
$$\phi M_n = 0,8 \times M_n$$

$$\phi M_n = 1167,17 \text{ Kn.m}$$

**PERHITUNGAN AKSIAL KOLOM SPIRAL LANTAI 3**

**Data Kolom**

b	800	mm	
h	800	mm	
fc'	29,05	Mpa	
d'	40	mm	
d	760	mm	
fy	420	Mpa	
D	25	mm	(Dia. Tulangan)
n	16	buah	(Jumlah Tulangan)
Ast	7853,98	mm <sup>2</sup>	
Ag	640000	mm <sup>2</sup>	
as'	3926,99	mm <sup>2</sup>	
as	3926,99	mm <sup>2</sup>	
φ	0,65		



**Kapasitas Maksimum (Po) dari Kolom**

$$P_0 = 0,85 \times f_{c'} \times (A_g - A_{st}) + A_{st} \times f_y$$

$$P_0 = 18907937,2 \text{ N}$$

$$P_0 = 18907,937 \text{ Kn}$$

**Kekuatan Nominal Maksimum Penampang Kolom**

$$P_n (\text{max}) = 0,8 \times P_0$$

$$= 15126,34976 \text{ Kn}$$

**Eksentrisitas Minimum**

$$e_{\text{min}} = 0,1 \times h$$

$$= 80 \text{ mm}$$

$$= 1210,107981 \text{ Kn.m}$$

**Kuat Rencana Kolom**

$$\phi P_{n\text{max}} = \phi \times P_n (\text{max})$$

$$= 9832,127343 \text{ Kn}$$

**Garis netral pada kondisi Seimbang**

$$c_b = \frac{800}{(800 + f_y) \times d}$$

$$= 498,3606557 \text{ mm}$$

$$a_b = 0,85 \times c_b$$

$$= 423,6065574 \text{ mm}$$

$$f_s' = E_s \times e's$$

$$= \frac{800 \times ((c - d')/c)}{}$$

$$= 735,7894737 \text{ Mpa}$$

$$f_s' \geq f_y = 420 \text{ Mpa}$$

**Kapasitas Penampang pada Kondisi Seimbang (balance)**

$$P_{nb} = 0,85 \times f_{c'} \times a_b \times b + A_s' \times f_s' - A_s \times f_y$$

$$= 0,85 \times 11,24 \times (0,85 \times 600 \times 351) / (600 + 400) \times 400$$

$$= 8367923,934 \text{ N}$$

$$= 8367,923934 \text{ Kn}$$

$$\phi P_{nb} = 5439,150557$$

$$M_{nb} = 0,85 \times f_{c'} \times a_b \times b \times (y - a_b/2) + A_s' \times f_s' \times (y - d') + A_s \times f_y \times (d - y)$$

$$= 2762337625 \text{ Kn.mm}$$

$$= 2762,337625 \text{ Kn.m}$$

$$\phi M_{nb} = 2209,8701 \text{ Kn.m}$$

**Eksentrisitas pada kondisi seimbang**

$$e_b = M_{nb} / P_{nb}$$

$$= 0,3301 \text{ m}$$

$$= 330,1103 \text{ mm}$$

**Kapasitas Penampang pada Momen Murni**

$$M_n = \frac{A_s \times f_y \times (d - (0,59 \times A_s \times f_y) / (f_{c'} \times b))}{}$$

$$= 1184434017,69 \text{ N}$$

$$= 1184,43 \text{ Kn.m}$$

$$\phi M_n = 0,8 \times M_n$$

$$= 947,55 \text{ Kn.m}$$

## KAPASITAS GESER KOLOM LANTAI 1

### Data Material

Kuat Tekan Beton	$f_c'$	=		29,05	Mpa
Tegangan Leleh Baja $f_y$	$f_y$	=	(BJTS-40)	420	Mpa
Faktor Reduksi Beton	$\phi$	=		0,8	

### Dimensi Kolom

Lebar	$b$	=		700	mm
Tinggi	$h$	=		4420	mm
Selimit Beton	$d'$	=		40	mm
Tinggi Efektif Beton	$d$	=	$h-d'$	4380	mm

### Gaya Geser Ultimate Kolom

Kuat Geser Ultimate Kolom	$V_u$	=		150,786	Kn
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### Tulangan Geser Kolom

**2Ø13 - 125**

Diameter Sengkang	$d_s$	=		13	mm
Luas Penampang Sengkang	$A_v$	=	$2(1/4\pi d_s^2)$	265,46	mm <sup>2</sup>
Jarak Antar Sengkang	$s$	=		125	mm
Jarak Sengkang Maksimum	$s_{max}$	=	$1/2 b$	350	mm

### Kontrol Jarak Antar Tulangan Maksimum

$s$	$\leq$	$s_{max}$
125	$\leq$	350

### Kuat Geser Beton dan Baja Tulangan

Kuat Geser Beton	$V_c$	=	$1/6[(\sqrt{f_c'}) (b d)]$	2360,735	Kn
Kuat Geser Tulangan Geser	$V_s$	=	$(A_v f_y d)/s$	3125,43065	Kn

### Kuat Geser Rencana Kolom

Kuat Geser Rencana Kolom	$V_n$	=	$V_c + V_s$	5486,165	Kn
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### Kuat Geser Ultimate Kolom

Kuat Geser Ultimate Kolom	$V_r$	=	$\phi V_n$	4388,93226	Kn
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$V_u$	$\leq$	$\phi V_n$
150,7857	$\leq$	4388,932

Oke

## KAPASITAS GESER KOLOM LANTAI 2

### Data Material

Kuat Tekan Beton	$f_c'$	=		29,05	Mpa
Tegangan Leleh Baja $f_y$	$f_y$	=	(BJTS-40)	420	Mpa
Faktor Reduksi Beton	$\phi$	=		0,8	

### Dimensi Kolom

Lebar	$b$	=		700	mm
Tinggi	$h$	=		4420	mm
Selimit Beton	$d'$	=		40	mm
Tinggi Efektif Beton	$d$	=	$h-d'$	4380	mm

### Gaya Geser Ultimate Kolom

Kuat Geser Ultimate Kolom	$V_u$	=		131,4985	Kn
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### Tulangan Geser Kolom

**2Ø13 - 125**

Diameter Sengkang	$d_s$	=		13	mm
Luas Penampang Sengkang	$A_v$	=	$2(1/4\pi d_s^2)$	265,46	mm <sup>2</sup>
Jarak Antar Sengkang	$s$	=		125	mm
Jarak Sengkang Maksimum	$s_{max}$	=	$1/2 b$	350	mm

### Kontrol Jarak Antar Tulangan Maksimum

$s$	$\leq$	$s_{max}$
125	$\leq$	350

### Kuat Geser Beton dan Baja Tulangan

Kuat Geser Beton	$V_c$	=	$1/6[(\sqrt{f_c'}) (b d)]$	2360,735	Kn
Kuat Geser Tulangan Geser	$V_s$	=	$(A_v f_y d)/s$	3125,43065	Kn

### Kuat Geser Rencana Kolom

Kuat Geser Rencana Kolom	$V_n$	=	$V_c + V_s$	5486,165	Kn
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### Kuat Geser Ultimate Kolom

Kuat Geser Ultimate Kolom	$V_r$	=	$\phi V_n$	4388,93226	Kn
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$V_u$	$\leq$	$V_r$
131,4985	$\leq$	4388,932

**Oke**

### KAPASITAS GESER KOLOM LANTAI 3

#### Data Material

Kuat Tekan Beton	$f_c'$	=		29,05	Mpa
Tegangan Leleh Baja $f_y$	$f_y$	=	(BJTD-40)	420	Mpa
Faktor Reduksi Beton	$\phi$	=		0,8	

#### Dimensi Kolom

Lebar	$b$	=		700	mm
Tinggi	$h$	=		4420	mm
Selimit Beton	$d'$	=		40	mm
Tinggi Efektif Beton	$d$	=	$h-d'$	4380	mm

#### Gaya Geser Ultimate Kolom

Kuat Geser Ultimate Kolom	$V_u$	=		171,9235	Kn
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#### Tulangan Geser Kolom

**2Ø13 - 125**

Diameter Sengkang	$d_s$	=		13	mm
Luas Penampang Sengkang	$A_v$	=	$2(1/4\pi d_s^2)$	157,08	mm <sup>2</sup>
Jarak Antar Sengkang	$s$	=		125	mm
Jarak Sengkang Maksimum	$s_{max}$	=	$1/2 b$	350	mm

#### Kontrol Jarak Antar Tulangan Maksimum

$s$	$\leq$	$s_{max}$
125	$\leq$	350

#### Kuat Geser Beton dan Baja Tulangan

Kuat Geser Beton	$V_c$	=	$1/6[(\sqrt{f_c'}) (b d)]$	2360,735	Kn
Kuat Geser Tulangan Geser	$V_s$	=	$(A_v f_y d)/s$	1849,36725	Kn

#### Kuat Geser Rencana Kolom

Kuat Geser Rencana Kolom	$V_n$	=	$V_c + V_s$	4210,102	Kn
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#### Kuat Geser Ultimate Kolom

Kuat Geser Ultimate Kolom	$V_r$	=	$\phi V_n$	3368,08154	Kn
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$V_u$	$\leq$	$V_r$
171,9235	$\leq$	3368,082

Oke

## KAPASITAS GESER KOLOM SPIRAL LT 1

### Data Material

Kuat Tekan Beton	$f_c'$	=		29,05	Mpa
Tegangan Leleh Baja $f_y$	$f_y$	=	(BJTD-40)	420	Mpa
Faktor Reduksi Beton	$\phi$	=		0,8	

### Dimensi Kolom

Lebar	$b$	=		800	mm
Tinggi	$h$	=		4420	mm
Selimit Beton	$d'$	=		40	mm
Tinggi Efektif Beton	$d$	=	$h-d'$	4380	mm

### Gaya Geser Ultimate Kolom

Kuat Geser Ultimate Kolom	$V_u$	=		132,5738	Kn
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### Tulangan Geser Kolom

**2Ø13 - 125**

Diameter Sengkang	$d_s$	=		13	mm
Luas Penampang Sengkang	$A_v$	=	$2(1/4\pi d_s^2)$	157,08	mm <sup>2</sup>
Jarak Antar Sengkang	$s$	=		125	mm
Jarak Sengkang Maksimum	$s_{max}$	=	$1/2 b$	400	mm

### Kontrol Jarak Antar Tulangan Maksimum

$s$	$\leq$	$s_{max}$
125	$\leq$	400

### Kuat Geser Beton dan Baja Tulangan

Kuat Geser Beton	$V_c$	=	$1/6[(\sqrt{f_c'}) (b d)]$	2360,735	Kn
Kuat Geser Tulangan Geser	$V_s$	=	$(A_v f_y d)/s$	1849,36725	Kn

### Kuat Geser Rencana Kolom

Kuat Geser Rencana Kolom	$V_n$	=	$V_c + V_s$	4210,102	Kn
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### Kuat Geser Ultimate Kolom

Kuat Geser Ultimate Kolom	$V_r$	=	$\phi V_n$	3368,08154	Kn
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$V_u$	$\leq$	$V_r$
132,5738	$\leq$	3368,082

**Oke**

## KAPASITAS GESER KOLOM SPIRAL LT 2

### Data Material

Kuat Tekan Beton	$f_c'$	=		29,05	Mpa
Tegangan Leleh Baja $f_y$	$f_y$	=	(BJTD-40)	420	Mpa
Faktor Reduksi Beton	$\phi$	=		0,8	

### Dimensi Kolom

Lebar	$b$	=		800	mm
Tinggi	$h$	=		4420	mm
Selimit Beton	$d'$	=		40	mm
Tinggi Efektif Beton	$d$	=	$h-d'$	4380	mm

### Gaya Geser Ultimate Kolom

Kuat Geser Ultimate Kolom	$V_u$	=		130,2754	Kn
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### Tulangan Geser Kolom

**2Ø13 - 125**

Diameter Sengkang	$d_s$	=		13	mm
Luas Penampang Sengkang	$A_v$	=	$2(1/4\pi d_s^2)$	157,08	mm <sup>2</sup>
Jarak Antar Sengkang	$s$	=		125	mm
Jarak Sengkang Maksimum	$s_{max}$	=	$1/2 b$	400	mm

### Kontrol Jarak Antar Tulangan Maksimum

$s$	$\leq$	$s_{max}$
125	$\leq$	400

### Kuat Geser Beton dan Baja Tulangan

Kuat Geser Beton	$V_c$	=	$1/6[(\sqrt{f_c'}) (b d)]$	2360,735	Kn
Kuat Geser Tulangan Geser	$V_s$	=	$(A_v f_y d)/s$	1849,36725	Kn

### Kuat Geser Rencana Kolom

Kuat Geser Rencana Kolom	$V_n$	=	$V_c + V_s$	4210,102	Kn
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### Kuat Geser Ultimate Kolom

Kuat Geser Ultimate Kolom	$V_r$	=	$\phi V_n$	3368,08154	Kn
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$V_u$	$\leq$	$V_r$
130,2754	$\leq$	3368,082

Oke



### KAPASITAS GESER KOLOM SPIRAL LT 3

#### Data Material

Kuat Tekan Beton	$f_c'$	=		29,05	Mpa
Tegangan Leleh Baja $f_y$	$f_y$	=	(BJTD-40)	420	Mpa
Faktor Reduksi Beton	$\phi$	=		0,8	

#### Dimensi Kolom

Lebar	$b$	=		800	mm
Tinggi	$h$	=		4420	mm
Selimit Beton	$d'$	=		40	mm
Tinggi Efektif Beton	$d$	=	$h-d'$	4380	mm

#### Gaya Geser Ultimate Kolom

Kuat Geser Ultimate Kolom	$V_u$	=		98,5751	Kn
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#### Tulangan Geser Kolom

**2Ø13 - 125**

Diameter Sengkang	$d_s$	=		13	mm
Luas Penampang Sengkang	$A_v$	=	$2(1/4\pi d_s^2)$	157,08	mm <sup>2</sup>
Jarak Antar Sengkang	$s$	=		125	mm
Jarak Sengkang Maksimum	$s_{max}$	=	$1/2 b$	400	mm

#### Kontrol Jarak Antar Tulangan Maksimum

$s$	$\leq$	$s_{max}$
125	$\leq$	400

#### Kuat Geser Beton dan Baja Tulangan

Kuat Geser Beton	$V_c$	=	$1/6[(\sqrt{f_c'}) (b d)]$	2360,735	Kn
Kuat Geser Tulangan Geser	$V_s$	=	$(A_v f_y d)/s$	1849,36725	Kn

#### Kuat Geser Rencana Kolom

Kuat Geser Rencana Kolom	$V_n$	=	$V_c + V_s$	4210,102	Kn
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#### Kuat Geser Ultimate Kolom

Kuat Geser Ultimate Kolom	$V_r$	=	$\phi V_n$	3368,08154	Kn
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$V_u$	$\leq$	$V_r$
98,5751	$\leq$	3368,082

**Oke**