

LAMPIRAN 1 – Perhitungan Momen Inersia dan Modulus Elastisitas Penampang Komposit

DATA PERENCANAAN :

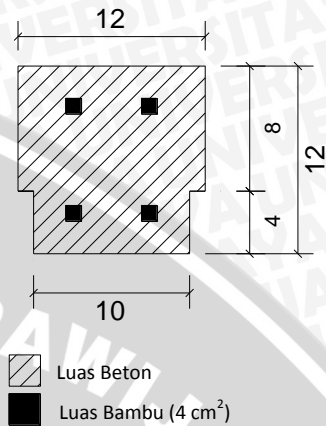
Kuat tekan balok,  $f'_c = 20,722 \text{ Mpa}$

Selimut Beton = 2 cm

As (Luas tulangan tarik) =  $2 \text{ cm}^2$

$E_{\text{bambu}} = 166703 \text{ kg/cm}^2$

$E_{\text{beton}} = 4700 \sqrt{f'_c} = 4700 \sqrt{20,722}$   
 $= 21395,0691 \text{ Mpa} = 209819,954 \text{ kg/cm}^2$



PERHITUNGAN :

$$n = \frac{E_{\text{bambu}}}{E_{\text{beton}}} = \frac{166703}{209819,954} = 0,7945$$

$$\bar{y} = \frac{10 \times 12 \times \frac{12}{2} + 0,7945 \times 2 \times 10 + 2 \times 1 \times 8 \times \frac{8}{2}}{10 \times 12 + 0,7945 \times 2 + 2 \times 1 \times 8}$$

$$\bar{y} = \frac{720 + 15,89 + 64}{120 + 1,589 + 16} = \frac{799,89}{137,589} = 5,814 \text{ cm}$$

$$I_{gt \text{ transformasi}} = \frac{10 \times 12^3}{12} + 10 \times 12 \times (6 - 5,814)^2 + 0,7945 \times 2 \times (10 - 5,814)^2 + \frac{1 \times 8^3}{12} + 1 \times 8 \times (5,814 - 4)^2$$

$$I_{gt \text{ transformasi}} = 1440 + 4,1515 + 27,8434 + 42,6667 + 26,3248$$

$$I_{gt \text{ transformasi}} = 1540,9864 \text{ cm}^4$$

$$A_{\text{komp}} \times E_{\text{komp}} = A_{\text{bambu}} \times E_{\text{bambu}} + A_{\text{beton}} \times E_{\text{beton}}$$

$$(12 \times 8 + 10 \times 4) \times E_{\text{komp}} = 4 \times 166703 + (12 \times 8 + 10 \times 4 - 4) \times 209819,954$$

$$E_{\text{komp}} = \frac{666812 + 27696233,93}{136} = 208551,808 \text{ kg/cm}^2$$



LAMPIRAN 2 - Spesifikasi Material pada Program SAP2000 v14.2.2

**Material Property Data**

General Data  
 Material Name and Display Color:    
 Material Type:   
 Material Notes:

Weight and Mass  
 Weight per Unit Volume:   
 Mass per Unit Volume:

Units

Isotropic Property Data  
 Modulus of Elasticity, E:   
 Poisson's Ratio, U:   
 Coefficient of Thermal Expansion, A:   
 Shear Modulus, G:

Other Properties for Rebar Materials  
 Minimum Yield Stress, Fy:   
 Minimum Tensile Stress, Fu:   
 Expected Yield Stress, Fye:   
 Expected Tensile Stress, Fue:

Switch To Advanced Property Display

**Material Property Data**

General Data  
 Material Name and Display Color:    
 Material Type:   
 Material Notes:

Weight and Mass  
 Weight per Unit Volume:   
 Mass per Unit Volume:

Units

Isotropic Property Data  
 Modulus of Elasticity, E:   
 Poisson's Ratio, U:   
 Coefficient of Thermal Expansion, A:   
 Shear Modulus, G:

Other Properties for Concrete Materials  
 Specified Concrete Compressive Strength, f'c:   
 Lightweight Concrete  
 Shear Strength Reduction Factor:

Switch To Advanced Property Display

**Material Property Data**

General Data  
 Material Name and Display Color:    
 Material Type:   
 Material Notes:

Weight and Mass  
 Weight per Unit Volume:   
 Mass per Unit Volume:

Units

Isotropic Property Data  
 Modulus of Elasticity, E:   
 Poisson's Ratio, U:   
 Coefficient of Thermal Expansion, A:   
 Shear Modulus, G:

Other Properties for Concrete Materials  
 Specified Concrete Compressive Strength, f'c:   
 Lightweight Concrete  
 Shear Strength Reduction Factor:

Switch To Advanced Property Display

### LAMPIRAN 3 - Spesifikasi Penampang Pada SAP2000 v14.2.2

**Rectangular Section**

Section Name: Balok 10\_10

Section Notes: Modify/Show Notes...

Properties: Section Properties...

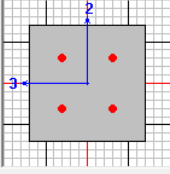
Property Modifiers: Set Modifiers...

Material: + Mutu rangka

Dimensions:

Depth (t3): 0,1

Width (t2): 0,1



Display Color:

Concrete Reinforcement... OK Cancel

**Reinforcement Data**

Rebar Material:

Longitudinal Bars: + Bambu

Confinement Bars (Ties): + A615Gr60

Design Type:

Column (P-M2-M3 Design)

Beam (M3 Design Only)

Reinforcement Configuration:

Rectangular

Circular

Confinement Bars:

Ties

Spiral

Longitudinal Bars - Rectangular Configuration:

Clear Cover for Confinement Bars: 0,02

Number of Longit Bars Along 3-dir Face: 2

Number of Longit Bars Along 2-dir Face: 2

Longitudinal Bar Size: + bambu 1\_1

Confinement Bars:

Confinement Bar Size: + bambu 1\_1

Longitudinal Spacing of Confinement Bars: 0,1

Number of Confinement Bars in 3-dir: 2

Number of Confinement Bars in 2-dir: 2

Check/Design:

Reinforcement to be Checked

Reinforcement to be Designed

OK Cancel

**Tee Section**

Section Name: Balok T

Section Notes: Modify/Show Notes...

Properties: Section Properties...

Property Modifiers: Set Modifiers...

Material: + Mutu Balok

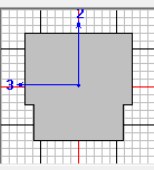
Dimensions:

Outside stem (t3): 0,12

Outside flange (t2): 0,12

Flange thickness (tf): 0,08

Stem thickness (tw): 0,1



Display Color:

Concrete Reinforcement... OK Cancel

**Reinforcement Data**

Rebar Material:

Longitudinal Bars: + Bambu

Confinement Bars (Ties): + A615Gr60

Design Type:

Column (P-M2-M3 Design)

Beam (M3 Design Only)

Concrete Cover to Longitudinal Rebar Center:

Top: 0,02

Bottom: 0,02

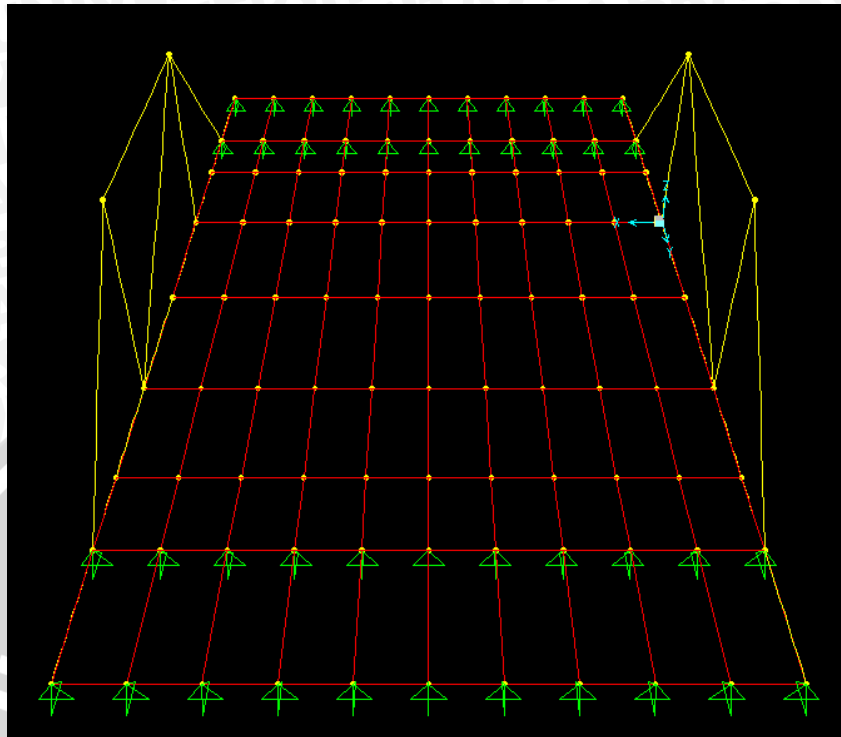
Reinforcement Overrides for Ductile Beams:

	Left	Right
Top	0,	0,
Bottom	0,	0,

OK Cancel



LAMPIRAN 4 – Hasil Momen, Regangan, dan Defleksi SAP2000 v14.2.2



- Akibat Beban 50 kg

Posisi (cm)	Momen (kgm)		Defleksi $10^{-3}$ (mm)		Regangan $10^{-6}$ (m/m)	
	Balok A	Balok B	Balok A	Balok B	Balok A	Balok B
0	0	0	0	0	0	0
40	-0,189	-0,0602	0,58	0,19	-0,4	-0,1
80	-0,4467	-0,4534	1,34	1,36	-1,0	-1,0
120	-0,0592	-0,1906	0,18	0,58	-0,1	-0,4
160	0	0	0	0	0	0

- Akibat Beban 100 kg

Posisi (cm)	Momen (kgm)		Defleksi $10^{-3}$ (mm)		Regangan $10^{-6}$ (m/m)	
	Balok A	Balok B	Balok A	Balok B	Balok A	Balok B
0	0	0	0	0	0	0
40	-0,378	-0,1205	1,16	0,37	-0,9	-0,3
80	-0,8932	-0,9066	2,68	2,72	-2,0	-2,1
120	-0,1183	-0,3812	0,37	1,17	-0,3	-0,9
160	0	0	0	0	0	0

- Akibat Beban 150 kg

Posisi (cm)	Momen (kgm)		Defleksi $10^{-3}$ (mm)		Regangan $10^{-6}$ (m/m)	
	Balok A	Balok B	Balok A	Balok B	Balok A	Balok B
0	0	0	0	0	0	0
40	-0,5671	-0,1807	1,75	0,56	-1,3	-0,4
80	-1,34	-1,3601	4,03	4,08	-3,0	-3,1
120	-0,1775	-0,5718	0,55	1,75	-0,4	-1,3
160	0	0	0	0	0	0

- Akibat Beban 290 kg

Posisi (cm)	Momen (kgm)		Defleksi $10^{-3}$ (mm)		Regangan $10^{-6}$ (m/m)	
	Balok A	Balok B	Balok A	Balok B	Balok A	Balok B
0	0	0	0	0	0	0
40	-1,0963	-0,3494	3,38	1,08	-2,5	-0,8
80	-2,5906	-2,6295	7,79	7,88	-5,9	-6,0
120	-0,3431	-1,1056	1,06	3,39	-0,8	-2,5
160	0	0	0	0	0	0



## LAMPIRAN 5 – Hasil Pengujian Regangan Pada Balok Melintang

## A dan B Pada Jembatan Komposit Bambu

## A. Pembacaan Regangan Balok A

## A.1 Pembacaan Akibat Beban 50 kg (permbacaan pertama)

Posisi	Pemb. Awal	Pemb. Akhir	Regangan $10^{-6}$ (m/m)
0	8572	8576	4
40	8584	8587	3
80	8584	8590	6
120	8595	8592	-3
160	8593	8593	0

## A.2 Pembacaan Akibat Beban 50 kg (permbacaan kedua)

Posisi	Pemb. Awal	Pemb. Akhir	Regangan $10^{-6}$ (m/m)
0	8599	8598	- 1
40	8599	8601	2
80	8599	8597	-2
120	8599	8598	-1
160	8601	8602	1

## A.3 Pembacaan Akibat Beban 50 kg (permbacaan ketiga)

Posisi	Pemb. Awal	Pemb. Akhir	Regangan $10^{-6}$ (m/m)
0	8585	8586	1
40	8585	8587	2
80	8602	8606	4
120	8596	8598	2
160	8589	8592	3

## A.4 Pembacaan Akibat Beban 100 kg (pembacaan pertama)

Posisi	Pemb. Awal	Pemb. Akhir	Regangan $10^{-6}$ (m/m)
0	8516	8518	2
40	8520	8523	3
80	8519	8522	3
120	8522	8525	3
160	8526	8525	-1

## A.5 Pembacaan Akibat Beban 100 kg (pembacaan kedua)

Posisi	Pemb. Awal	Pemb. Akhir	Regangan $10^{-6}$ (m/m)
0	8613	8612	-1
40	8595	8593	-2
80	8594	8590	-4
120	8585	8581	-4
160	8589	8592	3

## A.6 Pembacaan Akibat Beban 100 kg (pembacaan ketiga)

Posisi	Pemb. Awal	Pemb. Akhir	Regangan $10^{-6}$ (m/m)
0	8602	8604	2
40	8605	8604	-1
80	8602	8598	-4
120	8605	8602	-3
160	8605	8602	-3

## A.7 Pembacaan Akibat Beban 150 kg (pembacaan pertama)

Posisi	Pemb. Awal	Pemb. Akhir	Regangan $10^{-6}$ (m/m)
0	8552	8556	4
40	8560	8555	-5
80	8555	8553	-2
120	8561	8559	-2
160	8558	8557	-1

A.8 Pembacaan Akibat Beban 150 kg (permbacaan kedua)

Posisi	Pemb. Awal	Pemb. Akhir	Regangan $10^{-6}$ (m/m)
0	8613	8608	-5
40	8604	8601	-3
80	8613	8605	-8
120	8607	8604	-3
160	8611	8608	-3

A.9 Pembacaan Akibat Beban 150 kg (permbacaan ketiga)

Posisi	Pemb. Awal	Pemb. Akhir	Regangan $10^{-6}$ (m/m)
0	8610	8612	2
40	8616	8613	-3
80	8627	8623	-4
120	8626	8622	-4
160	8628	8626	-2

B. Pembacaan Regangan Balok B

B.1 Pembacaan Akibat Beban 50 kg (permbacaan pertama)

Posisi	Pemb. Awal	Pemb. Akhir	Regangan $10^{-6}$ (m/m)
0	7563	7564	1
40	7566	7568	2
80	7582	7583	1
120	7571	7573	2
160	7570	7572	2

B.2 Pembacaan Akibat Beban 50 kg (permbacaan kedua)

Posisi	Pemb. Awal	Pemb. Akhir	Regangan $10^{-6}$ (m/m)
0	7491	7492	1
40	7505	7507	2
80	7513	7516	3
120	7518	7516	-2
160	7515	7513	-2



## B.3 Pembacaan Akibat Beban 50 kg (permbacaan ketiga)

Posisi	Pemb. Awal	Pemb. Akhir	Regangan $10^{-6}$ (m/m)
0	7507	7506	-1
40	7507	7509	2
80	7507	7510	3
120	7507	7504	-3
160	7508	7507	-1

## B.4 Pembacaan Akibat Beban 100 kg (permbacaan pertama)

Posisi	Pemb. Awal	Pemb. Akhir	Regangan $10^{-6}$ (m/m)
0	7421	7422	1
40	7425	7426	1
80	7421	7423	2
120	7420	7421	1
160	7423	7425	2

## B.5 Pembacaan Akibat Beban 100 kg (permbacaan kedua)

Posisi	Pemb. Awal	Pemb. Akhir	Regangan $10^{-6}$ (m/m)
0	7526	7524	-2
40	7526	7522	-4
80	7521	7515	-6
120	7523	7518	-5
160	7523	7517	-6

## B.6 Pembacaan Akibat Beban 100 kg (permbacaan ketiga)

Posisi	Pemb. Awal	Pemb. Akhir	Regangan $10^{-6}$ (m/m)
0	7530	7533	3
40	7535	7532	-3
80	7558	7553	-5
120	7550	7547	-3
160	7547	7545	-2

B.7 Pembacaan Akibat Beban 150 kg (permbacaan pertama)

Posisi	Pemb. Awal	Pemb. Akhir	Regangan $10^{-6}$ (m/m)
0	7533	7530	-3
40	7521	7525	4
80	7532	7529	-3
120	7533	7526	-7
160	7532	7529	-3

B.8 Pembacaan Akibat Beban 150 kg (permbacaan kedua)

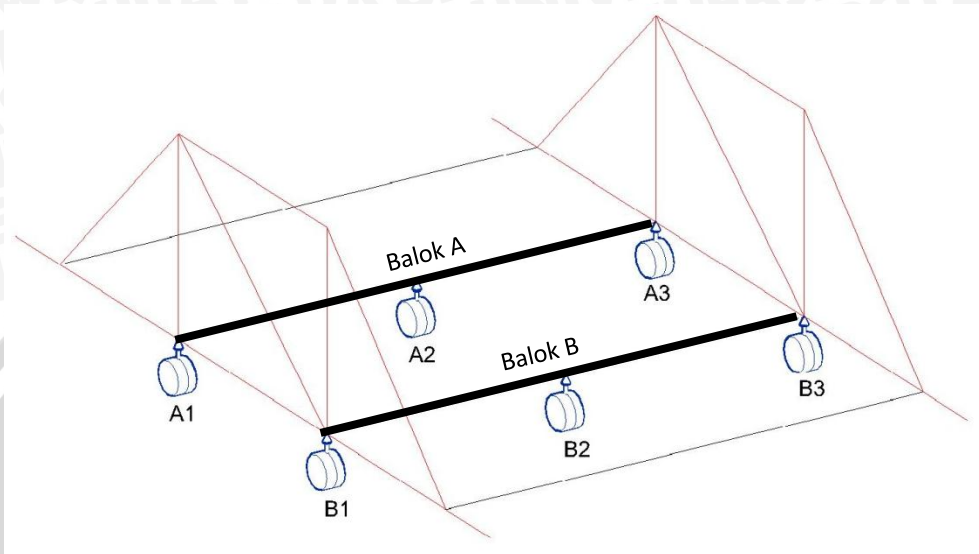
Posisi	Pemb. Awal	Pemb. Akhir	Regangan $10^{-6}$ (m/m)
0	7528	7531	3
40	7538	7536	-2
80	7541	7540	-1
120	7542	7540	-2
160	7546	7543	-3

B.9 Pembacaan Akibat Beban 150 kg (permbacaan ketiga)

Posisi	Pemb. Awal	Pemb. Akhir	Regangan $10^{-6}$ (m/m)
0	7424	7426	2
40	7429	7428	-1
80	7426	7425	-1
120	7424	7423	-1
160	7424	7426	2

LAMPIRAN 6 – Hasil Pengujian Defleksi (Beban 290 kg) Pada Balok

Melintang A dan B Pada Jembatan Komposit Bambu



Jarak (cm)	Defleksi (mm)					
	A1	A2	A3	B1	B2	B3
0	0,000	0,000	0,000	0,000	0,000	0,000
40	0,002	0,007	0,002	0,000	0,000	0,000
80	0,002	0,011	0,002	0,000	0,003	0,000
120	0,002	0,005	0,002	0,000	0,000	0,000
160	0,000	0,000	0,000	0,000	0,000	0,000

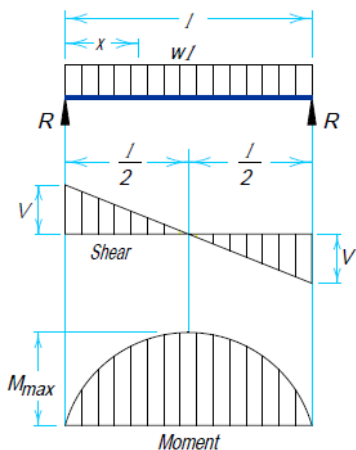
Jarak (cm)	Defleksi Aktual (mm)	
	A2 <sub>aktual</sub>	B2 <sub>aktual</sub>
0	0,000	0,000
40	0,005	0,000
80	0,009	0,003
120	0,003	0,000
160	0,000	0,000

Defleksi aktual pada A2 = Defleksi pada A2 – Defleksi rata-rata A1 dan A3

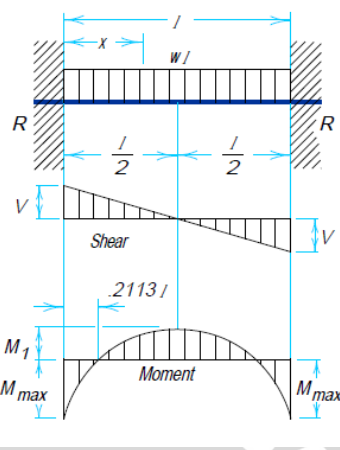
Defleksi aktual pada B2 = Defleksi pada B2 – Defleksi rata-rata B1 dan B3

LAMPIRAN 7 – Perhitungan Pemodelan Tumpuan Pada Balok

Melintang Pada Jembatan Komposit Bambu



tumpuan sendi-sendi  
 $M_{max} \text{ (at center)} = \frac{1}{8} ql^2$



tumpuan jepit-jepit  
 $M_{max} \text{ (at center)} = \frac{1}{24} ql^2$

Balok A					
Pembacaan	Momen Lapangan Eksperimen (kgm)	Momen Lapangan Teoritis (kgm)		Pemodelan tumpuan (%)	
		sendi-sendi	Jepit-jepit	Sendi-sendi	Jepit-jepit
(a)	(b)	(c)	(d)	$\frac{(c) -  (b) }{(c)} \times 100\%$	$\frac{(d) -  (b) }{(d)} \times 100\%$
1	-2,2110	<b>12,5</b>	<b>4,167</b>		
2	-3,3166				
3	-2,7638				
Rata-rata	<b>-2,764</b>			<b>77,890</b>	<b>33,669</b>

Balok B					
Pembacaan	Momen Lapangan Eksperimen (kgm)	Momen Lapangan Teoritis (kgm)		Pemodelan tumpuan (%)	
		sendi-sendi	Jepit-jepit	Sendi-sendi	Jepit-jepit
(a)	(b)	(c)	(d)	$\frac{(c) -  (b) }{(c)} \times 100\%$	$\frac{(d) -  (b) }{(d)} \times 100\%$
1	-1,6583	<b>12,5</b>	<b>4,167</b>		
2	-2,7638				
3	-2,2110				
Rata-rata	<b>-2,211</b>			<b>82,312</b>	<b>46,935</b>
<b>Analisis tumpuan</b>				<b>80,101</b>	<b>40,302</b>



LAMPIRAN 8 – Pengujian Tekan Beton



- Komposisi benda uji : 1:2:2
- Elemen Uji : Rangka
- Ukuran benda uji : Kubus 15x15x15 cm
- Umur benda uji : 7 hari dan 28 hari

Benda Uji	Luas penampang (cm <sup>2</sup> )	Berat (kg)	Umur (hari)	Beban Maksimum		Kuat Tekan (28 hari)	
				(kN)	(kg)	(kg/cm <sup>2</sup> )	MPa
A1	225	7,48	7	362	36913,727	209,493	20,544
A2	225	7,34	7	348	35486,124	201,391	19,750
A3	225	7,42	7	361	36811,755	208,915	20,488
A4	225	7,6	28	513	52311,442	192,971	18,924
A5	225	7,24	28	502	51189,754	188,833	18,518
A6	225	7,24	28	475	48436,520	178,677	17,522
Kuat Tekan Beton Rata-rata						197,779	19,396

Kuat tekan beton rata-rata ( $f'c$ )

$$f'c = \frac{(209,493 + 201,391 + 208,915 + 199,366 + 188,833 + 178,677)}{6}$$

$$= 197,779 \text{ kg/cm}^2 = 19,396 \text{ MPa}$$

Komposisi benda uji : 1:2:2

Elemen Uji : Balok dan pelat

Benda Uji	Luas penampang (cm <sup>2</sup> )	Berat (kg)	Umur (hari)	Beban Maksimum		Kuat Tekan (28 hari)	
				(kN)	(kg)	(kg/cm <sup>2</sup> )	MPa
A1	225	7,1	7	421	42930,053	243,637	23,893
A2	225	7,26	7	409	41706,393	236,693	23,212
A3	225	7,22	7	363	37015,699	210,072	20,601
A4	225	7,04	28	536	54656,789	201,623	19,772
A5	225	7,4	28	524	53433,130	197,109	19,330
A6	225	7,12	28	475	48436,520	178,677	17,522
Kuat Tekan Beton Rata-rata						211,302	20,722

Kuat tekan beton rata-rata ( $f'c$ )

$$f'c = \frac{(243,637 + 236,693 + 210,072 + 201,623 + 197,109 + 178,677)}{6}$$
$$= 211,302 \text{ kg/cm}^2 = 20,722 \text{ MPa}$$

Komposisi benda uji : 1:2:2

Elemen Uji : Abutment

Benda Uji	Luas penampang (cm <sup>2</sup> )	Berat (kg)	Umur (hari)	Beban Maksimum		Kuat Tekan (28 hari)	
				(kN)	(kg)	(kg/cm <sup>2</sup> )	MPa
A1	225	7,7	7	451	45989,201	260,999	25,595
A2	225	7,94	7	399	40686,677	230,906	22,644
A3	225	7,58	7	348	35486,124	201,391	19,750
A4	225	8,06	28	476	48538,492	179,053	17,559
A5	225	8,08	28	637	64955,923	239,615	23,498
A6	225	8,06	28	626	63834,235	235,477	23,092
Kuat Tekan Beton Rata-rata						224,574	22,023

Kuat tekan beton rata-rata ( $f'c$ )

$$f'c = \frac{(260,999 + 230,906 + 201,391 + 179,053 + 239,615 + 235,574)}{6}$$
$$= 224,574 \text{ kg/cm}^2 = 22,023 \text{ MPa}$$

LAMPIRAN 9 – Perhitungan Pmax

DATA PERENCANAAN :

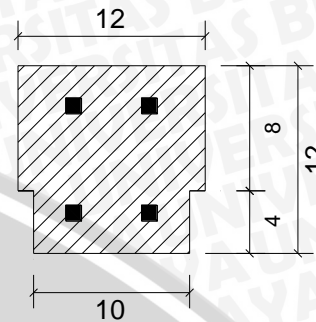
Kuat tekan balok,  $f'_c = 20,722 \text{ Mpa} = 3005,366 \text{ Psi}$

Selimit Beton = 2 cm

As (Luas tulangan tarik) =  $2 \text{ cm}^2$

$E_{\text{bambu}} = 166703 \text{ kg/cm}^2$

$E_{\text{beton}} = 4700 \sqrt{f'_c} = 4700 \sqrt{20,722}$   
 $= 21395,0691 \text{ Mpa} = 209819,954 \text{ kg/cm}^2$



Luas Beton  
 Luas Bambu ( $4 \text{ cm}^2$ )

PERHITUNGAN :

$$n = \frac{E_{\text{bambu}}}{E_{\text{beton}}} = \frac{166703}{209819,954} = 0,7945$$

$$\bar{y} = \frac{10 \times 12 \times \frac{12}{2} + 0,7945 \times 2 \times 10 + 2 \times 1 \times 8 \times \frac{8}{2}}{10 \times 12 + 0,7945 \times 2 + 2 \times 1 \times 8}$$

$$\bar{y} = \frac{720 + 15,89 + 64}{120 + 1,589 + 16} = \frac{799,89}{137,589} = 5,814 \text{ cm}$$

$$I_{gt \text{ transformasi}} = \frac{10 \times 12^3}{12} + 10 \times 12 \times (6 - 5,814)^2 + 0,7945 \times 2 \times (10 - 5,814)^2 + \frac{1 \times 8^3}{12} + 1 \times 8 \times (5,814 - 4)^2$$

$$I_{gt \text{ transformasi}} = 1440 + 4,1515 + 27,8434 + 42,6667 + 26,3248$$

$$I_{gt \text{ transformasi}} = 1540,9864 \text{ cm}^4$$

$$yt = 12 \text{ cm} - 5,814 \text{ cm} = 6,186 \text{ cm}$$

$$fr = 7,5 \sqrt{f'_c} = 7,5 \sqrt{3005,366 \text{ Psi}} = 411,159 \text{ Psi} = 2,8349 \text{ MPa} = 27,8013 \text{ kg/cm}^2$$

$$M_{cr} = \frac{I_{gt} \times fr}{yt} = \frac{1540,9864 \text{ cm}^4 \times 27,8013 \text{ kg/cm}^2}{6,186 \text{ cm}} = 6925,5456 \text{ kgcm}$$

$$M_{cr} = \frac{1}{8} \times q \times l^2$$

$$q = \frac{M_{cr} \times 8}{l^2} = \frac{6925,5456 \times 8}{100^2} = 5,540436 \text{ kg/cm} = 554,0436 \text{ kg/m}$$



LAMPIRAN 10 – Dokumentasi







