

BAB VI

KESIMPULAN DAN SARAN

6.1 Kesimpulan

Berdasarkan hasil penelitian dan pembahasan maka diperoleh beberapa kesimpulan sebagai berikut :

1. Rata – rata beban maksimum yang mampu diterima oleh balok setelah diuji adalah 72,8083 kN, sedangkan rata – rata beban maksimum balok hasil analisis teori adalah 46,7138 kN. Hal ini menunjukkan rata – rata rasio beban maksimum hasil pengujian terhadap analisis sebesar 1,5582.
2. Rata – rata rasio beban luluh pertama terhadap hasil analisis teori sebesar 1,012, sedangkan rata – rata rasio beban pada retak pertama adalah sebesar 2,2417.
3. Nilai tegangan lentur balok hasil pengujian adalah sebesar 0,9937 dari tegangan lentur balok hasil analisis teori.
4. Beban yang dihasilkan pada batas defleksi yang diijinkan oleh BBTS 2 memiliki rasio dari hasil analisis yaitu sebesar 1,0909. Namun pada benda uji BBTS 1 dan BBTS 3 memiliki rasio beban pada batas defleksi yang diijinkan terhadap hasil analisis teori masing – masing adalah 0,3816 dan 0,9760.

6.2 Saran

Berdasarkan penelitian yang telah dilakukan, hal – hal yang perlu diperhatikan untuk penelitian selanjutnya adalah sebagai berikut :

1. Proses pemadatan beton harus dilakukan dengan baik karena dimensi baja profil siku yang cukup besar dapat mengakibatkan penyebaran agregat yang tidak merata.
2. Tumpuan sendi dan *roll* pada balok ketika proses pengujian harus diperhatikan baik – baik, jangan menimbulkan beda tinggi pada kedua tumpuan tersebut karena dapat mempengaruhi pembacaan data lendutan.
3. Pemasangan *LVDT* harus benar dan tidak boleh miring.
4. Sebelum melakukan pengujian, harus dipastikan bahwa semua alat yang terhubung dengan komputer (*LVDT* dan *Load Cell*) telah dikalibrasi agar tidak terjadi kesalahan.

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LAMPIRAN I
PENGUJIAN BAHAN

PEMERIKSAAN GRADASI BESAR BUTIRAN PASIR

Bahan : Pasir
Asal : Kali Progo
Diperiksa : 25 September 2013

DAFTAR AYAKAN

No. Saringan	Berat Saringan (gram)	Berat Saringan + Tertahan (gram)	Berat Tertahan (gram)	Σ Berat Tertahan (gram)	Persentase Berat Tertahan (%)	Persentase Lolos (%)
3/4"	558	558	0	0	0	100
1/2"	462	466	4	4	0.4	99.6
3/8"	547	553	6	10	1	99
4	416	429	13	23	2.3	97.7
8	329	357	28	51	5.1	94.9
30	295	630	335	386	38.6	61.4
50	294	660	366	752	75.2	24.8
100	286	520	234	986	98.6	1.4
200	339	351	12	998	99.8	0.2
Pan	377	379	2	1000	100	0
Total			1000		321	

$$\text{Modulus halus butir} = \frac{321}{100} = 3,21$$

Kesimpulan: MHB pasir $1,5 \leq 3,21 \leq 3,8$ Syarat terpenuhi (OK)



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PEMERIKSAAN BERAT JENIS DAN PENYERAPAN PASIR

Bahan : Pasir
Asal : Kali Progo
Diperiksa : 27 September 2013

	Nomor Pemeriksaan	I
A	Berat Contoh Jenuh Kering Permukaan (SSD) – (500)	500 gram
B	Berat Contoh Kering	487 gram
C	Berat Labu+Air, Temperatur 25°C	707 gram
D	Berat Labu+Contoh (SSD) + Air, Temperatur 25°C	1020 gram
E	Berat Jenis <i>Bulk</i> = $\frac{(A)}{(C + 500 - D)}$	2,6738
F	BJ Jenuh Kering Permukaan (SSD) = $\frac{(B)}{(C + 500 - D)}$	2,6043
G	Berat Jenis Semu (<i>Apparent</i>) = $\frac{(B)}{(C + B - D)}$	2,7989
H	Penyerapan (<i>Absorption</i>) = $\frac{(500 - B)}{(B)} \times 100 \%$	0,0267%



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PEMERIKSAAN KADAR AIR PADA PASIR

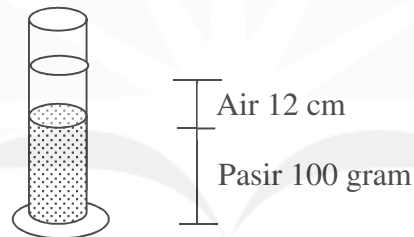
Bahan : Pasir
Asal : Kali Progo
Diperiksa : 26 Maret 2013

No.	Pemeriksaan		H1	H2
1.	Cawan	gram	9,520	9,247
2.	Cawan+berat pasir basah	gram	72,643	81,215
3.	Cawan+berat pasir kering	gram	71,148	79,555
4.	Berat air = (2) - (3)	gram	1,495	1,66
5.	Berat contoh kering = (3) - (1)	gram	61,628	70,308
6.	Kadar air (w) = $\frac{(4)}{(5)} \times 100\%$		2,4258%	2,3610%
Rata – rata			2,3934%	



PEMERIKSAAN KANDUNGAN LUMPUR DALAM PASIR

- I. Waktu Pemeriksaan: 26 September 2013
- II. Bahan
 - a. Pasir kering tungku, Asal : Kali Progo, Berat: 100 gram
 - b. Air jernih asal : LSBB Prodi TS FT-UAJY
- III. Alat
 - a. Gelas ukur, ukuran: 250 cc
 - b. Timbangan
 - c. Tungku (*oven*), suhu dibuat antara 105-110°C
 - d. Air tetap jernih setelah 5 kali pengocokan
 - e. Pasir+piring masuk tungku tanggal 25 September jam 09.48 WIB
- IV. Sketsa



- V. Hasil
- Setelah pasir keluar tungku tanggal 26 September jam 10.00 WIB

- a. Berat piring+pasir = 223,2 gram
- b. Berat piring kosong = 123,5 gram
- c. Berat pasir = 99,7 gram

$$\begin{aligned}\text{Kandungan Lumpur} &= \frac{100-99,7}{100} \times 100\% \\ &= 0,3 \%\end{aligned}$$

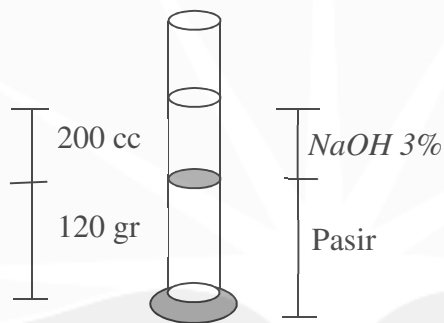


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PEMERIKSAAN KANDUNGAN ZAT ORGANIK DALAM PASIR

- I. Waktu Pemeriksaan: 26 September 2013
- II. Bahan
 - a. Pasir kering tungku, Asal: Kali Progo, Volume: 120 gram
 - b. Larutan NaOH 3%
- III. Alat
Gelas ukur, ukuran: 250cc
- IV. Sketsa



- V. Hasil
Setelah didiamkan selama 24 jam, warna larutan di atas pasir sesuai dengan warna *Gardner Standard Color* No. 8.



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PEMERIKSAAN GRADASI BESAR BUTIRAN *SPLIT*

Bahan : *Split*
Asal : Clereng
Diperiksa : 25 September 2013

DAFTAR AYAKAN

No. Saringan	Berat Saringan (gram)	Berat Saringan + Tertahan (gram)	Berat Tertahan (gram)	Σ Berat Tertahan (gram)	Persentase Berat Tertahan (%)	Persentase Lolos (%)
¾"	559	559	0	0	0	100
½"	462	508	46	46	4.6	95.4
3/8"	547	955	408	454	45.4	59.2
4	416	935	519	973	97.3	2.7
8	329	342	13	986	98.6	1.4
30	295	297	2	988	98.8	1.2
50	294	295	1	989	98.9	1.1
100	286	289	3	992	99.2	0.8
200	339	342	3	995	99.5	0.5
Pan	378	383	5	1000	100	0
Total			1000		642.3	

$$\text{Modulus halus butir} = \frac{642,3}{100} = 6,423$$

Kesimpulan: MHB *split* $6 \leq 6,423 \leq 7,1$ Syarat terpenuhi (OK)



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PEMERIKSAAN BERAT JENIS DAN PENYERAPAN *SPLIT*

Bahan : Batu Pecah (*Split*)
Asal : Clereng
Diperiksa : 27 September 2013

	Nomor Pemeriksaan	I
A	Berat Contoh Kering	984 gram
B	Berat Contoh Jenuh Kering Permukaan (SSD)	999 gram
C	Berat Contoh Dalam Air	631 gram
D	Berat Jenis <i>Bulk</i> = $\frac{(A)}{(B) - (C)}$	2,6739
E	BJ Jenuh Kering Permukaan (SSD) = $\frac{(B)}{(B) - (C)}$	2,7147
F	Berat Jenis Semu (<i>Apparent</i>) = $\frac{(A)}{(A) - (C)}$	2,7875
G	Penyerapan (<i>Absorption</i>) = $\frac{(B) - (A)}{(A)} \times 100 \%$	1,5244%



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PEMERIKSAAN KADAR AIR PADA *SPLIT*

Bahan : Split
Asal : Clereng
Diperiksa : 26 Maret 2013

No.	Pemeriksaan	K1	K2
1.	Cawan gram	9,678	8,391
2.	Cawan+berat <i>split</i> basah gram	82,936	75,626
3.	Cawan+berat <i>split</i> kering gram	82,045	74,671
4.	Berat air = (2) - (3) gram	0,891	0,955
5.	Berat contoh kering = (3) - (1) gram	72,367	66,28
6.	Kadar air (w) = $\frac{(4)}{(5)} \times 100\%$	1,23%	1,44%
Rata - rata		1,335%	



PEMERIKSAAN KANDUNGAN LUMPUR DALAM *SPLIT*

- I. Waktu Pemeriksaan: 26 September 2013
- II. Bahan
 - a. *Split* kering tungku asal : Kali Progo, Berat: 100 gram
 - b. Air jernih asal : LSBB Prodi TS FT-UAJY
- III. Alat
 - a. Pan
 - b. Timbangan
 - c. Tungku (*oven*), suhu dibuat antara 105-110°C
 - d. Air tetap jernih setelah 5 kali pencucian dalam air
 - e. *Split*+pan masuk tungku tanggal 25 September jam 10.30 WIB
- IV. Hasil

Setelah pasir keluar tungku tanggal 26 September jam 10.45 WIB

 - a. Berat pan+*split* = 227 gram
 - b. Berat piring kosong = 128 gram
 - c. Berat *split* = 99 gram

$$\begin{aligned}\text{KandunganLumpur} &= \frac{100-99}{100} \times 100\% \\ &= 1\%\end{aligned}$$

Kesimpulan: Kandungan lumpur $1 \leq 1$, Syarat terpenuhi (OK)



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PEMERIKSAAN LOS ANGELES ABRASION TEST

Bahan : Agregat kasar
Asal : Kali Progo
Diperiksa : 25 September 2013

Gradasi Saringan		Nomor Contoh
		I
<i>Lolos</i>	<i>Tertahan</i>	<i>Berat Masing-Masing Agregat</i>
$\frac{3}{4}$ "	$\frac{1}{2}$ "	2500 gram
$\frac{1}{2}$ "	$\frac{3}{8}$ "	2500 gram

Nomor Contoh	I
Berat sebelumnya (A)	5000 gram
Berat sesudah diayak saringan No. 12 (B)	3752 gram
Berat sesudah (A)-(B)	1248 gram
$\text{Keausan} = \frac{(A) - (B)}{(A)} \times 100\%$	24,96%
Keausan Rata-rata	24,96%



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LAMPIRAN II

DATA PENGUJIAN KUAT TARIK BAJA

Baja Siku 29,4 x 29,4 x 3 mm

Tebal = 2,05 mm

Lebar = 16 mm

Luas = 32,8 mm²

P_o = 104 mm

Beban (kgf)	Bacaan pada Strainometer (ΔP)(10 ⁻²)	Beban (N)	f (MPa)	ϵ (10 ⁻⁴)	ϵ terkoreksi (10 ⁻⁴)
0	0	0,0000	0,0000	0,0000	0,0
100	1,5	980,6710	29,8985	1,4423	1,8269
200	3	1961,3420	59,7970	2,8846	3,6539
300	5	2942,0130	89,6955	4,8077	5,4808
400	6,5	3922,6840	119,5940	6,2500	7,3077
500	8	4903,3550	149,4925	7,6923	9,0737
600	10	5884,0260	179,3910	9,6154	10,9007
700	12	6864,6970	209,2895	11,5385	12,7276
800	15	7845,3680	239,1880	14,4231	14,5545
900	17	8826,0390	269,0866	16,3462	16,3815
1000	20	9806,7100	298,9851	19,2308	18,2084
1030	85	10100,9113	307,9546	81,7308	82,4217
1420	11500	13925,5282	424,5588	11057,6923	11058,3832
1520	12000	14906,1992	454,4573	11538,4615	11539,1524

Beban Maksimum = 1530 kgf

Tegangan Leleh = 298,9851 MPa

Tegangan Maksimum = 457,4471 MPa

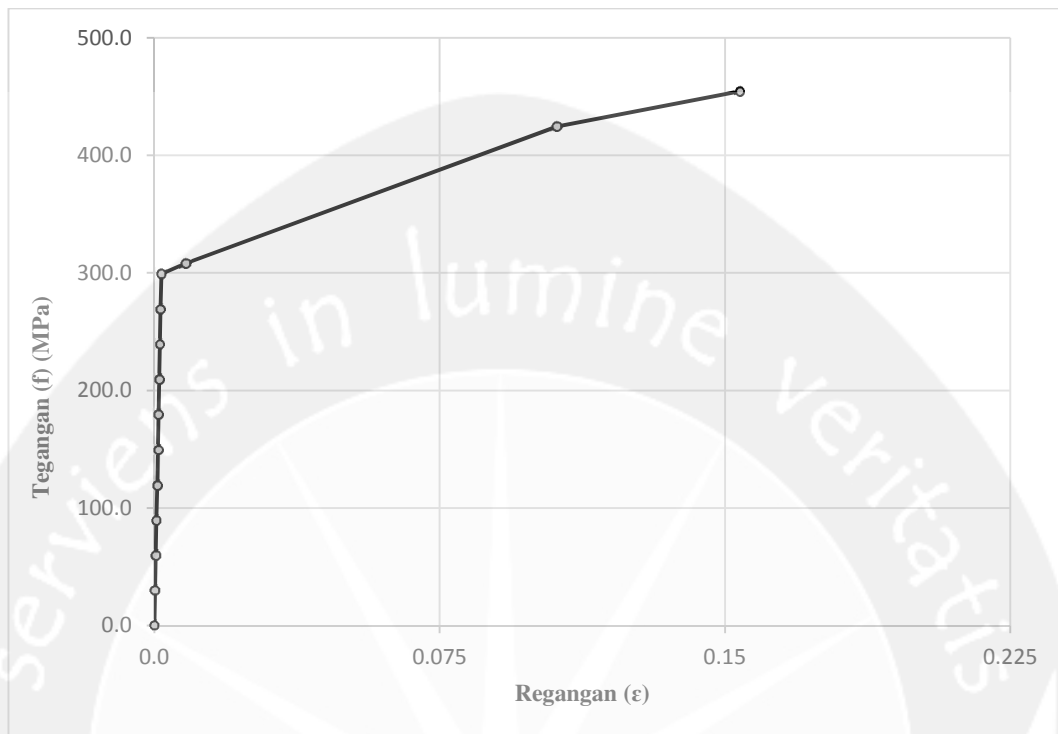
Regangan Koreksi = 0,6909 x 10⁻⁴

Modulus Elastis = 164201,817 MPa



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Grafik Tegangan Regangan Baja Profil Siku

Baja Tulangan P6

Diameter = 5,63 mm

Luas = 24,8947 mm²

P₀ = 104,4 mm

Beban Maksimum = 1235 kgf

Tegangan Leleh = 323,0207 MPa

Tegangan Maksimum = 486,5006 MPa



LAMPIRAN III

PERENCANAAN ADUKAN UNTUK BETON NORMAL

(SNI 03-2834-2000)

A. Data Bahan

1. Bahan Agregat halus (pasir) : Sungai Progo, Yogyakarta.
2. Bahan Agregat kasar : Clereng, Yogyakarta.
3. Jenis semen : Gresik (Tipe 1)

B. Data *Specific Gravity*

1. *Specific gravity* agregat halus (pasir) : 2,7364 g/cm³.
2. *Specific gravity* agregat kasar (krikil) : 2,7307 g/cm³.
3. *Absorption* agregat halus (pasir) : 0,0267%
4. *Absorption* agregat kasar (krikil) : 1,5244%

C. Hitungan

1. Kuat tekan beton yang disyaratkan (f_c') pada umur 28 hari. $f_c' = 20$ MPa.
2. Menentukan nilai deviasi standar berdasarkan tingkat mutu pengendalian pelaksanaan campuran.
3. Berdasarkan SNI butir 4.2.3.1 1 (5) nilai margin ditentukan sebesar 12 MPa.
4. Menetapkan kuat tekan beton rata-rata yang direncanakan berdasarkan SNI butir 4.2.3.1 3.

$$f_c' = f_c' + M = 20 + 12 = 32 \text{ MPa.}$$



5. Menentukan jenis semen

Jenis semen kelas I (PC).

6. Menetapkan jenis agregat

a) Agregat halus : pasir alam.

Direncanakan golongan 2.

b) Agregat kasar : batu pecah

7. Menetapkan faktor air – semen, berdasarkan jenis semen yang dipakai dan kuat tekan rata-rata silinder beton yang direncanakan pada umur tertentu.

Perkiraan Kekuatan Tekan (MPa) Beton dengan Faktor Air Semen, dan Agregat Kasar yang Biasa Dipakai di Indonesia

Jenis semen	Jenis agregat Kasar	Kekuatan tekan (MPa)				Bentuk Bentuk uji
		Pada umur (hari)				
		3	7	28	29	
Semen Portland Tipe I	Batu tak dipecahkan	17	23	33	40	Silinder
	Batu pecah	19	27	37	45	
Semen tahan sulfat Tipe II, V	Batu tak dipecahkan	20	28	40	48	Kubus
	Batu pecah	25	32	45	54	
Semen Portland tipe III	Batu tak dipecahkan	21	28	38	44	Silinder
	Batu pecah	25	33	44	48	
	Batu tak dipecahkan Batu pecah	25 30	31 40	46 53	53 60	Kubus

(Sumber : SNI 03-2834-2000 : Tabel 2)

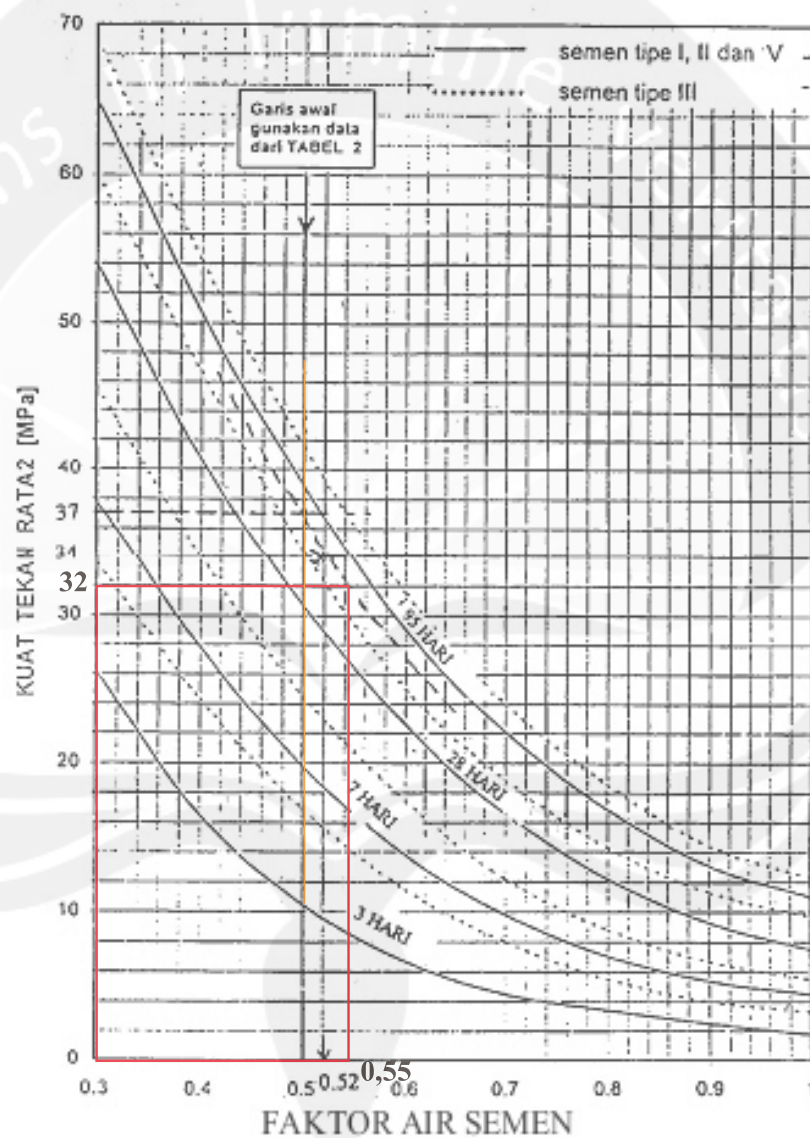
Berdasarkan tabel 2 SNI 03-2834-2000 didapat kuat tekan 37 MPa, Dari titik kekuatan tekan 37 MPa tarik garis datar hingga memotong garis tengah yang menunjukkan faktor air semen 0,50. Melalui titik potong ini lalu gambarkan kurva yang berbentuk kira-kira sama dengan kurva di sebelah atas dan di sebelah bawahnya (garis dengan warna kuning). Kemudian dari titik kekuatan tekan beton yang dirancang (dalam hal ini 32 MPa) tarik garis datar hingga memotong kurva garis kuning tadi. Dari



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titik potong ini tarik garis tegak ke bawah hingga memotong sumbu X (absiska) dan dibaca faktor air semen yang diperoleh. Didapatkan sebesar 0,55.



Hubungan Kuat Tekan Silinder dengan Fas

(Sumber : SNI 03-2834-2000 : Grafik 1)



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8. Menetapkan faktor air semen maksimum.

Persyaratan Jumlah Semen Minimum dan Faktor Air Semen Maksimum Untuk Berbagai Macam Pembetonan dalam Lingkungan Khusus

Lokasi	Jumlah Semen minimum Per m ³ beton (kg)	Nilai Faktor Air Semen Maksimum
Beton di dalam ruang bangunan :		
a. Keadaan keliling non-korosif	275	0,6
b. Keadaan keliling korosif disebabkan oleh kondensasi atau uap korosif	325	0,52
Beton diluar ruangan bangunan :		
a. tidak terlindung dari hujan dan terik matahari langsung	325	0,60
b. terlindung dari hujan dan terik matahari langsung	275	0,60
Beton masuk kedalam tanah :		
a. mengalami keadaan basah dan kering berganti-ganti	325	0,55
b. mendapat pengaruh sulfat dan alkali dari tanah		Lihat Tabel 5
Beton yang kontinu berhubungan:		
a. Air tawar		Lihat Tabel 6
b. Air laut		Lihat Tabel 6

(Sumber : SNI 03-2834-2000 : Tabel 4)

Berdasarkan tabel 4 SNI 03-2834-2000, untuk beton dalam ruang bangunan sekeliling non-korosif fas maksimum 0,6. Dibandingkan dengan no.7, dipakai terkecil. Jadi digunakan fas 0,55.

9. Menetapkan nilai “slump”

Jenis konstruksi balok, berdasarkan SK SNI T-15-1990-03 digunakan nilai slump dengan nilai maksimum 150 mm dan minimum 75 mm.

Slump dalam cm		
Pemakaian beton	Maks.	Min.
Dinding, plat fondasi, dan fondasi telapak bertulang	12,5	5,0
Fondasi telapak tidak bertulang, kaison, dan struktur di bawah tanah	9,0	2,5
Pelat, balok, kolom, dan dinding	15,0	7,5
Pengerasan jalan	7,5	5,0
Pembetonan massa	7,5	2,5



10. Ukuran butiran maksimum (krikil) adalah 10 mm.

11. Menetapkan jumlah air yang diperlukan tiap m³ beton.

Perkiraan Kadar Air Bebas (kg/m³) yang Dibutuhkan Untuk Beberapa Tingkat Kemudahan Pengerjaan Adukan Beton

Slump (mm)		0-10	10-30	30-60	60-180
Ukuran besar butir agregat maksimum	Jenis agregat	---	---	---	---
10	Batu tak dipecahkan	150	180	205	225
	Batu pecah	180	205	230	250
20	Batu tak dipecahkan	135	160	180	195
	Batu pecah	170	190	210	225
40	Batu tak dipecahkan	115	140	160	175
	Batu pecah	155	175	190	205

Catatan : Koreksi suhu udara :
Untuk suhu di atas 25 °C, setiap kenaikan 5 °C harus ditambah air 5 liter per m² adukan beton.

(Sumber : SNI 03-2834-2000 : Tabel 3)

- Ukuran butir maksimum 10 mm.
- Nilai *Slump* 75-150 mm.
- Agregat halus berupa batu tak di pecah, maka $W_h = 225$
- Agregat kasar berupa batu pecah, maka $W_k = 250$

$$W = \frac{2}{3}W_h + \frac{1}{3}W_k$$

dengan : W_h adalah perkiraan jumlah air untuk agregat halus

W_k adalah perkiraan jumlah air untuk agregat kasar

$$W = \frac{2}{3} \times 225 + \frac{1}{3} \times 250 = 233,3333 \text{ kg}$$

12. Menghitung berat semen yang diperlukan :

- Berdasarkan tabel 4 SNI 03-2834-2000, diperoleh semen minimum 275 kg.



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b) Berdasarkan $f_{as} = 0,55$. Semen per m^3 beton $= \frac{A}{f_{as}} = \frac{233,3333}{0,55}$
 $= 424,2424 \text{ kg}$

Dipilih berat semen yang paling besar. Digunakan berat semen 424,2424 kg.

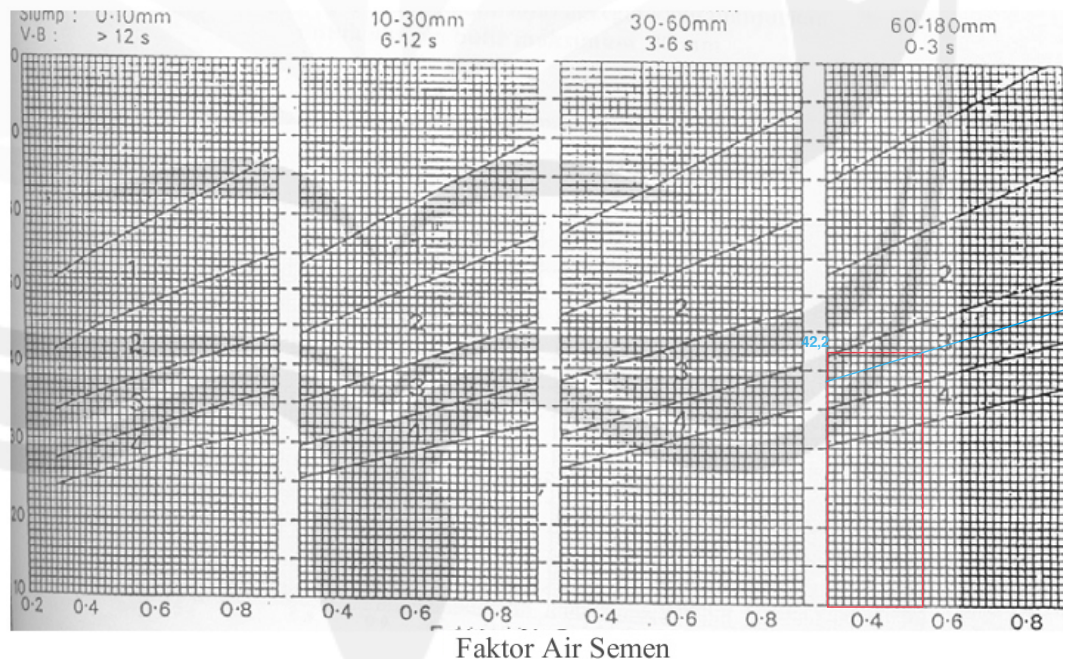
13. Penyesuaian jumlah air atau f_{as} .

$$f_{as \text{ rencana}} = 0,55$$

$$f_{as \text{ mak}} > f_{as \text{ rencana}}$$

$$0,6 > 0,55 \dots\dots\dots \text{oke}$$

14. Perbandingan agregat halus dan kasar



**Persen Pasir Terhadap Kadar Total Agregat yang Dianjurkan
Untuk Ukuran Butir Maksimum 10 mm
(Sumber : SNI 03-2834-2000 : Tabel 13)**

- a) Ukuran maksimum 10 mm.
- b) Nilai *Slump* 75 mm – 150 mm



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c) *fas* 0,55.

d) Jenis gradasi pasir no. 3.

Diambil proporsi pasir = 42,2%.

15. Berat jeis agregat campuran :

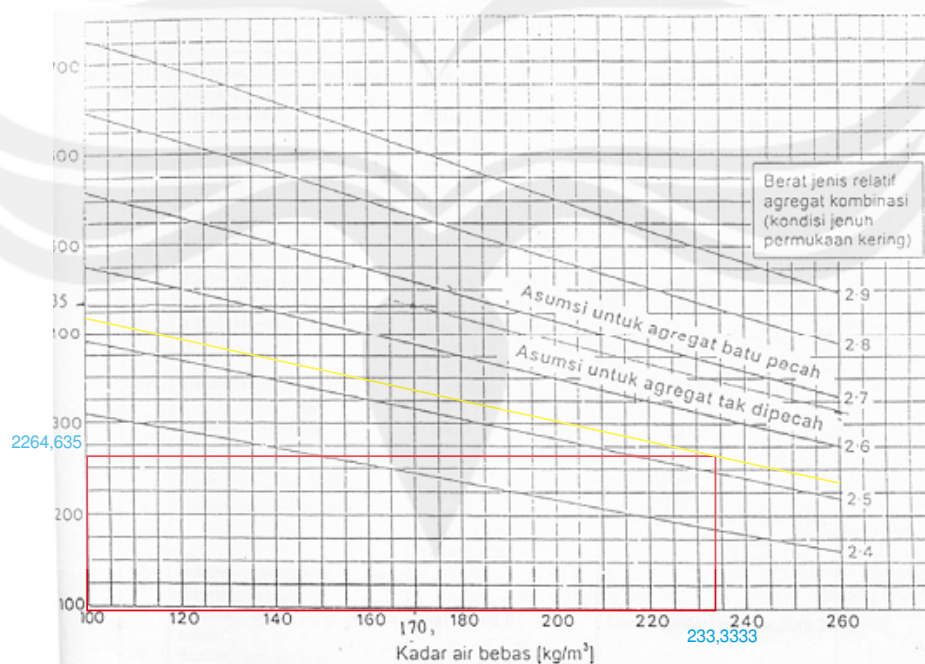
$$\begin{aligned} &= \frac{P}{100} \times B_j \text{ agregat halus} + \frac{K}{100} \times B_j \text{ agregat kasar} \\ &= \frac{42,2}{100} \times 2,7311 + \frac{57,8}{100} \times 2,7307 \\ &= 2,7309 \end{aligned}$$

dimana :

P = % agregat halus terhadap agregat campuran

K = % agregat kasar terhadap agregat campuran

16. Berat jenis beton



Perkiraan Berat Isi Beton yang Telah Selesai Didapatkan

(Sumber : SNI 03-2834-2000 : Grafik 16)



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Bj campuran (langkah 15) $\rightarrow 2,7309 \text{ kg/m}^3 \rightarrow$ dibuat garis bantu diantara 2,5 dan 2,6.

Keperluan air yaitu 233,3333 kg (langkah 11) \rightarrow ditarik garis vertical ke atas sampai menyentuh garis bantu, kemudian tarik ke kiri di dapat 2264,635 kg/m^3 .

17. Berat agregat campuran

$$\begin{aligned} &= \text{berat tiap m}^3 - \text{keperluan air dan semen} \\ &= 2264,635 - (233,3333 + 424,2424) \\ &= 1607,0593 \text{ kg} \end{aligned}$$

18. Menghitung berat agregat halus

$$\begin{aligned} \text{berat agregat halus} &= \% \text{ berat agregat halus} \times \text{keperluan agregat} \\ &\text{campuran} \\ &= 42,2\% \times 1607,0593 \text{ kg} \\ &= 678,179 \text{ kg} \end{aligned}$$

19. Menghitung berat agregat kasar

$$\begin{aligned} \text{berat agregat kasar} &= \% \text{ berat agregat kasar} \times \text{keperluan agregat} \\ &\text{campuran} \\ &= 57,8\% \times 1607,0593 \text{ kg} \\ &= 928,8803 \text{ kg} \end{aligned}$$



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Kebutuhan Bahan Susun Adukan Beton Normal :

- a) Semen = 424,2424 kg/m³
- b) Pasir = 678,179 kg/m³
- c) Krikil = 928,8803 kg/m³
- d) Air = 233,3333 liter/m³



LAMPIRAN IV

PERHITUNGAN DESAIN BALOK BERTULANG

(SNI 03-2847-2002)

A. Perencanaan Balok Bertulang dengan Sengkang Baja Tulangan \emptyset 6 mm

1. Diketahui :

a) Dimensi balok :

- 1) Tinggi balok = 200 mm
- 2) Lebar balok = 125 mm
- 3) Panjang balok (l_u) = 1800 mm
- 4) Selimut beton = 10 mm
- 5) f_c' = 20 MPa

b) Dimensi profil :

- 1) Lebar siku = 30 mm
- 2) Tinggi siku = 30 mm
- 3) Tebal = 3 mm
- 4) Pusat berat ($C_x = C_z$) = 8,44 mm
- 5) Jenis baja = BJ34
- 6) F_u = 340 MPa
- 7) f_y = 210 MPa
- 8) A_g = 172,7 mm²

c) Dimensi sengkang :

- \emptyset sengkang = 6 mm



PERHITUNGAN DIMENSI BALOK

$$\begin{aligned}h_{min} &= \frac{l}{16} \left(0,4 + \frac{fy}{700} \right) \\ &= \frac{1800}{16} \left(0,4 + \frac{210}{700} \right) \\ &= 78,75 \text{ mm}\end{aligned}$$

Digunakan $h = 200 \text{ mm}$

$$\begin{aligned}b &= \frac{1}{2} h \\ &= \frac{1}{2} 200 \\ &= 100 \text{ mm}\end{aligned}$$

$$\begin{aligned}b &= \frac{2}{3} h \\ &= \frac{2}{3} 200 \\ &= 133,33 \text{ mm}\end{aligned}$$

Digunakan $b = 125 \text{ mm}$



ANALISIS BALOK BETON BERTULANG

Berdasarkan pada gambar 3.4, maka :

$$\sum F_H = 0$$

$$C_c + C_s = T$$

$$a \cdot b \cdot 0,85 \cdot f'_c + A_s \cdot f_s' = A_s \cdot f_y$$

$$\text{di mana : } f_s' = E_s \cdot \epsilon_{cu} \cdot \frac{c-d'}{c}$$

$$= E_s \cdot \epsilon_{cu} \cdot \frac{a - \beta_1 \cdot d'}{a}$$

$$= 200000 \times 0,003 \cdot \frac{a - 0,85 \cdot 24,4}{a}$$

$$a \cdot 125 \cdot 0,85 \cdot 20 + 2.172,7 \cdot 600 \cdot \frac{a - 0,85 \cdot 24,4}{a} = 2.172,7 \cdot 210$$

$$\text{Diperoleh : } a_1 = 23,3251 \text{ mm}$$

$$a_2 = -86,7162 \text{ mm}$$

$$\text{Diambil } a = 23,3251 \text{ mm}$$

$$C_c = a \times 125 \times 0,85 \times 20$$

$$= 23,3251 \times 125 \times 0,85 \times 20$$

$$= 49565,8375 \text{ N}$$

$$C_s = 600 \times 2 \times 172,7 \times \frac{a - 0,85 \times 24,4}{a}$$

$$= 600 \times 2 \times 172,7 \times \frac{23,3251 - 0,85 \times 24,4}{23,3251}$$

$$= 22968,2241 \text{ N}$$

$$z_1 = d - \frac{a}{2}$$



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$$\begin{aligned} &= 175,6 - \frac{23,3251}{2} \\ &= 163,9375 \text{ mm} \\ z_2 &= d - a \\ &= 175,6 - 23,3251 \\ &= 152,2749 \text{ mm} \\ Mn &= C_c \cdot z_1 + C_s \cdot z_2 \\ &= (49565,8375 \times 163,9375) + (22968,2241 \times 152,2749) \\ &= 11,6232 \text{ kNm} \\ Mu &= \phi \cdot Mn \\ &= 0,8 \times 11,6232 \\ &= 9,2986 \text{ kNm} \\ Mu &= \frac{1}{6} \cdot P \cdot l \\ P &= \frac{6 \times Mu}{l} \\ &= 30,9953 \text{ kN} \\ Vu &= \frac{1}{2} \cdot P \\ &= 15,4977 \text{ kN} \\ Vc &= \frac{1}{6} \cdot \sqrt{f'c} \cdot b \cdot d \\ &= \frac{1}{6} \cdot \sqrt{20} \times 125 \times 175,6 \\ &= 16,3606 \text{ kN} \\ Vu &< Vc \\ 15,4977 \text{ kN} &< 16,3606 \text{ kN} \longrightarrow \text{lentur lebih lemah dari geser} \dots\dots \text{(OK)} \end{aligned}$$



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LAMPIRAN V

DATA PENGUJIAN SILINDER BETON

Benda Uji	Nilai <i>Slump</i> (mm)	Dimensi		Berat (kg)	Berat Jenis (ton/m ³)	Umur Beton (hari)	<i>F</i> (kN)	<i>fc'</i> (MPa)
		<i>d</i> (cm)	<i>h</i> (cm)					
SB 1	10,2	15,0433	30,21	12,54	2,3354	28	445	25,037
SB 2	9,1	15,0867	30,1367	12,84	2,3834	28	505	28,2498
SB 3	7,6	15,0233	30,1633	12,54	2,3453	28	680	39,0508



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LAMPIRAN VI

**DATA PENGUJIAN BALOK BETON BETULANG DENGAN PROFIL SIKU
SEBAGAI PENGGANTI TULANGAN LONGITUDINAL**

Tabel Data Logger Pengujian Benda Uji BBTS 1

No.	LOAD CELL; AVE (kg)	LVDT1; AVE (mm)	LVDT2; AVE (mm)	LVDT3; AVE (mm)
1	0.0000	0.000000000	0.000000000	0.000000000
2	0.8894	-0.002616036	-0.032107789	0.003373829
3	0.9191	-0.001835372	-0.032724965	0.003385691
4	8.3918	-0.002538782	-0.023214925	0.007876630
5	18.3565	-0.004160286	-0.004422821	0.016578719
6	27.7391	0.001740229	0.020216983	0.018548694
7	29.3323	0.008448241	0.024055196	0.018445207
8	32.4022	0.013509542	0.033620603	0.019537773
9	39.3698	0.021318614	0.052761193	0.020868406
10	46.1225	0.030483278	0.070450850	0.022365114
11	48.4925	0.029773362	0.077594779	0.022774162
12	55.3917	0.033534370	0.096743509	0.024342861
13	80.6221	0.049000453	0.167723600	0.028745856
14	113.6758	0.072342284	0.263315830	0.034694642
15	134.2106	0.083126016	0.325858980	0.037704006
16	134.3761	0.084884949	0.332830310	0.037704006
17	133.5131	0.085178502	0.331433090	0.037476987
18	132.9393	0.085363105	0.334157500	0.037353043
19	139.9226	0.088127948	0.356419770	0.038659547
20	221.2047	0.143077720	0.584608670	0.048193231
21	289.4526	0.189851640	0.791215960	0.059262067
22	323.5517	0.218818320	0.900156440	0.065655082
23	323.5864	0.224683060	0.922944660	0.066991039
24	411.6317	0.284527390	1.157364000	0.082936548
25	499.0617	0.348831300	1.420424100	0.098773256
26	516.2233	0.366174220	1.496186900	0.103087480
27	533.4073	0.385374490	1.569508700	0.106839270
28	695.5006	0.503379880	2.023995900	0.134090470
29	792.2996	0.598866340	2.409665300	0.160080970



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30	813.7459	0.648034330	2.602805600	0.169940260
31	918.0089	0.732272030	2.914059400	0.189140570
32	913.0878	0.738845830	2.943604000	0.190607830
33	1053.8643	0.857742490	3.432918300	0.218920900
34	1110.2373	0.934013310	3.717495000	0.236136510
35	1163.7867	1.004551900	3.973611600	0.246555790
36	1221.1702	1.066326000	4.168735000	0.256884660
37	1290.3296	1.127972400	4.447118800	0.272904220
38	1320.2570	1.188023200	4.681610100	0.288009140
39	1452.1844	1.298044000	5.133336500	0.315962670
40	1525.2186	1.417983100	5.576219600	0.343465830
41	1695.0642	1.579694300	6.256969000	0.384758000
42	1792.1544	1.711271900	6.832328800	0.419343830
43	1892.5243	1.890513800	7.558674300	0.460244570
44	2002.2546	2.011963800	8.124345800	0.495095880
45	2028.0313	2.089516200	8.414797800	0.511702840
46	2066.6006	2.165100800	8.645095800	0.525918840
47	2111.1782	2.210233700	8.919388800	0.543937390
48	2119.4395	2.259098300	9.072596500	0.551534300
49	2217.7041	2.367575600	9.591667200	0.580628630
50	2350.7695	2.511466500	10.244126000	0.620649460
51	2423.9124	2.645690900	10.768031000	0.652219410
52	2454.0293	2.710735600	11.055831000	0.666851040
53	2585.0051	2.977541900	12.156441000	0.730645360
54	2637.8499	3.041658600	12.393117000	0.746298430
55	2664.4250	3.080149700	12.533483000	0.755152290
56	2716.0752	3.134244900	12.757641000	0.769113540
57	2753.1082	3.172451700	12.967176000	0.782927450
58	2818.0381	3.271398300	13.396777000	0.807361540
59	2900.4275	3.346756700	13.766109000	0.829741360
60	2960.4937	3.444418000	14.112183000	0.848746180
61	2990.5603	3.500927900	14.341627000	0.862903300
62	3013.5886	3.546212200	14.535897000	0.876044810
63	3053.9199	3.608854100	14.825905000	0.891293290
64	3061.5042	3.629245500	14.913263000	0.895944950
65	3092.3569	3.667047500	15.062758000	0.906277540
66	3109.2195	3.696299600	15.184725000	0.914034720
67	3181.4329	3.802648100	15.629992000	0.939925430
68	3192.8921	3.821538400	15.733088000	0.945875050
69	3205.8013	3.841481000	15.818592000	0.951792300



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70	3259.2700	3.898184800	16.034004000	0.963778670
71	3293.3672	3.949675300	16.251396000	0.976535680
72	3316.4443	3.984900200	16.393524000	0.984741990
73	3341.1890	4.018581900	16.554979000	0.993668620
74	3370.9482	4.072304200	16.724459000	1.003202000
75	3396.0627	4.102704000	16.884827000	1.011780900
76	3396.1858	4.122097000	16.963507000	1.016148700
77	3500.7974	4.316821100	17.845655000	1.068311000
78	3540.1477	4.359667800	18.023758000	1.077760300
79	3591.9280	4.412255800	18.243456000	1.090537000
80	3630.3430	4.455913500	18.436399000	1.103725400
81	3666.2515	4.502687500	18.632847000	1.118204100
82	3691.0215	4.540725200	18.772474000	1.125569100
83	3727.4155	4.584702000	18.959890000	1.137226500
84	3753.8296	4.630203200	19.131899000	1.146837500
85	3790.6475	4.682175600	19.322227000	1.159011600
86	3820.0073	4.725928800	19.509441000	1.170875200
87	3820.4041	4.748711100	19.593632000	1.175245000
88	3849.4016	4.801793600	19.873861000	1.190541400
89	3902.8389	4.860000600	20.119785000	1.207058100
90	3962.8904	4.927833100	20.387033000	1.221924400
91	3990.3604	4.967376700	20.554348000	1.225467200
92	4019.7898	5.017111300	20.740030000	1.229582700
93	4038.5281	5.051799800	20.880106000	1.238099900
94	4066.7813	5.075534800	21.036688000	1.254758200
95	4107.1929	5.115750800	21.255352000	1.270137700
96	4127.5283	5.159308400	21.420591000	1.281363200
97	4153.3286	5.206955000	21.582146000	1.290175800
98	4165.6372	5.238750000	21.705139000	1.296615800
99	4194.0410	5.381516900	22.353716000	1.333346600
100	4253.4819	5.441139700	22.585363000	1.350535600
101	4308.4287	5.513919400	22.832653000	1.365410300
102	4324.7759	5.546321400	22.954531000	1.372808800
103	4354.0454	5.574323700	23.085297000	1.380243200
104	4404.1641	5.615598700	23.317282000	1.394050200
105	4442.8496	5.667797600	23.525709000	1.408225900
106	4474.0889	5.716381100	23.721972000	1.419199300
107	4493.6450	5.754531400	23.868107000	1.427951300
108	4574.4023	5.858991600	24.359934000	1.457458400
109	4618.0630	5.921368100	24.615175000	1.470779100



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110	4651.2129	5.980268500	24.818182000	1.481879400
111	4685.7529	6.022723700	25.035091000	1.494270800
112	4698.5830	6.044744000	25.172014000	1.503587100
113	4728.3682	6.078986200	25.343840000	1.515704500
114	4760.8501	6.137949000	25.560713000	1.530262800
115	4768.9390	6.153603600	25.665737000	1.536233800
116	4798.7759	6.198338000	25.844032000	1.543954500
117	4818.8970	6.236078300	25.993828000	1.552105500
118	4829.1807	6.267229100	26.116308000	1.560552500
119	4895.1978	6.380469800	26.637917000	1.591691700
120	4930.2876	6.420205600	26.815166000	1.600254700
121	4993.6509	6.503679800	27.146711000	1.619942900
122	5019.6104	6.558992900	27.355461000	1.634409800
123	5043.1245	6.597113600	27.535431000	1.643405600
124	5069.4985	6.636381100	27.717419000	1.654004000
125	5103.8364	6.675287200	27.935305000	1.669273700
126	5169.5801	6.908461600	28.973003000	1.730091800
127	5207.8716	6.964738800	29.182613000	1.743228800
128	5248.4575	7.002304600	29.370951000	1.754348400
129	5292.3232	7.052923700	29.602209000	1.766374300
130	5340.2798	7.115231500	29.850079000	1.781967800
131	5367.8804	7.165216900	30.053200000	1.795024600
132	5392.7744	7.203652400	30.231255000	1.804195300
133	5411.8237	7.239780900	30.385164000	1.812241000
134	5428.4160	7.261826500	30.510555000	1.818202000
135	5457.1396	7.301184200	30.698296000	1.827502100
136	5460.1025	7.358010800	31.004383000	1.842782500
137	5564.5381	7.474384800	31.442499000	1.868178200
138	5609.7988	7.542075600	31.747969000	1.887379900
139	5622.6431	7.579940300	31.905460000	1.896173500
140	5653.5229	7.624121700	32.107243000	1.909124700
141	5668.4199	7.659640300	32.270473000	1.919518700
142	5966.1929	8.249600400	34.861420000	2.078537500
143	5998.1641	8.296402000	35.063793000	2.089665200
144	6004.1587	8.323555900	35.183136000	2.097746600
145	6051.0464	8.509174300	35.635384000	2.122413200
146	6104.4956	8.577745400	35.918850000	2.142623900
147	6137.9951	8.627570200	36.156742000	2.159501100
148	6155.9277	8.673916800	36.357353000	2.172569500
149	6197.5757	8.746222500	36.676777000	2.193472400



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150	6231.7905	8.805189100	36.922123000	2.208582900
151	6264.1597	8.865980100	37.182056000	2.225347300
152	6276.3965	8.906062100	37.368404000	2.236609500
153	6276.6157	8.928607900	37.476570000	2.241088200
154	6286.9624	8.959205600	37.603905000	2.249338400
155	6279.3584	8.979256600	37.709484000	2.255126000
156	6375.7217	9.131691900	38.377831000	2.299768200
157	6430.4814	9.208501800	38.732002000	2.320012100
158	6448.1724	9.263665200	38.955528000	2.333379300
159	6488.6675	9.324394200	39.234886000	2.351401100
160	6523.5903	9.393991500	39.543755000	2.371912700
161	6533.6270	9.468491600	39.847408000	2.387270900
162	6546.9326	9.497740700	40.016628000	2.396458100
163	6556.1001	9.520770100	40.148338000	2.402418100
164	6655.8613	9.857186300	41.611679000	2.492763800
165	6667.2705	9.909784300	41.814644000	2.501640600
166	6692.3486	9.938724500	41.971447000	2.511038300
167	6727.1973	10.001554000	42.219643000	2.528275500
168	6740.0010	10.033563000	42.368671000	2.537693000
169	6767.5977	10.076010000	42.571308000	2.549376200
170	6783.2207	10.120683000	42.751873000	2.557818200
171	6830.3677	10.228960000	43.260921000	2.584646200
172	6928.6338	10.383636000	43.888809000	2.625963700
173	6982.0308	10.512080000	44.428867000	2.662809400
174	7005.1997	10.602394000	44.840263000	2.687333800
175	7008.8838	10.659282000	45.098392000	2.701216200
176	7067.8057	10.879161000	46.053085000	2.757346600
177	7133.3774	11.025150000	46.675964000	2.798308100
178	7165.9443	11.387031000	48.227760000	2.892793400
179	7206.9429	11.449683000	48.506901000	2.910643100
180	7226.3506	11.536427000	48.873589000	2.931439200
181	7248.9473	11.678023000	49.505966000	2.967474700
182	7252.9634	11.722023000	49.662888000	2.977222400
183	7277.9277	11.992517000	50.804394000	3.057492500
184	7325.1812	12.085110000	51.171562000	3.078175800
185	7352.2339	12.149831000	51.469944000	3.097008700
186	7352.9224	12.182966000	51.624058000	3.107062600
187	7353.3042	12.208680000	51.744663000	3.113876600
188	7358.8579	12.286076000	52.071556000	3.135863800
189	7467.0078	12.454815000	52.734169000	3.181184300



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190	7468.0820	12.550180000	53.156231000	3.206288800
191	7469.2021	12.820884000	54.211555000	3.263852800
192	7503.0771	12.859399000	54.410366000	3.275896800
193	7521.6787	12.934894000	54.709583000	3.291992700
194	7540.4561	13.183488000	55.682777000	3.351311400
195	7553.1099	13.245293000	56.022953000	3.373309100
196	7572.9966	13.406596000	56.688557000	3.411029600
197	7617.8008	13.474754000	56.976440000	3.430306400
198	7636.0771	13.518834000	57.179840000	3.442600300
199	7642.0088	13.561117000	57.361763000	3.451014800
200	7644.6875	13.598513000	57.506516000	3.458030000



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Tabel Data Logger Pengujian Benda Uji BBTS 2

No.	LOAD CELL; AVE (kg)	LVDT1; AVE (mm)	LVDT2; AVE (mm)	LVDT3; AVE (mm)
1	0,0000	0,000000000	0,000000000	0,000000000
2	2,2287	0,016469557	0,049374055	0,001900437
3	2,3212	0,016076786	0,049240522	0,001535157
4	2,3616	0,015711663	0,050000999	0,001672189
5	2,4276	0,016699690	0,051142532	0,002051785
6	2,8519	0,016685866	0,052521814	0,002180636
7	3,1522	0,016679361	0,054005314	0,002199043
8	4,6083	0,016593162	0,065552525	0,002952100
9	40,5013	0,005833833	0,148050520	0,036066588
10	53,0936	0,006477879	0,163198190	0,050731782
11	84,8107	0,029361887	0,197825160	0,090276912
12	155,1298	0,096580260	0,281731750	0,184024600
13	212,7939	0,164041770	0,352632020	0,261237350
14	330,8279	0,314730110	0,514159440	0,433718170
15	371,5897	0,380895410	0,577596660	0,503330830
16	458,8206	0,494744600	0,685947600	0,631712620
17	577,2235	0,651589630	0,850585280	0,811762510
18	635,2391	0,749240880	0,937019230	0,904157100
19	651,9276	0,764748390	0,962154090	0,935318350
20	740,9941	0,871359350	1,085722700	1,062421400
21	821,3535	0,972521190	1,200501100	1,183040600
22	891,4139	1,071558800	1,304334900	1,288223700
23	928,9873	1,134752800	1,356654800	1,348277000
24	966,2349	1,187053200	1,407349500	1,405993600
25	1012,7268	1,252432000	1,471017800	1,473539400
26	1050,0311	1,301652100	1,517130100	1,529228700
27	1082,3074	1,345274100	1,562519400	1,579255700
28	1103,2097	1,373343800	1,596610700	1,610630500
29	1150,1316	1,445303900	1,665113900	1,678044200
30	1194,9097	1,509298800	1,728020300	1,744148700
31	1218,0725	1,546838900	1,758538700	1,783034900
32	1246,0908	1,585912800	1,801493500	1,827463300
33	1307,3635	1,664217400	1,888220500	1,912629100
34	1353,6053	1,733380900	1,945419100	1,979922500
35	1393,8417	1,791348300	1,995758900	2,039935600
36	1422,2928	1,832878000	2,026353800	2,080699200



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37	1459,0731	1,883537400	2,074931600	2,134552000
38	1477,7021	1,911396600	2,103539900	2,165170200
39	1498,6057	1,939476800	2,131532700	2,195370200
40	1506,5770	1,959047900	2,140173200	2,211484200
41	1528,6549	1,996428600	2,172259600	2,246332600
42	1599,3445	2,089506600	2,265020100	2,342865900
43	1653,7900	2,166942600	2,335368200	2,420431400
44	1696,8014	2,229814500	2,395923400	2,483683800
45	1716,9941	2,263268900	2,426570200	2,516225600
46	1751,3718	2,311272600	2,459634100	2,564979100
47	1775,2610	2,347020400	2,491220700	2,601335300
48	1783,3578	2,367322000	2,501439100	2,616089300
49	1788,6697	2,376764500	2,508915200	2,625821100
50	1800,1985	2,393538200	2,527324700	2,641855000
51	1800,9188	2,399368000	2,532140000	2,647147400
52	1798,2854	2,399750200	2,531851800	2,647181300
53	1815,4680	2,416300300	2,559544800	2,670688900
54	1866,9403	2,485776900	2,648159000	2,737997800
55	1893,0731	2,521139400	2,678734500	2,775723900
56	1934,4828	2,577482200	2,723796600	2,835146200
57	1963,8506	2,615335200	2,767011900	2,876638400
58	1981,3628	2,648506200	2,797618200	2,903739900
59	1986,0159	2,658474200	2,808701300	2,914114000
60	1991,5575	2,663137900	2,816690400	2,923071600
61	2003,2253	2,673504400	2,831989500	2,939494400
62	2042,1860	2,725085300	2,878650700	2,990377200
63	2068,4026	2,766239200	2,921128300	3,030537600
64	2078,0974	2,785381800	2,935787400	3,046398600
65	2089,8357	2,801807400	2,949169900	3,063234100
66	2090,6133	2,809010500	2,949407800	3,069420100
67	2112,1106	2,841998600	2,969370600	3,101217000
68	2132,7622	2,873894200	2,987608900	3,130155300
69	2135,5037	2,881275700	2,991391700	3,136755700
70	2163,2705	2,920180300	3,031827400	3,176188000
71	2222,0801	2,990385500	3,120458100	3,252682200
72	2312,9539	3,111413500	3,229354600	3,378557700
73	2375,9316	3,201998900	3,311854400	3,468971300
74	2398,0344	3,244180700	3,340843700	3,507975600
75	2405,2151	3,261873500	3,363718000	3,530376400
76	2468,0664	3,338629700	3,457569600	3,609627200



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77	2529,3057	3,426250200	3,538587100	3,696043300
78	2575,7520	3,488403300	3,609314900	3,761754500
79	2609,3479	3,534490100	3,665751500	3,812712700
80	2642,6868	3,587360400	3,709492700	3,859654700
81	2667,7925	3,627544200	3,750669500	3,898391700
82	2681,7705	3,649104400	3,773099400	3,921227000
83	2681,9731	3,655065800	3,780064300	3,926909900
84	2686,4036	3,665494200	3,789269700	3,934356000
85	2692,9900	3,676278100	3,797460800	3,944464200
86	2694,4983	3,682206200	3,801927600	3,950087100
87	2721,5581	3,722854400	3,832677400	3,993072500
88	2756,1201	3,771604300	3,875031200	4,039251300
89	2787,7510	3,807344700	3,915712600	4,083908100
90	2813,1138	3,844424000	3,948453900	4,117269000
91	2824,4734	3,866619300	3,967670900	4,138531200
92	2839,7305	3,884511000	3,985082100	4,157521200
93	2849,1438	3,896645300	3,997415800	4,170928500
94	2890,7178	3,948457700	4,054560700	4,222345400
95	2919,8115	3,991119600	4,099651800	4,264315100
96	2960,8992	4,047349500	4,160114300	4,320184200
97	2983,5898	4,084421600	4,195436500	4,355651400
98	2994,0342	4,100091900	4,207903400	4,373481300
99	3004,4309	4,115945300	4,220965900	4,390848200
100	3010,4868	4,133532000	4,230157900	4,409980300
101	3028,0166	4,155612500	4,247323500	4,432383500
102	3063,0967	4,203318600	4,296345700	4,478496100
103	3102,8574	4,261476000	4,362808200	4,533074400
104	3130,6875	4,300343500	4,411018400	4,573669900
105	3152,8479	4,331715600	4,438040300	4,605451100
106	3173,4973	4,362524000	4,460931300	4,636166600
107	3193,9678	4,387462100	4,486040100	4,664615600
108	3212,9543	4,414713900	4,515762300	4,692287900
109	3214,0757	4,422364200	4,523829500	4,699608800
110	3220,0962	4,431395500	4,536060300	4,708877600
111	3232,1819	4,450436600	4,550362600	4,727329300
112	3251,1895	4,478614800	4,581915900	4,750800600
113	3288,1716	4,526279400	4,625756300	4,799945400
114	3306,7744	4,557144600	4,650656200	4,828583700
115	3320,1499	4,576464200	4,665673700	4,849941700
116	3368,3567	4,639904500	4,741750700	4,921994200



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117	3389,3062	4,673207800	4,776410600	4,952854200
118	3406,8687	4,699338900	4,801634800	4,977283000
119	3434,5957	4,734418900	4,836414800	5,014408600
120	3448,8003	4,768341500	4,852513800	5,039179800
121	3451,2864	4,773214300	4,859479900	5,045538400
122	3467,6453	4,784441900	4,879729700	5,066938400
123	3491,6177	4,811794300	4,915604100	5,100534000
124	3517,8704	4,852499500	4,951439400	5,135626300
125	3524,9409	4,865186700	4,966034900	5,149863700
126	3553,2476	4,902962700	5,010574300	5,188658700
127	3578,4050	4,934799700	5,048068500	5,222553700
128	3586,2434	4,949868700	5,064636200	5,239904400
129	3599,2539	4,972099800	5,080729000	5,256894100
130	3619,3652	5,003998300	5,101649300	5,284637900
131	3626,3259	5,028924000	5,113282700	5,298817200
132	3653,8911	5,063618700	5,162529500	5,342474900
133	3690,1670	5,109280100	5,216601400	5,389318500
134	3734,3621	5,163056400	5,283433900	5,448990300
135	3754,0972	5,195023500	5,309761000	5,479352000
136	3768,5669	5,212754200	5,328414400	5,500578400
137	3778,5046	5,228924800	5,342714300	5,517220500
138	3788,9414	5,249257600	5,357469100	5,533147800
139	3808,6636	5,276017700	5,382125400	5,560070000
140	3835,1018	5,318374200	5,418808900	5,596593900
141	3850,2271	5,341149300	5,442190200	5,618634200
142	3862,1995	5,354661900	5,451204800	5,636021100
143	3875,7097	5,370225000	5,464230500	5,657892700
144	3886,1221	5,386789300	5,476375600	5,671950800
145	3909,8044	5,423025100	5,512800200	5,702872300
146	3927,8381	5,445127000	5,543152800	5,728621000
147	3940,0823	5,464284400	5,569020300	5,748750700
148	3976,2004	5,528474800	5,619800100	5,810645100
149	4011,2690	5,575766100	5,656281500	5,855852600
150	4059,1912	5,637841700	5,709376800	5,920341000
151	4105,4087	5,704900700	5,777909300	5,984849900
152	4137,3711	5,743681000	5,820190000	6,029058900
153	4172,0200	5,792959700	5,859415100	6,077064500
154	4179,0537	5,810230300	5,874755400	6,094463800
155	4205,4033	5,840904700	5,915900700	6,129096000
156	4210,5439	5,855529800	5,928731400	6,140408000



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157	4219,0962	5,874183700	5,945271000	6,154907200
158	4227,8374	5,883188200	5,958666800	6,167807100
159	4238,9604	5,900625200	5,973083500	6,184294700
160	4240,1899	5,908878300	5,979618100	6,191582200
161	4240,7793	5,910789500	5,984123700	6,194584400
162	4245,0542	5,913763500	5,990824700	6,201388400
163	4257,9097	5,928597900	6,006280400	6,217724300
164	4258,5840	5,933604200	6,009281600	6,223122600
165	4305,2930	5,998037800	6,063961000	6,286765100
166	4338,4731	6,050091300	6,109971000	6,335670000
167	4365,7363	6,086463500	6,145307500	6,369595100
168	4399,3408	6,128845200	6,186524900	6,414408200
169	4411,8560	6,152633200	6,210256100	6,438359300
170	4426,0674	6,166846300	6,225960700	6,457693100
171	4440,4336	6,186196800	6,245936900	6,478131800
172	4455,8262	6,217928400	6,271833900	6,503202900
173	4476,6367	6,239504800	6,301907500	6,529094200
174	4487,4263	6,261460300	6,323455300	6,548293100
175	4524,4443	6,305460500	6,374116900	6,594448600
176	4527,1338	6,316624200	6,386634800	6,606232200
177	4547,9790	6,346218100	6,416601700	6,633179700
178	4573,6543	6,381988000	6,453543700	6,673228300
179	4591,3428	6,406441700	6,480061100	6,697561300
180	4592,9360	6,418097000	6,485542300	6,705956000
181	4637,9448	6,482629300	6,535670800	6,772638800
182	4674,9370	6,529075600	6,574236400	6,820511300
183	4681,0698	6,546665700	6,588214900	6,836482500
184	4682,1953	6,561170100	6,597531300	6,848151200
185	4693,1323	6,571445900	6,610513700	6,861412000
186	4712,0308	6,593655600	6,635648300	6,886881800
187	4728,3032	6,623025400	6,657084900	6,907136400
188	4732,3379	6,639292200	6,666222100	6,917137600
189	4732,7339	6,638071500	6,673468600	6,922529200
190	4747,5068	6,651468300	6,691643200	6,940117800
191	4764,6084	6,670348600	6,713443300	6,961536400
192	4772,6255	6,685753800	6,727726000	6,975747100
193	4798,7485	6,747374500	6,797279800	7,039847400
194	4804,3950	6,761396400	6,807576200	7,050789800
195	4805,3120	6,764585500	6,813135600	7,053687600
196	4809,9585	6,773883800	6,819032700	7,060038600



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197	4811,2266	6,775564200	6,821035400	7,062705000
198	4813,3428	6,780199100	6,823662300	7,066638000
199	4818,4819	6,785784700	6,831159600	7,072982300
200	4825,4014	6,792089900	6,841690500	7,081898200
201	4840,3320	6,803713300	6,859070300	7,099936000
202	4854,1123	6,817546800	6,872127500	7,116980100
203	4862,5815	6,832637300	6,881183100	7,130605700
204	4880,8999	6,869188800	6,916461500	7,165654700
205	4907,9990	6,904345500	6,954939800	7,197794000
206	4930,7358	6,938120400	6,985321000	7,227896700
207	4933,6177	6,947912200	6,993199300	7,235568000
208	4952,8447	6,980643300	7,011282000	7,257938400
209	4971,0522	6,995609300	7,028416200	7,282139300
210	4977,2847	7,002904400	7,039251300	7,293088900
211	4999,3389	7,028821500	7,065625700	7,320496600
212	5012,8081	7,055302100	7,086984200	7,340306800
213	5025,1309	7,076150400	7,107758000	7,359088900
214	5028,8652	7,083238600	7,112612700	7,366304400
215	5030,0703	7,094474300	7,118646100	7,371865300
216	5036,2432	7,107472400	7,135407400	7,384345500
217	5042,1538	7,118536900	7,147831000	7,393259500
218	5046,1436	7,120592600	7,157490700	7,403642700
219	5051,2964	7,129064100	7,166163900	7,410123800
220	5054,2168	7,138879300	7,173250200	7,415859200
221	5056,7798	7,141579200	7,176956700	7,419838400
222	5058,3682	7,148625400	7,179404300	7,423640300
223	5060,3472	7,147751300	7,187499000	7,428576500
224	5074,6143	7,161963500	7,207154300	7,444905800
225	5086,4058	7,174622500	7,221749800	7,460021500
226	5087,2563	7,178210700	7,223018600	7,463300200
227	5093,8730	7,187336000	7,231191600	7,472609000
228	5095,7666	7,193739400	7,237469200	7,479438300
229	5097,9863	7,197577500	7,241170400	7,483137600
230	5115,9707	7,221579600	7,265626400	7,504584300
231	5119,2627	7,225163000	7,270041500	7,510616300
232	5122,7007	7,230065300	7,276125000	7,517488500
233	5127,9648	7,238233600	7,285610700	7,524497500
234	5142,6172	7,254963400	7,303497300	7,541153900
235	5147,7427	7,263045300	7,313277700	7,551512200
236	5156,9897	7,288006800	7,334278100	7,578905600



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237	5181,0581	7,314030200	7,361046300	7,607301700
238	5197,0039	7,336621300	7,380189900	7,629359200
239	5217,7188	7,360632400	7,405997800	7,655099400
240	5243,2944	7,410007000	7,452026800	7,700361300
241	5255,3823	7,426110700	7,469705100	7,722209500
242	5263,1592	7,436917300	7,484108400	7,734031700
243	5284,4155	7,466278100	7,513540700	7,761693000
244	5285,4727	7,472879900	7,520123000	7,767764600
245	5302,2280	7,489363200	7,538546600	7,786473300
246	5318,6172	7,513197900	7,562409900	7,809534500
247	5340,8345	7,544287700	7,590150400	7,840523200
248	5351,9351	7,564858400	7,603405500	7,855915100
249	5358,8120	7,586024800	7,612564100	7,868667600
250	5362,2744	7,592810600	7,619776700	7,874567000
251	5364,3511	7,599361900	7,624656700	7,879794600
252	5370,1084	7,606689500	7,629620100	7,890109500
253	5379,1958	7,616385000	7,646661800	7,905473200
254	5384,8350	7,623001100	7,654118100	7,913730100
255	5408,3545	7,644697200	7,678079100	7,940002900
256	5414,7964	7,658623700	7,690723900	7,953217500
257	5426,5386	7,670188400	7,708468900	7,968057600
258	5427,5850	7,675744100	7,713601600	7,973858800
259	5438,9434	7,692853500	7,729412100	7,988034700
260	5446,8413	7,703664300	7,739278800	7,999682900
261	5451,2256	7,709649600	7,746357400	8,007568400
262	5451,5884	7,715717800	7,749006700	8,011327700
263	5457,8115	7,720662600	7,758442400	8,020434400
264	5482,9912	7,758857700	7,796212200	8,058990500
265	5511,5908	7,797313200	7,833550500	8,095904400
266	5519,0542	7,813765500	7,848142600	8,107268300
267	5539,9302	7,843802000	7,872399800	8,133400000
268	5555,5605	7,862243700	7,887294800	8,155085600
269	5564,8394	7,877683600	7,903602100	8,170342400
270	5578,7031	7,892642500	7,924864300	8,189901400
271	5595,8066	7,914893200	7,950911500	8,213265400
272	5604,8936	7,932518000	7,971379300	8,228926700
273	5622,3179	7,950830000	7,996382200	8,251890200
274	5629,4058	7,958153200	8,011185600	8,266774200
275	5635,6572	7,966560800	8,018533700	8,276670500
276	5655,6250	7,991183300	8,040639900	8,302546500



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277	5665,6440	8,010547600	8,057264300	8,319944400
278	5674,5396	8,020109200	8,070899000	8,333807900
279	5681,6260	8,032616600	8,083609600	8,346294400
280	5700,6045	8,067462900	8,107193900	8,374629000
281	5709,5425	8,082189600	8,120105700	8,392386400
282	5725,6025	8,108806600	8,144173600	8,414451600
283	5728,1196	8,118735300	8,153434800	8,421524000
284	5733,4053	8,125573200	8,164026300	8,431176200
285	5734,5757	8,130453100	8,169525100	8,436487200
286	5735,6377	8,138723400	8,183192300	8,447612800
287	5752,7349	8,158184100	8,206025100	8,468242600
288	5755,1758	8,162492800	8,215148900	8,474362400
289	5769,1372	8,181356400	8,240447000	8,491725900
290	5786,0059	8,199214000	8,255168000	8,513451600
291	5791,1206	8,209382100	8,260340700	8,524503700
292	5809,9453	8,242781600	8,290069600	8,558972400
293	5844,1968	8,282650000	8,331562000	8,600826300
294	5847,0195	8,291961700	8,337041900	8,608634900
295	5873,3657	8,328142200	8,365822800	8,641274500
296	5877,5107	8,343462000	8,377123800	8,653419500
297	5880,8643	8,349753400	8,383359900	8,660560600
298	5887,4019	8,361984300	8,396229700	8,672010400
299	5897,7329	8,375599900	8,409193000	8,685832000
300	5934,6240	8,421442000	8,457820900	8,730034800
301	5948,7432	8,445157100	8,484377900	8,753562900
302	5960,4785	8,464420300	8,501513500	8,771233600
303	5971,5825	8,478634800	8,520526900	8,789835000
304	6006,2407	8,526540800	8,578869800	8,846302000
305	6027,1494	8,557218600	8,614676500	8,875326200
306	6040,5269	8,575847600	8,636302900	8,895267500
307	6065,4712	8,616488500	8,671731000	8,928193100
308	6072,3735	8,632104900	8,687760400	8,942834900
309	6077,4336	8,640049000	8,696575200	8,954154000
310	6111,0161	8,679885900	8,733784700	8,994947400
311	6119,9834	8,696825000	8,753881500	9,013657600
312	6120,4766	8,700962100	8,761785500	9,020297100
313	6120,9482	8,710569400	8,770292300	9,030386000
314	6121,2793	8,723862600	8,780711200	9,044327700
315	6169,4688	8,779486700	8,829712900	9,098710100
316	6203,4331	8,830759000	8,868485500	9,142374000



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317	6231,3164	8,860134100	8,901068700	9,180945400
318	6242,7075	8,882264100	8,926768300	9,207830400
319	6255,9170	8,904304500	8,947090100	9,229520800
320	6266,8296	8,920898400	8,965631500	9,245993600
321	6273,4556	8,935673700	8,980544100	9,259557700
322	6292,6904	8,959639500	9,008648900	9,285397500
323	6320,2412	9,003465700	9,049673100	9,321829800
324	6337,3506	9,034949300	9,079484900	9,349969900
325	6349,1504	9,050670600	9,100401900	9,370187800
326	6356,9824	9,067637400	9,116885200	9,386074100
327	6364,4946	9,085688600	9,130750700	9,400256200
328	6378,8115	9,110603300	9,152135800	9,422278400
329	6388,0361	9,119768100	9,166002300	9,437902500
330	6399,4355	9,137300500	9,185746200	9,457320200
331	6403,7397	9,146787600	9,196126000	9,468847300
332	6412,2563	9,156971900	9,211144400	9,482468600
333	6431,0703	9,185006100	9,234439800	9,507774400
334	6443,9399	9,215167000	9,257089600	9,528219200
335	6456,3818	9,232002300	9,276199300	9,548917800
336	6462,5742	9,244672800	9,289570800	9,562852900
337	6494,2808	9,300644900	9,358457600	9,628724100
338	6510,8667	9,324150100	9,380489300	9,653151500
339	6529,6284	9,350787200	9,403883000	9,680254000
340	6548,6943	9,389061900	9,431730300	9,708575200
341	6556,2305	9,409532500	9,447960900	9,723961800
342	6572,0981	9,428355200	9,471107500	9,747744600
343	6588,1343	9,447403000	9,496939700	9,771937400
344	6603,5376	9,474411000	9,522813800	9,796691900
345	6617,8354	9,498280500	9,551964800	9,819997800
346	6619,3638	9,505023000	9,563756900	9,831324600
347	6627,4497	9,522155800	9,577452700	9,845672600
348	6634,8657	9,538728700	9,591409700	9,859908100
349	6642,5532	9,557104100	9,607702300	9,875009500
350	6642,7505	9,560590700	9,614196800	9,882069600
351	6644,1211	9,565933200	9,624170300	9,889074300
352	6653,2642	9,578684800	9,637636200	9,902514500
353	6670,4248	9,600556400	9,658274700	9,925931900
354	6687,2710	9,629801800	9,683356300	9,951149900
355	6701,5649	9,650525100	9,707886700	9,973965600
356	6715,3872	9,677366300	9,729187000	9,997156100



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357	6718,8755	9,694763200	9,740631100	10,010437000
358	6721,4414	9,704030000	9,749413500	10,020011000
359	6732,2905	9,716797800	9,767170000	10,037039000
360	6754,8110	9,745810500	9,795237500	10,068762000
361	6766,5518	9,767869900	9,817157700	10,090781000
362	6772,5498	9,784130100	9,832251500	10,106169000
363	6774,5254	9,839416500	9,889781000	10,160839000
364	6812,4360	9,876975100	9,928918800	10,204730000
365	6815,5664	9,890248300	9,941186900	10,217275000
366	6837,0225	9,921042400	9,969298400	10,247752000
367	6847,6440	9,949008000	9,999638600	10,273112000
368	6849,7896	9,963983500	10,012511000	10,285131000
369	6856,7646	9,979108800	10,033982000	10,304832000
370	6861,5522	9,987072000	10,044864000	10,315931000
371	6869,6431	10,001700000	10,061696000	10,332336000
372	6881,3413	10,018569000	10,077764000	10,350430000
373	6890,3193	10,042799000	10,095494000	10,369327000
374	6894,4741	10,054818000	10,105591000	10,380351000
375	6906,4990	10,083453000	10,127244000	10,401918000
376	6921,7393	10,099469000	10,152505000	10,424448000
377	6924,3975	10,110342000	10,169797000	10,438188000
378	6935,7764	10,126146000	10,188256000	10,457487000
379	6936,4448	10,141082000	10,201759000	10,468803000
380	6950,5186	10,163942000	10,221261000	10,491035000
381	6958,9302	10,190468000	10,248224000	10,517148000
382	6967,3350	10,213237000	10,272035000	10,536741000
383	6979,1006	10,230061000	10,291080000	10,557310000
384	6980,0371	10,245082000	10,301659000	10,569694000
385	6990,4307	10,280773000	10,331802000	10,608562000
386	7000,7207	10,300074000	10,347246000	10,627730000
387	7008,7373	10,317237000	10,363793000	10,644612000
388	7011,3145	10,331832000	10,378593000	10,657986000
389	7011,5391	10,484571000	10,537169000	10,800832000
390	7029,1147	10,509889000	10,555799000	10,824023000
391	7043,3037	10,533983000	10,580697000	10,846248000
392	7063,6489	10,567403000	10,606989000	10,875304000
393	7082,0083	10,590697000	10,633747000	10,905581000
394	7101,7861	10,623321000	10,670414000	10,939747000
395	7107,6421	10,645432000	10,688970000	10,960242000
396	7114,9141	10,668773000	10,709508000	10,981472000



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397	7128,1147	10,719302000	10,774583000	11,038613000
398	7130,9800	10,732759000	10,790182000	11,053608000
399	7134,4761	10,781269000	10,820080000	11,086547000
400	7140,2363	10,796294000	10,830648000	11,102090000
401	7148,1558	10,804743000	10,849182000	11,120133000
402	7151,6528	10,813532000	10,863849000	11,134902000
403	7153,5688	10,827541000	10,878126000	11,147339000
404	7159,0991	10,844595000	10,899882000	11,163631000
405	7170,8486	10,871244000	10,926950000	11,186913000
406	7173,7314	10,903728000	10,964160000	11,223309000
407	7173,9253	10,919342000	10,976828000	11,234976000
408	7174,1821	10,959687000	11,020392000	11,283910000
409	7185,5513	10,980528000	11,036583000	11,303729000
410	7188,8057	10,991882000	11,048714000	11,317048000
411	7198,5913	11,269087000	11,295271000	11,584321000
412	7220,9072	11,305205000	11,332644000	11,619079000
413	7227,2681	11,322108000	11,355401000	11,638671000
414	7242,2114	11,346738000	11,386155000	11,665130000
415	7256,0459	11,380072000	11,417496000	11,693851000
416	7267,1738	11,405095000	11,445376000	11,720497000
417	7280,1880	11,438744000	11,473386000	11,750528000
418	7288,5674	11,465644000	11,498474000	11,776636000
419	7298,9644	11,500227000	11,531876000	11,805902000
420	7297,4873	11,492843000	11,548249000	11,822355000
421	7301,7075	11,495688000	11,565907000	11,841080000
422	7313,1094	11,512639000	11,593583000	11,868926000
423	7326,4341	11,543384000	11,626896000	11,900373000
424	7332,3813	11,572561000	11,655356000	11,927176000
425	7347,8530	11,752792000	11,832355000	12,109976000
426	7366,1792	11,789981000	11,868474000	12,145164000
427	7383,3032	11,819149000	11,906791000	12,181690000
428	7396,5122	11,855518000	11,942823000	12,217543000
429	7421,0713	11,907161000	11,994042000	12,268117000
430	7425,2212	11,947879000	12,031125000	12,303407000
431	7429,2456	11,998671000	12,083238000	12,357607000
432	7429,5952	12,029272000	12,105749000	12,382463000
433	7430,9995	12,104832000	12,193634000	12,466721000
434	7434,2041	12,138276000	12,228035000	12,501244000
435	7438,0664	12,162709000	12,247724000	12,521441000
436	7440,7241	12,184175000	12,265191000	12,541024000



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437	7444,5405	12,203628000	12,285228000	12,560036000
438	7452,1387	12,223488000	12,304765000	12,582691000
439	7459,4082	12,255595000	12,329662000	12,608404000
440	7464,9956	12,287045000	12,355083000	12,632120000
441	7469,3296	12,305872000	12,377087000	12,654762000
442	7476,9780	12,331745000	12,407078000	12,681877000
443	7494,5874	12,830895000	12,894140000	13,178835000
444	7498,9956	12,858964000	12,924765000	13,206585000
445	7499,3462	12,889062000	12,950314000	13,229207000
446	7507,9067	12,916165000	12,978786000	13,257633000
447	7502,7109	12,917276000	12,980064000	13,260720000
448	7517,7852	12,946595000	13,008470000	13,287659000
449	7524,4658	12,975348000	13,040441000	13,317804000
450	7526,7964	12,989954000	13,053114000	13,330407000
451	7529,9639	13,010311000	13,077889000	13,357305000
452	7542,8628	13,033669000	13,098651000	13,379164000



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Tabel Data Logger Pengujian Benda Uji BBTS 3

No.	LOAD CELL; AVE (kg)	LVDT1; AVE (mm)	LVDT2; AVE (mm)	LVDT3; AVE (mm)
1	0.0000	0.000000000	0.000000000	0.000000000
2	2.6086	0.008205910	0.044202156	0.002168773
3	24.8651	0.011277333	0.078312919	0.009936596
4	54.4896	0.029361887	0.108137650	0.033591848
5	64.6572	0.039803259	0.098717168	0.043188933
6	144.6003	0.126589450	0.178847400	0.121472560
7	221.6398	0.227778870	0.266067830	0.216628610
8	251.7761	0.259989380	0.295584830	0.253953430
9	265.8864	0.274230780	0.306534380	0.275593280
10	295.1163	0.307761880	0.337987540	0.309951310
11	328.6321	0.372443910	0.380795750	0.374741640
12	434.2860	0.537365560	0.534519730	0.548652530
13	434.9958	0.549724460	0.551935790	0.567084250
14	465.0912	0.582037390	0.576424180	0.595291380
15	587.6636	0.694805860	0.691318150	0.712341310
16	692.7226	0.812876340	0.807664690	0.836417020
17	698.9353	0.844498040	0.837588790	0.868243460
18	806.4058	0.957795080	0.928017260	0.987143930
19	963.3664	1.115072600	1.075735600	1.148557500
20	1014.1456	1.200599300	1.157313500	1.228897900
21	1124.9318	1.305563600	1.272588600	1.349862800
22	1272.5872	1.465833800	1.428831700	1.522070400
23	1343.4258	1.572244600	1.519680300	1.632953200
24	1439.8523	1.705492500	1.636574000	1.757398200
25	1466.8976	1.760329200	1.688392300	1.811167200
26	1496.5062	1.792512100	1.719256000	1.847693200
27	1518.4792	1.825572400	1.749264700	1.884180700
28	1584.0709	1.888367800	1.825454200	1.954691500
29	1637.7181	1.970583000	1.904283300	2.038728000
30	1729.0858	2.120036100	2.061677900	2.198620800
31	1794.1038	2.210246600	2.173827900	2.299810600
32	1825.4919	2.271410900	2.231804800	2.359181600
33	1871.1295	2.336479200	2.300435300	2.430148100
34	1878.6449	2.366788400	2.342588900	2.471560500
35	1951.7257	2.4711027	2.4450903	2.5760536
36	2046.5603	2.588407300	2.574617400	2.704777500



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37	2096.1223	2.678292500	2.666702000	2.796505700
38	2116.1421	2.728611200	2.724386000	2.853324900
39	2126.2080	2.758407400	2.754859000	2.887596800
40	2207.4915	2.890196600	2.890650700	3.030341600
41	2275.8289	2.987733600	2.989187000	3.124833300
42	2312.6667	3.063571000	3.070268200	3.198604800
43	2327.2927	3.108352700	3.123312700	3.245378300
44	2361.8137	3.164516700	3.182349900	3.306281100
45	2393.3672	3.220603900	3.256681400	3.366548500
46	2420.0969	3.295100500	3.379798900	3.465892600
47	2505.7446	3.392894700	3.474139000	3.559416300
48	2559.1450	3.487070300	3.556225100	3.650728000
49	2601.8357	3.581478600	3.635285400	3.737641800
50	2630.4353	3.651959400	3.710893200	3.804581600
51	2643.0522	3.700561500	3.761083100	3.851700300
52	2644.6477	3.720931800	3.788313900	3.879727600
53	2718.7664	3.853032400	3.966607600	4.032231300
54	2787.2932	3.959761400	4.077279100	4.147398900
55	2825.0366	4.158410100	4.322356700	4.363831500
56	2872.6995	4.208172300	4.369555000	4.417157200
57	2870.7700	4.218740500	4.377913500	4.426890400
58	2938.0408	4.290931700	4.453894600	4.503719800
59	2969.7297	4.327883200	4.505180400	4.546810600
60	3482.4053	5.362232700	5.802141700	5.673916300
61	3497.6765	5.388948400	5.829992800	5.697011900
62	3509.9299	5.421167400	5.863165900	5.734559100
63	3527.5876	5.455387100	5.893094500	5.769205600
64	3534.6189	5.468064800	5.918610600	5.786377900
65	3547.1406	5.487324700	5.939723000	5.804026600
66	3569.6572	5.509409000	5.963972100	5.827626700
67	3583.1726	5.528117200	5.985346800	5.847878500
68	3690.3779	5.758108600	6.219267800	6.096675900
69	3715.7769	5.783614600	6.241227600	6.122352100
70	3742.1333	5.806587200	6.267365000	6.150240400
71	3759.3547	5.829175900	6.289777300	6.171146900
72	3769.0393	5.845825200	6.304363300	6.184961800
73	3772.4199	5.854005800	6.313540900	6.192576400
74	3792.7959	5.876946900	6.336405800	6.221855200
75	3827.5242	5.909979300	6.370109600	6.256929900
76	3845.0903	5.936405700	6.396231200	6.280775500



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77	3855.6277	5.951489400	6.414349100	6.297524000
78	3864.7751	5.996702700	6.460544600	6.344706100
79	3902.5068	6.027251200	6.490061300	6.379163300
80	3929.6763	6.061001800	6.518809800	6.409949800
81	3945.2817	6.154084200	6.542549100	6.440507400
82	3945.6216	6.212840600	6.555190600	6.447440100
83	3948.0435	6.212601200	6.563283900	6.453531300
84	3959.1821	6.222698200	6.580253600	6.467208400
85	3969.9192	6.232817600	6.593891600	6.481646100
86	3979.1113	6.246311200	6.604445500	6.495674100
87	3979.3042	6.252359900	6.609623900	6.501258900
88	3985.3535	6.262906100	6.621228200	6.510963000
89	3990.0176	6.269604200	6.629987700	6.518693900
90	3992.8938	6.277464900	6.636353500	6.526491600
91	3999.4675	6.282460700	6.644153600	6.534692300
92	4015.3894	6.296605600	6.658688500	6.552058700
93	4041.4226	6.325245400	6.685432400	6.580846300
94	4070.4099	6.360967200	6.723107800	6.615863300
95	4096.2666	6.396279800	6.755570400	6.651907900
96	4111.8979	6.417217300	6.777683300	6.678725700
97	4115.5176	6.433223200	6.791772400	6.693775700
98	4122.5742	6.451130400	6.808270000	6.707788000
99	4131.8105	6.466780200	6.824733700	6.724462000
100	4135.7588	6.474272300	6.835485900	6.735678200
101	4173.8169	6.607531100	6.989738900	6.873858000
102	4184.0942	6.626244100	7.005970000	6.891320700
103	4215.2656	6.655783700	7.041129100	6.927980900
104	4272.0811	6.715658700	7.102863300	6.987213600
105	4320.8418	6.774721100	7.158742400	7.048179100
106	4349.6909	6.816046700	7.203249500	7.093038100
107	4394.8247	6.869021900	7.263529300	7.150922300
108	4404.9292	6.897947800	7.291478200	7.178687100
109	4413.5176	6.919376400	7.310024300	7.200372200
110	4420.5649	6.945810300	7.331975000	7.230522200
111	4433.3716	6.965353500	7.351246400	7.250007600
112	4461.5640	6.998299100	7.382731900	7.284072400
113	4488.9409	7.033479200	7.421194100	7.320560900
114	4532.8647	7.092151200	7.476739400	7.377746100
115	4554.2559	7.131868800	7.519359100	7.423296900
116	4569.6313	7.191980800	7.581602600	7.484000200



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117	4631.4160	7.259298300	7.647589700	7.559326200
118	4655.9453	7.308105900	7.693006500	7.606247900
119	4680.9102	7.348386800	7.735144100	7.649810800
120	4718.5703	7.408725700	7.797490100	7.711773900
121	4726.4150	7.439515600	7.827507500	7.740127100
122	4746.2358	7.472302400	7.869857800	7.778213500
123	4757.0864	7.515962600	7.916996000	7.827241900
124	4772.4556	7.539553200	7.940774400	7.853027800
125	4774.9873	7.561204400	7.960761500	7.877430900
126	4781.0952	7.584446900	7.975468200	7.894271900
127	4810.3569	7.616727400	8.032144500	7.939151800
128	4833.7202	7.657570400	8.075483300	7.978049800
129	4854.5122	7.800906700	8.248390200	8.128324500
130	4904.7988	7.860941900	8.308661500	8.189514200
131	4951.8203	7.922603600	8.364796600	8.253777500
132	4981.6626	7.970647300	8.414687200	8.307336800
133	4998.6987	8.008376100	8.451196700	8.346076000
134	5007.4277	8.034351300	8.475074800	8.372240100
135	5019.3872	8.061098100	8.498727800	8.398482300
136	5046.8481	8.103337300	8.536355000	8.442225500
137	5068.3750	8.135494200	8.571345300	8.480275200
138	5082.1558	8.171489700	8.602512400	8.514234500
139	5087.9146	8.197382900	8.626865400	8.538771600
140	5088.5479	8.215076400	8.644919400	8.555980700
141	5094.9443	8.287340200	8.737251300	8.641841900
142	5106.7720	8.302124000	8.753795600	8.658097300
143	5111.2031	8.315080600	8.775827400	8.674737900
144	5144.6646	8.356854400	8.816675200	8.714570000
145	5151.0913	8.371994000	8.834222800	8.732371300
146	5172.4604	8.398667300	8.862921700	8.762558900
147	5201.8789	8.445392600	8.901991800	8.807526600
148	5225.7451	8.486277600	8.948450100	8.851550100
149	5239.7397	8.524196600	8.986221300	8.890193000
150	5252.6260	8.552711500	9.013908400	8.923348400
151	5257.9829	8.599800100	9.053998000	8.966350600
152	5265.6777	8.622785600	9.073041000	8.988751400
153	5280.6206	8.652188300	9.105210300	9.019537900
154	5291.6704	8.681164700	9.135839500	9.047735200
155	5298.1021	8.708201400	9.167254400	9.072608000
156	5313.0723	8.733412700	9.194621100	9.102539100



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157	5348.3335	8.841200800	9.305413200	9.211360000
158	5391.3701	8.911024100	9.372921000	9.283407200
159	5396.0933	8.948607400	9.404373200	9.320301100
160	5398.4839	8.973251300	9.426023500	9.344187700
161	5445.5439	9.038750600	9.502055200	9.418216700
162	5456.4150	9.087870600	9.549325000	9.465751600
163	5461.6748	9.133760500	9.587717100	9.502674100
164	5464.9634	9.163950900	9.621841400	9.533054400
165	5477.8008	9.461408600	9.898710300	9.802217500
166	5491.0117	9.489875800	9.917762800	9.826289200
167	5499.7056	9.510100400	9.933202700	9.846393600
168	5503.6558	9.521946000	9.947736700	9.861361500
169	5514.0259	9.537374500	9.965638200	9.881325700
170	5520.8604	9.560885400	9.986042000	9.902459100
171	5530.8374	9.588053700	10.016290000	9.932777400
172	5541.5342	9.611826900	10.037941000	9.956075700
173	5550.6919	9.631148300	10.062841000	9.978165600
174	5561.8179	9.656047800	10.086479000	10.002699000
175	5567.8857	9.685256000	10.107897000	10.026988000
176	5595.9233	9.759055100	10.186090000	10.113152000
177	5634.2202	9.830020000	10.251239000	10.181760000
178	5654.7896	9.884054200	10.302699000	10.236877000
179	5658.2930	9.926274300	10.341553000	10.278746000
180	5665.2905	9.966188400	10.382483000	10.318897000
181	5666.2939	9.997239100	10.418868000	10.352684000
182	5667.1396	10.021049000	10.443465000	10.381386000
183	5674.9434	10.049805000	10.470516000	10.414191000
184	5684.5664	10.087931000	10.503338000	10.450627000
185	5688.8423	10.117633000	10.536488000	10.481556000
186	5703.5371	10.159931000	10.576867000	10.524993000
187	5714.9038	10.208343000	10.619843000	10.573362000
188	5715.1343	10.478130000	10.848343000	10.846454000
189	5737.2026	10.520372000	10.889577000	10.892401000
190	5755.0132	10.566954000	10.936741000	10.941537000
191	5765.6006	10.606117000	10.983613000	10.986581000
192	5777.4595	10.648627000	11.031517000	11.034283000
193	5787.0156	10.693278000	11.082170000	11.083296000
194	5794.7305	10.743785000	11.128690000	11.132125000
195	5795.7505	10.778442000	11.166107000	11.170588000
196	5798.8608	10.862134000	11.247162000	11.259030000



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197	5805.9331	10.899254000	11.278875000	11.293719000
198	5813.0640	10.932459000	11.315343000	11.330499000
199	5819.3975	11.067308000	11.429776000	11.450688000
200	5873.8262	11.170938000	11.535113000	11.558138000
201	5889.4678	11.257901000	11.624443000	11.650425000
202	5891.4766	11.323982000	11.688797000	11.719213000
203	5897.1787	11.397031000	11.761153000	11.797264000
204	5943.3945	11.923241000	12.244059000	12.320945000
205	5978.4668	12.021142000	12.347707000	12.428045000
206	5993.5337	12.627460000	12.951898000	13.007059000
207	5999.7651	12.705974000	13.024616000	13.087730000
208	6018.5708	12.765755000	13.073134000	13.149834000
209	6033.3608	12.838634000	13.117523000	13.225274000
210	6039.3032	12.991812000	13.238158000	13.366071000
211	6054.2798	13.060437000	13.313922000	13.439977000
212	6058.2163	13.117819000	13.375817000	13.501004000
213	6063.2495	13.177067000	13.437085000	13.567031000
214	6078.0796	13.485612000	13.736292000	13.880908000
215	6114.9097	13.594008000	13.837339000	13.990943000
216	6116.8135	13.675609000	13.920527000	14.079722000
217	6123.5298	13.871928000	14.108164000	14.277518000
218	6125.3052	13.933269000	14.172874000	14.344393000
219	6140.3828	14.655264000	14.757921000	14.991780000
220	6143.6328	14.694190000	14.800153000	15.028943000
221	6150.9878	14.756419000	14.872315000	15.097513000
222	6168.0474	14.859228000	14.962328000	15.197790000
223	6178.9512	15.045635000	15.127911000	15.377205000
224	6195.4658	15.099322000	15.179523000	15.434934000
225	6221.3350	15.173399000	15.263633000	15.516145000
226	6223.7974	15.660332000	15.748173000	16.021694000
227	6239.6030	15.818893000	15.913524000	16.187628000
228	6264.0889	15.880412000	15.963997000	16.249973000
229	6291.6748	15.962714000	16.042141000	16.340391000
230	6299.2852	16.041203000	16.132360000	16.424213000
231	6300.6401	16.115496000	16.194527000	16.497585000
232	6309.1304	16.188175000	16.267414000	16.578268000
233	6313.8179	16.263123000	16.341667000	16.654289000
234	6314.5342	16.329199000	16.417864000	16.724644000
235	6345.3179	16.833841000	16.896084000	17.243353000
236	6359.2080	16.912109000	16.983147000	17.333199000




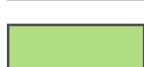


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237	6357.4102	16.981222000	17.048212000	17.404810000
238	6362.8550	17.049234000	17.110798000	17.477606000
239	6381.2852	17.433987000	17.487522000	17.868729000
240	6419.9072	17.569616000	17.635880000	18.013689000
241	6421.1621	17.765827000	17.824551000	18.218950000
242	6398.4619	17.874866000	17.941006000	18.335814000
243	6435.9243	18.282522000	18.347733000	18.742382000
244	6448.9614	18.374897000	18.431223000	18.837397000
245	6453.8848	18.605503000	18.664303000	19.074823000
246	6455.6113	19.091009000	19.124468000	19.541718000
247	6474.9614	19.153397000	19.181156000	19.604946000
248	6503.3179	19.238831000	19.264273000	19.701494000
249	6505.5449	19.317217000	19.340326000	19.781956000
250	6515.8296	19.500128000	19.518681000	19.969370000
251	6531.7671	19.803921000	19.805754000	20.283062000
252	6570.8765	20.002100000	20.014542000	20.489031000
253	6592.2471	20.709803000	20.704742000	21.189901000
254	6599.5376	21.508270000	21.456093000	21.941029000
255	6615.4126	21.570366000	21.520386000	22.009722000
256	6621.6470	21.634315000	21.582979000	22.074228000
257	6650.6411	22.242285000	22.195539000	22.687513000
258	6654.9429	22.320555000	22.272682000	22.768652000

Keterangan :

	= Data pada retak pertama
	= Data pada lendutan maksimum
	= Data pada luluh
	= Data pada beban maksimum

LVDT 1 = y_{i-1}

LVDT 2 = y_{i+1}

LVDT 3 = y_i



LAMPIRAN VII

PERHITUNGAN BALOK BERTULANG BBTS 1

1. Diketahui :

a) Dimensi balok :

- 1) Tinggi balok = 200 mm
- 2) Lebar balok = 125 mm
- 3) Panjang balok (l_u) = 1800 mm
- 4) Selimut beton = 10 mm
- 5) f_c' = 25,037 MPa
- 6) β = 0,85
- 7) E_c = $4700\sqrt{25,037} = 23517,38357$ MPa

b) Dimensi profil :

- 1) Lebar siku = 29,4 mm
- 2) Tinggi siku = 29,4 mm
- 3) Tebal = 3 mm
- 4) Pusat berat ($C_x=C_z$) = 8,4 mm
- 5) Jenis baja = BJ 50
- 6) F_u = 457,4471 MPa
- 7) f_y = 298,9851 MPa
- 8) A_g = 172,7 mm²
- 9) E_s = 164201,817 MPa



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c) Dimensi sengkang :

$$1) \text{ } \emptyset \text{ sengkang} = 5,63 \text{ mm}$$

$$2) f_y = 323,0207 \text{ MPa}$$

2. Perhitungan :

$$d' = \text{Selimut beton} + \emptyset \text{ sengkang} + C_z$$

$$d' = 10 + 5,63 + 8,4$$

$$d' = 24,03 \text{ mm}$$

$$d = h - d'$$

$$d = 200 - 24,03$$

$$d = 175,97 \text{ mm}$$

$$y = (a/2) + ((h-a)/2) = 100 \text{ mm}$$

$$A_s = n \times A_{1 \text{ tul}} = 2 \times 172,7 = 345,4 \text{ mm}^2$$

$$\rho = \frac{A_s}{b \cdot d} = \frac{365,4}{125 \times 175,97} = 0,0157$$

$$n = \frac{E_s}{E_c} = \frac{164201,817}{23517,38357} = 6,9821$$

Mencari nilai a dengan rumus seperti pada subbab 3.7 keseimbangan gaya:

$$\sum F_H = 0$$

$$C_c + C_s = T$$

$$a \cdot b \cdot 0,85 \cdot f'_c + A_s \cdot f_s' = A_s \cdot f_y$$

$$\text{di mana : } f_s' = E_s \cdot \varepsilon_{cu} \cdot \frac{c-d'}{c}$$

$$= E_s \cdot \varepsilon_{cu} \cdot \frac{a - \beta_1 \cdot d'}{a}$$



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$$= 164201,817 \times 0,003 \cdot \frac{a - 0,85 \cdot 24,03}{a}$$

$$a \cdot 125 \cdot 0,85 \cdot 25,037 + 2 \cdot 172,7 \cdot 164201,817 \times 0,003 \cdot \frac{a - 0,85 \cdot 24,03}{a}$$

$$= 2 \cdot 172,7 \cdot 298,9851$$

$$a = 25,6979 \text{ mm}$$

Mencari Momen maksimum (M_{maks}) analisis :

$$C_c = a \times 125 \times 0,85 \times 25,037$$

$$= 25,6979 \times 125 \times 0,85 \times 25,037$$

$$= 68361,0717 \text{ N}$$

$$C_s = 164201,817 \times 0,003 \times 2 \times 172,7 \times \frac{a - 0,85 \times 24,03}{a}$$

$$= 164201,817 \times 0,003 \times 2 \times 172,7 \times \frac{25,6979 - 0,85 \times 24,03}{25,6979}$$

$$= 42519,1232 \text{ N}$$

$$M_n = (C_c \times z_1) + (C_s \times z_2)$$

dimana :

$$z_1 = (d - a/2)$$

$$= (175,97 - 25,6979/2)$$

$$= 163,1211 \text{ mm}$$

$$z_2 = d - d'$$

$$= 175,97 - 24,03$$

$$= 151,94 \text{ mm}$$

$$M_n = 17,6115 \text{ kNm}$$

$$M_u \leq \phi M_n, \text{ dimana } \phi = 0,8$$



Maka,

$$M_u = 14,0892 \text{ kNm}$$

Mencari beban maksimum (P_{maks}) analisis :

$$M_u = \frac{1}{6} \times P \times L$$

$$P = (6 \times M_u)/L$$

$$P = (6 \times 14,0892)/1,8$$

$$P = 46,964 \text{ kN}$$

Momen Inersia (I)

$$I = \frac{1}{12} \times b \times h^3$$

$$I = \frac{1}{12} \times 125 \times 200^3 = 83333333,3333 \text{ mm}^4$$

Pada Saat Retak Pertama

Modulus retak (f_r)

$$f_r = 0,7 \times \sqrt{f'_c}$$

$$f_r = 0,7 \times \sqrt{25,037} = 3,5026 \text{ MPa}$$

Momen dan beban teoristis :

$$M_{cr} = \frac{f_r \times I}{y} = \frac{3,5016 \times 83333333,3333}{100} = 2918824,202 \text{ Nmm}$$

$$M_{cr} = 2,9188 \text{ kNm}$$

$$P_{cr} = (6 \times M)/L$$

$$P_{cr} = (6 \times 2,9188)/1,8 = 9,7294 \text{ kN} = 972,94 \text{ kg}$$



Kelengkungan teoritis :

$$\phi_{retak} = \frac{f_r/E_c}{y} = \frac{3,5026/23517,38357}{100} = 1,48936 \times 10^{-6} 1/mm$$

$$\phi_{retak} = 0,001489 1/m$$

Pada Saat Luluh

Dengan menganggap beban elastis, maka :

Momen dan beban teoritis :

$$M_y = A_s \times f_y \times z$$

$$M_y = 345,4 \times 298,9851 \times 163,1211$$

$$M_y = 16845426,86 \text{ Nmm}$$

$$M_y = 16,8454 \text{ kNm}$$

$$P_y = (6 \times M)/L$$

$$P_y = (6 \times 16,8454)/1,8 = 56,1514 \text{ kN} = 5615,14 \text{ kg}$$

Kelengkungan teoritis :

$$k = \sqrt{[(\rho^2 \cdot n^2) + 2\rho n]} - (\rho \cdot n)$$

$$k = \sqrt{[(0,0157^2 \times 6,9821^2) + 2 \times 0,0157 \times 6,9821]} - (0,0157 \times 6,9821)$$

$$k = 0,3713$$

$$\text{Maka, } k \times d = 0,3713 \times 175,97 = 65,3368 \text{ mm}$$

$$\phi_y = \frac{f_y/E_s}{d - kd} = \frac{298,9851/164201,817}{175,97 - 65,3368} = 1,64584 \times 10^{-5} 1/mm$$
$$= 0,016458 1/m$$



PERHITUNGAN BALOK BERTULANG BBTS 2

1. Diketahui :

a) Dimensi balok :

- 1) Tinggi balok = 200 mm
- 2) Lebar balok = 125 mm
- 3) Panjang balok (l_u) = 1800 mm
- 4) Selimut beton = 10 mm
- 5) f_c' = 28,2498 MPa
- 6) β = 0,85
- 7) E_c = $4700\sqrt{28,2498} = 24980,75423$ MPa

b) Dimensi profil :

- 1) Lebar siku = 29,4 mm
- 2) Tinggi siku = 29,4 mm
- 3) Tebal = 3 mm
- 4) Pusat berat ($C_x=C_z$) = 8,4 mm
- 5) Jenis baja = BJ 50
- 6) F_u = 457,4471 MPa
- 7) f_y = 298,9851 MPa
- 8) A_g = 172,7 mm²
- 9) E_s = 164201,817 MPa



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c) Dimensi sengkang :

$$1) \text{ } \emptyset \text{ sengkang} = 5,63 \text{ mm}$$

$$2) f_y = 323,0207 \text{ MPa}$$

2. Perhitungan :

$$d' = \text{Selimut beton} + \emptyset \text{ sengkang} + C_z$$

$$d' = 10 + 5,63 + 8,4$$

$$d' = 24,03 \text{ mm}$$

$$d = h - d'$$

$$d = 200 - 24,03$$

$$d = 175,97 \text{ mm}$$

$$y = (a/2) + ((h-a)/2) = 100 \text{ mm}$$

$$A_s = n \times A_{1 \text{ tul}} = 2 \times 172,7 = 345,4 \text{ mm}^2$$

$$\rho = \frac{A_s}{b \cdot d} = \frac{365,4}{125 \times 175,97} = 0,0157$$

$$n = \frac{E_s}{E_c} = \frac{164201,817}{24980,75423} = 6,5731$$

Mencari nilai a dengan rumus seperti pada subbab 3.7 keseimbangan gaya:

$$\sum F_H = 0$$

$$C_c + C_s = T$$

$$a \cdot b \cdot 0,85 \cdot f'_c + A_s \cdot f_s' = A_s \cdot f_y$$

$$\text{di mana : } f_s' = E_s \cdot \varepsilon_{cu} \cdot \frac{c-d'}{c}$$

$$= E_s \cdot \varepsilon_{cu} \cdot \frac{a - \beta_1 \cdot d'}{a}$$



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$$= 164201,817 \times 0,003 \cdot \frac{a - 0,85 \cdot 24,03}{a}$$

$$a \cdot 125 \cdot 0,85 \cdot 28,2498 + 2 \cdot 172,7 \cdot 164201,817 \times 0,003 \cdot \frac{a - 0,85 \cdot 24,03}{a}$$

$$= 2 \cdot 172,7 \cdot 298,9851$$

$$a = 24,664 \text{ mm}$$

Mencari Momen maksimum (M_{maks}) analisis :

$$C_c = a \times 125 \times 0,85 \times 28,2498$$

$$= 24,664 \times 125 \times 0,85 \times 28,2498$$

$$= 74030,0134 \text{ N}$$

$$C_s = 164201,817 \times 0,003 \times 2 \times 172,7 \times \frac{a - 0,85 \times 24,03}{a}$$

$$= 164201,817 \times 0,003 \times 2 \times 172,7 \times \frac{24,664 - 0,85 \times 24,03}{24,664}$$

$$= 35614,1234 \text{ N}$$

$$M_n = (C_c \times z_1) + (C_s \times z_2)$$

dimana :

$$z_1 = (d - a/2)$$

$$= (175,97 - 24,664/2)$$

$$= 163,638 \text{ mm}$$

$$z_2 = d - d'$$

$$= 175,97 - 24,03$$

$$= 151,94 \text{ mm}$$

$$M_n = 17,5253 \text{ kNm}$$

$$M_u \leq \phi M_n, \text{ dimana } \phi = 0,8$$



Maka,

$$M_u = 14,0202 \text{ kNm}$$

Mencari beban maksimum (P_{maks}) analisis :

$$M_u = \frac{1}{6} \times P \times L$$

$$P = (6 \times M_u)/L$$

$$P = (6 \times 14,0202)/1,8$$

$$P = 46,734 \text{ kN}$$

Momen Inersia (I)

$$I = \frac{1}{12} \times b \times h^3$$

$$I = \frac{1}{12} \times 125 \times 200^3 = 83333333,3333 \text{ mm}^4$$

Pada Saat Retak Pertama

Modulus retak (f_r)

$$f_r = 0,7 \times \sqrt{f'_c}$$

$$f_r = 0,7 \times \sqrt{28,2498} = 3,7205 \text{ MPa}$$

Momen dan beban teoristis :

$$M_{cr} = \frac{f_r \times I}{y} = \frac{3,7205 \times 83333333,3333}{100} = 3100448,22 \text{ Nmm}$$

$$M_{cr} = 3,1004 \text{ kNm}$$

$$P_{cr} = (6 \times M)/L$$

$$P_{cr} = (6 \times 3,1004)/1,8 = 10,3348 \text{ kN} = 1033,4827 \text{ kg}$$



Kelengkungan teoristis :

$$\phi_{retak} = \frac{f_r/E_c}{y} = \frac{3,7205/24980,75423}{100} = 1,4894 \times 10^{-6} 1/mm$$

$$\phi_{retak} = 0,001489 1/m$$

Pada Saat Luluh

Dengan menganggap beban elastis, maka :

Momen dan beban teoristis :

$$M_y = A_s \times f_y \times z$$

$$M_y = 345,4 \times 298,9851 \times 163,638$$

$$M_y = 16898806,84 \text{ Nmm}$$

$$M_y = 16,8988 \text{ kNm}$$

$$P_y = (6 \times M)/L$$

$$P_y = (6 \times 16,8988)/1,8 = 56,3293 \text{ kN} = 5632,9356 \text{ kg}$$

Kelengkungan teoristis :

$$k = \sqrt{[(\rho^2 \cdot n^2) + 2\rho n]} - (\rho \cdot n)$$

$$k = \sqrt{[(0,0157^2 \times 6,5731^2) + 2 \times 0,0157 \times 6,5731]} - (0,0157 \times 6,5731)$$

$$k = 0,3627$$

$$\text{Maka, } k \times d = 0,3627 \times 175,97 = 63,8257 \text{ mm}$$

$$\phi_y = \frac{f_y/E_s}{d - kd} = \frac{298,9851/164201,817}{175,97 - 63,8257} = 1,6237 \times 10^{-5} 1/mm$$
$$= 0,016237 1/m$$



PERHITUNGAN BALOK BERTULANG BBTS 3

1. Diketahui :

a) Dimensi balok :

- 1) Tinggi balok = 200 mm
- 2) Lebar balok = 125 mm
- 3) Panjang balok (l_u) = 1800 mm
- 4) Selimut beton = 10 mm
- 5) f'_c = 39,0508 MPa
- 6) β = 0,7853
- 7) E_c = $4700\sqrt{39,0508} = 29370,60047$ MPa

b) Dimensi profil :

- 1) Lebar siku = 29,4 mm
- 2) Tinggi siku = 29,4 mm
- 3) Tebal = 3 mm
- 4) Pusat berat ($C_x=C_z$) = 8,4 mm
- 5) Jenis baja = BJ 50
- 6) F_u = 457,4471 MPa
- 7) f_y = 298,9851 MPa
- 8) A_g = 172,7 mm²
- 9) E_s = 164201,817 MPa



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c) Dimensi sengkang :

$$1) \text{ } \emptyset \text{ sengkang} = 5,63 \text{ mm}$$

$$2) f_y = 323,0207 \text{ MPa}$$

2. Perhitungan :

$$d' = \text{Selimut beton} + \emptyset \text{ sengkang} + C_z$$

$$d' = 10 + 5,63 + 8,4$$

$$d' = 24,03 \text{ mm}$$

$$d = h - d'$$

$$d = 200 - 24,03$$

$$d = 175,97 \text{ mm}$$

$$y = (a/2) + ((h-a)/2) = 100 \text{ mm}$$

$$A_s = n \times A_{1 \text{ tul}} = 2 \times 172,7 = 345,4 \text{ mm}^2$$

$$\rho = \frac{A_s}{b \cdot d} = \frac{365,4}{125 \times 175,97} = 0,0157$$

$$n = \frac{E_s}{E_c} = \frac{164201,817}{29370,60047} = 5,5907$$

Mencari nilai a dengan rumus seperti pada subbab 3.7 keseimbangan gaya:

$$\sum F_H = 0$$

$$C_c + C_s = T$$

$$a \cdot b \cdot 0,85 \cdot f'_c + A_s \cdot f_s' = A_s \cdot f_y$$

$$\text{di mana : } f_s' = E_s \cdot \epsilon_{cu} \cdot \frac{c-d'}{c}$$

$$= E_s \cdot \epsilon_{cu} \cdot \frac{a - \beta_1 \cdot d'}{a}$$



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$$= 164201,817 \times 0,003 \cdot \frac{a - 0,85 \cdot 24,03}{a}$$

$$a \cdot 125 \cdot 0,85 \cdot 39,0508 + 2.172,7 \cdot 164201,817 \times 0,003 \cdot \frac{a - 0,85 \cdot 24,03}{a}$$

$$= 2.172,7 \cdot 298,9851$$

$$a = 20,9037 \text{ mm}$$

Mencari Momen maksimum (M_{maks}) analisis :

$$C_c = a \times 125 \times 0,85 \times 39,0508$$

$$= 20,9037 \times 125 \times 0,85 \times 39,0508$$

$$= 86732,5346 \text{ N}$$

$$C_s = 164201,817 \times 0,003 \times 2 \times 172,7 \times \frac{a - 0,85 \times 24,03}{a}$$

$$= 164201,817 \times 0,003 \times 2 \times 172,7 \times \frac{20,9037 - 0,85 \times 24,03}{20,9037}$$

$$= 20142,3949 \text{ N}$$

$$M_n = (C_c \times z_1) + (C_s \times z_2)$$

dimana :

$$z_1 = (d - a/2)$$

$$= (175,97 - 20,9037/2)$$

$$= 165,5182 \text{ mm}$$

$$z_2 = d - d'$$

$$= 175,97 - 24,03$$

$$= 151,94 \text{ mm}$$

$$M_n = 17,4162 \text{ kNm}$$

$$M_u \leq \phi M_n, \text{ dimana } \phi = 0,8$$



Maka,

$$M_u = 13,933 \text{ kNm}$$

Mencari beban maksimum (P_{maks}) analisis :

$$M_u = \frac{1}{6} \times P \times L$$

$$P = (6 \times M_u)/L$$

$$P = (6 \times 13,933)/1,8$$

$$P = 46,4433 \text{ kN}$$

Momen Inersia (I)

$$I = \frac{1}{12} \times b \times h^3$$

$$I = \frac{1}{12} \times 125 \times 200^3 = 83333333,3333 \text{ mm}^4$$

Pada Saat Retak Pertama

Modulus retak (f_r)

$$f_r = 0,7 \times \sqrt{f'_c}$$

$$f_r = 0,7 \times \sqrt{39,0508} = 4,3743 \text{ MPa}$$

Momen dan beban teoritis :

$$M_{cr} = \frac{f_r \times I}{y} = \frac{4,3743 \times 83333333,3333}{100} = 3645287,292 \text{ Nmm}$$

$$M_{cr} = 3,6453 \text{ kNm}$$

$$P_{cr} = (6 \times M)/L$$

$$P_{cr} = (6 \times 3,6453)/1,8 = 12,1509 \text{ kN} = 1215,0968 \text{ kg}$$



Kelengkungan teoritis :

$$\phi_{retak} = \frac{f_r/E_c}{y} = \frac{4,3743/29370,60047}{100} = 1,4894 \times 10^{-6} 1/mm$$

$$\phi_{retak} = 0,001489 1/m$$

Pada Saat Luluh

Dengan menganggap beban elastis, maka :

Momen dan beban teoritis :

$$M_y = A_s \times f_y \times z$$

$$M_y = 345,4 \times 298,9851 \times 165,5182$$

$$M_y = 17092974,06 \text{ Nmm}$$

$$M_y = 17,0930 \text{ kNm}$$

$$P_y = (6 \times M)/L$$

$$P_y = (6 \times 17,0930)/1,8 = 56,9766 \text{ kN} = 5697,6580 \text{ kg}$$

Kelengkungan teoritis :

$$k = \sqrt{[(\rho^2 \cdot n^2) + 2\rho n]} - (\rho \cdot n)$$

$$k = \sqrt{[(0,0157^2 \times 5,5907^2) + 2 \times 0,0157 \times 5,5907]} - (0,0157 \times 5,5907)$$

$$k = 0,3403$$

$$\text{Maka, } k \times d = 0,3403 \times 175,97 = 59,8876 \text{ mm}$$

$$\phi_y = \frac{f_y/E_s}{d - kd} = \frac{298,9851/164201,817}{175,97 - 59,8876} = 1,5686 \times 10^{-5} 1/mm$$
$$= 0,01569 1/m$$



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LAMPIRAN VIII

TABEL BEBAN, MOMEN, LENDUTAN, DAN KELENGKUNGAN BALOK

Tabel Beban, Momen, Lendutan, dan Kelengkungan BBTS 1

No.	Beban (P) (kg)	Lendutan (δ) (mm)	Kelengkungan (ϕ) (mm)	Momen (M) (kNm)	EI (kN/m)
1	0.0000	0.0000000	0.0000000	0.0000000	0.0000
2	0.8894	-0.0321078	-0.0041471	0.0026682	-0.6434
3	0.9191	-0.0327250	-0.0041332	0.0027574	-0.6671
4	8.3918	-0.0232149	-0.0041507	0.0251755	-6.0654
5	18.3565	-0.0044228	-0.0041741	0.0550696	-13.1933
6	27.7391	0.0202170	-0.0015140	0.0832174	-54.9646
7	29.3323	0.0240552	-0.0004387	0.0879968	-200.5864
8	32.4022	0.0336206	0.0008055	0.0972065	120.6845
9	39.3698	0.0527612	0.0032343	0.1181094	36.5178
10	46.1225	0.0704509	0.0056204	0.1383675	24.6188
11	48.4925	0.0775948	0.0061820	0.1454775	23.5325
12	55.3917	0.0967435	0.0081592	0.1661751	20.3665
13	80.6221	0.1677236	0.0159232	0.2418663	15.1895
14	113.6758	0.2633158	0.0266269	0.3410275	12.8076
15	134.2106	0.3258590	0.0333577	0.4026318	12.0701
16	134.3761	0.3328303	0.0342307	0.4031284	11.7768
17	133.5131	0.3314331	0.0341658	0.4005393	11.7234
18	132.9393	0.3341575	0.0344815	0.3988179	11.5662
19	139.9226	0.3564198	0.0367229	0.4197679	11.4307
20	221.2047	0.5846087	0.0631300	0.6636140	10.5119
21	289.4526	0.7912160	0.0862543	0.8683577	10.0674
22	323.5517	0.9001564	0.0987665	0.9706551	9.8278
23	323.5864	0.9229447	0.1013646	0.9707593	9.5769
24	411.6317	1.1573640	0.1276018	1.2348951	9.6777
25	499.0617	1.4204241	0.1571709	1.4971850	9.5258
26	516.2233	1.4961869	0.1656186	1.5486698	9.3508
27	533.4073	1.5695087	0.1741205	1.6002219	9.1903
28	695.5006	2.0239959	0.2259195	2.0865018	9.2356
29	792.2996	2.4096653	0.2688370	2.3768989	8.8414
30	813.7459	2.6028056	0.2910959	2.4412376	8.3864
31	918.0089	2.9140594	0.3268050	2.7540266	8.4271



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32	913.0878	2.9436040	0.3301234	2.7392635	8.2977
33	1053.8643	3.4329183	0.3852819	3.1615929	8.2059
34	1110.2373	3.7174950	0.4179235	3.3307119	7.9697
35	1163.7867	3.9736116	0.4485052	3.4913601	7.7844
36	1221.1702	4.1687350	0.4721292	3.6635106	7.7596
37	1290.3296	4.4471188	0.5029283	3.8709888	7.6969
38	1320.2570	4.6816101	0.5293615	3.9607710	7.4822
39	1452.1844	5.1333365	0.5799455	4.3565532	7.5120
40	1525.2186	5.5762196	0.6307271	4.5756558	7.2546
41	1695.0642	6.2569690	0.7067147	5.0851926	7.1955
42	1792.1544	6.8323288	0.7704913	5.3764632	6.9780
43	1892.5243	7.5586743	0.8528699	5.6775729	6.6570
44	2002.2546	8.1243458	0.9146118	6.0067638	6.5676
45	2028.0313	8.4147978	0.9480908	6.0840939	6.4172
46	2066.6006	8.6450958	0.9758359	6.1998018	6.3533
47	2111.1782	8.9193888	1.0041748	6.3335346	6.3072
48	2119.4395	9.0725965	1.0228626	6.3583185	6.2162
49	2217.7041	9.5916672	1.0797986	6.6531123	6.1614
50	2350.7695	10.2441260	1.1514294	7.0523085	6.1248
51	2423.9124	10.7680310	1.2109283	7.2717372	6.0051
52	2454.0293	11.0558310	1.2432865	7.3620879	5.9215
53	2585.0051	12.1564410	1.3672692	7.7550153	5.6719
54	2637.8499	12.3931170	1.3942179	7.9135497	5.6760
55	2664.4250	12.5334830	1.4103328	7.9932750	5.6677
56	2716.0752	12.7576410	1.4353659	8.1482256	5.6768
57	2753.1082	12.9671760	1.4573773	8.2593246	5.6673
58	2818.0381	13.3967770	1.5053452	8.4541143	5.6161
59	2900.4275	13.7661090	1.5453383	8.7012825	5.6307
60	2960.4937	14.1121830	1.5859109	8.8814811	5.6002
61	2990.5603	14.3416270	1.6116748	8.9716809	5.5667
62	3013.5886	14.5358970	1.6330020	9.0407658	5.5363
63	3053.9199	14.8259050	1.6652173	9.1617597	5.5018
64	3061.5042	14.9132630	1.6750619	9.1845126	5.4831
65	3092.3569	15.0627580	1.6917250	9.2770707	5.4838
66	3109.2195	15.1847250	1.7052955	9.3276585	5.4698
67	3181.4329	15.6299920	1.7552789	9.5442987	5.4375
68	3192.8921	15.7330880	1.7662876	9.5786763	5.4231
69	3205.8013	15.8185920	1.7756488	9.6174039	5.4163
70	3259.2700	16.0340040	1.8004631	9.7778100	5.4307
71	3293.3672	16.2513960	1.8248000	9.8801016	5.4143



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72	3316.4443	16.3935240	1.8408940	9.9493329	5.4046
73	3341.1890	16.5549790	1.8586224	10.0235670	5.3930
74	3370.9482	16.7244590	1.8790359	10.1128446	5.3819
75	3396.0627	16.8848270	1.8963969	10.1881881	5.3724
76	3396.1858	16.9635070	1.9053307	10.1885574	5.3474
77	3500.7974	17.8456550	2.0025854	10.5023922	5.2444
78	3540.1477	18.0237580	2.0227905	10.6204431	5.2504
79	3591.9280	18.2434560	2.0474638	10.7757840	5.2630
80	3630.3430	18.4363990	2.0684862	10.8910290	5.2652
81	3666.2515	18.6328470	2.0899126	10.9987545	5.2628
82	3691.0215	18.7724740	2.1062061	11.0730645	5.2574
83	3727.4155	18.9598900	2.1270139	11.1822465	5.2573
84	3753.8296	19.1318990	2.1468427	11.2614888	5.2456
85	3790.6475	19.3222270	2.1686379	11.3719425	5.2438
86	3820.0073	19.5094410	2.1893619	11.4600219	5.2344
87	3820.4041	19.5936320	2.1991853	11.4612123	5.2116
88	3849.4016	19.8738610	2.2294572	11.5482048	5.1798
89	3902.8389	20.1197850	2.2565669	11.7085167	5.1886
90	3962.8904	20.3870330	2.2871017	11.8886712	5.1981
91	3990.3604	20.5543480	2.3070790	11.9710812	5.1888
92	4019.7898	20.7400300	2.3297976	12.0593694	5.1761
93	4038.5281	20.8801060	2.3455706	12.1155843	5.1653
94	4066.7813	21.0366880	2.3602706	12.2003439	5.1690
95	4107.1929	21.2553520	2.3830827	12.3215787	5.1704
96	4127.5283	21.4205910	2.4017173	12.3825849	5.1557
97	4153.3286	21.5821460	2.4208749	12.4599858	5.1469
98	4165.6372	21.7051390	2.4350657	12.4969116	5.1321
99	4194.0410	22.3537160	2.5068540	12.5821230	5.0191
100	4253.4819	22.5853630	2.5325432	12.7604457	5.0386
101	4308.4287	22.8326530	2.5615752	12.9252861	5.0458
102	4324.7759	22.9545310	2.5755235	12.9743277	5.0375
103	4354.0454	23.0852970	2.5899134	13.0621362	5.0435
104	4404.1641	23.3172820	2.6144780	13.2124923	5.0536
105	4442.8496	23.5257090	2.6377055	13.3285488	5.0531
106	4474.0889	23.7219720	2.6599955	13.4222667	5.0460
107	4493.6450	23.8681070	2.6766736	13.4809350	5.0365
108	4574.4023	24.3599340	2.7304009	13.7232069	5.0261
109	4618.0630	24.6151750	2.7594985	13.8541890	5.0205
110	4651.2129	24.8181820	2.7834692	13.9536387	5.0130
111	4685.7529	25.0350910	2.8069273	14.0572587	5.0081



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112	4698.5830	25.1720140	2.8209584	14.0957490	4.9968
113	4728.3682	25.3438400	2.8391417	14.1851046	4.9963
114	4760.8501	25.5607130	2.8638136	14.2825503	4.9872
115	4768.9390	25.6657370	2.8746873	14.3068170	4.9768
116	4798.7759	25.8440320	2.8954461	14.3963277	4.9721
117	4818.8970	25.9938280	2.9125695	14.4566910	4.9636
118	4829.1807	26.1163080	2.9262432	14.4875421	4.9509
119	4895.1978	26.6379170	2.9835003	14.6855934	4.9223
120	4930.2876	26.8151660	3.0034862	14.7908628	4.9246
121	4993.6509	27.1467110	3.0410505	14.9809527	4.9262
122	5019.6104	27.3554610	3.0645634	15.0588312	4.9139
123	5043.1245	27.5354310	3.0845733	15.1293735	4.9049
124	5069.4985	27.7174190	3.1045792	15.2084955	4.8987
125	5103.8364	27.9353050	3.1272045	15.3115092	4.8962
126	5169.5801	28.9730030	3.2421281	15.5087403	4.7835
127	5207.8716	29.1826130	3.2660894	15.6236148	4.7836
128	5248.4575	29.3709510	3.2864559	15.7453725	4.7910
129	5292.3232	29.6022090	3.3122384	15.8769696	4.7934
130	5340.2798	29.8500790	3.3401375	16.0208394	4.7965
131	5367.8804	30.0532000	3.3628368	16.1036412	4.7887
132	5392.7744	30.2312550	3.3826517	16.1783232	4.7827
133	5411.8237	30.3851640	3.4000463	16.2354711	4.7751
134	5428.4160	30.5105550	3.4135978	16.2852480	4.7707
135	5457.1396	30.6982960	3.4344476	16.3714188	4.7668
136	5460.1025	31.0043830	3.4676829	16.3803075	4.7237
137	5564.5381	31.4424990	3.5180527	16.6936143	4.7451
138	5609.7988	31.7479690	3.5515285	16.8293964	4.7386
139	5622.6431	31.9054600	3.5693053	16.8679293	4.7258
140	5653.5229	32.1072430	3.5913115	16.9605687	4.7227
141	5668.4199	32.2704730	3.6091076	17.0052597	4.7118
142	5966.1929	34.8614200	3.8953945	17.8985787	4.5948
143	5998.1641	35.0637930	3.9180865	17.9944923	4.5927
144	6004.1587	35.1831360	3.9311199	18.0124761	4.5820
145	6051.0464	35.6353840	3.9899732	18.1531392	4.5497
146	6104.4956	35.9188500	4.0211348	18.3134868	4.5543
147	6137.9951	36.1567420	4.0465310	18.4139853	4.5506
148	6155.9277	36.3573530	4.0686131	18.4677831	4.5391
149	6197.5757	36.6767770	4.1036055	18.5927271	4.5308
150	6231.7905	36.9221230	4.1310146	18.6953715	4.5256
151	6264.1597	37.1820560	4.1597342	18.7924791	4.5177



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152	6276.3965	37.3684040	4.1801247	18.8291895	4.5045
153	6276.6157	37.4765700	4.1923002	18.8298471	4.4915
154	6286.9624	37.6039050	4.2064434	18.8608872	4.4838
155	6279.3584	37.7094840	4.2178489	18.8380752	4.4663
156	6375.7217	38.3778310	4.2909987	19.1271651	4.4575
157	6430.4814	38.7320020	4.3300480	19.2914442	4.4552
158	6448.1724	38.9555280	4.3552435	19.3445172	4.4417
159	6488.6675	39.2348860	4.3856478	19.4660025	4.4386
160	6523.5903	39.5437550	4.4193921	19.5707709	4.4284
161	6533.6270	39.8474080	4.4541358	19.6008810	4.4006
162	6546.9326	40.0166280	4.4721453	19.6407978	4.3918
163	6556.1001	40.1483380	4.4864272	19.6683003	4.3840
164	6655.8613	41.6116790	4.6483338	19.9675839	4.2956
165	6667.2705	41.8146440	4.6721147	20.0018115	4.2811
166	6692.3486	41.9714470	4.6888095	20.0770458	4.2819
167	6727.1973	42.2196430	4.7164646	20.1815919	4.2790
168	6740.0010	42.3686710	4.7326848	20.2200030	4.2724
169	6767.5977	42.5713080	4.7548566	20.3027931	4.2699
170	6783.2207	42.7518730	4.7756920	20.3496621	4.2611
171	6830.3677	43.2609210	4.8320589	20.4911031	4.2407
172	6928.6338	43.8888090	4.9020518	20.7859014	4.2402
173	6982.0308	44.4288670	4.9615328	20.9460924	4.2217
174	7005.1997	44.8402630	5.0067989	21.0155991	4.1974
175	7008.8838	45.0983920	5.0355242	21.0266514	4.1757
176	7067.8057	46.0530850	5.1417553	21.2034171	4.1238
177	7133.3774	46.6759640	5.2104498	21.4001322	4.1072
178	7165.9443	48.2277600	5.3829204	21.4978329	3.9937
179	7206.9429	48.5069010	5.4135298	21.6208287	3.9939
180	7226.3506	48.8735890	5.4547138	21.6790518	3.9744
181	7248.9473	49.5059660	5.5249040	21.7468419	3.9361
182	7252.9634	49.6628880	5.5430466	21.7588902	3.9254
183	7277.9277	50.8043940	5.6681926	21.8337831	3.8520
184	7325.1812	51.1715620	5.7100320	21.9755436	3.8486
185	7352.2339	51.4699440	5.7425758	22.0567017	3.8409
186	7352.9224	51.6240580	5.7592899	22.0587672	3.8301
187	7353.3042	51.7446630	5.7725590	22.0599126	3.8215
188	7358.8579	52.0715560	5.8085904	22.0765737	3.8007
189	7467.0078	52.7341690	5.8826615	22.4010234	3.8080
190	7468.0820	53.1562310	5.9293833	22.4042460	3.7785
191	7469.2021	54.2115550	6.0504733	22.4076063	3.7034



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192	7503.0771	54.4103660	6.0717971	22.5092313	3.7072
193	7521.6787	54.7095830	6.1060492	22.5650361	3.6955
194	7540.4561	55.6827770	6.2163642	22.6213683	3.6390
195	7553.1099	56.0229530	6.2521628	22.6593297	3.6242
196	7572.9966	56.6885570	6.3273094	22.7189898	3.5906
197	7617.8008	56.9764400	6.3590581	22.8534024	3.5938
198	7636.0771	57.1798400	6.3813473	22.9082313	3.5899
199	7642.0088	57.3617630	6.4020850	22.9260264	3.5810
200	7644.6875	57.5065160	6.4188969	22.9340625	3.5729



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Tabel Beban, Momen, Lendutan, dan Kelengkungan BBTS 2

No.	Beban (P) (kg)	Lendutan (δ) (mm)	Kelengkungan (ϕ) (mm)	Momen (M) (kNm)	EI (kN/m)
1	0,0000	0,0000000	0,0000000	0,0000000	0,0000
2	2,2287	0,0019004	-0,0062043	0,0066861	-1,0777
3	2,3212	0,0015352	-0,0062247	0,0069637	-1,1187
4	2,3616	0,0016722	-0,0062368	0,0070849	-1,1360
5	2,4276	0,0020518	-0,0063739	0,0072829	-1,1426
6	2,8519	0,0021806	-0,0064846	0,0085557	-1,3194
7	3,1522	0,0021990	-0,0066287	0,0094567	-1,4266
8	4,6083	0,0029521	-0,0076241	0,0138249	-1,8133
9	40,5013	0,0360666	-0,0081751	0,1215039	-14,8626
10	53,0936	0,0507318	-0,0068213	0,1592809	-23,3507
11	84,8107	0,0902769	-0,0046633	0,2544321	-54,5603
12	155,1298	0,1840246	-0,0010263	0,4653894	-453,4717
13	212,7939	0,2612374	0,0005801	0,6383818	1100,4856
14	330,8279	0,4337182	0,0038547	0,9924836	257,4750
15	371,5897	0,5033308	0,0048170	1,1147692	231,4259
16	458,8206	0,6317126	0,0082733	1,3764619	166,3739
17	577,2235	0,8117625	0,0121350	1,7316704	142,7004
18	635,2391	0,9041571	0,0122054	1,9057174	156,1371
19	651,9276	0,9353184	0,0143734	1,9557827	136,0694
20	740,9941	1,0624214	0,0167761	2,2229822	132,5091
21	821,3535	1,1830406	0,0193059	2,4640606	127,6326
22	891,4139	1,2882237	0,0200554	2,6742416	133,3429
23	928,9873	1,3482770	0,0205146	2,7869619	135,8523
24	966,2349	1,4059936	0,0217585	2,8987048	133,2220
25	1012,7268	1,4735394	0,0223629	3,0381804	135,8581
26	1050,0311	1,5292287	0,0239675	3,1500933	131,4318
27	1082,3074	1,5792557	0,0250718	3,2469222	129,5050
28	1103,2097	1,6106305	0,0251307	3,3096291	131,6969
29	1150,1316	1,6780442	0,0245671	3,4503948	140,4480
30	1194,9097	1,7441487	0,0250978	3,5847291	142,8302
31	1218,0725	1,7830349	0,0260692	3,6542175	140,1736
32	1246,0908	1,8274633	0,0267520	3,7382724	139,7379
33	1307,3635	1,9126291	0,0272820	3,9220905	143,7609
34	1353,6053	1,9799225	0,0281045	4,0608159	144,4899
35	1393,8417	2,0399356	0,0292764	4,1815251	142,8292
36	1422,2928	2,0806992	0,0302167	4,2668784	141,2095



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37	1459,0731	2,1345520	0,0310635	4,3772193	140,9120
38	1477,7021	2,1651702	0,0315404	4,4331063	140,5533
39	1498,6057	2,1953702	0,0319731	4,4958171	140,6125
40	1506,5770	2,2114842	0,0323747	4,5197310	139,6068
41	1528,6549	2,2463326	0,0323977	4,5859647	141,5522
42	1599,3445	2,3428659	0,0331205	4,7980335	144,8659
43	1653,7900	2,4204314	0,0338552	4,9613700	146,5468
44	1696,8014	2,4836838	0,0341630	5,0904042	149,0036
45	1716,9941	2,5162256	0,0342612	5,1509823	150,3444
46	1751,3718	2,5649791	0,0359052	5,2541154	146,3332
47	1775,2610	2,6013353	0,0364430	5,3257830	146,1403
48	1783,3578	2,6160893	0,0363418	5,3500734	147,2156
49	1788,6697	2,6258211	0,0365963	5,3660091	146,6273
50	1800,1985	2,6418550	0,0362847	5,4005955	148,8394
51	1800,9188	2,6471474	0,0362787	5,4027564	148,9237
52	1798,2854	2,6471813	0,0362761	5,3948562	148,7167
53	1815,4680	2,6706889	0,0365533	5,4464040	148,9991
54	1866,9403	2,7379978	0,0342060	5,6008209	163,7381
55	1893,0731	2,7757239	0,0351574	5,6792193	161,5370
56	1934,4828	2,8351462	0,0369014	5,8034484	157,2692
57	1963,8506	2,8766384	0,0370930	5,8915518	158,8320
58	1981,3628	2,9037399	0,0361355	5,9440884	164,4942
59	1986,0159	2,9141140	0,0361053	5,9580477	165,0189
60	1991,5575	2,9230716	0,0366315	5,9746725	163,1021
61	2003,2253	2,9394944	0,0373495	6,0096759	160,9038
62	2042,1860	2,9903772	0,0377018	6,1265580	162,5002
63	2068,4026	3,0305376	0,0373708	6,2052078	166,0444
64	2078,0974	3,0463986	0,0371628	6,2342922	167,7563
65	2089,8357	3,0632341	0,0375491	6,2695071	166,9683
66	2090,6133	3,0694201	0,0380422	6,2718399	164,8654
67	2112,1106	3,1012170	0,0391065	6,3363318	162,0277
68	2132,7622	3,1301553	0,0398808	6,3982866	160,4355
69	2135,5037	3,1367557	0,0400844	6,4065111	159,8255
70	2163,2705	3,1761880	0,0400368	6,4898115	162,0960
71	2222,0801	3,2526822	0,0394521	6,6662403	168,9706
72	2312,9539	3,3785577	0,0416347	6,9388617	166,6604
73	2375,9316	3,4689713	0,0424089	7,1277948	168,0730
74	2398,0344	3,5079756	0,0430927	7,1941032	166,9449
75	2405,2151	3,5303764	0,0435161	7,2156453	165,8154
76	2468,0664	3,6096272	0,0423055	7,4041992	175,0174



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77	2529,3057	3,6960433	0,0427249	7,5879171	177,5993
78	2575,7520	3,7617545	0,0425791	7,7272560	181,4801
79	2609,3479	3,8127127	0,0425184	7,8280437	184,1096
80	2642,6868	3,8596547	0,0422456	7,9280604	187,6658
81	2667,7925	3,8983917	0,0418570	8,0033775	191,2078
82	2681,7705	3,9212270	0,0420250	8,0453115	191,4410
83	2681,9731	3,9269099	0,0418690	8,0459193	192,1690
84	2686,4036	3,9343560	0,0413948	8,0592108	194,6913
85	2692,9900	3,9444642	0,0415189	8,0789700	194,5851
86	2694,4983	3,9500871	0,0416040	8,0834949	194,2959
87	2721,5581	3,9930725	0,0430613	8,1646743	189,6058
88	2756,1201	4,0392513	0,0431867	8,2683603	191,4561
89	2787,7510	4,0839081	0,0444759	8,3632530	188,0401
90	2813,1138	4,1172690	0,0441660	8,4393414	191,0823
91	2824,4734	4,1385312	0,0442772	8,4734202	191,3720
92	2839,7305	4,1575212	0,0445449	8,5191915	191,2494
93	2849,1438	4,1709285	0,0447796	8,5474314	190,8778
94	2890,7178	4,2223454	0,0441672	8,6721534	196,3481
95	2919,8115	4,2643151	0,0437859	8,7594345	200,0516
96	2960,8992	4,3201842	0,0432905	8,8826976	205,1883
97	2983,5898	4,3556514	0,0431445	8,9507694	207,4604
98	2994,0342	4,3734813	0,0438967	8,9821026	204,6189
99	3004,4309	4,3908482	0,0444785	9,0132927	202,6437
100	3010,4868	4,4099803	0,0456271	9,0314604	197,9408
101	3028,0166	4,4323835	0,0461831	9,0840498	196,6964
102	3063,0967	4,4784961	0,0457328	9,1892901	200,9344
103	3102,8574	4,5330744	0,0441865	9,3085722	210,6657
104	3130,6875	4,5736699	0,0435978	9,3920625	215,4252
105	3152,8479	4,6054511	0,0441146	9,4585437	214,4083
106	3173,4973	4,6361666	0,0448878	9,5204919	212,0954
107	3193,9678	4,6646156	0,0455729	9,5819034	210,2544
108	3212,9543	4,6922879	0,0454100	9,6388629	212,2632
109	3214,0757	4,6996088	0,0453024	9,6422271	212,8415
110	3220,0962	4,7088776	0,0450299	9,6602886	214,5303
111	3232,1819	4,7273293	0,0453859	9,6965457	213,6465
112	3251,1895	4,7508006	0,0441070	9,7535685	221,1340
113	3288,1716	4,7999454	0,0447855	9,8645148	220,2613
114	3306,7744	4,8285837	0,0449367	9,9203232	220,7624
115	3320,1499	4,8499417	0,0457745	9,9604497	217,5980
116	3368,3567	4,9219942	0,0462333	10,1050701	218,5668



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117	3389,3062	4,9528542	0,0456090	10,1679186	222,9367
118	3406,8687	4,9772830	0,0453592	10,2206061	225,3258
119	3434,5957	5,0144086	0,0457984	10,3037871	224,9816
120	3448,8003	5,0391798	0,0457504	10,3464009	226,1487
121	3451,2864	5,0455384	0,0458383	10,3538592	225,8781
122	3467,6453	5,0669384	0,0469705	10,4029359	221,4780
123	3491,6177	5,1005340	0,0473670	10,4748531	221,1426
124	3517,8704	5,1356263	0,0467314	10,5536112	225,8357
125	3524,9409	5,1498637	0,0468506	10,5748227	225,7138
126	3553,2476	5,1886587	0,0463780	10,6597428	229,8446
127	3578,4050	5,2225537	0,0462239	10,7352150	232,2437
128	3586,2434	5,2399044	0,0465304	10,7587302	231,2194
129	3599,2539	5,2568941	0,0460959	10,7977617	234,2454
130	3619,3652	5,2846379	0,0463628	10,8580956	234,1983
131	3626,3259	5,2988172	0,0455428	10,8789777	238,8739
132	3653,8911	5,3424749	0,0458802	10,9616733	238,9197
133	3690,1670	5,3893185	0,0452755	11,0705010	244,5139
134	3734,3621	5,4489903	0,0451490	11,2030863	248,1357
135	3754,0972	5,4793520	0,0453920	11,2622916	248,1121
136	3768,5669	5,5005784	0,0459988	11,3057007	245,7824
137	3778,5046	5,5172205	0,0462802	11,3355138	244,9323
138	3788,9414	5,5331478	0,0459569	11,3668242	247,3367
139	3808,6636	5,5600700	0,0461997	11,4259908	247,3175
140	3835,1018	5,5965939	0,0456005	11,5053054	252,3067
141	3850,2271	5,6186342	0,0453929	11,5506813	254,4601
142	3862,1995	5,6360211	0,0466175	11,5865985	248,5458
143	3875,7097	5,6578927	0,0481330	11,6271291	241,5626
144	3886,1221	5,6719508	0,0480737	11,6583663	242,5104
145	3909,8044	5,7028723	0,0469919	11,7294132	249,6048
146	3927,8381	5,7286210	0,0468962	11,7835143	251,2679
147	3940,0823	5,7487507	0,0464197	11,8202469	254,6388
148	3976,2004	5,8106451	0,0473015	11,9286012	252,1821
149	4011,2690	5,8558526	0,0479658	12,0338070	250,8833
150	4059,1912	5,9203410	0,0493463	12,1775736	246,7776
151	4105,4087	5,9848499	0,0486890	12,3162261	252,9572
152	4137,3711	6,0290589	0,0494247	12,4121133	251,1319
153	4172,0200	6,0770645	0,0501754	12,5160600	249,4460
154	4179,0537	6,0944638	0,0503942	12,5371611	248,7819
155	4205,4033	6,1290960	0,0501387	12,6162099	251,6264
156	4210,5439	6,1404080	0,0496555	12,6316317	254,3855



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157	4219,0962	6,1549072	0,0490360	12,6572886	258,1225
158	4227,8374	6,1678071	0,0493759	12,6835122	256,8765
159	4238,9604	6,1842947	0,0494881	12,7168812	256,9686
160	4240,1899	6,1915822	0,0494668	12,7205697	257,1537
161	4240,7793	6,1945844	0,0494256	12,7223379	257,4040
162	4245,0542	6,2013884	0,0498189	12,7351626	255,6293
163	4257,9097	6,2177243	0,0500570	12,7737291	255,1835
164	4258,5840	6,2231226	0,0503359	12,7757520	253,8097
165	4305,2930	6,2867651	0,0511531	12,9158790	252,4944
166	4338,4731	6,3356700	0,0511278	13,0154193	254,5665
167	4365,7363	6,3695951	0,0507419	13,0972089	258,1142
168	4399,3408	6,4144082	0,0513446	13,1980224	257,0478
169	4411,8560	6,4383593	0,0513829	13,2355680	257,5869
170	4426,0674	6,4576931	0,0522579	13,2782022	254,0898
171	4440,4336	6,4781318	0,0524130	13,3213008	254,1603
172	4455,8262	6,5032029	0,0516644	13,3674786	258,7370
173	4476,6367	6,5290942	0,0516776	13,4299101	259,8787
174	4487,4263	6,5482931	0,0511671	13,4622789	263,1044
175	4524,4443	6,5944486	0,0509320	13,5733329	266,4992
176	4527,1338	6,6062322	0,0509205	13,5814014	266,7175
177	4547,9790	6,6331797	0,0503540	13,6439370	270,9606
178	4573,6543	6,6732283	0,0510925	13,7209629	268,5515
179	4591,3428	6,6975613	0,0508620	13,7740284	270,8119
180	4592,9360	6,7059560	0,0508273	13,7788080	271,0909
181	4637,9448	6,7726388	0,0526978	13,9138344	264,0309
182	4674,9370	6,8205113	0,0537711	14,0248110	260,8245
183	4681,0698	6,8364825	0,0538084	14,0432094	260,9853
184	4682,1953	6,8481512	0,0537601	14,0465859	261,2827
185	4693,1323	6,8614120	0,0540864	14,0793969	260,3129
186	4712,0308	6,8868818	0,0544460	14,1360924	259,6352
187	4728,3032	6,9071364	0,0534162	14,1849096	265,5542
188	4732,3379	6,9171376	0,0528761	14,1970137	268,4959
189	4732,7339	6,9225292	0,0533518	14,1982017	266,1240
190	4747,5068	6,9401178	0,0537124	14,2425204	265,1626
191	4764,6084	6,9615364	0,0539281	14,2938252	265,0534
192	4772,6255	6,9757471	0,0538014	14,3178765	266,1244
193	4798,7485	7,0398474	0,0535041	14,3962455	269,0683
194	4804,3950	7,0507898	0,0532607	14,4131850	270,6158
195	4805,3120	7,0536876	0,0529654	14,4159360	272,1764
196	4809,9585	7,0600386	0,0527161	14,4298755	273,7282



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197	4811,2266	7,0627050	0,0528810	14,4336798	272,9462
198	4813,3428	7,0666380	0,0529415	14,4400284	272,7546
199	4818,4819	7,0729823	0,0529020	14,4554457	273,2494
200	4825,4014	7,0818982	0,0530016	14,4762042	273,1277
201	4840,3320	7,0999360	0,0537088	14,5209960	270,3651
202	4854,1123	7,1169801	0,0544286	14,5623369	267,5494
203	4862,5815	7,1306057	0,0547391	14,5877445	266,4959
204	4880,8999	7,1656547	0,0545659	14,6426997	268,3489
205	4907,9990	7,1977940	0,0536303	14,7239970	274,5464
206	4930,7358	7,2278967	0,0532352	14,7922074	277,8652
207	4933,6177	7,2355680	0,0530025	14,8008531	279,2485
208	4952,8447	7,2579384	0,0523952	14,8585341	283,5861
209	4971,0522	7,2821393	0,0540253	14,9131566	276,0402
210	4977,2847	7,2930889	0,0544022	14,9318541	274,4715
211	4999,3389	7,3204966	0,0546546	14,9980167	274,4145
212	5012,8081	7,3403068	0,0538327	15,0384243	279,3547
213	5025,1309	7,3590889	0,0534269	15,0753927	282,1684
214	5028,8652	7,3663044	0,0536758	15,0865956	281,0691
215	5030,0703	7,3718653	0,0530610	15,0902109	284,3935
216	5036,2432	7,3843455	0,0525811	15,1087296	287,3413
217	5042,1538	7,3932595	0,0520151	15,1264614	290,8090
218	5046,1436	7,4036427	0,0529202	15,1384308	286,0614
219	5051,2964	7,4101238	0,0525020	15,1538892	288,6347
220	5054,2168	7,4158592	0,0519589	15,1626504	291,8201
221	5056,7798	7,4198384	0,0521141	15,1703394	291,0986
222	5058,3682	7,4236403	0,0519251	15,1751046	292,2499
223	5060,3472	7,4285765	0,0521903	15,1810416	290,8788
224	5074,6143	7,4449058	0,0520694	15,2238429	292,3761
225	5086,4058	7,4600215	0,0523671	15,2592174	291,3896
226	5087,2563	7,4633002	0,0525371	15,2617689	290,4950
227	5093,8730	7,4726090	0,0526690	15,2816190	290,1442
228	5095,7666	7,4794383	0,0527668	15,2872998	289,7144
229	5097,9863	7,4831376	0,0527527	15,2939589	289,9179
230	5115,9707	7,5045843	0,0521963	15,3479121	294,0424
231	5119,2627	7,5106163	0,0526028	15,3577881	291,9576
232	5122,7007	7,5174885	0,0528787	15,3681021	290,6295
233	5127,9648	7,5244975	0,0525151	15,3838944	292,9425
234	5142,6172	7,5411539	0,0523847	15,4278516	294,5106
235	5147,7427	7,5515122	0,0526701	15,4432281	293,2065
236	5156,9897	7,5789056	0,0535526	15,4709691	288,8928



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237	5181,0581	7,6073017	0,0539527	15,5431743	288,0890
238	5197,0039	7,6293592	0,0541907	15,5910117	287,7063
239	5217,7188	7,6550994	0,0543569	15,6531564	287,9702
240	5243,2944	7,7003613	0,0538689	15,7298832	292,0032
241	5255,3823	7,7222095	0,0548603	15,7661469	287,3871
242	5263,1592	7,7340317	0,0547038	15,7894776	288,6360
243	5284,4155	7,7616930	0,0543567	15,8532465	291,6520
244	5285,4727	7,7677646	0,0542526	15,8564181	292,2700
245	5302,2280	7,7864733	0,0545037	15,9066840	291,8461
246	5318,6172	7,8095345	0,0543461	15,9558516	293,5969
247	5340,8345	7,8405232	0,0546608	16,0225035	293,1259
248	5351,9351	7,8559151	0,0543566	16,0558053	295,3790
249	5358,8120	7,8686676	0,0538746	16,0764360	298,4046
250	5362,2744	7,8745670	0,0536547	16,0868232	299,8215
251	5364,3511	7,8797946	0,0535571	16,0930533	300,4843
252	5370,1084	7,8901095	0,0543909	16,1103252	296,1950
253	5379,1958	7,9054732	0,0547900	16,1375874	294,5355
254	5384,8350	7,9137301	0,0550341	16,1545050	293,5363
255	5408,3545	7,9400029	0,0557229	16,2250635	291,1738
256	5414,7964	7,9532175	0,0557087	16,2443892	291,5950
257	5426,5386	7,9680576	0,0557458	16,2796158	292,0331
258	5427,5850	7,9738588	0,0558372	16,2827550	291,6113
259	5438,9434	7,9880347	0,0553804	16,3168302	294,6320
260	5446,8413	7,9996829	0,0556423	16,3405239	293,6711
261	5451,2256	8,0075684	0,0559130	16,3536768	292,4844
262	5451,5884	8,0113277	0,0557931	16,3547652	293,1325
263	5457,8115	8,0204344	0,0561764	16,3734345	291,4647
264	5482,9912	8,0589905	0,0562911	16,4489736	292,2126
265	5511,5908	8,0959044	0,0560945	16,5347724	294,7663
266	5519,0542	8,1072683	0,0552629	16,5571626	299,6075
267	5539,9302	8,1334000	0,0550598	16,6197906	301,8497
268	5555,5605	8,1550856	0,0560633	16,6666815	297,2834
269	5564,8394	8,1703424	0,0559399	16,6945182	298,4366
270	5578,7031	8,1899014	0,0562296	16,7361093	297,6388
271	5595,8066	8,2132654	0,0560726	16,7874198	299,3872
272	5604,8936	8,2289267	0,0553956	16,8146808	303,5381
273	5622,3179	8,2518902	0,0556568	16,8669537	303,0528
274	5629,4058	8,2667742	0,0564210	16,8882174	299,3252
275	5635,6572	8,2766705	0,0568246	16,9069716	297,5288
276	5655,6250	8,3025465	0,0573270	16,9668750	295,9667



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277	5665,6440	8,3199444	0,0572077	16,9969320	297,1092
278	5674,5396	8,3338079	0,0576608	17,0236188	295,2375
279	5681,6260	8,3462944	0,0576363	17,0448780	295,7319
280	5700,6045	8,3746290	0,0574601	17,1018135	297,6293
281	5709,5425	8,3923864	0,0582478	17,1286275	294,0650
282	5725,6025	8,4144516	0,0575923	17,1768075	298,2483
283	5728,1196	8,4215240	0,0570878	17,1843588	301,0164
284	5733,4053	8,4311762	0,0572753	17,2002159	300,3078
285	5734,5757	8,4364872	0,0572996	17,2037271	300,2416
286	5735,6377	8,4476128	0,0573310	17,2069131	300,1328
287	5752,7349	8,4682426	0,0572276	17,2582047	301,5714
288	5755,1758	8,4743624	0,0571083	17,2655274	302,3295
289	5769,1372	8,4917259	0,0561648	17,3074116	308,1538
290	5786,0059	8,5134516	0,0572521	17,3580177	303,1856
291	5791,1206	8,5245037	0,0579285	17,3733618	299,9106
292	5809,9453	8,5589724	0,0585094	17,4298359	297,8982
293	5844,1968	8,6008263	0,0587441	17,5325904	298,4572
294	5847,0195	8,6086349	0,0588266	17,5410585	298,1823
295	5873,3657	8,6412745	0,0588584	17,6200971	299,3642
296	5877,5107	8,6534195	0,0586253	17,6325321	300,7665
297	5880,8643	8,6605606	0,0588008	17,6425929	300,0401
298	5887,4019	8,6720104	0,0585807	17,6622057	301,5022
299	5897,7329	8,6858320	0,0586871	17,6931987	301,4836
300	5934,6240	8,7300348	0,0580807	17,8038720	306,5370
301	5948,7432	8,7535629	0,0577591	17,8462296	308,9770
302	5960,4785	8,7712336	0,0576533	17,8814355	310,1544
303	5971,5825	8,7898350	0,0580508	17,9147475	308,6045
304	6006,2407	8,8463020	0,0587193	18,0187221	306,8618
305	6027,1494	8,8753262	0,0578757	18,0814482	312,4185
306	6040,5269	8,8952675	0,0578384	18,1215807	313,3137
307	6065,4712	8,9281931	0,0568167	18,1964136	320,2654
308	6072,3735	8,9428349	0,0565804	18,2171205	321,9685
309	6077,4336	8,9541540	0,0571684	18,2323008	318,9228
310	6111,0161	8,9949474	0,0576224	18,3330483	318,1582
311	6119,9834	9,0136576	0,0576609	18,3599502	318,4126
312	6120,4766	9,0202971	0,0577847	18,3614298	317,7561
313	6120,9482	9,0303860	0,0579910	18,3628446	316,6497
314	6121,2793	9,0443277	0,0584082	18,3638379	314,4053
315	6169,4688	9,0987101	0,0588221	18,5084064	314,6508
316	6203,4331	9,1423740	0,0585504	18,6102993	317,8512



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317	6231,3164	9,1809454	0,0600688	18,6939492	311,2090
318	6242,7075	9,2078304	0,0606628	18,7281225	308,7248
319	6255,9170	9,2295208	0,0607647	18,7677510	308,8594
320	6266,8296	9,2459936	0,0605457	18,8004888	310,5172
321	6273,4556	9,2595577	0,0602898	18,8203668	312,1652
322	6292,6904	9,2853975	0,0602507	18,8780712	313,3256
323	6320,2412	9,3218298	0,0590521	18,9607236	321,0848
324	6337,3506	9,3499699	0,0585506	19,0120518	324,7117
325	6349,1504	9,3701878	0,0589303	19,0474512	323,2199
326	6356,9824	9,3860741	0,0587626	19,0709472	324,5425
327	6364,4946	9,4002562	0,0584073	19,0934838	326,9023
328	6378,8115	9,4222784	0,0581818	19,1364345	328,9077
329	6388,0361	9,4379025	0,0590035	19,1641083	324,7963
330	6399,4355	9,4573202	0,0591594	19,1983065	324,5184
331	6403,7397	9,4688473	0,0594781	19,2112191	322,9965
332	6412,2563	9,4824686	0,0596821	19,2367689	322,3206
333	6431,0703	9,5077744	0,0596103	19,2932109	323,6557
334	6443,9399	9,5282192	0,0584182	19,3318197	330,9213
335	6456,3818	9,5489178	0,0589634	19,3691454	328,4944
336	6462,5742	9,5628529	0,0591462	19,3877226	327,7931
337	6494,2808	9,6287241	0,0598346	19,4828424	325,6118
338	6510,8667	9,6531515	0,0601664	19,5326001	324,6432
339	6529,6284	9,6802540	0,0605838	19,5888852	323,3355
340	6548,6943	9,7085752	0,0596358	19,6460829	329,4343
341	6556,2305	9,7239618	0,0590430	19,6686915	333,1248
342	6572,0981	9,7477446	0,0596027	19,7162943	330,7956
343	6588,1343	9,7719374	0,0599532	19,7644029	329,6638
344	6603,5376	9,7966919	0,0596159	19,8106128	332,3042
345	6617,8354	9,8199978	0,0589750	19,8535062	336,6426
346	6619,3638	9,8313246	0,0593869	19,8580914	334,3849
347	6627,4497	9,8456726	0,0591737	19,8823491	335,9999
348	6634,8657	9,8599081	0,0589678	19,9045971	337,5504
349	6642,5532	9,8750095	0,0585213	19,9276596	340,5200
350	6642,7505	9,8820696	0,0589352	19,9282515	338,1385
351	6644,1211	9,8890743	0,0588045	19,9323633	338,9598
352	6653,2642	9,9025145	0,0588708	19,9597926	339,0440
353	6670,4248	9,9259319	0,0593033	20,0112744	337,4396
354	6687,2710	9,9511499	0,0589142	20,0618130	340,5261
355	6701,5649	9,9739656	0,0589519	20,1046947	341,0353
356	6715,3872	9,9971561	0,0587759	20,1461616	342,7623



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357	6718,8755	10,0104370	0,0585480	20,1566265	344,2754
358	6721,4414	10,0200110	0,0586579	20,1643242	343,7617
359	6732,2905	10,0370390	0,0590110	20,1968715	342,2559
360	6754,8110	10,0687620	0,0596476	20,2644330	339,7359
361	6766,5518	10,0907810	0,0596534	20,2996554	340,2931
362	6772,5498	10,1061690	0,0595956	20,3176494	340,9251
363	6774,5254	10,1608390	0,0592480	20,3235762	343,0252
364	6812,4360	10,2047300	0,0603566	20,4373080	338,6093
365	6815,5664	10,2172750	0,0603115	20,4466992	339,0184
366	6837,0225	10,2477520	0,0605163	20,5110675	338,9345
367	6847,6440	10,2731120	0,0597577	20,5429320	343,7702
368	6849,7896	10,2851310	0,0593768	20,5493688	346,0844
369	6856,7646	10,3048320	0,0596573	20,5702938	344,8075
370	6861,5522	10,3159310	0,0599926	20,5846566	343,1199
371	6869,6431	10,3323360	0,0601276	20,6089293	342,7532
372	6881,3413	10,3504300	0,0604527	20,6440239	341,4905
373	6890,3193	10,3693270	0,0600361	20,6709579	344,3088
374	6894,4741	10,3803510	0,0600293	20,6834223	344,5554
375	6906,4990	10,4019180	0,0593139	20,7194970	349,3194
376	6921,7393	10,4244480	0,0596922	20,7652179	347,8715
377	6924,3975	10,4381880	0,0596237	20,7731925	348,4050
378	6935,7764	10,4574870	0,0600572	20,8073292	346,4585
379	6936,4448	10,4688030	0,0594765	20,8093344	349,8749
380	6950,5186	10,4910350	0,0596867	20,8515558	349,3501
381	6958,9302	10,5171480	0,0595604	20,8767906	350,5146
382	6967,3350	10,5367410	0,0588210	20,9020050	355,3494
383	6979,1006	10,5573100	0,0593479	20,9373018	352,7893
384	6980,0371	10,5696940	0,0592647	20,9401113	353,3319
385	6990,4307	10,6085620	0,0604549	20,9712921	346,8915
386	7000,7207	10,6277300	0,0608140	21,0021621	345,3508
387	7008,7373	10,6446120	0,0608194	21,0262119	345,7155
388	7011,3145	10,6579860	0,0605547	21,0339435	347,3544
389	7011,5391	10,8008320	0,0579924	21,0346173	362,7133
390	7029,1147	10,8240230	0,0582358	21,0873441	362,1028
391	7043,3037	10,8462480	0,0577816	21,1299111	365,6858
392	7063,6489	10,8753040	0,0576216	21,1909467	367,7605
393	7082,0083	10,9055810	0,0586718	21,2460249	362,1165
394	7101,7861	10,9397470	0,0585759	21,3053583	363,7223
395	7107,6421	10,9602420	0,0586082	21,3229263	363,8216
396	7114,9141	10,9814720	0,0584663	21,3447423	365,0777



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397	7128,1147	11,0386130	0,0583341	21,3843441	366,5839
398	7130,9800	11,0536080	0,0584275	21,3929400	366,1451
399	7134,4761	11,0865470	0,0571745	21,4034283	374,3527
400	7140,2363	11,1020900	0,0577238	21,4207089	371,0897
401	7148,1558	11,1201330	0,0586341	21,4444674	365,7337
402	7151,6528	11,1349020	0,0592423	21,4549584	362,1561
403	7153,5688	11,1473390	0,0589011	21,4607064	364,3515
404	7159,0991	11,1636310	0,0582785	21,4772973	368,5287
405	7170,8486	11,1869130	0,0575632	21,5125458	373,7205
406	7173,7314	11,2233090	0,0578730	21,5211942	371,8693
407	7173,9253	11,2349760	0,0573782	21,5217759	375,0863
408	7174,1821	11,2839100	0,0587741	21,5225463	366,1910
409	7185,5513	11,3037290	0,0590347	21,5566539	365,1523
410	7188,8057	11,3170480	0,0593500	21,5664171	363,3769
411	7198,5913	11,5843210	0,0604284	21,5957739	357,3779
412	7220,9072	11,6190790	0,0600309	21,6627216	360,8595
413	7227,2681	11,6386710	0,0599833	21,6818043	361,4640
414	7242,2114	11,6651300	0,0597367	21,7266342	363,7066
415	7256,0459	11,6938510	0,0590134	21,7681377	368,8677
416	7267,1738	11,7204970	0,0590523	21,8015214	369,1900
417	7280,1880	11,7505280	0,0588926	21,8405640	370,8541
418	7288,5674	11,7766360	0,0589154	21,8657022	371,1373
419	7298,9644	11,8059020	0,0579701	21,8968932	377,7274
420	7297,4873	11,8223550	0,0603618	21,8924619	362,6874
421	7301,7075	11,8410800	0,0620565	21,9051225	352,9868
422	7313,1094	11,8689260	0,0631630	21,9393282	347,3446
423	7326,4341	11,9003730	0,0630466	21,9793023	348,6199
424	7332,3813	11,9271760	0,0626435	21,9971439	351,1481
425	7347,8530	12,1099760	0,0634805	22,0435590	347,2493
426	7366,1792	12,1451640	0,0631873	22,0985376	349,7307
427	7383,3032	12,1816900	0,0637440	22,1499096	347,4823
428	7396,5122	12,2175430	0,0636745	22,1895366	348,4839
429	7421,0713	12,2681170	0,0635031	22,2632139	350,5847
430	7425,2212	12,3034070	0,0627810	22,2756636	354,8154
431	7429,2456	12,3576070	0,0633305	22,2877368	351,9274
432	7429,5952	12,3824630	0,0629905	22,2887856	353,8436
433	7430,9995	12,4667210	0,0634976	22,2929985	351,0841
434	7434,2041	12,5012440	0,0636177	22,3026123	350,5724
435	7438,0664	12,5214410	0,0632449	22,3141992	352,8221
436	7440,7241	12,5410240	0,0632682	22,3221723	352,8182



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437	7444,5405	12,5600360	0,0631216	22,3336215	353,8190
438	7452,1387	12,5826910	0,0637129	22,3564161	350,8931
439	7459,4082	12,6084040	0,0631551	22,3782246	354,3376
440	7464,9956	12,6321200	0,0622112	22,3949868	359,9832
441	7469,3296	12,6547620	0,0626565	22,4079888	357,6323
442	7476,9780	12,6818770	0,0624931	22,4309340	358,9346
443	7494,5874	13,1788350	0,0632635	22,4837622	355,3986
444	7498,9956	13,2065850	0,0629441	22,4969868	357,4122
445	7499,3462	13,2292070	0,0619038	22,4980386	363,4355
446	7507,9067	13,2576330	0,0620315	22,5237201	363,1013
447	7502,7109	13,2607200	0,0624100	22,5081327	360,6495
448	7517,7852	13,2876590	0,0620253	22,5533556	363,6154
449	7524,4658	13,3178040	0,0619819	22,5733974	364,1934
450	7526,7964	13,3304070	0,0617746	22,5803892	365,5287
451	7529,9639	13,3573050	0,0626410	22,5898917	360,6247
452	7542,8628	13,3791640	0,0626008	22,6285884	361,4744



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Tabel Beban, Momen, Lendutan, dan Kelengkungan BBTS 3

No.	Beban (P) (kg)	Lendutan (δ) (mm)	Kelengkungan (ϕ) (mm)	Momen (M) (kNm)	EI (kN/m)
1	0.0000	0.0000000	0.0000000	0.0000000	0.0000
2	2.6086	0.0442022	-0.0048071	0.0078258	-1.6280
3	24.8651	0.0783129	-0.0069717	0.0745954	-10.6997
4	54.4896	0.1081377	-0.0070316	0.1634689	-23.2478
5	64.6572	0.0987172	-0.0052143	0.1939717	-37.2003
6	144.6003	0.1788474	-0.0062492	0.4338008	-69.4173
7	221.6398	0.2660678	-0.0060589	0.6649193	-109.7417
8	251.7761	0.2955848	-0.0047667	0.7553282	-158.4582
9	265.8864	0.3065344	-0.0029579	0.7976591	-269.6744
10	295.1163	0.3379875	-0.0025847	0.8853489	-342.5371
11	328.6321	0.3807958	-0.0003756	0.9858964	-2624.5918
12	434.2860	0.5345197	0.0025420	1.3028579	512.5373
13	434.9958	0.5519358	0.0032508	1.3049874	401.4327
14	465.0912	0.5764242	0.0032121	1.3952737	434.3779
15	587.6636	0.6913182	0.0038559	1.7629909	457.2237
16	692.7226	0.8076647	0.0052293	2.0781678	397.4083
17	698.9353	0.8375888	0.0054400	2.0968059	385.4416
18	806.4058	0.9280173	0.0088476	2.4192173	273.4335
19	963.3664	1.0757356	0.0106307	2.8900992	271.8640
20	1014.1456	1.1573135	0.0099883	3.0424368	304.6001
21	1124.9318	1.2725886	0.0121573	3.3747954	277.5932
22	1272.5872	1.4288317	0.0149475	3.8177616	255.4109
23	1343.4258	1.5196803	0.0173982	4.0302774	231.6498
24	1439.8523	1.6365740	0.0172730	4.3195569	250.0758
25	1466.8976	1.6883923	0.0173613	4.4006928	253.4773
26	1496.5062	1.7192560	0.0183618	4.4895186	244.5028
27	1518.4792	1.7492647	0.0193524	4.5554376	235.3936
28	1584.0709	1.8254542	0.0195561	4.7522127	243.0041
29	1637.7181	1.9042833	0.0202590	4.9131543	242.5175
30	1729.0858	2.0616779	0.0215528	5.1872574	240.6772
31	1794.1038	2.1738279	0.0215547	5.3823114	249.7051
32	1825.4919	2.2318048	0.0215148	5.4764757	254.5452
33	1871.1295	2.3004353	0.0223382	5.6133885	251.2913
34	1878.6449	2.3425889	0.0233744	5.6359347	241.1160
35	1951.7257	2.4450903	0.0235914	5.8551771	248.1910
36	2046.5603	2.5746174	0.0246530	6.1396809	249.0437



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37	2096.1223	2.6667020	0.0248017	6.2883669	253.5459
38	2116.1421	2.7243860	0.0253653	6.3484263	250.2804
39	2126.2080	2.7548590	0.0261927	6.3786240	243.5266
40	2207.4915	2.8906507	0.0279836	6.6224745	236.6556
41	2275.8289	2.9891870	0.0272746	6.8274867	250.3240
42	2312.6667	3.0702682	0.0263370	6.9380001	263.4313
43	2327.2927	3.1233127	0.0259091	6.9818781	269.4757
44	2361.8137	3.1823499	0.0265696	7.0854411	266.6751
45	2393.3672	3.2566814	0.0255812	7.1801016	280.6792
46	2420.0969	3.3797989	0.0256886	7.2602907	282.6272
47	2505.7446	3.4741390	0.0251799	7.5172338	298.5412
48	2559.1450	3.5562251	0.0258161	7.6774350	297.3899
49	2601.8357	3.6352854	0.0258520	7.8055071	301.9310
50	2630.4353	3.7108932	0.0246311	7.8913059	320.3803
51	2643.0522	3.7610831	0.0241756	7.9291566	327.9818
52	2644.6477	3.7883139	0.0250210	7.9339431	317.0920
53	2718.7664	3.9666076	0.0244823	8.1562992	333.1514
54	2787.2932	4.0772791	0.0257757	8.3618796	324.4090
55	2825.0366	4.3223567	0.0246896	8.4751098	343.2661
56	2872.6995	4.3695550	0.0256587	8.6180985	335.8742
57	2870.7700	4.3779135	0.0257127	8.6123100	334.9441
58	2938.0408	4.4538946	0.0262613	8.8141224	335.6312
59	2969.7297	4.5051804	0.0260558	8.9091891	341.9278
60	3482.4053	5.8021417	0.0183458	10.4472159	569.4603
61	3497.6765	5.8299928	0.0175083	10.4930295	599.3188
62	3509.9299	5.8631659	0.0184785	10.5297897	569.8404
63	3527.5876	5.8930945	0.0189930	10.5827628	557.1940
64	3534.6189	5.9186106	0.0186080	10.6038567	569.8535
65	3547.1406	5.9397230	0.0181006	10.6414218	587.9060
66	3569.6572	5.9639721	0.0181872	10.7089716	588.8182
67	3583.1726	5.9853468	0.0182293	10.7495178	589.6835
68	3690.3779	6.2192678	0.0215975	11.0711337	512.6109
69	3715.7769	6.2412276	0.0219862	11.1473307	507.0149
70	3742.1333	6.2673650	0.0226529	11.2263999	495.5842
71	3759.3547	6.2897773	0.0223341	11.2780641	504.9715
72	3769.0393	6.3043633	0.0219735	11.3071179	514.5795
73	3772.4199	6.3135409	0.0217606	11.3172597	520.0801
74	3792.7959	6.3364058	0.0230358	11.3783877	493.9443
75	3827.5242	6.3701096	0.0233771	11.4825726	491.1891
76	3845.0903	6.3962312	0.0228914	11.5352709	503.9126



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77	3855.6277	6.4143491	0.0229210	11.5668831	504.6424
78	3864.7751	6.4605446	0.0232165	11.5943253	499.4004
79	3902.5068	6.4900613	0.0241014	11.7075204	485.7608
80	3929.6763	6.5188098	0.0240088	11.7890289	491.0295
81	3945.2817	6.5425491	0.0184382	11.8358451	641.9215
82	3945.6216	6.5551906	0.0126849	11.8368648	933.1461
83	3948.0435	6.5632839	0.0131178	11.8441305	902.9087
84	3959.1821	6.5802536	0.0131465	11.8775463	903.4759
85	3969.9192	6.5938916	0.0136583	11.9097576	871.9795
86	3979.1113	6.6044455	0.0140591	11.9373339	849.0793
87	3979.3042	6.6096239	0.0140534	11.9379126	849.4679
88	3985.3535	6.6212282	0.0137792	11.9560605	867.6909
89	3990.0176	6.6299877	0.0137796	11.9700528	868.6799
90	3992.8938	6.6363535	0.0139165	11.9786814	860.7551
91	3999.4675	6.6441536	0.0142770	11.9984025	840.3991
92	4015.3894	6.6586885	0.0148823	12.0461682	809.4276
93	4041.4226	6.6854324	0.0151015	12.1242678	802.8530
94	4070.4099	6.7231078	0.0147652	12.2112297	827.0300
95	4096.2666	6.7555704	0.0151966	12.2887998	808.6567
96	4111.8979	6.7776833	0.0162551	12.3356937	758.8824
97	4115.5176	6.7917724	0.0162556	12.3465528	759.5271
98	4122.5742	6.8082700	0.0156176	12.3677226	791.9113
99	4131.8105	6.8247337	0.0157410	12.3954315	787.4610
100	4135.7588	6.8354859	0.0161598	12.4072764	767.7856
101	4173.8169	6.9897389	0.0150446	12.5214507	832.2887
102	4184.0942	7.0059700	0.0150427	12.5522826	834.4418
103	4215.2656	7.0411291	0.0159049	12.6457968	795.0881
104	4272.0811	7.1028633	0.0155905	12.8162433	822.0536
105	4320.8418	7.1587424	0.0162895	12.9625254	795.7610
106	4349.6909	7.2032495	0.0166780	13.0490727	782.4123
107	4394.8247	7.2635293	0.0169293	13.1844741	778.7943
108	4404.9292	7.2914782	0.0167948	13.2147876	786.8371
109	4413.5176	7.3100243	0.0171344	13.2405528	772.7482
110	4420.5649	7.3319750	0.0183259	13.2616947	723.6582
111	4433.3716	7.3512464	0.0183415	13.3001148	725.1366
112	4461.5640	7.3827319	0.0187114	13.3846920	715.3236
113	4488.9409	7.4211941	0.0186449	13.4668227	722.2811
114	4532.8647	7.4767394	0.0186602	13.5985941	728.7501
115	4554.2559	7.5193591	0.0195366	13.6627677	699.3425
116	4569.6313	7.5816026	0.0194417	13.7088939	705.1284



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117	4631.4160	7.6475897	0.0211764	13.8942480	656.1182
118	4655.9453	7.6930065	0.0211383	13.9678359	660.7821
119	4680.9102	7.7351441	0.0216091	14.0427306	649.8535
120	4718.5703	7.7974901	0.0217332	14.1557109	651.3404
121	4726.4150	7.8275075	0.0213231	14.1792450	664.9708
122	4746.2358	7.8698578	0.0214267	14.2387074	664.5317
123	4757.0864	7.9169960	0.0221525	14.2712592	644.2273
124	4772.4556	7.9407744	0.0225728	14.3173668	634.2752
125	4774.9873	7.9607615	0.0232896	14.3249619	615.0800
126	4781.0952	7.9754682	0.0228629	14.3432856	627.3616
127	4810.3569	8.0321445	0.0229432	14.4310707	628.9920
128	4833.7202	8.0754833	0.0223046	14.5011606	650.1424
129	4854.5122	8.2483902	0.0207352	14.5635366	702.3578
130	4904.7988	8.3086615	0.0209425	14.7143964	702.6094
131	4951.8203	8.3647966	0.0220155	14.8554609	674.7734
132	4981.6626	8.4146872	0.0229339	14.9449878	651.6546
133	4998.6987	8.4511967	0.0232579	14.9960961	644.7737
134	5007.4277	8.4750748	0.0235054	15.0222831	639.0990
135	5019.3872	8.4987278	0.0237139	15.0581616	634.9938
136	5046.8481	8.5363550	0.0244759	15.1405443	618.5906
137	5068.3750	8.5713453	0.0253711	15.2051250	599.3091
138	5082.1558	8.6025124	0.0254467	15.2464674	599.1533
139	5087.9146	8.6268654	0.0253295	15.2637438	602.6076
140	5088.5479	8.6449194	0.0251966	15.2656437	605.8622
141	5094.9443	8.7372513	0.0259092	15.2848329	589.9378
142	5106.7720	8.7537956	0.0260275	15.3203160	588.6203
143	5111.2031	8.7758274	0.0258568	15.3336093	593.0208
144	5144.6646	8.8166752	0.0255610	15.4339938	603.8093
145	5151.0913	8.8342228	0.0258526	15.4532739	597.7459
146	5172.4604	8.8629217	0.0263529	15.5173812	588.8306
147	5201.8789	8.9019918	0.0267669	15.6056367	583.0204
148	5225.7451	8.9484501	0.0268373	15.6772353	584.1595
149	5239.7397	8.9862213	0.0269968	15.7192191	582.2621
150	5252.6260	9.0139084	0.0280077	15.7578780	562.6268
151	5257.9829	9.0539980	0.0278903	15.7739487	565.5709
152	5265.6777	9.0730410	0.0281676	15.7970331	560.8224
153	5280.6206	9.1052103	0.0281677	15.8418618	562.4119
154	5291.6704	9.1358395	0.0278466	15.8750112	570.0875
155	5298.1021	9.1672544	0.0269760	15.8943063	589.2013
156	5313.0723	9.1946211	0.0277044	15.9392169	575.3308



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157	5348.3335	9.3054132	0.0276106	16.0450005	581.1174
158	5391.3701	9.3729210	0.0282869	16.1741103	571.7874
159	5396.0933	9.4043732	0.0287622	16.1882799	562.8326
160	5398.4839	9.4260235	0.0289101	16.1954517	560.2012
161	5445.5439	9.5020552	0.0295628	16.3366317	552.6085
162	5456.4150	9.5493250	0.0294308	16.3692450	556.1951
163	5461.6748	9.5877171	0.0283871	16.3850244	577.2005
164	5464.9634	9.6218414	0.0280317	16.3948902	584.8707
165	5477.8008	9.8987103	0.0244316	16.4334024	672.6287
166	5491.0117	9.9177628	0.0244940	16.4730351	672.5340
167	5499.7056	9.9332027	0.0249484	16.4991168	661.3294
168	5503.6558	9.9477367	0.0253040	16.5109674	652.5035
169	5514.0259	9.9656382	0.0259639	16.5420777	637.1191
170	5520.8604	9.9860420	0.0257991	16.5625812	641.9834
171	5530.8374	10.0162900	0.0261211	16.5925122	635.2147
172	5541.5342	10.0379410	0.0262383	16.6246026	633.5994
173	5550.6919	10.0628410	0.0262342	16.6520757	634.7471
174	5561.8179	10.0864790	0.0262871	16.6854537	634.7388
175	5567.8857	10.1078970	0.0260823	16.7036571	640.4212
176	5595.9233	10.1860900	0.0281159	16.7877699	597.0919
177	5634.2202	10.2512390	0.0282261	16.9026606	598.8309
178	5654.7896	10.3026990	0.0287001	16.9643688	591.0913
179	5658.2930	10.3415530	0.0289665	16.9748790	586.0182
180	5665.2905	10.3824830	0.0289123	16.9958715	587.8431
181	5666.2939	10.4188680	0.0289261	16.9988817	587.6661
182	5667.1396	10.4434650	0.0298258	17.0014188	570.0239
183	5674.9434	10.4705160	0.0308061	17.0248302	552.6448
184	5684.5664	10.5033380	0.0309985	17.0536992	550.1459
185	5688.8423	10.5364880	0.0308991	17.0665269	552.3309
186	5703.5371	10.5768670	0.0313188	17.1106113	546.3367
187	5714.9038	10.6198430	0.0318538	17.1447114	538.2313
188	5715.1343	10.8483430	0.0366435	17.1454029	467.8975
189	5737.2026	10.8895770	0.0374853	17.2116078	459.1562
190	5755.0132	10.9367410	0.0379379	17.2650396	455.0869
191	5765.6006	10.9836130	0.0383432	17.2968018	451.1048
192	5777.4595	11.0315170	0.0388422	17.3323785	446.2255
193	5787.0156	11.0821700	0.0391144	17.3610468	443.8531
194	5794.7305	11.1286900	0.0391775	17.3841915	443.7290
195	5795.7505	11.1661070	0.0396627	17.3872515	438.3779
196	5798.8608	11.2471620	0.0408764	17.3965824	425.5899



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197	5805.9331	11.2788750	0.0409309	17.4177993	425.5416
198	5813.0640	11.3153430	0.0413196	17.4391920	422.0562
199	5819.3975	11.4297760	0.0404292	17.4581925	431.8214
200	5873.8262	11.5351130	0.0410225	17.6214786	429.5564
201	5889.4678	11.6244430	0.0418506	17.6684034	422.1780
202	5891.4766	11.6887970	0.0425647	17.6744298	415.2368
203	5897.1787	11.7611530	0.0436344	17.6915361	405.4493
204	5943.3945	12.2440590	0.0474590	17.8301835	375.6966
205	5978.4668	12.3477070	0.0487241	17.9354004	368.1012
206	5993.5337	12.9518980	0.0434760	17.9806011	413.5753
207	5999.7651	13.0246160	0.0444870	17.9992953	404.5967
208	6018.5708	13.0731340	0.0460779	18.0557124	391.8519
209	6033.3608	13.1175230	0.0494391	18.1000824	366.1087
210	6039.3032	13.2381580	0.0502172	18.1179096	360.7909
211	6054.2798	13.3139220	0.0505595	18.1628394	359.2369
212	6058.2163	13.3758170	0.0508372	18.1746489	357.5069
213	6063.2495	13.4370850	0.0519910	18.1897485	349.8634
214	6078.0796	13.7362920	0.0539912	18.2342388	337.7261
215	6114.9097	13.8373390	0.0550539	18.3447291	333.2140
216	6116.8135	13.9205270	0.0563308	18.3504405	325.7621
217	6123.5298	14.1081640	0.0574944	18.3705894	319.5196
218	6125.3052	14.1728740	0.0582643	18.3759156	315.3889
219	6140.3828	14.7579210	0.0570375	18.4211484	322.9656
220	6143.6328	14.8001530	0.0563543	18.4308984	327.0540
221	6150.9878	14.8723150	0.0566292	18.4529634	325.8560
222	6168.0474	14.9623280	0.0574024	18.5041422	322.3583
223	6178.9512	15.1279110	0.0580864	18.5368536	319.1255
224	6195.4658	15.1795230	0.0591023	18.5863974	314.4784
225	6221.3350	15.2636330	0.0595258	18.6640050	313.5448
226	6223.7974	15.7481730	0.0634883	18.6713922	294.0919
227	6239.6030	15.9135240	0.0642839	18.7188090	291.1897
228	6264.0889	15.9639970	0.0655537	18.7922667	286.6698
229	6291.6748	16.0421410	0.0675927	18.8750244	279.2465
230	6299.2852	16.1323600	0.0674863	18.8978556	280.0251
231	6300.6401	16.1945270	0.0685147	18.9019203	275.8812
232	6309.1304	16.2674140	0.0700947	18.9273912	270.0260
233	6313.8179	16.3416670	0.0703788	18.9414537	269.1358
234	6314.5342	16.4178640	0.0702225	18.9436026	269.7654
235	6345.3179	16.8960840	0.0756781	19.0359537	251.5385
236	6359.2080	16.9831470	0.0771142	19.0776240	247.3944







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237	6357.4102	17.0482120	0.0780186	19.0722306	244.4575
238	6362.8550	17.1107980	0.0795180	19.0885650	240.0534
239	6381.2852	17.4875220	0.0815949	19.1438556	234.6207
240	6419.9072	17.6358800	0.0821882	19.2597216	234.3368
241	6421.1621	17.8245510	0.0847522	19.2634863	227.2919
242	6398.4619	17.9410060	0.0855756	19.1953857	224.3091
243	6435.9243	18.3477330	0.0854509	19.3077729	225.9517
244	6448.9614	18.4312230	0.0868674	19.3468842	222.7174
245	6453.8848	18.6643030	0.0879840	19.3616544	220.0588
246	6455.6113	19.1244680	0.0867959	19.3668339	223.1307
247	6474.9614	19.1811560	0.0875339	19.4248842	221.9127
248	6503.3179	19.2642730	0.0899884	19.5099537	216.8052
249	6505.5449	19.3403260	0.0906369	19.5166347	215.3277
250	6515.8296	19.5186810	0.0919931	19.5474888	212.4886
251	6531.7671	19.8057540	0.0956449	19.5953013	204.8755
252	6570.8765	20.0145420	0.0961420	19.7126295	205.0366
253	6592.2471	20.7047420	0.0965257	19.7767413	204.8858
254	6599.5376	21.4560930	0.0917695	19.7986128	215.7428
255	6615.4126	21.5203860	0.0928692	19.8462378	213.7010
256	6621.6470	21.5829790	0.0931162	19.8649410	213.3350
257	6650.6411	22.1955390	0.0937202	19.9519233	212.8882
258	6654.9429	22.2726820	0.0944067	19.9648287	211.4768

Keterangan :

	= Data pada retak pertama
	= Data pada lendutan maksimum
	= Data pada luluh
	= Data pada beban maksimum