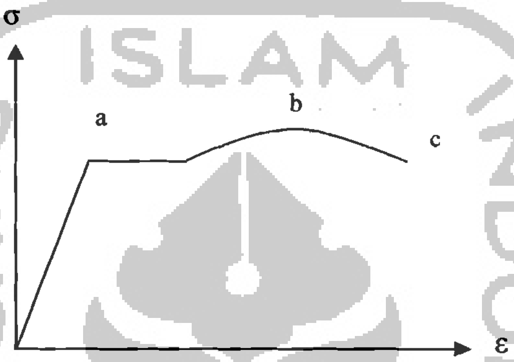
Lampiran 1

Hasil Pengujian Bahan

Pengujian ini merupakan uji terhadap kekuatan tarik bahan profil lipped channel 60 x 22 x 8 x 1,2 mm dan 70 x 22 x 10 x 1,2 mm yang dilakukan di laboratorium Teknik Sipil UII Jogjakarta. Adapun hasil pendahuluan sebagai berikut:

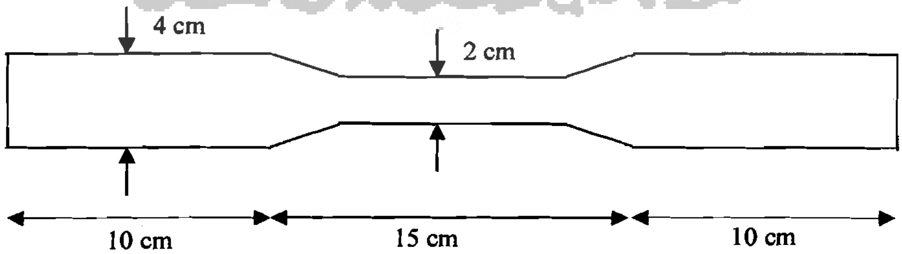


Gambar 1.1 Grafik tegangan – regangan

Beban leleh (a)

Beban maksimum (b)

Beban patah (c)



Gambar L1.1 Benda uji kuat tarik baja

1.1. hasil pengujian kuat tarik profil lipped channel 60 x 22 x 8 x 1,2 mm

a. **Sampel I**

Beban leleh = 240 kg

Beban maksimum = 385 kg

Perhitungan

Lebar = 2 cm

Tebal = 0.12 cm

A0 = l x t = 0.24 cm

Kuat leleh (Fy) $= \frac{P_y}{A_0}$

$= \frac{240}{0,24}$

$= 1000\ kg/cm^2$

$= 100$ Mpa

Kuat tarik (Fu) $= \frac{P_u}{A_0}$

$= \frac{385}{0,24}$

$= 1604,17\ kg/cm^2$

$= 160,417$ Mpa

b. Sampel II

Beban leleh = 287,5 kg

Beban maksimum = 380 kg

Perhitungan:

Lebar = 2,015 cm

Tebal = 0,12 cm

A0 = l x t = 0.2418 cm

Kuat leleh (Fy) $= \frac{P_y}{A_0}$

$= \frac{287,5}{0,2418}$

$=1188,99\ kg/cm^2$

$=118,899$ Mpa

Kuat tarik (Fu) $= \frac{P_u}{A_0}$

$= \frac{380}{0,2418}$

$=1571,55\ kg/cm^2$

$=157,155$ Mpa

c. Sampel III

Beban leleh = 227,5 kg

Beban maksimum = 360 kg

Perhitungan

Lebar = 2 cm

Tebal = 0.12 cm

$A_0 = l \times t$ = 0,240 cm

Kuat leleh $(F_y) = \frac{P_y}{A_0}$

$= \frac{227}{0,240}$

= 929,23 kg/cm2

= 92,923 Mpa

Kuat tarik $(F_u) = \frac{P_u}{A_0}$

$= \frac{360}{0,240}$

=1470,59 kg/cm2

=147,059 Mpa

kuat leleh rata-rata $= \frac{100 + 118{,}899 + 92{,}933}{3}$

$= 103{,}944$ Mpa

kuat tarik rata-rata $= \frac{160{,}417 + 157{,}155 + 147{,}059}{3}$

$= 154{,}877$ Mpa

Tabel 1.1 Hasil pengujian kuat tarik baja

Nilai hasil uji	Benda uji 1	Benda uji 2	Benda uji 3
Beban leleh (Kg)	240	287,5	227,5
Beban maksimum (Kg)	385	385	360
Tegangan Leleh (F_y)	100	118,899	92,933
Teg maksimum (F_u)	160,417	157,155	147,059
F_y rata-rata (Mpa) (F_u)		103,944	
F_u rata-rata (Mpa)		154,877	

1.2 hasil pengujian kuat tarik profil lipped channel 70 x 22 x 8 x 1,2 mm

a. Sampel I

Beban leleh = 252,5 kg

Beban maksimum = 387,5 kg

Perhitungan

Lebar = 2 cm

Tebal = 0.12 cm

A0 = l x t = 0.24 cm

Kuat leleh (F_y)= $\frac{P_y}{A_0}$

$= \frac{252,5}{0,240}$

= 1052,08 kg/cm^2

=105,208 Mpa

Kuat tarik (F_u) $= \frac{P_u}{A_0}$

$= \frac{387,5}{0,240}$

=1614,58 kg/cm^2

=161,458 Mpa

b. Sampel II

Beban leleh = 296 kg

Beban maksimum = 400 kg

Perhitungan

Lebar = 2,015 cm

Tebal = 0.12 cm

A0 = l x t = 0.2418 cm

Kuat leleh (F_y) $= \frac{P_y}{A_0}$

$= \frac{296}{0,2418}$

$=1233,33$ kg/cm^2

$=123,333$ Mpa

Kuat tarik (F_u) $= \frac{P_u}{A_0}$

$= \frac{400}{0,2418}$

$=1666,67$ kg/cm^2

$=166,667$ Mpa

c. Sampel III

Beban leleh = 235,5 kg

Beban maksimum = 377,5 kg

Perhitungan

Lebar = 2 cm

Tebal = 0.12 cm

A0 = l x t = 0.240 cm

Kuat leleh (F_y) $= \dfrac{P_y}{A_0}$

$= \dfrac{235{,}5}{0{,}240}$

= 981,25 kg/cm2

= 98,125 Mpa

Kuat tarik (F_u) $= \dfrac{P_u}{A_0}$

$= \dfrac{377{,}5}{0{,}240}$

=1088,89 kg/cm2

=108,889 Mpa

kuat leleh rata-rata $= \dfrac{105{,}208 + 123{,}333 + 98{,}125}{3}$

= 108,889 Mpa

kuat tarik rata-rata $= \dfrac{161{,}458 + 166{,}667 + 157{,}292}{3}$

= 161,806 Mpa

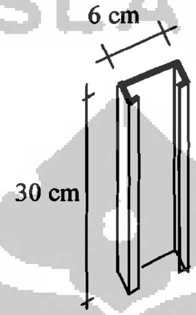
Tabel 1.2 Hasil pengujian kuat tarik baja

Nilai hasil uji	Benda uji 1	Benda uji 2	Benda uji 3
Beban leleh (Kg)	372,5	325	327,5
Beban maksimum (Kg)	387,5	400	377,5
Tegangan Leleh (F_y)	105,208	123,333	98,125
Teg maksimum (F_u)	161,458	166,667	157,292
F_y rata-rata (Mpa) (F_u)		108,889	
F_u rata-rata (Mpa)		166,853	

Lampiran 1

2. Uji kuat tekan baja

Pengujian ini merupakan uji terhadap kekuatan tekan bahan profil lipped channel 60 x 22x 8 x 1,2 mm yang dilakukan di laboratorium Teknik sipil UII Jogjakarta pengujian menggunakan dua buah benda uji yaitu untuk uji tekuk lokal dan uji tekuk keseluruhan.



Gambar benda uji untuk tekuk lokal & keseluruhan

2.1 Hasil pengujian kuat tekan profil lipped channel 60 x 22 x 8 x 1,2 mm untuk tekuk lokal

a. Sampel 1

beban maksimum = 1160 kg

$$\text{kuat desak sampel 1} = \frac{\text{beban maksimum}}{\text{luas tampang}}$$

$$= \frac{1160 \text{kg}}{114.10^{-2}\,\text{cm}^2}$$

$$= 805{,}56 \text{ kg/cm}^2$$

$$= 80{,}556 \text{ Mpa}$$

b. Sampel 2

beban maksimum $= 1335$ kg

kuat desak sampel 2 $= \dfrac{\text{beban maksimum}}{\text{luas tampang}}$

$= \dfrac{1335\text{kg}}{114.10^{-2}\,\text{cm}^2}$

$= 927{,}08$ kg/cm^2

$= 92{,}708$ Mpa

c. Sampel 3

beban maksimum $= 1390$ kg

kuat desak sample 3 $= \dfrac{\text{beban maksimum}}{\text{luas tampang}}$

$= \dfrac{1390\text{kg}}{114.10^{-2}\,\text{cm}^2}$

$= 965{,}28$ kg/cm^2

$= 96{,}528$ Mpa

Tabel 1.3 Hasil uji tekan baja untuk tekuk lokal

Hasil benda uji	Benda uji 1	Benda uji 2	Benda uji 3
Beban maksimum (kg)	1160	1335	1390
Kuat desak (Mpa)	80,556	92,708	96,528
Kuat desak rata-rata (Mpa)	89,931		

Lampiran 1

Hasil pengujian kuat tekan profil lipped channel 60 x 22 x 8 x 1,2 mm untuk tekuk lokal

a. Sampel 1

beban maksimum = 1150 kg

kuat desak sampel 1 $= \dfrac{\text{beban maksimum}}{\text{luas tampang}}$

$= \dfrac{1150\text{kg}}{114.10^{-2}\,\text{cm}^2}$

$= 798{,}61\ \text{kg/cm}^2$

= 79,861 Mpa

b. Sampel 2

beban maksimum = 1070 kg

kuat desak sampel 2 $= \dfrac{\text{beban maksimum}}{\text{luas tampang}}$

$= \dfrac{1070\text{kg}}{114.10^{-2}\,\text{cm}^2}$

$= 743{,}06\ \text{kg/cm}^2$

= 74,306 Mpa

c. Sampel 3 luas tampang

beban maksimum = 910 kg

kuat desak sampel 3 $= \dfrac{\text{beban maksimum}}{\text{luas tampang}}$

$= \dfrac{910\text{kg}}{114.10^{-2}\,\text{cm}^2}$

= 631,94 kg/cm^2

= 63,194 Mpa

Tabel 1.4 Hasil uji tekan baja untuk tekuk keseluruhan

Hasil benda uji	**Benda uji 1**	**Benda uji 2**	**Benda uji 3**
Beban maksimum (kg)	1150	1070	910
Kuat desak (Mpa)	79,861	74,306	63,194
Kuat desak rata-rata (Mpa)	72,120		

Lampiran 1

2.1 Hasil pengujian kuat tekan profil lipped channel 70 x 22 x 8 x 1,2 mm untuk tekuk lokal

a. Sampel 1

beban maksimum = 1320 kg

kuat desak sampel 1 $= \dfrac{\text{beban maksimum}}{\text{luas tampang}}$

$= \dfrac{1320\text{kg}}{156.10^{-2}\text{cm}^2}$

$= 846{,}15 \text{ kg/cm}^2$

$= 84{,}615$ Mpa

b. Sampel 2

beban maksimum = 1315 kg

kuat desak sampel 2 $= \dfrac{\text{beban maksimum}}{\text{luas tampang}}$

$= \dfrac{1315\text{kg}}{156.10^{-2}\text{cm}^2}$

$= 842{,}95 \text{ kg/cm}^2$

$= 84{,}295$ Mpa

c. Sampel 3

beban maksimum = 1465 kg

kuat desak sample 3 $= \dfrac{\text{beban maksimum}}{\text{luas tampang}}$

$= \dfrac{1465\text{kg}}{156.10^{-2}\text{cm}^2}$

$= 939{,}10\ kg/cm^2$

$= 93{,}910\ Mpa$

Tabel 1.5 hasil uji tekan baja untuk tekuk lokal

Hasil benda uji	Benda uji 1	Benda uji 2	Benda uji 3
Beban maksimum (kg)	1320	1315	1465
Kuat desak (Mpa)	84,615	84,295	93,91
Kuat desak rata-rata (Mpa)	87,607		

Hasil pengujian kuat tekan profil lipped channel 70 x 22 x 8 x 1,2 mm untuk tekuk lokal

a. Sampel 1

beban maksimum = 1150 kg

kuat desak sampel 1 $= \dfrac{\text{beban maksimum}}{\text{luas tampang}}$

$= \dfrac{1150kg}{114.10^{-2}\,cm^2}$

$= 798{,}61\ kg/cm^2$

$= 79{,}861\ Mpa$

b. Sampel 2

beban maksimum = 1070 kg

kuat desak sampel 2 $= \dfrac{\text{beban maksimum}}{\text{luas tampang}}$

$= \dfrac{1070\text{kg}}{114.10^{-2}\,\text{cm}^2}$

$= 743{,}06\ \text{kg/cm}^2$

$= 74{,}306$ Mpa

c. Sampel 3 luas tampang

beban maksimum = 910 kg

kuat desak sampel 3 $= \dfrac{\text{beban maksimum}}{\text{luas tampang}}$

$= \dfrac{910\text{kg}}{114.10^{-2}\,\text{cm}^2}$

$= 631{,}94\ \text{kg/cm}^2$

$= 63{,}194$ Mpa

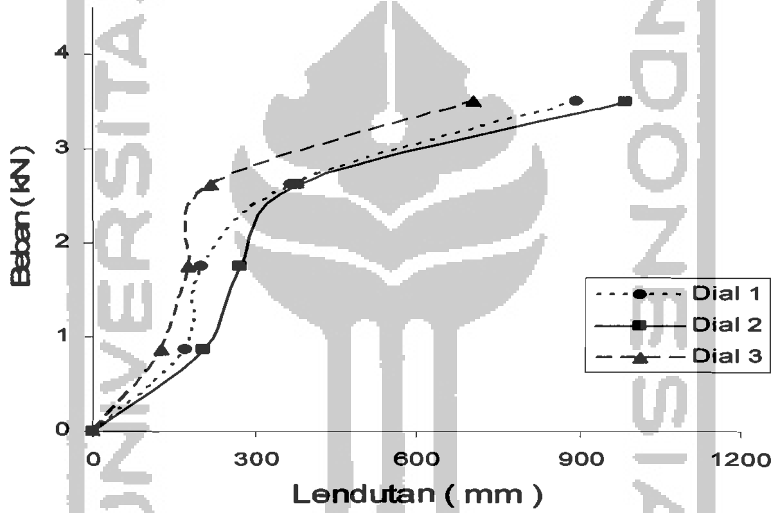
Tabel 1.6 hasil uji tekan baja untuk tekuk keseluruhan

Hasil benda uji	**Benda uji 1 (30 cm)**	**Benda uji 2 (30 cm)**	**Benda uji 3 (30 cm)**
Beban maksimum (kg)	1150	1070	910
Kuat desak (Mpa)	79,861	74,306	63,194
Kuat desak rata-rata (Mpa)	72,120		

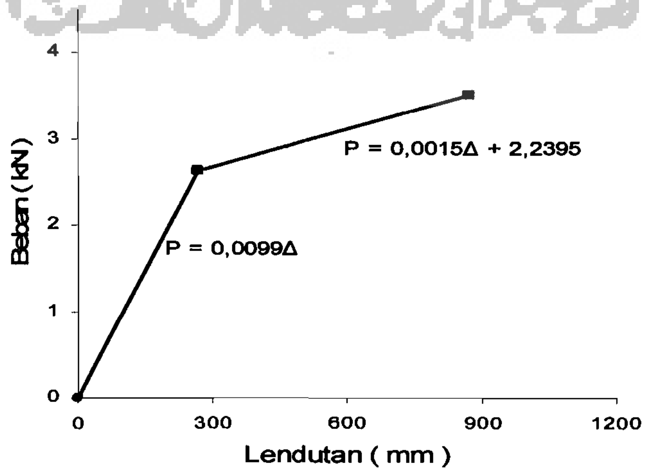
Hasil Pengujian Struktur Rangka Batang Kuda-kuda.

Tabel 5.5 Hubungan beban dan lendutan benda uji 1

Beban (kN)	Dial 1 (mm) (*10^-2)	Dial 2 (mm) (*10^-2)	Dial 3 (mm) (*10^-2)
0	0	0	0
0,875	175	205	127
1,750	202	274	177
2,625	369	382	220
3,500	894	985	705



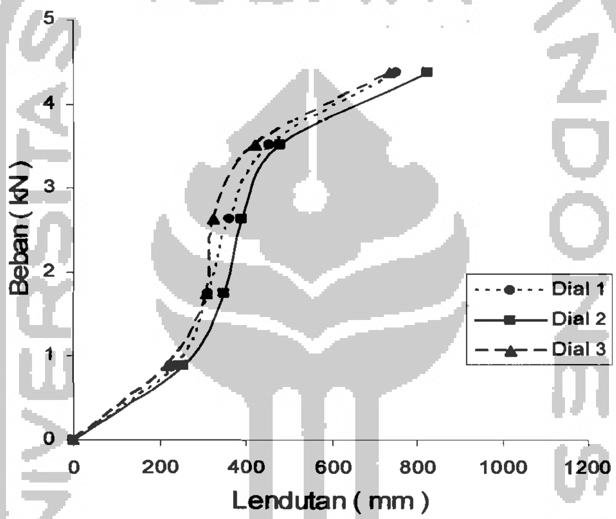
Gambar 5.2 Grafik Hubungan beban – lendutan benda uji 1



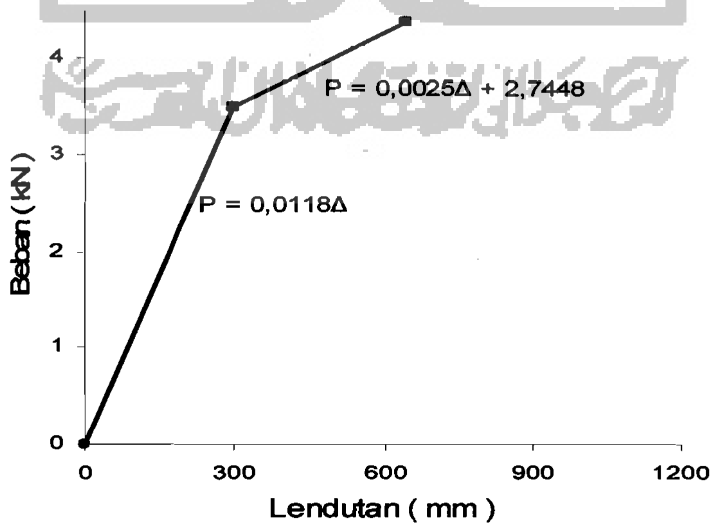
Gambar 5.3 Regresi hubungan beban – lendutan benda uji 1

Tabel 5.6 Hubungan beban dan lendutan benda uji 2

Beban (kN)	Dial 1 (mm) (*10^-2)	Dial 2 (mm) (*10^-2)	Dial 3 (mm) (*10^-2)
0,000	0	0	0
0,875	238	257	219
1,750	312	350	311
2,625	364	391	327
3,500	452	480	420
4,375	751	825	735



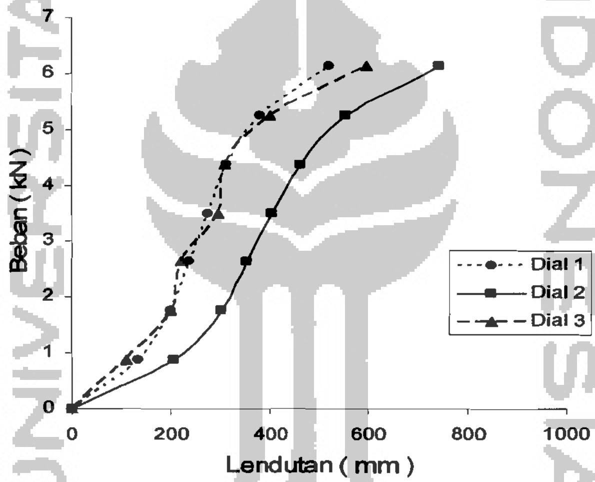
Ganbar 5.4 Grafik hubungan beban – lendutan benda uji 2



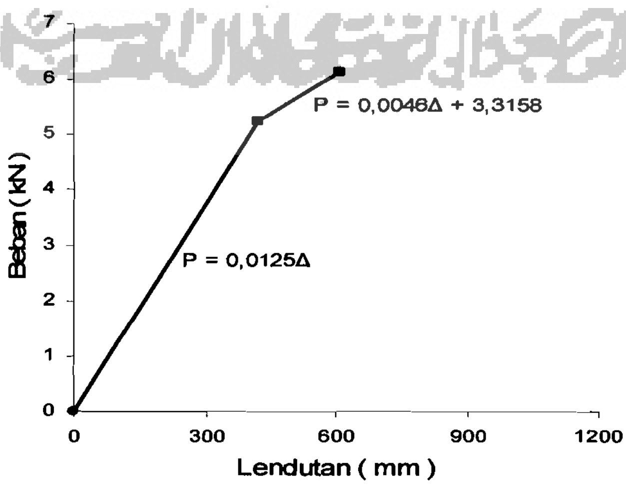
Gambar 5.5 Regresi hubungan beban – lendutan benda uji 2

Tabel 5.7 Hubungan beban dan lendutan benda uji 3

Beban (kN)	Dial 1 (mm) (*10^-2)	Dial 2 (mm) (*10^-2)	Dial 3 (mm) (*10^-2)
0,000	0	0	0
0,875	133	204	110
1,750	200	300	197
2,625	236	353	220
3,500	275	405	293
4,375	312	461	309
5,250	379	554	400
6,125	519	744	595



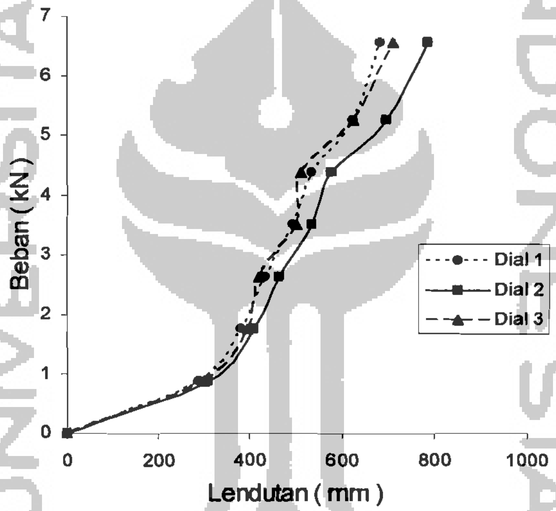
Gambar 5.6 Grafik hubungan beban – lendutan benda uji 3



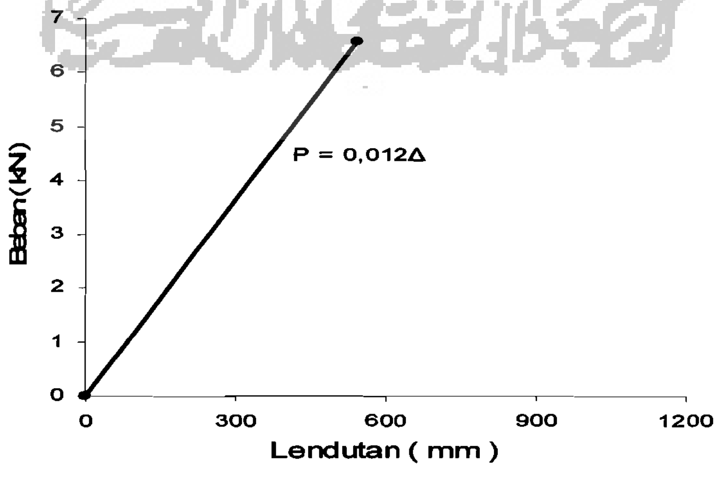
Gambar 5.7 Regresi hubungan beban – lendutan benda uji 3

Tabel 5.8 Hubunga beban dan lendutan benda uji 4

Beban (kN)	**Dial 1 (mm) (*10^-2)**	**Dial 2 (mm) (*10^-2)**	**Dial 3 (mm) (*10^-2)**
0	0	0	0
0,87	289	312	300
1,75	382	410	396
2,62	432	465	421
3,50	496	535	501
4,37	537	580	513
5,25	624	695	625
6,56	684	785	710



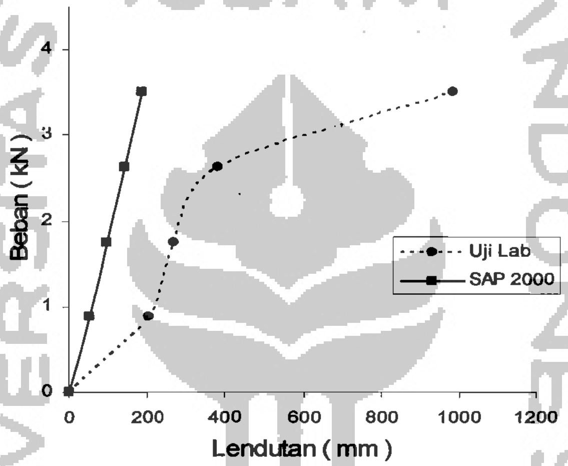
Gambar 5.8 Grafik hubungan beban – lendutan benda uji 4



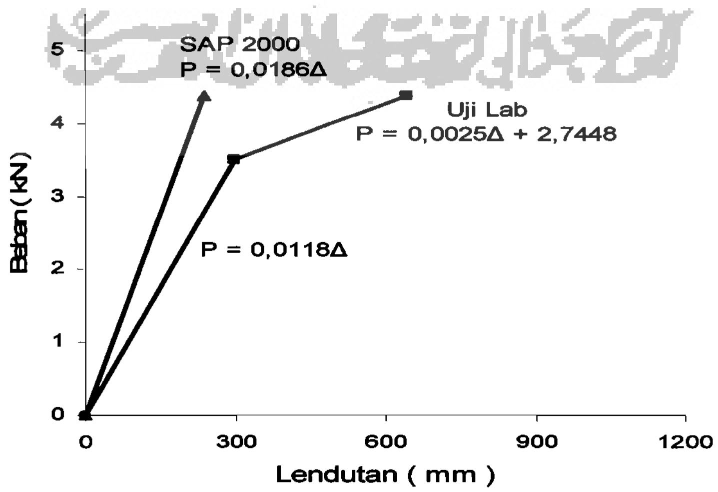
Gambar 5.9 Regresi hubungan beban – lendutan benda uji 4

Tabel 5.9 Hubungan beban – lendutan analisis SAP 2000 benda uji 1

No	Beban (kN)	Dial 1 (mm) (*10^-2)	Dial 2 (mm) (*10^-2)	Dial 3 (mm) (*10^-2)
1	0,000	0	0	0
2	0,875	86	171	86
3	1,750	157	314	157
4	2,625	227	454	227
5	3,500	298	597	298



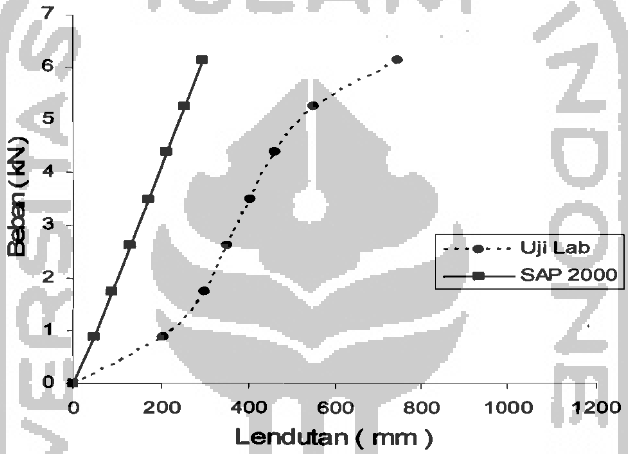
Gambah 5.10 Grafik Beban – Lendutan analisis SAP 2000 bebda uji 1



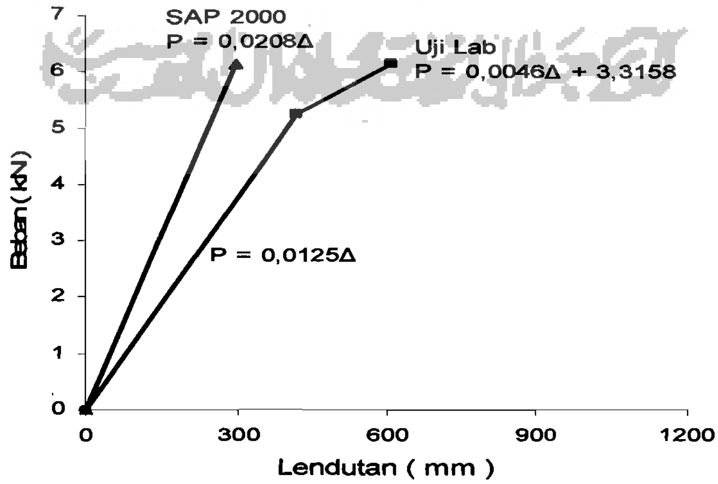
Gambah 5.11 Regresi Beban – Lendutan analisis SAP 2000 bebda uji 1

Tabel 5.10 Hubungan beban – lendutan analisis SAP 2000 benda uji 2

No	Beban (kN)	Dial 1 (mm) (*10^-2)	Dial 2 (mm) (*10^-2)	Dial 3 (mm) (*10^-2)
1	0,000	0	0	0
2	0,875	156	176	156
3	1,750	279	318	279
4	2,625	400	459	400
5	3,500	523	602	523
6	4,375	646	743	646



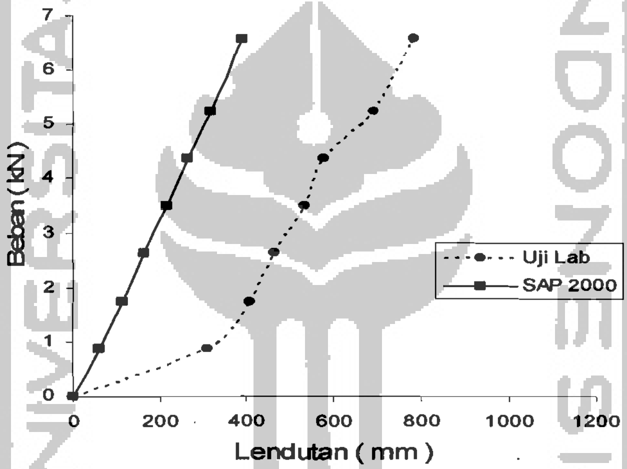
Gambah 5.12 Grafik Beban – Lendutan analisis SAP 2000 bebda uji 2



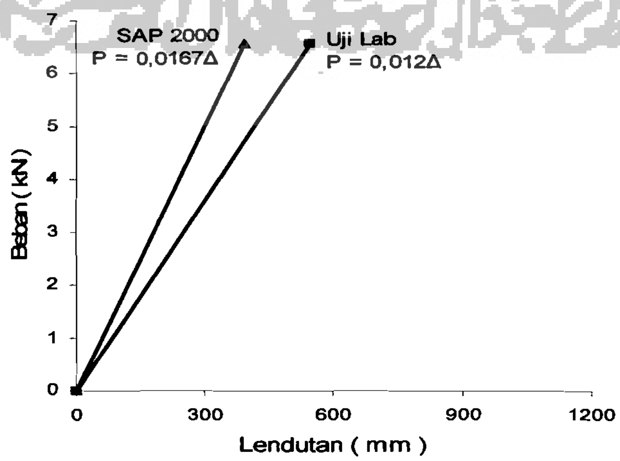
Gambah 5.13 Regresi Beban – Lendutan analisis SAP 2000 bebda uji 2

Tabel 5.10 Hubungan beban – lendutan analisis SAP 2000 benda uji 3

No	Beban (kN)	Dial 1 (mm) (*10^-2)	Dial 2 (mm) (*10^-2)	Dial 3 (mm) (*10^-2)
1	0,000	0	0	0
2	0,875	50	100	50
3	1,750	91	182	91
4	2,625	131	263	131
5	3,500	172	345	172
6	4,375	213	426	213
7	5,250	254	507	254
8	6,125	294	589	294



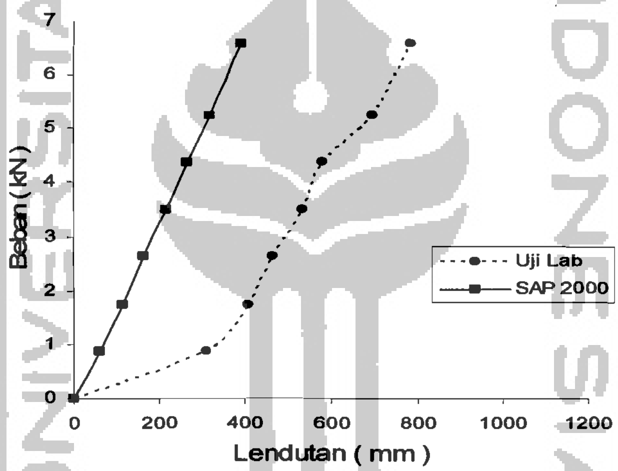
Gambah 5.14 Grafik Beban – Lendutan analisis SAP 2000 bebda uji 3



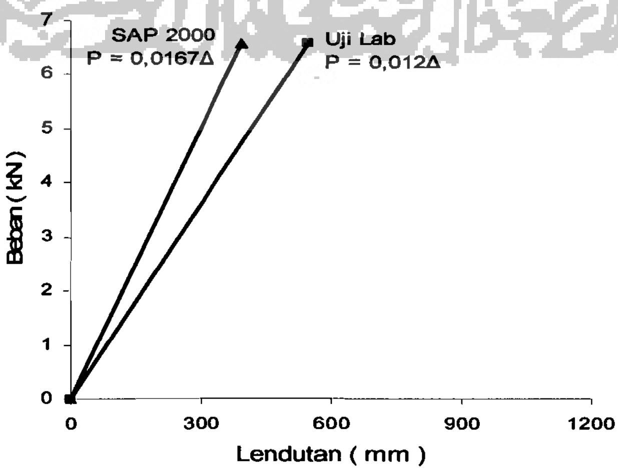
Gambah 5.15 Regresi Beban – Lendutan analisis SAP 2000 bebda uji 3

Tabel 5.9 Hubungan beban – lendutan analisis SAP 2000 benda uji 4

No	Beban (kN)	Dial 1 (mm) (*10^-2)	Dial 2 (mm) (*10^-2)	Dial 3 (mm) (*10^-2)
1	0,000	0,000	0,000	0,000
2	0,875	109,132	123,872	109,132
3	1,750	197,152	225,821	197,152
4	2,625	284,171	326,611	284,171
5	3,500	372,190	428,559	372,190
6	4,375	459,709	529,928	459,709
7	5,250	547,228	631,298	547,228
8	6,562	678,256	783,062	678,256



Gambar 5.10 Grafik hubungan beban – lendutan analisis SAP 2000



Gambar 5.11 Regresi hubungan beban – lendutan analisis SAP 2000

Perhitungan kekakuan benda uji

a. benda uji 1

Persamaan garis regresi 1

P = 0.0069 Δ

$\phi = \frac{P}{\Delta} = 0.0069\ \Delta$

P = 2,6249934 kN

Δ = 3.82 mm

$tg\ \varphi = k = \frac{2,6249934}{3.82}$

$= 0.6871711$ kN/mm

Persamaan garis regresi 2

P = 0.0069 Δ + 2.0707

$\phi = \frac{P}{\Delta} = 0.0069\ \Delta + 2,0707$

P = 3.4999913 kN

Δ = 9,85 mm

$tg\ \varphi = k = \frac{3,4999913}{9,85}$

$= 0,3553291$ kN/mm

b. benda uji 2

Persamaan garis regresi 1

P = 0,0073 Δ

$\phi = \frac{P}{\Delta} = 0,0073\ \Delta$

P = 3,4999913 kN

Δ = 4,8 mm

$$\text{tg}\,\varphi = k = \frac{3{,}4999913}{4{,}8}$$

$$= 0{,}7291648 \text{ kN/mm}$$

Persamaan garis regresi 2

$P = 0{,}0025\,\Delta + 2{,}2826$

$$\phi = \frac{P}{\Delta} = 0{,}0069\,\Delta + 2{,}2826$$

$P = 4{,}3749891$ kN

$\Delta = 8{,}25$ mm

$$\text{tg}\,\varphi = k = \frac{4{,}3749891}{8{,}25}$$

$$= 0{,}5303017 \text{ kN/mm}$$

c. **benda uji 3**

Persamaan garis regresi 1

$P = 0{,}0095\,\Delta$

$$\phi = \frac{P}{\Delta} = 0{,}0095\,\Delta$$

$P = 5{,}2499869$ kN

$\Delta = 5{,}54$ mm

$$\text{tg}\,\varphi = k = \frac{5{,}2499869}{5{,}54}$$

$$= 0{,}9476511 \text{ kN/mm}$$

Persamaan garis regresi 2

$P = 0{,}0046\,\Delta + 2{,}6987$

$$\phi = \frac{P}{\Delta} = 0{,}0046\,\Delta + 2{,}6987$$

$P = 6{,}1249847$ kN

$\Delta = 7{,}44$ mm

$$tg\ \varphi = k = \frac{6{,}1249847}{7{,}44}$$

$$= 0{,}9476511 \text{ kN/mm}$$

d. benda uji 4

Persamaan garis regresi 1

$P = 0{,}0084\ \Delta$

$$\phi = \frac{P}{\Delta} = 0{,}0084\ \Delta$$

$P = 6{,}5624836$ kN

$\Delta = 7{,}85$ mm

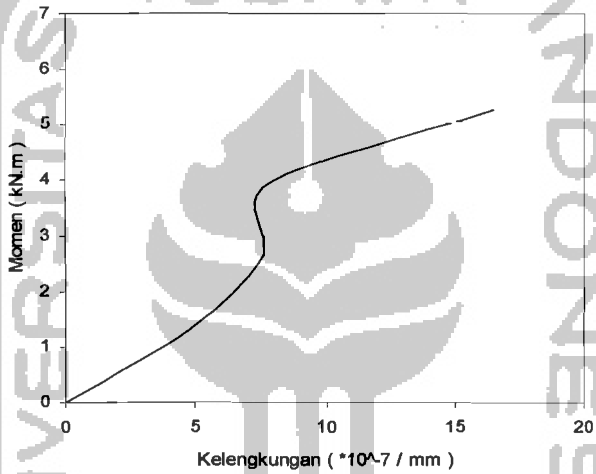
$$tg\ \varphi = k = \frac{6{,}5624836}{7{,}85}$$

$$= 0{,}8359852 \text{ kN/mm}$$

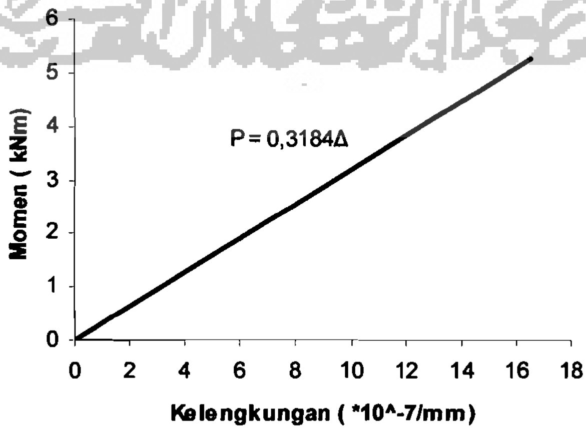
Benda Uji	Beban maks (kN)	Lendutan (mm)	Kekakuan (kN / mm)
1	3,500	9,85	0,3553291
2	4,375	8,25	0,5303017
3	6,125	7,44	0,8232506
4	6,562	7,85	0,8359852

Table 5.11 Hubungan momen - kelengkungan benda uji 1

Beban (kN)	Pembacaan dial (.10^{-2} mm)			Momen (kN.m)	Kelengkungan (.10^{-5}/mm)
	Dial 1	Dial 2	Dial 3		
0,000	0,000	0,000	0,000	0,000	0,000
0,875	1,750	2,050	1,270	1,312	4,800
1,750	2,020	2,740	1,770	2,625	7,511
2,625	3,690	3,820	2,200	3,937	7,778
3,500	8,940	9,850	7,050	5,250	16,489



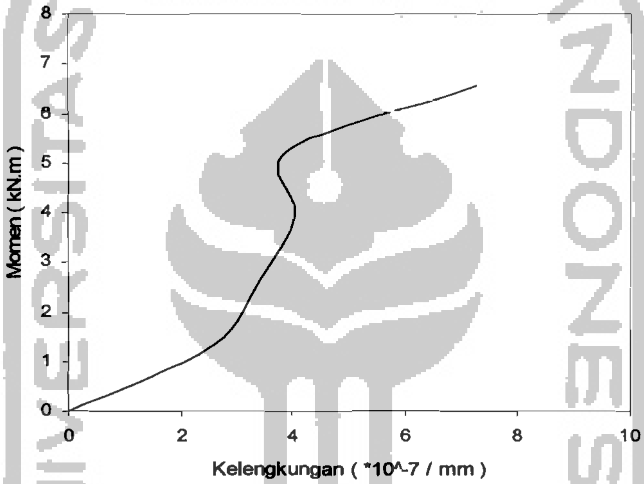
Gambar 5.14 Grafik Hubungan momen - kelengkungan benda uji 1



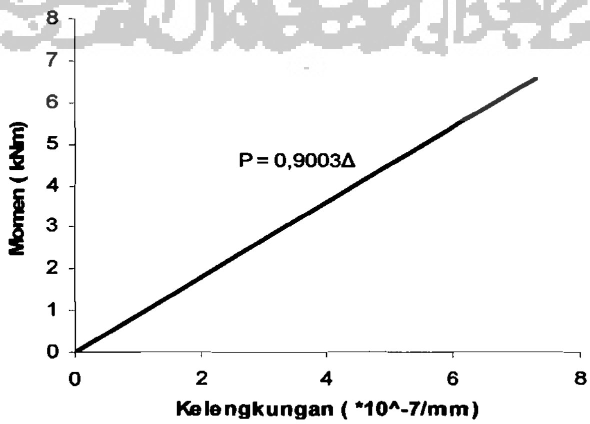
Gambar 5.15 Regresi Hubungan Momen - kelengkungan benda uji 1

Table 5.12 Hubungan momen - kelengkungan benda uji 2

Beban (kN)	Pembacaan dial (.10^{-2} mm)			Momen (kN.m)	Kelengkungan (.10^{-5} /mm)
	Dial 1	Dial 2	Dial 3		
0,000	0,000	0,000	0,000	0,000	0,000
0,875	2,38	2,57	2,19	1,312	2,533
1,750	3,12	3,50	3,11	2,625	3,422
2,625	3,64	3,91	3,27	3,937	4,044
3,500	4,52	4,80	4,20	5,250	3,911
4,375	7,51	8,25	7,35	6,562	7,289



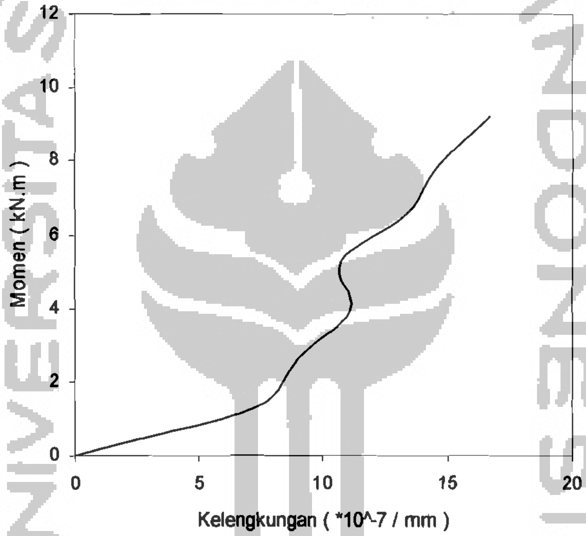
Gambar 5.16 Grafik Hubungan momen - kelengkungan benda uji 2



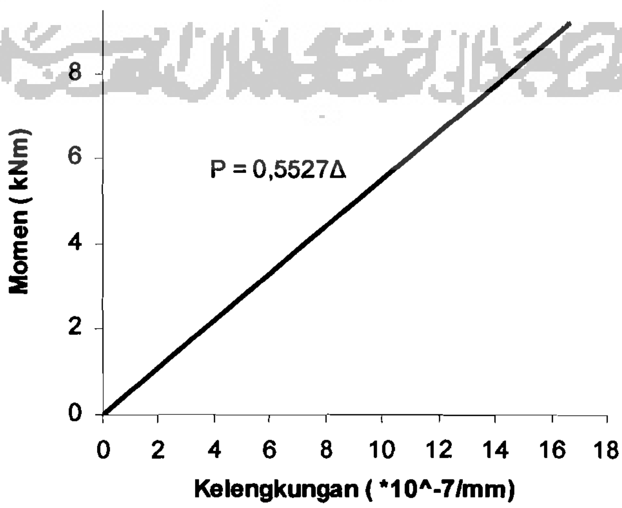
Gambar 5.17 Regresi Hubungan Momen - kelengkungan benda uji 2

Table 5.13 Hubungan momen - kelengkungan benda uji 3

Beban (kN)	Pembacaan dial ($.10^{-2}$ mm)			Momen (kN.m)	Kelengkungan ($.10^{-5}$ /mm)
	Dial 1	Dial 2	Dial 3		
0,000	0,00	0,00	0,00	0,00	0,0000
0,875	1,33	2,04	1,10	1,312	7,3330
1,750	2,00	3,00	1,97	2,625	9,0220
2,625	2,36	3,53	2,20	3,937	11,111
3,500	2,75	4,05	2,93	5,250	10,756
4,375	3,12	4,61	3,09	6,562	13,378
5,250	3,79	5,54	4,00	7,875	14,622
6,125	5,19	7,44	5,95	9,187	16,622



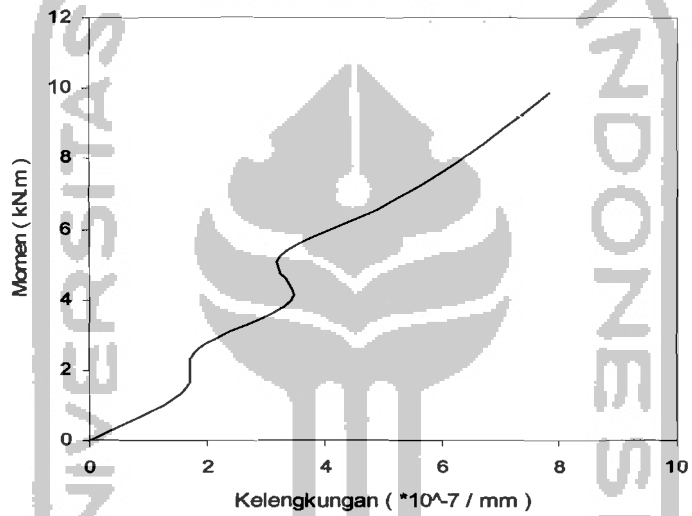
Gambar 5.18 Grafik Hubungan momen - kelengkungan benda uji 3



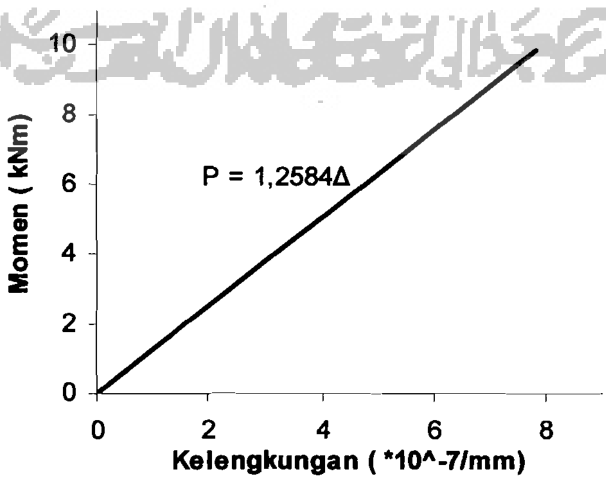
Gambar 5.19 Regresi Hubungan Momen - kelengkungan benda uji 3

Table 5.14 Hubungan momen - kelengkungan benda uji 4

Beban (kN)	Pembacaan dial (.10^{-2} mm)			Momen (kN.m)	Kelengkungan (.10^{-5} /mm)
	Dial 1	Dial 2	Dial 3		
0,000	0,00	0,00	0,00	0,00	0,000
0,875	2,89	3,12	3,00	1,312	1,556
1,750	3,82	4,10	3,96	2,625	1,867
2,625	4,32	4,65	4,21	3,937	3,422
3,500	4,96	5,35	5,01	5,250	3,244
4,375	5,37	5,80	5,13	6,562	4,889
5,250	6,24	6,95	6,25	7,875	6,267
6,562	6,84	7,85	7,10	9,844	7,822



Gambar 5.20 Grafik Hubungan momen - kelengkungan benda uji 4

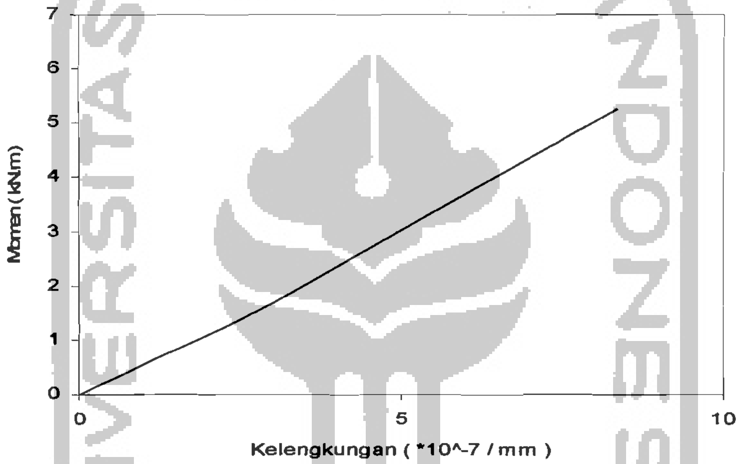


Gambar 5.21 Regresi Hubungan Momen - kelengkungan benda uji 4

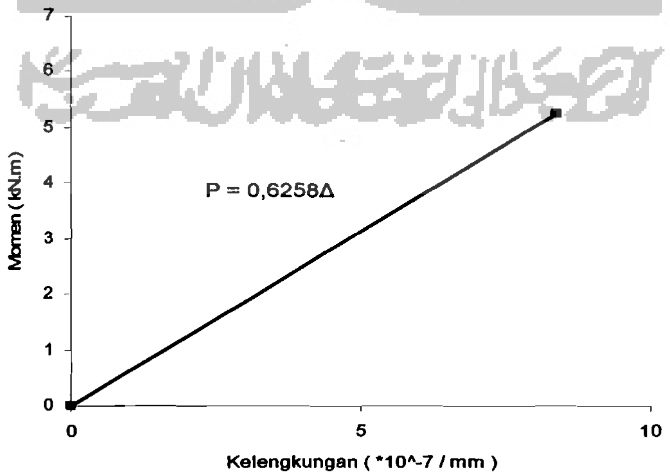
5.4.1 Hubungan momen (P) - Kelengkungan (ϕ) Hasil Analisis SAP 2000

Table 5.15 Hubungan momen - kelengkungan analisis SAP 2000 Benda uji 1

No	Beban (kN)	Dial 1 (mm)	Dial 2 (mm)	Dial 3 (mm)	Momen (kN.m)	Kelengkungan (*10^-7 /mm)
1	0	0,0000	0,0000	0,0000	0	0,000
2	0,875	0,2704	0,5408	0,2704	1,312	2,403
3	1,750	0,4957	0,9914	0,4957	2,625	4,406
4	2,625	0,7184	1,4369	0,7184	3,937	6,386
5	3,500	0,9437	1,8875	0,9437	5,250	8,389



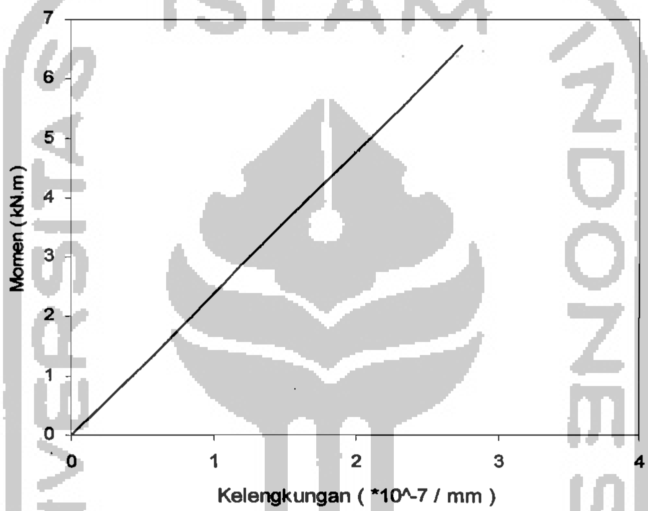
Gambar 5.22 Grafik Hubungan momen - kelengkungan analisis SAP 2000 Benda uji 1



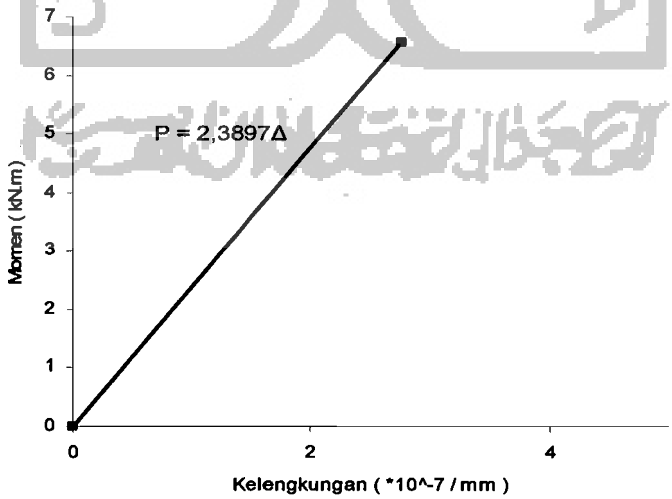
Gambar 5.23 Regresi Hubungan momen - kelengkungan analisis SAP 2000 Benda uji 1

Table 5.16 Hubungan momen - kelengkungan analisis SAP 2000 Benda uji 2

No	Beban (kN)	Dial 1 (mm)	Dial 2 (mm)	Dial 3 (mm)	Momen (kN.m)	Kelengkungan (*10^-7 /mm)
1	0	0	0	0	0	0,000
2	0,875	0,49	0,56	0,49	1,312	0,566
3	1,750	0,88	1,01	0,88	2,625	1,114
4	2,625	1,27	1,45	1,27	3,937	1,655
5	3,500	1,65	1,90	1,65	5,250	2,202
6	4,375	2,04	2,35	2,04	6,562	2,746



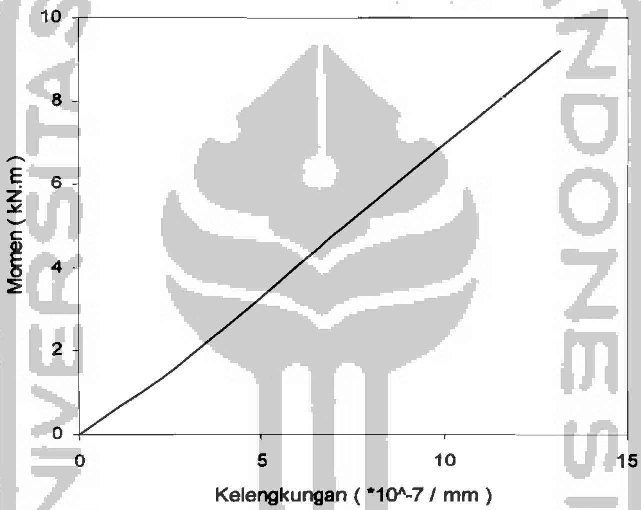
Gambar 5.24 Grafik Hubungan momen - kelengkungan analisis SAP 2000 Benda uji 2



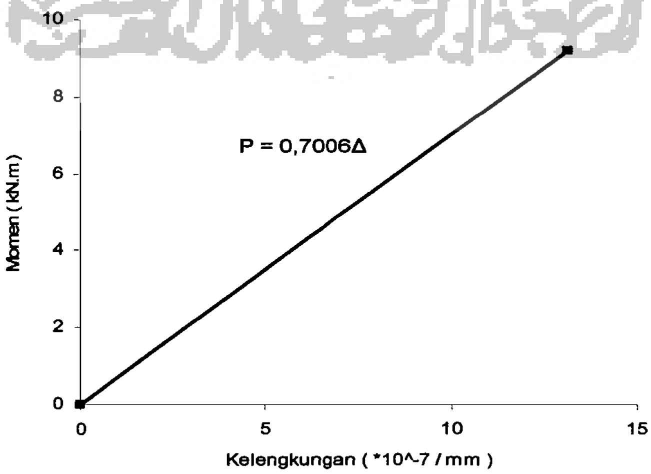
Gambar 5.25 Regresi Hubungan momen - kelengkungan analisis SAP 2000 Benda uji 2

Table 5.17 Hubungan momen - kelengkungan analisis SAP 2000 Benda uji 3

No	Beban (kN)	Dial 1 (mm)	Dial 2 (mm)	Dial 3 (mm)	Momen (kN.m)	Kelengkungan (*10^-7 /mm)
1	0	0	0	0	0	0,000
2	0,875	0,25	0,50	0,25	1,312	2,226
3	1,750	0,46	0,91	0,46	2,625	4,049
4	2,625	0,66	1,32	0,66	3,937	5,852
5	3,500	0,86	1,73	0,86	5,250	7,675
6	4,375	1,07	2,13	1,07	6,563	9,488
7	5,250	1,27	2,54	1,27	7,875	11,301
8	6,125	1,48	2,95	1,48	9,187	13,114



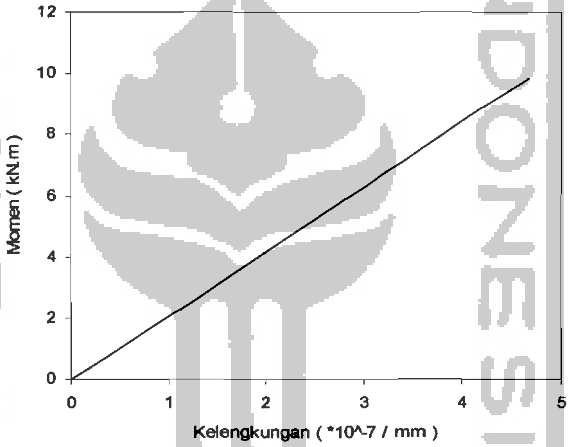
Gambar 5.26 Grafik Hubungan momen - kelengkungan analisis SAP 2000 Benda uji 3



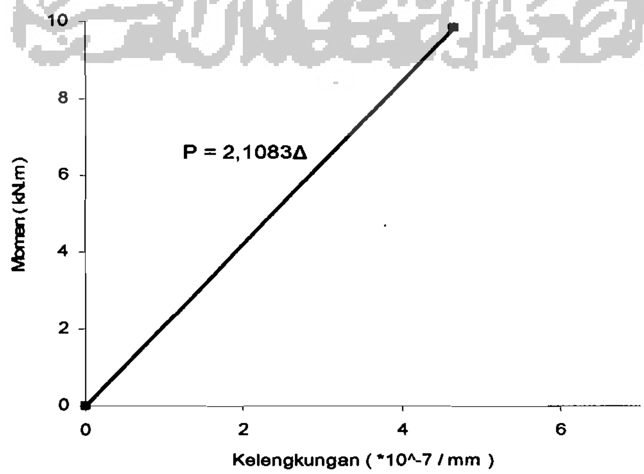
Gambar 5.27 Regresi hubungan momen - kelengkungan analisis SAP 2000 Benda uji 3

Table 5.18 Hubungan momen - kelengkungan analisis SAP 2000 Benda uji 4

No	Beban (kN)	Dial 1 (mm)	Dial 2 (mm)	Dial 3 (mm)	Momen (kN.m)	Kelengkungan ($*10^{-7}$ /mm)
1	0	0	0	0	0	0,000
2	0,875	0,55	0,62	0,55	1,312	0,657
3	1,750	0,99	1,13	0,99	2,625	1,277
4	2,625	1,42	1,64	1,42	3,937	1,891
5	3,500	1,87	2,15	1,87	5,250	2,511
6	4,375	2,30	2,66	2,30	6,562	3,128
7	5,250	2,74	3,16	2,74	7,875	3,745
8	6,562	3,40	3,92	3,40	9,844	4,669



Gambar 5.28 Grafik Hubungan Momen - kelengkungan analisis SAP 2000 Benda uji 4



Gambar 5.29 Regresi hubungan momen - kelengkungan analisis SAP 2000 Benda uji 4

Perhitungan Faktor kekakuan berdasarkan hubungan momen – kelengkungan

a. benda uji 1

Momen Maksimum = 5,256 kNm; ϕ = 16,489 . 10^{-5}/mm

$$EI = \frac{M}{\phi}$$

$$= \frac{5256}{16,489}$$

$$= 31839408,09 \text{ kNmm}^2$$

b. benda uji 2

Momen Maksimum = 6,563 kNm; ϕ = 7,289 . 10^{-5}/mm

$$EI = \frac{M}{\phi}$$

$$= \frac{6563}{7,289}$$

$$= 90039785,98 \text{ kNmm}^2$$

c. benda uji 3

Momen Maksimum = 6,563 kNm; ϕ = 7,289 . 10^{-5}/mm

$$EI = \frac{M}{\phi}$$

$$= \frac{6563}{7,289}$$

$$= 83816579,38 \text{ kNmm}^2$$

d. benda uji 4

Momen Maksimum = 9,187 kNm; ϕ = 16,622 . 10^{-5}/mm

$$EI = \frac{M}{\phi}$$

$$= \frac{9187}{16,622}$$

$$= 125850166,20 \text{ kNmm}^2$$

e. Analisis SAP 2000

Momen Maksimum = 9,187 kNm; ϕ = 7,822. 10^{-5}/mm

$$EI = \frac{M}{\phi}$$

$$= \frac{9187}{7,822}$$

$$= 117450779,85 \text{ kNmm}^2$$

Benda uji	Momen maksimum (kN.mm)	ϕ (10^{-5} / mm)	Fakor kekakuan (kN.mm)
1	5,250	16,489	31839408,09
2	6,263	7,289	90039785,98
3	9,187	16,622	125850166,20
4	9,844	7,822	125850166,20
SAP 2000	9,187	7,822	117450779,85

Data gaya batang (element force) aksial (P) analisa SAP 2000

Beban maksimum ($P_{maksimum}$) hasil pengujian digunakan untuk mencari gaya batang elemen kuda-kuda, data gaya batang (P) hasil analisa SAP 2000 diberikan pada tabel dibawah ini

Benda uji 1

$P_{maksimum}$ = 3,5 kN

Tabel L.3.1 Gaya batang benda uji 1

NO	Station	P
BATANG	mm	KN
1	0	-5,39388
1	798	-5,38875
1	1596	-5,38363
2	0	-5,33913
2	798	-5,33401
2	1596	-5,32889
3	0	-5,32889
3	798	-5,33401
3	1596	-5,33913
4	0	-5,38363
4	798	-5,38875
4	1596	-5,39388
5	0	5,063724
5	500	5,063724
5	1000	5,063724
5	1500	5,063724
5	2000	5,063724
5	2500	5,063724
5	3000	5,063724
6	0	5,063724
6	500	5,063724
6	1000	5,063724
6	1500	5,063724
6	2000	5,063724
6	2500	5,063724
6	3000	5,063724
7	0	-5,73E-02
7	798	-5,47E-02
7	1596	-5,22E-02

Tabel L.3.2 lanjutan Gaya batang Benda uji 1

8	0	0,118982
8	546	0,113858
8	1092	0,108734
9	0	-5,73E-02
9	0	-5,73E-02
9	798	-5,47E-02
9	1596	-5,22E-02

Benda uji 2

P $_{maksimum}$ **= 4,375 kN**

Tabel L.3.3 Gaya batang Benda uji 2

NO	Station	P
BATANG	mm	KN
1	0	6,318
1	500	6,318
1	1000	6,318
1	1500	6,318
2	0	6,318
2	500	6,318
2	1000	6,318
2	1500	6,318
3	0	6,318
3	500	6,318
3	1000	6,318
3	1500	6,318
4	0	6,318
4	500	6,318
4	1000	6,318
4	1500	6,318
5	0	0,033
5	273	0,031
5	546	0,028
6	0	-0,106
6	798	-0,103
6	1596	-0,101
7	0	0,124
7	546	0,119
7	1092	0,114
8	0	-0,106
8	798	-0,103
8	1596	-0,101
9	0	0,033
9	273	0,031
9	546	0,028
10	0	-6,729
10	798	-6,724
10	1596	-6,719
11	0	-6,626
11	798	-6,621
11	1596	-6,615
12	0	-6,615
12	798	-6,621
12	1596	-6,626
13	0	-6,719
13	798	-6,724
13	1596	-6,729

Benda uji 3

P $_{maksimum}$ = 6,125 kN

Tabel L.3.5 Gaya batang Benda uji 3

NO	Station	P
BATANG	mm	KN
1	0	-9,25842
1	798	-9,25279
1	1596	-9,24716
2	0	-9,19828
2	798	-9,19266
2	1596	-9,18703
3	0	-9,18703
3	798	-9,19266
3	1596	-9,19828
4	0	-9,24716
4	798	-9,25279
4	1596	-9,25842
5	0	8,694693
5	500	8,694693
5	1000	8,694693
5	1500	8,694693
5	2000	8,694693
5	2500	8,694693
5	3000	8,694693
6	0	8,694693
6	500	8,694693
6	1000	8,694693
6	1500	8,694693
6	2000	8,694693
6	2500	8,694693
6	3000	8,694693
7	0	-6,29E-02
7	798	-6,01E-02
7	1596	-5,73E-02
8	0	0,130693
8	546	0,125065
8	1092	0,119437
9	0	-6,29E-02
9	0	-6,29E-02
9	798	-6,01E-02
9	1596	-5,73E-02

Benda uji 4

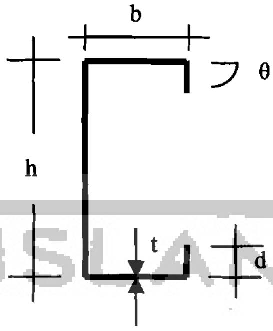
P $_{maksimum}$ = 6,56 kN

Tabel L.3.7 Gaya batang Benda uji 4

NO	Station	P
BATANG	mm	KN
1	0	9,298305
1	500	9,298305
1	1000	9,298305
1	1500	9,298305
2	0	9,298305
2	500	9,298305
2	1000	9,298305
2	1500	9,298305
3	0	9,298305
3	500	9,298305
3	1000	9,298305
3	1500	9,298305
4	0	9,298305
4	500	9,298305
4	1000	9,298305
4	1500	9,298305
5	0	3,05E-02
5	273	2,76E-02
5	546	2,48E-02
6	0	-9,80E-02
6	798	-9,52E-02
6	1596	-9,24E-02
7	0	0,117641
7	546	0,112013
7	1092	0,106385
8	0	-9,80E-02
8	798	-9,52E-02
8	1596	-9,24E-02
9	0	3,05E-02
9	273	2,76E-02
9	546	2,48E-02
10	0	-9,89966
10	798	-9,89514
10	1596	-9,89063
11	0	-9,80449
11	798	-9,79998
11	1596	-9,79546
12	0	-9,79546
12	798	-9,79998
12	1596	-9,80449
13	0	-9,89063
13	798	-9,89514
13	1596	-9,89966

Lampiran 3

Perhitungan Batang Tekan Light Lipped Channel



Gambar 4.1 profil Lipped Channel

1. Rangka kuda-kuda Baja profil 60 x 22 x 8 x 1,2mm

h = 60 mm

b = 22 mm

d = 8 mm

t = 1,2 mm

A = t x (b + 2h + 2d)

= 1,2 . (22 + (2 . 70) + (2 . 8)

= 144 mm²

$e_y = \frac{1}{2} . 60 = 30$ mm

$e_x = 6{,}967$ mm

$$Ix = \frac{1}{12} . t . h^3 + \frac{1}{2} . b . t . h^2 + \frac{2}{3} . t . d^3 + \frac{1}{2}\ d . t . h^2 - d^2 . t.h + \frac{1}{6} . b . t^3$$

$= \frac{1}{12} . 1{,}2 . 60^3 + \frac{1}{2} . 22 . 1{,}2 . 60^2 + \frac{2}{3} . 1{,}2. 8^3 + \frac{1}{2}\ 8 . 1{,}2 . 60^2 - 8^2 .$

$1{,}2.60 + \frac{1}{6} . 22 . 1{,}2^3$

$= 0{,}00822 . 10^7\ mm^4$

$Iy = \frac{1}{12} . h . t^3 + \frac{1}{2} . t . b^3 + \frac{2}{3} . d . t^3 + 2\ d . t . b^2 - (h. t + 2. b .t + 2.d.t).b^2.$

$\frac{(b+2.d)^2}{(h+2.b+2.d)^2}$

$= \frac{1}{12} . 60 . 1{,}2^3 + \frac{1}{2} . 1{,}2 . 22^3 + \frac{2}{3} . 8 . 1{,}2^3 + 2\ 8 . 1{,}2 . 22^2 - (60. 1.2 + 2.$

$22 .1{,}2 + 2.8.1{,}2) . 22^2 . \frac{(22+2.8)^2}{(60.2.22+2.8)^2}$

$= 0{,}001083.10^7\ mm^4$

$F_y = 103{,}94$ Mpa

$r_x = \sqrt{\frac{Ix}{A}}$

$= \sqrt{\frac{82214{,}90}{144}}$

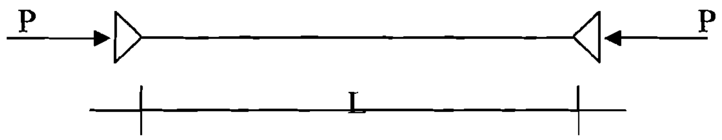
$= 23{,}89$ mm

$r_y = \sqrt{\frac{Iy}{A}}$

$= \sqrt{\frac{10833{,}184}{144}}$

$= 8{,}67$ mm

Lx = Ly = 1596 mm



Gambar L4.2 pembebanan batang tekan profil C

Pada tekanan aksial, penampang ini memiliki elemen yang diperkuat yaitu badan sedangkan elemen yang tidak diperkuat adalah sayap. Elemen yang tidak diperkuat harus ditinjau dahulu untuk menentukan tingkat tegangan efektif.

1. Perhitungan F_{cr} dengan Metode AISC

a. Elemen yang tidak diperkuat:

$\left[\frac{b}{t} = \frac{22}{1,2} = 18,333\right] < \left[\frac{250}{\sqrt{F_y}} = 24,521\right]$ maka tekuk setempat tidak mengurangi efisiensi : Qs = 1,0

b. elemen yang diperkuat

$$f = F_y \,.\, Qs$$

$$= 103,944 \times 1$$

$$= 103,944$$

$$\frac{bE}{t} = \frac{21}{f}.\left[1 - \frac{4,18}{(b/t).\sqrt{f}}\right]$$

$$\frac{bE}{t} = \frac{21}{\sqrt{103,944}}.\left[1 - \frac{4,18}{(18,33).\sqrt{103,944}}\right]$$

$$= 0,197514$$

A_{eff} $= \text{A brutto} - \left[\frac{b}{t} - \frac{bE}{t}\right] t^2$

$= 144 - [18{,}33 - 0{,}197514]$

$= 117{,}884$

Q_A $= \frac{A_{effek}}{A_{bruto}}$

$= \frac{117{,}884}{144}$

$= 0{,}819$

Q $= Q_A \cdot Q_s$

$= 0{,}819 \cdot 1$

$= 0{,}819$

Asumsi K = 1

$\frac{K \cdot L_y}{r_y} = \frac{1.1596}{8{,}67} = 184{,}0$

Cc $= \sqrt{\frac{2\pi^2 E}{Q.F_y}}$

$= \sqrt{\frac{2\pi^2.2.10^5}{0{,}816.103{,}94}}$

$= 215{,}285$

$\frac{K \cdot L_y}{r_y} <$ Cc KL/r

$$F_{cr} = Q \cdot Fy\left[1 - \frac{(KL/r)^2}{2.Cc^2}\right]$$

$$= 0{,}48 \cdot 103{,}944\left[1 - \frac{(184{,}0)^2}{2.215{,}285^2}\right]$$

$$= 54{,}011 \text{ Mpa}$$

P_{cr} $= F_{cr} \cdot A$

$= 54{,}011 \cdot 10^{-3} \cdot 144$

$= 7{,}778$ kN

$P_{maksimum} = 6{,}729$ kN

$P_{maksimum} < P_{cr}$ maka batang belum rusak

2. Rangka Kuda-kuda Baja Profil 70 x 22 x 8 x 1,2mm

h = 70 mm

b = 22 mm

d = 8 mm

t = 1,2 mm

A = t x (b + 2h + 2d)

= 1,2 . (22 + (2 . 70) + (2 . 8)

= 156 mm^2

$e_y = \frac{1}{2}.70 = 35$ mm

e_x = 6,43 mm

$Ix = \frac{1}{12}.t.h^3 + \frac{1}{2}.b.t.h^2 + \frac{2}{3}.t.d^3 + \frac{1}{2}d.t.h^2 - d^2.t.h + \frac{1}{6}.b.t^3$

$= \frac{1}{12}.\ 1{,}2\ .\ 70^3 + \frac{1}{2}.\ 22\ .\ 1{,}2\ .\ 70^2 + \frac{2}{3}.\ 1{,}2.\ 8^3 + \frac{1}{2}8\ .\ 1{,}2\ .\ 70^2 - 8^2\ .$
$1{,}2.70 + \frac{1}{6}.\ 22\ .\ 1{,}2^3$

$= 0{,}\ 0117.10^7\ mm^4$

$Iy = \frac{1}{12}.h.t^3 + \frac{1}{2}.t.b^3 + \frac{2}{3}.d.t^3 + 2\ d.t.b^2 - (h.\ t + 2.\ b\ .t + 2.d.t).b^2.$
$\frac{(b+2.d)^2}{(h+2.b+2.d)^2}$

$= \frac{1}{12}.\ 70\ .\ 1{,}2^3 + \frac{1}{2}.\ 1{,}2\ .\ 22^3 + \frac{2}{3}.\ 8\ .\ 1{,}2^3 + 2\ 8\ .\ 1{,}2\ .\ 22^2 - (70.\ 1.2 + 2.$
$22\ .1{,}2 + 2.8.1{,}2)\ .\ 22^2.\ \frac{(22+2.8)^2}{(70.2.22+2.8)^2}$

$= 0{,}00114 .10^7 \text{ mm}^4$

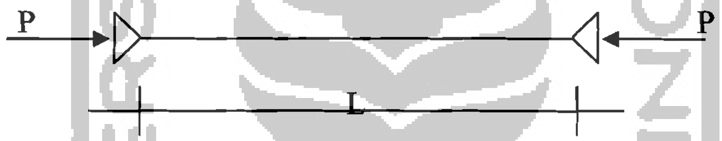
Fy $= 137{,}10$ Mpa

rx $= \sqrt{\dfrac{Ix}{A}} = 27{,}45$ mm

ry $= \sqrt{\dfrac{Iy}{A}} = 8{,}54$ mm

Lx = Ly = 1596 mm

Gambar pembebanan batang tekan profil C



pada tekanan aksial, penampang ini memiliki elemen yang diperkuat yaitu badan sedangkan elemen yang tidak diperkuat adalah sayap. Elemen yang tidak diperkuat harus ditinjau dahulu untuk menentukan tingkat tegangan efektif.

2. Perhitungan F_{cr} dengan Metode AISC

c. elemen yang tidak diperkuat:

$\left[\dfrac{b}{t} = \dfrac{22}{1{,}2} = 18{,}333\right] < \left[\dfrac{250}{\sqrt{Fy}} = 21{,}351\right]$ maka tekuk setempat tidak mengurangi

efisiensi : Qs = 1,0

d. elemen yang diperkuat

f = Fy . Qs

= 137,102 x 1

= 137,102

$$\frac{bE}{t} = \frac{21}{f}.\left[1 - \frac{4{,}18}{(b/t).\sqrt{f}}\right]$$

$$\frac{bE}{t} = \frac{21}{\sqrt{137{,}102}}.\left[1 - \frac{4{,}18}{(18{,}333).\sqrt{1137{,}102}}\right]$$

= 0,1502

A_{eff} = A brutto - $\left[.\frac{b}{t} - \frac{bE}{t}\right].t^2$

= 156 – [18,33-0,1502] . $1{,}2^2$

= 129,816 mm

Q_A = $\frac{A_{effek}}{A_{bruto}}$

= $\frac{129{,}816}{156}$

= 0,832

Q = $Q_A . Q_s$

= 0,832 . 1

= 0,832

Asumsi K = 1

$$\frac{K . L_y}{r_y} = \frac{1.1596}{8{,}54} = 186{,}9$$

$$Cc = \sqrt{\frac{2\pi^2 E}{Q.F_y}}$$

$$= \sqrt{\frac{2\pi^2.2.10^5}{0,832.137,102}}$$

$$= 185,924$$

$\frac{K.L_y}{r_y}$ < Cc KL/r

$$F_{cr} = Q . Fy\left[1-\frac{(KL/r)^2}{2.Cc^2}\right]$$

$$= 0,832.\ 137,102\left[1-\frac{(186,9)^2}{2.185,924^2}\right]$$

= 56,428 Mpa

P_{cr} = F_{cr} . A

= 56,428. 10^{-3} . 156

= 8,803 kN

$P_{maksimum}$ = 9,900 kN

$P_{maksimum} > P_{cr}$ maka batang rusak

Perhitungan Beban Kritis Elemen Struktur Rangka

Tabel 5.1 Kekuatan Batang Tekan Benda Uji 1

NO BATANG	P (kN)	L (mm)	KL/r	Fcr (Mpa)	Pcr (k N)	Keterangan
1	-5,394	1596	184,0	58,15982	8,375014	$P_{eks}<P_{cr}$
2	-5,339	1596	184,0	58,15982	8,375014	$P_{eks}<P_{cr}$
3	-5,339	1596	184,0	58,15982	8,375014	$P_{eks}<P_{cr}$
4	-5,394	1596	184,0	58,15982	8,375014	$P_{eks}<P_{cr}$
7	-0,057	1596	184,0	58,15982	8,375014	$P_{eks}<P_{cr}$
9	-0,057	1596	184,0	58,15982	8,375014	$P_{eks}<P_{cr}$

Tabel 5.2 Kekuatan Batang Tarik Benda Uji 1

NO BATANG	P (kN)	Pcr (k N)	Keterangan
5	5,064	19,74264	$P_{eks}<P_{cr}$
6	5,064	19,74264	$P_{eks}<P_{cr}$
8	0,119	19,74264	$P_{eks}<P_{cr}$

Tabel 5.3 Kekuatan Batang Tekan Benda Uji 2

NO BATANG	P (kN)	L (mm)	KL/r	Fcr (Mpa)	Pcr (k N)	Keterangan
6	-0,106	1596	184,0	54,010861	7,777564	$P_{eks}<P_{cr}$
8	-0,106	1596	184,0	54,010861	7,777564	$P_{eks}<P_{cr}$
10	-6,729	1596	184,0	54,010861	7,777564	$P_{eks}<P_{cr}$
11	-6,626	1596	184,0	54,010861	7,777564	$P_{eks}<P_{cr}$
12	-6,626	1596	184,0	54,010861	7,777564	$P_{eks}<P_{cr}$
13	-6,729	1596	184,0	54,010861	7,777564	$P_{eks}<P_{cr}$

Tabel 5.4 Kekuatan Batang Tarik Benda Uji 2

NO BATANG	P (kN)	Pcr (k N)	Keterangan
1	6,318	14,96794	$P_{eks}<P_{cr}$
2	6,318	14,96794	$P_{eks}<P_{cr}$
3	6,318	14,96794	$P_{eks}<P_{cr}$
4	6,318	14,96794	$P_{eks}<P_{cr}$
5	0,033	14,96794	$P_{eks}<P_{cr}$
7	0,124	14,96794	$P_{eks}<P_{cr}$
9	0,033	14,96794	$P_{eks}<P_{cr}$

Lampiran 5

Tabel 5.5 Kekuatan Batang desak Benda Uji 3

NO BATANG	P (kN)	L (mm)	KL/r	Fcr (Mpa)	Pcr (k N)	Keterangan
1	-9,258	1596	186,9	56,427912	8,802754	$P_{eks}<P_{cr}$
2	-9,193	1596	186,9	56,427912	8,802754	$P_{eks}<P_{cr}$
3	-9,193	1596	186,9	56,427912	8,802754	$P_{eks}<P_{cr}$
4	-9,258	1596	186,9	56,427912	8,802754	$P_{eks}<P_{cr}$
7	-0,063	1596	186,9	56,427912	8,802754	$P_{eks}<P_{cr}$
9	-0,060	1596	186,9	56,427912	8,802754	$P_{eks}<P_{cr}$

Tabel 5.6 Kekuatan Batang tarik Benda Uji 3

NO BATANG	P (kN)	Pcr (k N)	Keterangan
5	8,695	21,38786	$P_{eks}<P_{cr}$
6	8,695	21,38786	$P_{eks}<P_{cr}$
8	0,131	21,38786	$P_{eks}<P_{cr}$

Tabel 5.7 Kekuatan Batang Tekan Benda Uji 4

NO BATANG	P (kN)	L (mm)	KL/r	Fcr (Mpa)	Pcr (k N)	Keterangan
6	-0,098	1596	186,9	56,427912	8,802754	$P_{eks}<P_{cr}$
8	-0,098	1596	186,9	56,427912	8,802754	$P_{eks}<P_{cr}$
10	-9,900	1596	186,9	56,427912	8,802754	$P_{eks}<P_{cr}$
11	-9,800	1596	186,9	56,427912	8,802754	$P_{eks}<P_{cr}$
12	-9,804	1596	186,9	56,427912	8,802754	$P_{eks}<P_{cr}$
13	-9,900	1596	186,9	56,427912	8,802754	$P_{eks}<P_{cr}$

Tabel 5.8 Kekuatan Batang Tarik Benda Uji 4

NO BATANG	P (kN)	Pcr (k N)	Keterangan
1	9,298	21,38786	$P_{eks}<P_{cr}$
2	9,298	21,38786	$P_{eks}<P_{cr}$
3	9,298	21,38786	$P_{eks}<P_{cr}$
4	9,298	21,38786	$P_{eks}<P_{cr}$
5	0,028	21,38786	$P_{eks}<P_{cr}$
7	0,118	21,38786	$P_{eks}<P_{cr}$
9	0,030	21,38786	$P_{eks}<P_{cr}$

Perhitungan Koefisien Tekuk

1. Koefisien Tekuk Uji desak

a. benda uji 1

Fcr = 87,607 Mpa

b = 22 mm

t = 1,2 mm

E = 2.10^5

μ = 0,3

$$Fcr = k\frac{\pi^2 E}{12\left(1-\mu^2\right)\left(b/t\right)^2}$$

$$k = \frac{F_{cr}.12.\left(1-\mu\right)\left(b/t\right)^2}{\pi^2 E}$$

$$= \frac{87{,}607.12.\left(1-0{,}3\right)\left(\frac{22}{1{,}2}\right)^2}{3{,}14^2.(2.10^5)}$$

= 0,163

b. benda uji 2

Fcr = 94,231 Mpa

b = 22 mm

t = 1,2 mm

E = 2.10^5

μ = 0,3

Fcr $= k\dfrac{\pi^2 E}{12(1-\mu^2)(b/t)^2}$

K $= \dfrac{F_{cr}.12.(1-\mu)(b/t)^2}{\pi^2 E}$

$= \dfrac{94{,}231.12.(1-0{,}3)\left(\dfrac{22}{1{,}2}\right)^2}{3{,}14^2.(2.10^5)}$

$= 0{,}175$

c. **benda uji 3**

Fcr = 102,564 Mpa

b = 22 mm

t = 1,2 mm

E = 2.10^5

μ = 0,3

Fcr $= k\dfrac{\pi^2 E}{12(1-\mu^2)(b/t)^2}$

K $= \dfrac{F_{cr}.12.(1-\mu)(b/t)^2}{\pi^2 E}$

$= \dfrac{102{,}564.12.(1-0{,}3)\left(\dfrac{22}{1{,}2}\right)^2}{3{,}14^2.(2.10^5)}$

$= 0{,}191$

Tabel lampiran 6.1 Koefisien tekuk uji desak profil

Benda uji	F_{cr} (Mpa)	π	A (mm)	b/t	μ	Koefisien Tekuk (k)
Benda uji 1	87,607	3,14	156	18,333	0,3	0,163
Benda uji 2	94,231	3,14	156	18,333	0,3	0,175
Benda uji 3	102,564	3,14	156	18,333	0,3	0,910

2. Koefisien tekuk hasil pengujian

a. benda uji 1

Pcr = 5.394 kN

b = 22 mm

t = 1,2 mm

E = 2.10^5

μ = 0,3

Fcr $= \frac{P_{cr}}{A}$

$= \frac{5,394}{156} \times 1000$

= 34,557 kN/mm^2

Fcr $= k \frac{\pi^2 E}{12(1-\mu^2)(b/t)^2}$

k $= \frac{F_{cr}.12.(1-\mu)(b/t)^2}{\pi^2 E}$

$$= \frac{34,557.12.(1-0,3)\left(\frac{22}{1,2}\right)^2}{3,14^2.(2.10^5)}$$

= 0,064

b. **benda uji 2**

Fcr = 9,899 kN

b = 22 mm

t = 1,2 mm

E = 2.10^5

μ = 0,3

Fcr $= \frac{P_{cr}}{A}$

$= \frac{9,899}{156} \text{ x } 1000$

= 63,445 kN/mm^2

Fcr $= k\frac{\pi^2 E}{12(1-\mu^2)(b/t)^2}$

k $= \frac{F_{cr}.12.(1-\mu)(b/t)^2}{\pi^2 E}$

$$= \frac{63,445.12.(1-0,3)\left(\frac{22}{1,2}\right)^2}{3,14^2.(2.10^5)}$$

= 0,118

c. **benda uji 3**

Pcr = 9,258 kN

b = 22 mm

t = 1,2 mm

E = 2.10^5

μ = 0,3

Fcr $= \frac{P_{cr}}{A}$

$= \frac{9{,}258}{156} \text{ x } 1000$

$= 59{,}346 \text{ kN/mm}^2$

Fcr $= k \frac{\pi^2 E}{12(1-\mu^2)(b/t)^2}$

K $= \frac{P_{cr}.12.(1-\mu)(b/t)^2}{\pi^2 E}$

$= \frac{59{,}346.12.(1-0{,}3)\left(\frac{22}{1{,}2}\right)^2}{3{,}14^2.(2.10^5)}$

$= 0{,}110$

Tabel lampiran 6.2 Koefisien tekuk uji desak profil

Benda uji	F_{cr} (Mpa)	π	A (mm2)	b/t	μ	Koefisien Tekuk (k)
Benda Uji 1	5,394	3,14	156	18,333	0,3	0,064
Benda Uji 2	9,899	3,14	156	18,333	0,3	0,118
Benda Uji 3	9,258	3,14	156	18,333	0,3	0,110

Tabel 5.5 Kekuatan Batang desak Benda Uji 3

NO BATANG	P (kN)	L (mm)	KL/r	Fcr (Mpa)	Pcr (k N)	Keterangan
1	-9,258	1596	186,9	56,427912	8,802754	$P_{eks}<P_{cr}$
2	-9,193	1596	186,9	56,427912	8,802754	$P_{eks}<P_{cr}$
3	-9,193	1596	186,9	56,427912	8,802754	$P_{eks}<P_{cr}$
4	-9,258	1596	186,9	56,427912	8,802754	$P_{eks}<P_{cr}$
7	-0,063	1596	186,9	56,427912	8,802754	$P_{eks}<P_{cr}$
9	-0,060	1596	186,9	56,427912	8,802754	$P_{eks}<P_{cr}$

Tabel 5.6 Kekuatan Batang tarik Benda Uji 3

NO BATANG	P (kN)	Pcr (k N)	Keterangan
5	8,695	21,38786	$P_{eks}<P_{cr}$
6	8,695	21,38786	$P_{eks}<P_{cr}$
8	0,131	21,38786	$P_{eks}<P_{cr}$

Tabel 5.7 Kekuatan Batang Tekan Benda Uji 4

NO BATANG	P (kN)	L (mm)	KL/r	Fcr (Mpa)	Pcr (k N)	Keterangan
6	-0,098	1596	186,9	56,427912	8,802754	$P_{eks}<P_{cr}$
8	-0,098	1596	186,9	56,427912	8,802754	$P_{eks}<P_{cr}$
10	-9,900	1596	186,9	56,427912	8,802754	$P_{eks}<P_{cr}$
11	-9,800	1596	186,9	56,427912	8,802754	$P_{eks}<P_{cr}$
12	-9,804	1596	186,9	56,427912	8,802754	$P_{eks}<P_{cr}$
13	-9,900	1596	186,9	56,427912	8,802754	$P_{eks}<P_{cr}$

Tabel 5.8 Kekuatan Batang Tarik Benda Uji 4

NO BATANG	P (kN)	Pcr (k N)	Keterangan
1	9,298	21,38786	$P_{eks}<P_{cr}$
2	9,298	21,38786	$P_{eks}<P_{cr}$
3	9,298	21,38786	$P_{eks}<P_{cr}$
4	9,298	21,38786	$P_{eks}<P_{cr}$
5	0,028	21,38786	$P_{eks}<P_{cr}$
7	0,118	21,38786	$P_{eks}<P_{cr}$
9	0,030	21,38786	$P_{eks}<P_{cr}$

Lampiran 5

Perhitungan Beban Kritis Elemen Struktur Rangka

Tabel 5.1 Kekuatan Batang Tekan Benda Uji 1

NO BATANG	P (kN)	L (mm)	KL/r	Fcr (Mpa)	Pcr (k N)	Keterangan
1	-5,394	1596	184,0	58,15982	8,375014	$P_{eks}<P_{cr}$
2	-5,339	1596	184,0	58,15982	8,375014	$P_{eks}<P_{cr}$
3	-5,339	1596	184,0	58,15982	8,375014	$P_{eks}<P_{cr}$
4	-5,394	1596	184,0	58,15982	8,375014	$P_{eks}<P_{cr}$
7	-0,057	1596	184,0	58,15982	8,375014	$P_{eks}<P_{cr}$
9	-0,057	1596	184,0	58,15982	8,375014	$P_{eks}<P_{cr}$

Tabel 5.2 Kekuatan Batang Tarik Benda Uji 1

NO BATANG	P (kN)	Pcr (k N)	Keterangan
5	5,064	19,74264	$P_{eks}<P_{cr}$
6	5,064	19,74264	$P_{eks}<P_{cr}$
8	0,119	19,74264	$P_{eks}<P_{cr}$

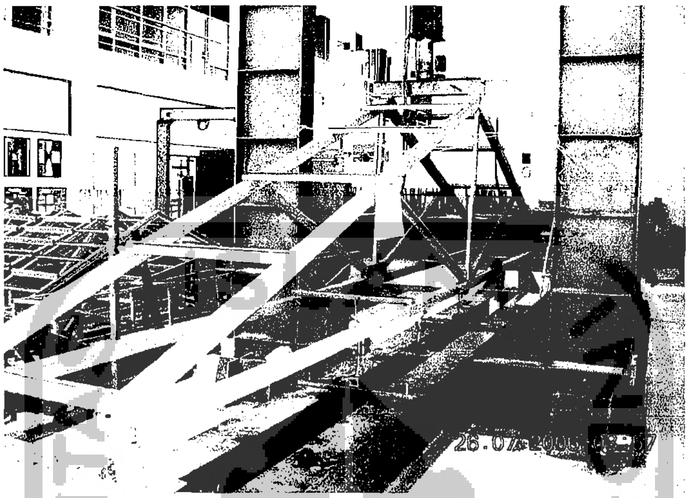
Tabel 5.3 Kekuatan Batang Tekan Benda Uji 2

NO BATANG	P (kN)	L (mm)	KL/r	Fcr (Mpa)	Pcr (k N)	Keterangan
6	-0,106	1596	184,0	54,010861	7,777564	$P_{eks}<P_{cr}$
8	-0,106	1596	184,0	54,010861	7,777564	$P_{eks}<P_{cr}$
10	-6,729	1596	184,0	54,010861	7,777564	$P_{eks}<P_{cr}$
11	-6,626	1596	184,0	54,010861	7,777564	$P_{eks}<P_{cr}$
12	-6,626	1596	184,0	54,010861	7,777564	$P_{eks}<P_{cr}$
13	-6,729	1596	184,0	54,010861	7,777564	$P_{eks}<P_{cr}$

Tabel 5.4 Kekuatan Batang Tarik Benda Uji 2

NO BATANG	P (kN)	Pcr (k N)	Keterangan
1	6,318	14,96794	$P_{eks}<P_{cr}$
2	6,318	14,96794	$P_{eks}<P_{cr}$
3	6,318	14,96794	$P_{eks}<P_{cr}$
4	6,318	14,96794	$P_{eks}<P_{cr}$
5	0,033	14,96794	$P_{eks}<P_{cr}$
7	0,124	14,96794	$P_{eks}<P_{cr}$
9	0,033	14,96794	$P_{eks}<P_{cr}$

Dokumentasi Pelaksanaan Pengujian

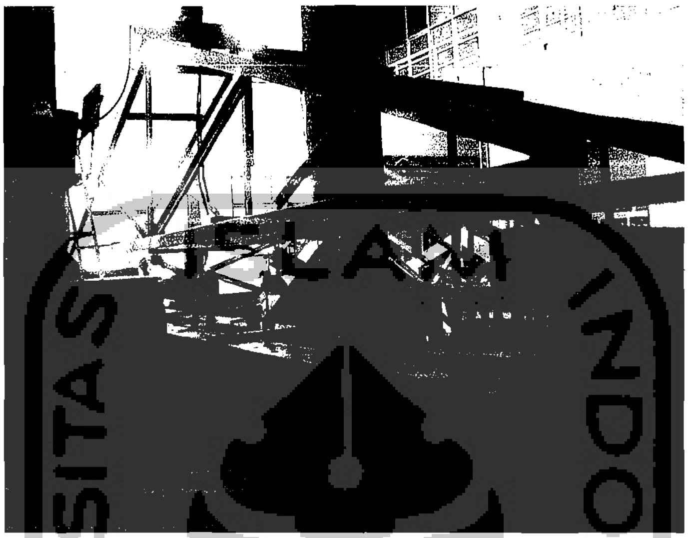


Gambar L7.1 Benda Uji 1 sebelum pengujian

Gambar L7.2 Benda Uji 1 setelah pengujian

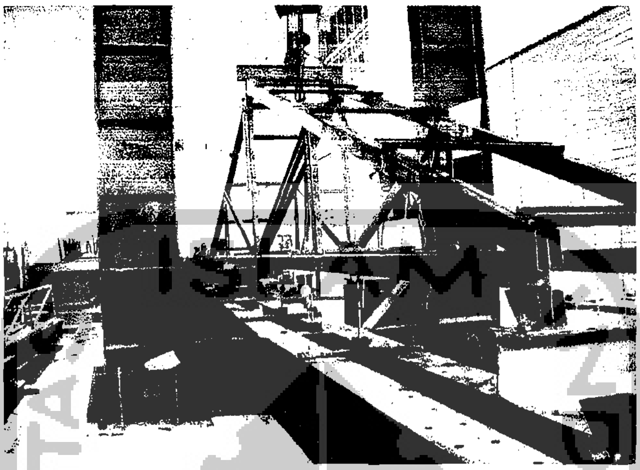

Gambar L7.3 Benda Uji 2 sebelum pengujian


Gambar L7.4 Benda Uji 2 setelah pengujian



Gambar L7.5 Benda Uji 3 sebelum pengujian

Gambar L7.6 Benda Uji 3 setelah pengujian



Gambar L7.7 Benda Uji 4 sebelum pengujian

Gambar L7.8 Benda Uji 4 setelah pengujian

AKULTAS TEKNIK SIPIL DAN PERENCANAAN
. KALIURANG KM 14,4 TELP.895042
MAIL : FTSP UII.AC.ID JOGJAKARTA KODE POS 55584

FM-UII-AA-FPU-09

UNTUK DOSEN

KARTU PRESENSI KONSULTASI
TUGAS AKHIR MAHASISWA

PERIODE KE	:	III (Mar 06 - Agst 06)
TAHUN	:	2005 - 2006
Perpanjangan Sampai Akhir Agustus 2006		

N A M A	NO.MHS.	BID.STUDI
Ridawan Esny S	97 511 090	Teknik Sipil
Abdi Ardiansyah	97 511 277	Teknik Sipil

JUDUL TUGAS AKHIR

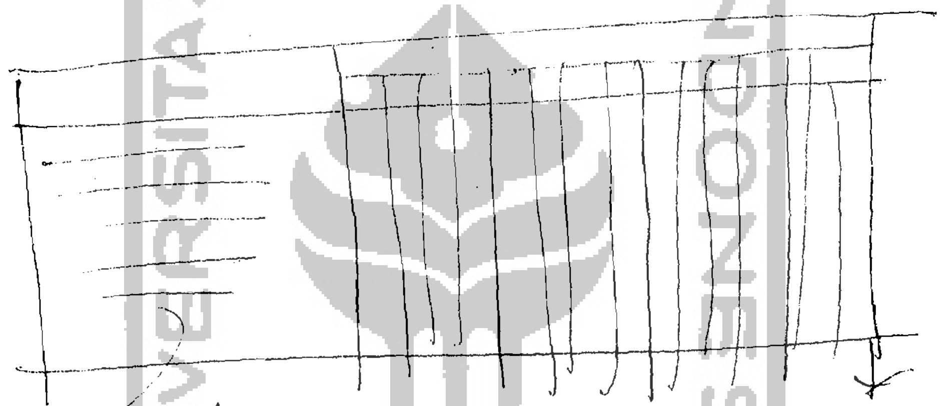
:u Rangka Baja Profil Bentukan Dingin Dengan Sambungan Baut

›imbing I : Fatkhurrohman N,Ir.MT
›nbing II : Fatkhurrohman N,Ir.MT

Jogjakarta , 19-Apr-06
a.n. Dekan

Ir.H.Munadhir, MS

CATATAN KONSULTASI TUGAS AKHIR

TANGGAL	KONSULTASI KE :	TANDA TANGAN
	Dibuat Gambar benda uji. Las atau Baut.	11/7/2006
	Bila Pot Gambar (Pelat) [illegible] jarak [illegible] L ≤ 50 i min.	
	Buat jadwal kegiatan harian.	
		
	Usahakan selesai sebelum tg [illegible] Agustus harus sudah selesai	8/08 2006
	Usahakan selesai laporan tgl 17 Agustus Rencana Sidang ± tgl 30 Agustus	

Usahakan Sidang tgl 21-22-23 Agustus.

Daftar Sidang 18/09-2006

Siapkan Pendadaran 22/12-2006