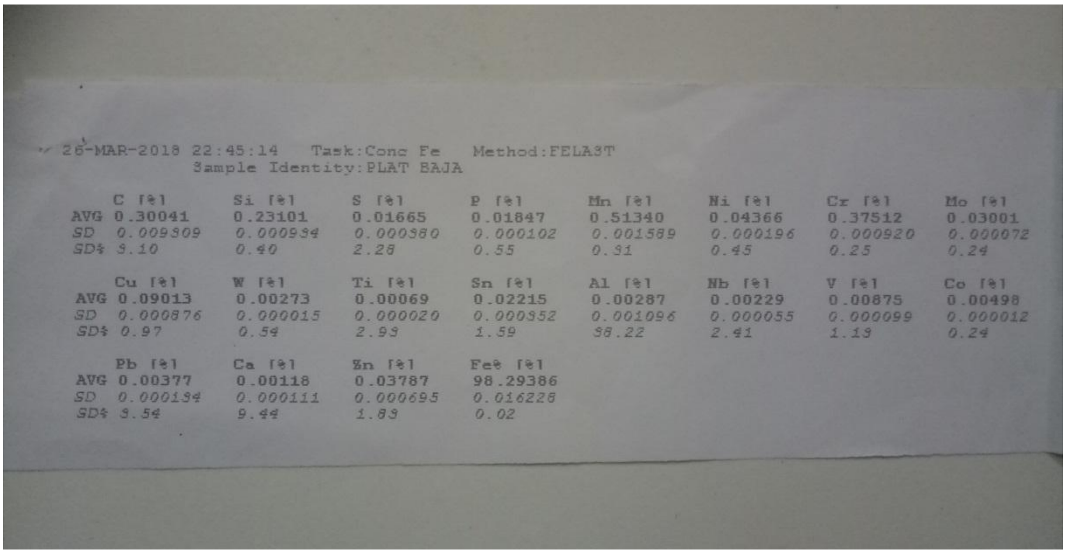
LAMPIRAN

Lampiran 1. Hasil uji komposisi bahan



26-MAR-2018 22:45:14 Task:Conc Fe Method:FELA3T
Sample Identity:PLAT BAJA

	C [%]	Si [%]	S [%]	P [%]	Mn [%]	Ni [%]	Cr [%]	Mo [%]
AVG	0.30041	0.23101	0.01665	0.01847	0.51340	0.04366	0.37512	0.03001
SD	0.009309	0.000934	0.000380	0.000102	0.001589	0.000196	0.000920	0.000072
SD%	3.10	0.40	2.28	0.55	0.31	0.45	0.25	0.24

	Cu [%]	W [%]	Ti [%]	Sn [%]	Al [%]	Nb [%]	V [%]	Co [%]
AVG	0.09013	0.00273	0.00069	0.02215	0.00287	0.00229	0.00875	0.00498
SD	0.000876	0.000015	0.000020	0.000352	0.001096	0.000055	0.000099	0.000012
SD%	0.97	0.54	2.93	1.59	38.22	2.41	1.13	0.24

	Pb [%]	Ca [%]	Zn [%]	Fe% [%]
AVG	0.00377	0.00118	0.03787	98.29386
SD	0.000134	0.000111	0.000695	0.016228
SD%	3.54	9.44	1.83	0.02

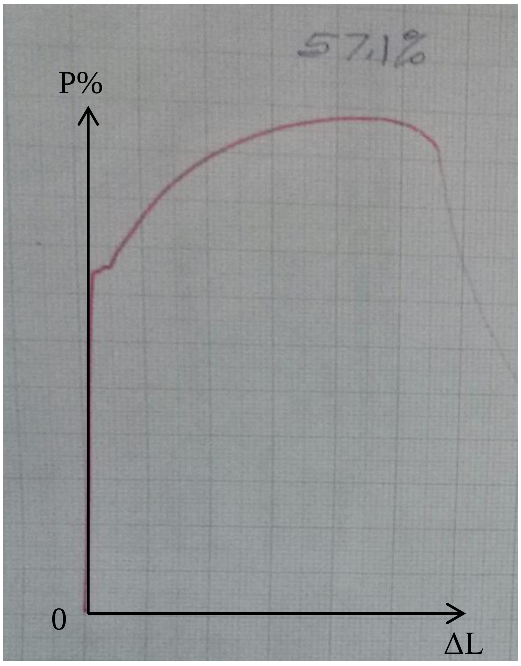
Gambar 1.1 Hasil Uji Komposisi Bahan

Lampiran 2. Tabel hasil pengujian tarik pada baja karbon rendah dengan beberapa variasi pendinginan

NO	Spesimen	t	l	Lo	Li	P
1	Udara	2,90 mm	12,80 mm	50 mm	58 mm	4 Ton
2		2,90 mm	12,80 mm	50 mm	50,75 mm	
3		2,90 mm	12,80 mm	50 mm	51,6 mm	
1	Oli	2,90 mm	12,80 mm	50 mm	50,60 mm	
2		2,90 mm	12,80 mm	50 mm	50,05 mm	
3		2,90 mm	12,80 mm	50 mm	50,50 mm	
1	Air	2,90 mm	12,80 mm	50 mm	51,20 mm	
2		2,90 mm	12,80 mm	50 mm	50,75 mm	
3		2,90 mm	12,80 mm	50 mm	50,35 mm	

Lampiran 3. Perhitungan kekuatan tarik pada baja karbon rendah dengan pendinginan udara

Spesimen 1



Gambar 3.1 Kurva Spesimen 1 *raw material*

1. Perhitungan luas penampang

   A_O= t x l

   Dimana:

   A_O= Luas penampang (mm^2)

   t = Tinggi benda uji (mm)

   l = Lebar benda uji (mm)

   A_O= 2,90 mm x 12,80 mm

   = 37,12 mm^2

2. Perhitungan *yield point*

$P_y = \frac{t_y \text{ x } 1 \text{ mm}}{100} \text{ x } P$

Dimana:

P_y = Beban maksimal (kg)

t_y = Tinggi *yield* (mm)

P = Beban yang diberikan(kg)

$P_y = \frac{70{,}5 \text{ mm x } 1 \text{ mm}}{100}$ x 4.000 kg

= 2.820 kg

3. Perhitungan tegangan luluh

$\sigma_y = \frac{F_y}{A_O}$

Dimana:

σ_y = Tegangan luluh (N/mm^2)

F_y = Gaya luluh (N)

A_O= Luas penampang (mm^2)

$\sigma_y = \frac{2820 \text{ kg}}{37{,}12 \text{ mm}^2}$

= 75,96 kg/mm^2

= 75,96 kg/mm^2 x 9,8 m/s^2

= 744,40 N/mm^2

4. Perhitungan keuletan (Regangan)

$$e = \frac{L_i - L_o}{L_o} \text{ x } 100\%$$

Dimana:

e = Regangan (%)

L_i = Panjang akhir (mm)

L_o = Panjang awal (mm)

$$e = \frac{58 \text{ mm} - 50 \text{ mm}}{50 \text{ mm}} \text{ x } 100\%$$

$$= \frac{8 \text{ mm}}{50 \text{ mm}} \text{ x } 100\%$$

= 16%

5. Perhitungan modulus elastisitas

$$E = \frac{\sigma_y}{e}$$

$$= \frac{744{,}40 \text{ N/mm}^2}{16\%}$$

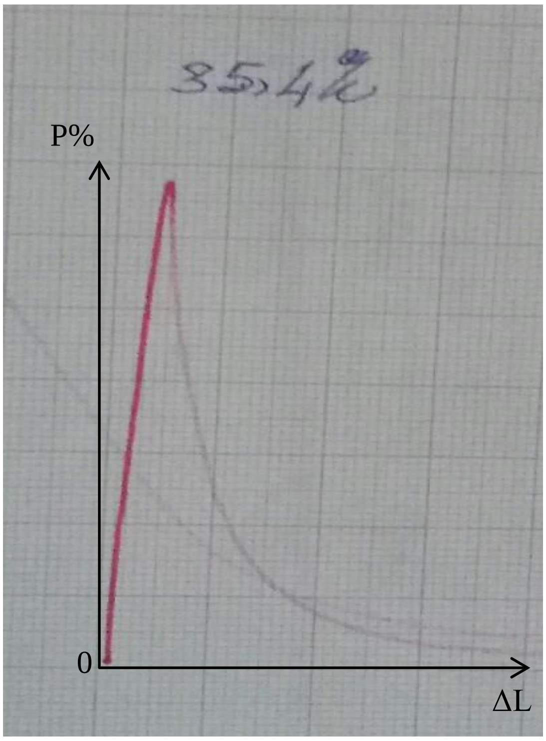
= 46,525 N/mm^2

Spesimen 2

1. Perhitungan *yield point*

$$P_y = \frac{60 \text{ mm x } 1 \text{ mm}}{100} \text{ x } 4.000 \text{ kg}$$

= 2.400 kg



Gambar 3.2 Kurva Spesimen 2 *raw material*

2. Perhitungan tegangan luluh

$$\sigma_y = \frac{2.400 \text{ kg}}{37{,}12 \text{ mm}^2}$$

$= 64{,}65 \text{ kg/mm}^2$

$= 64{,}65 \text{ kg/mm}^2 \text{ x } 9{,}8 \text{ m/s}^2$

$= 633{,}57 \text{ N/mm}^2$

3. Perhitungan keuletan (Regangan)

$$e = \frac{50{,}75 \text{ mm} - 50 \text{ mm}}{50 \text{ mm}} \text{ x } 100\%$$

$$= \frac{0,75 \text{ mm}}{50 \text{ mm}} \times 100\%$$

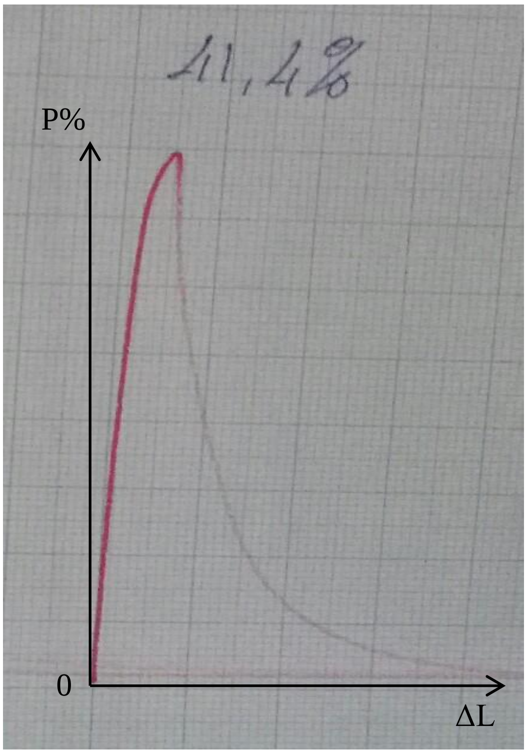
$$= 1,5\%$$

4. Perhitungan modulus elastisitas

$$E = \frac{633,57 \text{ N/mm}^2}{1,5\%}$$

$$= 422,38 \text{ N/mm}^2$$

Spesimen 3



Gambar 3.3 Kurva Spesimen 3 *raw material*

1. Perhitungan *yield point*

$$P_y = \frac{70 \text{ mm x } 1 \text{ mm}}{100} \times 4.000 \text{ kg}$$

= 2.800 kg

2. Perhitungan tegangan luluh

$\sigma_y = \frac{2.800 \text{ kg}}{37{,}12 \text{ mm}^2}$

= 75,43 kg/mm^2

= 75,43 kg/mm^2 x 9,8 m/s^2

= 739,21 N/mm^2

3. Perhitungan keuletan (Regangan)

e = $\frac{51{,}6 \text{ mm} - 50 \text{ mm}}{50 \text{ mm}}$ x 100%

= $\frac{1{,}6 \text{ mm}}{50 \text{ mm}}$ x 100%

= 3,2 %

4. Perhitungan modulus elastisitas

E = $\frac{739{,}21 \text{ N/mm}^2}{3{,}2 \%}$

= 231 N/mm^2

Rata-rata:

1. Yield point $P_y = \frac{2.820+2.400+2.800}{3}$ kg

= 2.673,33 kg

2. Tegangan luluh $\sigma_y = \frac{744{,}40+633{,}57+739{,}21}{3}$ N/mm^2

= 705,72 N/mm^2

3. Regangan e = $\frac{16+1{,}5+3{,}2}{3}$ %

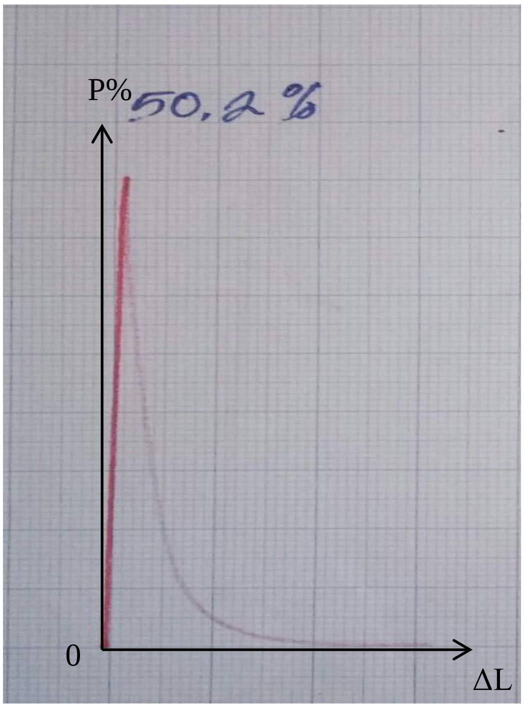
$= 6,9\ \%$

4. Elastisitas $E = \frac{46,52+422,38+231}{3}\ N/mm^2$

$= 233,3\ N/mm^2$

Lampiran 4. Perhitungan kekuatan tarik pada baja karbon rendah dengan pendinginan menggunakan oli

Spesimen 1



Gambar 4.1 Kurva Spesimen 1 Pendinginan Oli

1. Perhitungan *yield point*

$$P_y = \frac{80\ \text{mm x 1 mm}}{100} \text{ x 4.000 kg}$$

$= 3.200$ kg

2. Perhitungan tegangan luluh

$$\sigma_y = \frac{3.200\ \text{kg}}{37{,}12\ \text{mm}^2}$$

$= 86{,}20\ \text{kg/mm}^2$

$= 86{,}20\ \text{kg/mm}^2 \text{ x } 9{,}8\ \text{m/s}^2$

$= 844{,}76\ \text{N/mm}^2$

3. Perhitungan keuletan (Regangan)

$$e = \frac{50{,}60\ \text{mm} - 50\ \text{mm}}{50\ \text{mm}} \times 100\%$$

$$= \frac{0{,}6\ \text{mm}}{50\ \text{mm}} \times 100\%$$

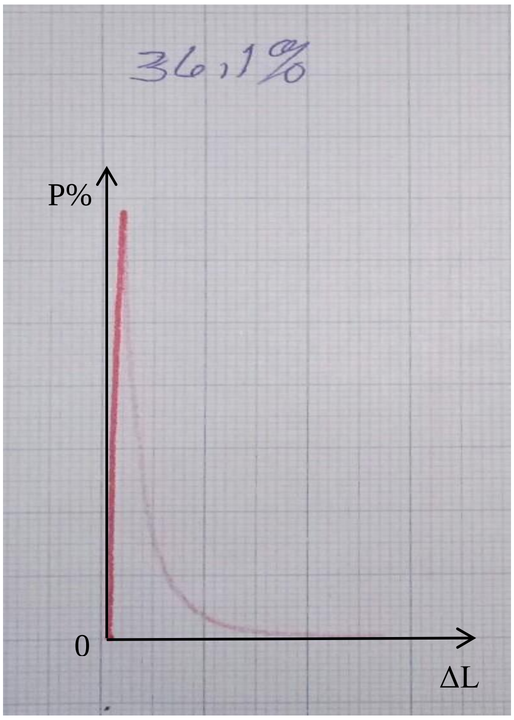
$$= 1{,}2\ \%$$

4. Perhitungan modulus elastisitas

$$E = \frac{844{,}76\ \text{N/mm}^2}{1{,}2\ \%}$$

$$= 703{,}96\ \text{N/mm}^2$$

Spesimen 2



Gambar 4.2 Kurva Spesimen 2 Pendinginan Oli

1. Perhitungan *yield point*

$$P_y = \frac{60{,}8 \text{ mm x } 1 \text{ mm}}{100} \text{ x } 4.000 \text{ kg}$$

$$= 2.432 \text{ kg}$$

2. Perhitungan tegangan luluh

$$\sigma_y = \frac{2.432 \text{ kg}}{37{,}12 \text{ mm}^2}$$

$$= 65{,}51 \text{ kg/mm}^2$$

$$= 65{,}51 \text{ kg/mm}^2 \text{ x } 9{,}8 \text{ m/s}^2$$

$$= 641{,}99 \text{ N/mm}^2$$

3. Perhitungan keuletan (Regangan)

$$e = \frac{50{,}05 \text{ mm} - 50 \text{ mm}}{50 \text{ mm}} \text{ x } 100\%$$

$$= \frac{0{,}05 \text{ mm}}{50 \text{ mm}} \text{ x } 100\%$$

$$= 0{,}1 \%$$

4. Perhitungan modulus elastisitas

$$E = \frac{641{,}99 \text{ N/mm}^2}{0{,}1 \%}$$

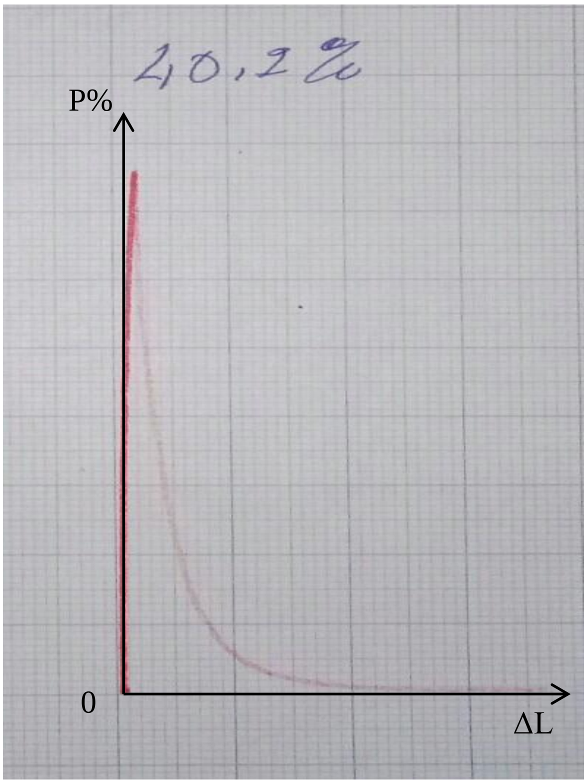
$$= 6419{,}9 \text{ N/mm}^2$$

Spesimen 3

1. Perhitungan *yield point*

$P_y = \frac{70{,}6 \text{ mm x } 1 \text{ mm}}{100}$ x 4.000 kg

= 2.824 kg



Gambar 4.3 Kurva Spesimen 3 Pendinginan Oli

2. Perhitungan tegangan luluh

$\sigma_y = \frac{2.824 \text{ kg}}{37{,}12 \text{ mm}^2}$

= 76,07 kg/mm^2

= 76,07 kg/mm^2 x 9,8 m/s^2

= 745,48 N/mm^2

3. Perhitungan keuletan (Regangan)

$$e = \frac{50{,}50\ \text{mm} - 50\ \text{mm}}{50\ \text{mm}} \times 100\%$$

$$= \frac{0{,}5\ \text{mm}}{50\ \text{mm}} \times 100\%$$

= 1 %

4. Perhitungan modulus elastisitas

$$E = \frac{745{,}48\ \text{N/mm}^2}{1\ \%}$$

$= 745{,}48\ \text{N/mm}^2$

Rata-rata :

1. Yield point $P_y = \frac{3.200+2.432+1.608}{3}$ kg

   = 2.413,33 kg

2. Tegangan luluh $\sigma_y = \frac{844{,}76+641{,}99+745{,}48}{3}$ N/mm^2

   = 744,07 N/mm^2

3. Regangan $e = \frac{1{,}2+0{,}1+1}{3}$ %

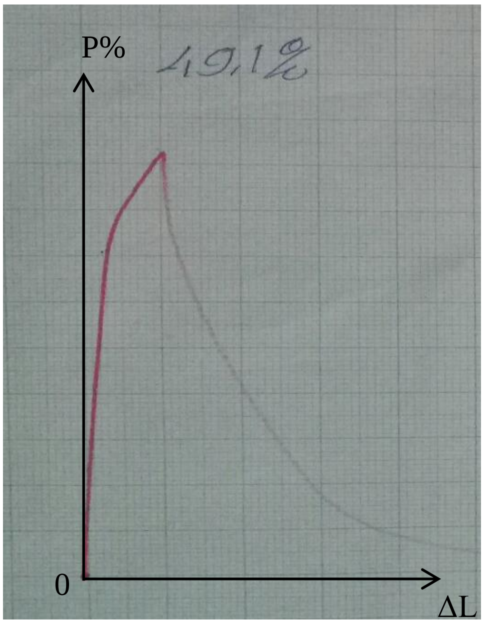
   = 0,76 %

4. Elastisitas $E = \frac{703{,}96+6.419{,}9+745{,}48}{3}$ N/mm^2

   = 2.623,11 N/mm^2

Lampiran 5. Perhitungan kekuatan tarik pada baja karbon rendah dengan pendinginan menggunakan air

Spesimen 1



Gambar 5.1 Kurva Spesimen 1 Pendinginan Udara

1. Perhitungan *yield point*

$$P_y = \frac{70 \text{ mm x } 1 \text{ mm}}{100} \text{ x } 4.000 \text{ kg}$$

$= 2.800$ kg

2. Perhitungan tegangan luluh

$$\sigma_y = \frac{2.800 \text{ kg}}{37{,}12 \text{ mm}^2}$$

$= 75{,}43 \text{ kg/mm}^2$

$= 75{,}43 \text{ kg/mm}^2 \text{ x } 9{,}8 \text{ m/s}^2$

$= 739{,}21 \text{ N/mm}^2$

3. Perhitungan keuletan (Regangan)

$$e = \frac{51,20\ \text{mm} - 50\ \text{mm}}{50\ \text{mm}} \times 100\%$$

$$= \frac{1,2\ \text{mm}}{50\ \text{mm}} \times 100\%$$

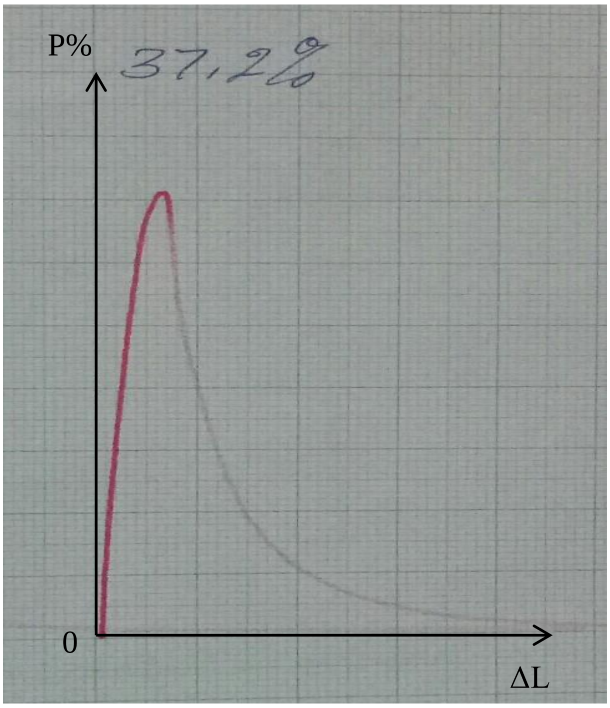
$$= 2,4\ \%$$

4. Perhitungan modulus elastisitas

$$E = \frac{739,21\ \text{N/mm}^2}{2,4\ \%}$$

$$= 308\ \text{N/mm}^2$$

Spesimen 2



Gambar 5.2 Kurva Spesimen 2 Pendinginan Udara

1. Perhitungan *yield point*

$$P_y = \frac{60{,}5 \text{ mm x } 1 \text{ mm}}{100} \text{ x } 4.000 \text{ kg}$$

$=2.420$ kg

2. Perhitungan tegangan luluh

$$\sigma_y = \frac{2.420 \text{ kg}}{37{,}12 \text{ mm}^2}$$

$= 64{,}65 \text{ kg/mm}^2$

$= 64{,}65 \text{ kg/mm}^2 \text{ x } 9{,}8 \text{ m/s}^2$

$= 633{,}57 \text{ N/mm}^2$

3. Perhitungan keuletan (Regangan)

$$e = \frac{50{,}75 \text{ mm} - 50 \text{ mm}}{50 \text{ mm}} \text{ x } 100\%$$

$$= \frac{0{,}75 \text{ mm}}{50 \text{ mm}} \text{ x } 100\%$$

$= 1{,}5$ %

4. Perhitungan modulus elastisitas

$$E = \frac{633{,}57 \text{ N/mm}^2}{1{,}5 \text{ \%}}$$

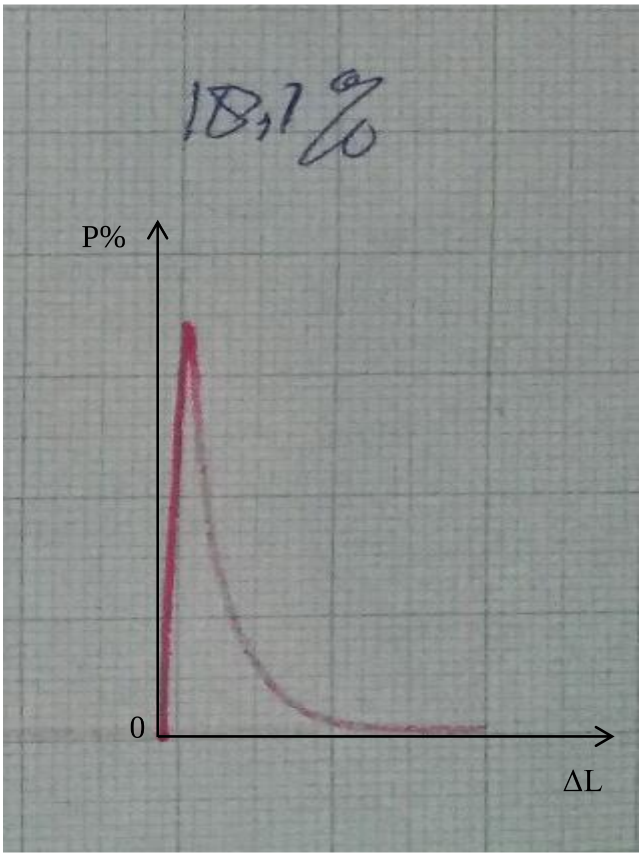
$= 422{,}38 \text{ N/mm}^2$

Spesimen 3

1. Perhitungan *yield point*

$$P_y = \frac{30{,}4 \text{ mm x } 1 \text{ mm}}{100} \text{ x } 4.000 \text{ kg}$$

=724 kg



Gambar 5.3 Kurva Spesimen 3 Pendinginan Udara

2. Perhitungan tegangan luluh

$$\sigma_y = \frac{724 \text{ kg}}{37{,}12 \text{ mm}^2}$$

$= 32{,}75 \text{ kg/mm}^2$

$= 32{,}75 \text{ kg/mm}^2 \text{ x } 9{,}8 \text{ m/s}^2$

$= 320{,}95 \text{ N/mm}^2$

3. Perhitungan keuletan (Regangan)

$$e = \frac{50{,}35 \text{ mm} - 50 \text{ mm}}{50 \text{ mm}} \text{ x } 100\%$$

$= \frac{0,,35 \text{ mm}}{50 \text{ mm}}$ x 100%

= 0,7 %

4. Perhitungan modulus elastisitas

$E = \frac{320,95 \text{ N/mm}^2}{0,7\ \%}$

= 458,5 N/mm^2

Rata-rata :

5. Yield point $P_y = \frac{2.800+2.420+1.216}{3}$ kg

= 2.145,33 kg

6. Tegangan luluh $\sigma_y = \frac{739,21+633,57+320,95}{3}$ N/mm^2

= 564,57 N/mm^2

7. Regangan e = $\frac{2,4+1,5+0,7}{3}$ %

= 1,53 %

8. Elastisitas E= $\frac{308+422,38+458,5}{3}$ N/mm^2

= 396,29 N/mm^2

Lampiran 6. Foto-foto pelaksanaan penelitian

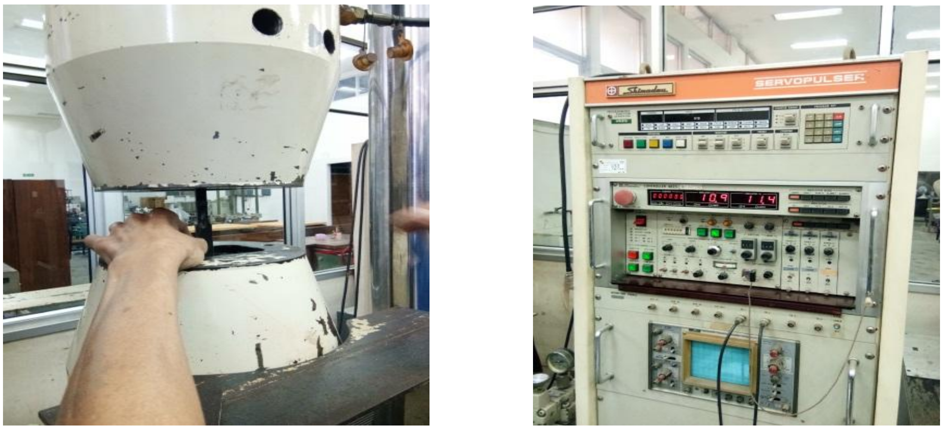
Gambar 6.1 Media Pendingin Pengelasan SMAW

Gambar 6.2 Mesin Las SMAW

Gambar 6.3 Elektroda E6013

Gambar 6.4 Hasil Pengelasan SMAW Pada Baja Karbon Rendah

Gambar 6.5 Spesimen Pengujian Tarik



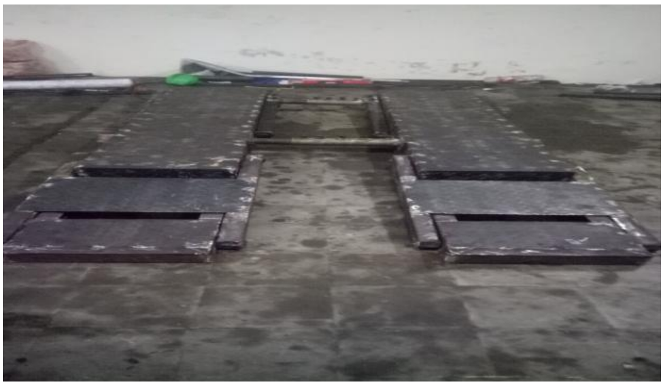
Gambar 6.6 Mesin Uji Tarik

Lampiran 7. Foto-foto penerapan las SMAW pada pembuatan *portable electric hydraulic jack*

Gambar 7.1 Perakitan *Frame* Bawah

Gambar 7.2 Perakitan *Frame* Samping

Gambar 7.3 Proses Pengelasan SMAW



Gambar 7.4 Perakitan *Frame* Atas dan Pemasangan Plat Bordes

Gambar 7.5 Pemasangan *Hydraulic*

Gambar 7.6 Uji Coba *Portable Electric Hydraulic Jack* Pada Mobil Avanza