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LAMPIRAN

Lampiran 1. Hasil Perhitungan Pengujian

1. Perhitungan Pengujian Torsi

$$\tau g = \frac{16.T\ max}{\pi.d^3}$$

Keterangan :

τg = Tegangan geser (MPa)

Tmax = Momen puntir (N.m)

d = Diameter (m)

a. *Welding Time* 5 *Cycle* (1 – 3)

1) Diket: Tmax = 49,5 N.m

π = 3,14

d = 4 mm = 0,004 m

$$\tau g = \frac{16X49,5}{3,14X(0,004)^3}$$

$$= \frac{792}{0,00000020096}$$

$= 3941082802,55\ N/m^2 = 3941,08\ MPa$

2) Diket: Tmax = 65 N.m

π = 3,14

d = 4 mm = 0,004 m

$$\tau g = \frac{16X65}{3,14X(0,004)^3}$$

$$= \frac{1040}{0,00000020096}$$

$= 5175159235,67\ N/m^2 = 5175,16\ MPa$

3) Diket: Tmax = 51 N.m

π = 3,14

d = 4 mm = 0,004 m

$\tau g = \frac{16X51}{3,14X(0,004)^3}$

$= \frac{816}{0,00000020096}$

= 4060509554,14 N/m^2 = 4060,51 MPa

b. *Welding Time* 6 *Cycle* (1 – 3)

1) Diket: Tmax = 59 N.m

π = 3,14

d = 4 mm = 0,004 m

$\tau g = \frac{16X59}{3,14X(0,004)^3}$

$= \frac{944}{0,00000020096}$

= 4697452229,30 N/m^2 = 4697,45 MPa

2) Diket: Tmax = 66,5 N.m

π = 3,14

d = 4 mm = 0,004 m

$\tau g = \frac{16X66,5}{3,14X(0,004)^3}$

$= \frac{1064}{0,00000020096}$

= 5294585987,26 N/m^2 = 5294,58 MPa

3) Diket: Tmax = 65 N.m

π = 3,14

d = 4 mm = 0,004 m

$\tau g = \frac{16X65}{3,14X(0,004)^3}$

$= \frac{1040}{0,00000020096}$

= 5175159235,67 N/m^2 = 5175,16 MPa

c. *Welding Time* 7 *Cycle* (1 – 3)

1) Diket: Tmax = 70 N.m

π = 3,14

d = 4 mm = 0,004 m

$\tau g = \frac{16X70}{3,14X(0,004)^3}$

$= \frac{1120}{0,00000020096}$

= 5573248407,64 N/m^2 = 5573,24 MPa

2) Diket: Tmax = 71,5 N.m

π = 3,14

d = 4 mm = 0,004 m

$\tau g = \frac{16X71,5}{3,14X(0,004)^3}$

$= \frac{1144}{0,00000020096}$

= 5692675159,23 N/m^2 = 5692,67 MPa

3) Diket: Tmax = 82 N.m

π = 3,14

d = 4 mm = 0,004 m

$\tau g = \frac{16X82}{3,14X(0,004)^3}$

$= \frac{1312}{0,00000020096}$

= 6528662420,38 N/m^2 = 6528,66 MPa

d. *Welding Time* 8 *Cycle* (1 – 3)

1) Diket: Tmax = 94 N.m

π = 3,14

d = 4 mm = 0,004 m

$\tau g = \frac{16X94}{3,14X(0,004)^3}$

$= \frac{1504}{0,00000020096}$

= 7484076433,12 N/m^2 = 7484,08 MPa

2) Diket: Tmax = 81 N.m

π = 3,14

d = 4 mm = 0,004 m

$\tau g = \frac{16X81}{3,14X(0,004)^3}$

$= \frac{1296}{0,00000020096}$

= 6449044585,99 N/m^2 = 6449,04 MPa

3) Diket: Tmax = 89,5 N.m

π = 3,14

d = 4 mm = 0,004 m

$\tau g = \frac{16X89,5}{3,14X(0,004)^3}$

$= \frac{1432}{0,00000020096}$

= 7125796178,34 N/m^2 = 7125,80 MPa

2. Perhitungan Pengujian Tekan

$\sigma = \frac{F}{A}$

Keterangan :

F = Besar gaya tekan / Tarik (N)

A = Luas penampang (m²)

σ = Tegangan (N/m²)

a. *Welding Time* 5 *Cycle* (1-3)

1) Diket. F : 11,39 kN = 11.390 N

A : $\pi.d^3$ = 3,14 x $(0,004)^3$ = 0,00000020096 m^2

$\sigma = \frac{F}{A}$

$= \frac{11390}{0,00000020096}$

= 56677945859,87 N/m^2 = 56677,94 MPa

2) Diket. F : 6,27 kN = 6.270 N

A : $\pi.d^3$ = 3,14 x $(0,004)^3$ = 0,00000020096 m^2

$$\sigma = \frac{F}{A}$$

$$= \frac{6270}{0{,}00000020096}$$

$= 31200238853{,}50\ N/m^2 = 31200{,}24\ MPa$

3) Diket. F : 8,5 kN = 8.500 N

A : $\pi.d^3 = 3{,}14 \times (0{,}004)^3 = 0{,}00000020096\ m^2$

$$\sigma = \frac{F}{A}$$

$$= \frac{8500}{0{,}00000020096}$$

$= 42296974522{,}29\ N/m^2 = 42296{,}97\ MPa$

b. *Welding Time* 6 *Cycle* (1-3)

1) Diket. F : 12,46 kN = 12.460 N

A : $\pi.d^3 = 3{,}14 \times (0{,}004)^3 = 0{,}00000020096\ m^2$

$$\sigma = \frac{F}{A}$$

$$= \frac{12460}{0{,}00000020096}$$

$= 62002388535{,}03\ N/m^2 = 62002{,}39\ MPa$

2) Diket. F : 10,92 kN = 10.920 N

A : $\pi.d^3 = 3{,}14 \times (0{,}004)^3 = 0{,}00000020096\ m^2$

$$\sigma = \frac{F}{A}$$

$$= \frac{10920}{0{,}00000020096}$$

$= 54339171974{,}52\ N/m^2 = 54339{,}17\ MPa$

3) Diket. F : 8,16 kN = 8.160 N

A : $\pi.d^3 = 3{,}14 \times (0{,}004)^3 = 0{,}00000020096$ m2

$$\sigma = \frac{F}{A}$$

$$= \frac{8160}{0{,}00000020096}$$

$= 40605095541{,}40\ N/m^2 = 40605{,}09\ MPa$

c. *Welding Time* 7 *Cycle* (1-3)

1) Diket. F : 12,93 kN = 12.930 N

$A : \pi.d^3 = 3{,}14 \times (0{,}004)^3 = 0{,}00000020096\ m^2$

$$\sigma = \frac{F}{A}$$

$$= \frac{12930}{0{,}00000020096}$$

$= 64341162420{,}38\ N/m^2 = 64341{,}16\ MPa$

2) Diket. F : 11,47 kN = 11.470 N

$A : \pi.d^3 = 3{,}14 \times (0{,}004)^3 = 0{,}00000020096\ m^2$

$$\sigma = \frac{F}{A}$$

$$= \frac{11470}{0{,}00000020096}$$

$= 57076035031{,}85\ N/m^2 = 57076{,}03\ MPa$

3) Diket. F : 9,26 kN = 9.260 N

$A : \pi.d^3 = 3{,}14 \times (0{,}004)^3 = 0{,}00000020096\ m^2$

$$\sigma = \frac{F}{A}$$

$$= \frac{9260}{0{,}00000020096}$$

$= 46078821656{,}05\ N/m^2 = 46078{,}82\ MPa$

d. *Welding Time* 8 *Cycle* (1-3)

1) Diket. F : 16,24 kN = 16.240 N

A : $\pi.d^3$ = 3,14 x $(0,004)^3$ = 0,00000020096 m^2

$$\sigma = \frac{F}{A}$$

$$= \frac{16240}{0,00000020096}$$

= 80812101910,83 N/m^2 = 80812,10 MPa

2) Diket. F : 10,61 kN = 10.610 N

A : $\pi.d^3$ = 3,14 x $(0,004)^3$ = 0,00000020096 m^2

$$\sigma = \frac{F}{A}$$

$$= \frac{10610}{0,00000020096}$$

= 52796576433,12 N/m^2 = 52796,58 MPa

3) Diket. F : 15,41 kN = 15.410 N

A : $\pi.d^3$ = 3,14 x $(0,004)^3$ = 0,00000020096 m^2

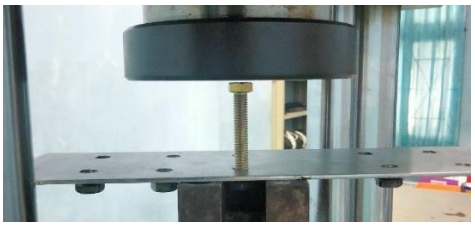
$$\sigma = \frac{F}{A}$$

$$= \frac{15410}{0,00000020096}$$

= 76681926751,59 N/m^2 = 76681,93 MPa

Lampiran 2. Proses Pembuatan Spesimen dan Proses Pengujian

NO	Gambar	Keterangan
1		Proses pemotongan plat menggunakan mesin *shearing* dengan ukuran 320mm x 80mm
2		Setelah mendapatkan potongan plat sesuai dengan ukuran, selanjutnya dilakukan pengukuran lubang mulai dari diameter dan juga jarak antar lubang
3		Proses pengeboran plat dengan diameter 9 mm dan jarak antar lubangnya 40 mm

4		Proses pengelasan *spot nut welding* pada tiap lubang sejumlah 12 *nut*
5		Setelah spesimen jadi tahapan selanjutnya adalah pengujian tekan seperti gambar disamping
6		Proses pengujian torsi di PT. Trimitra Marganda Unggul

Lampiran 2. Lembar Sertifikat Hasil Pengujian

PT.TRIMITRA MARGANDA UNGGUL TEGAL

TORQUE TEST ANALYSIS

No.Ref : 001/QLY/WSN/III/24
Eff.Date : 16 Maret 2024

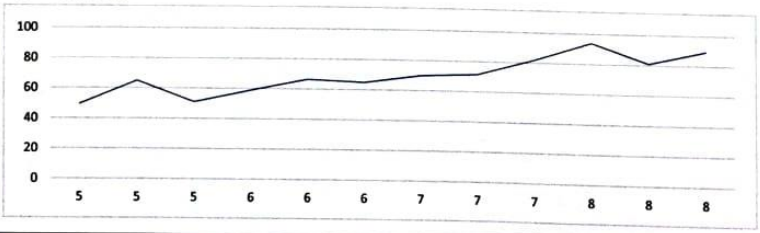
Customer : M. Akbar Setyawan
Day : Friday
Date : March 15, 2024
Time : 02.00 p.m
Tools : Torque Wrench 100 N.m
12214/GQI-Sert/10/23

Model : D03B
Part No. : Spec.01
Part Name : Speciment M8 x 12
Process : Torque Test

I. Torque Test

No	Parameter					Torque Test	
	Squeeze Time	Weld. Current	Weld. Time	Hold Time	Air Preassure		
1	25	10	5	1	0.25	49,5	Loose
2	25	10	5	1	0.25	65	Loose
3	25	10	5	1	0.25	51	Loose
4	25	10	6	1	0.25	59	Loose
5	25	10	6	1	0.25	66,5	Loose
6	25	10	6	1	0.25	65	Loose
7	25	10	7	1	0.25	70	Loose
8	25	10	7	1	0.25	71,5	Loose
9	25	10	7	1	0.25	82	Loose
10	25	10	8	1	0.25	94	Loose
11	25	10	8	1	0.25	81	Loose
12	25	10	8	1	0.25	89,5	Loose

II. Graphic



Note :

Approved	Checked
PT. Trimitra Marganda Unggul Jakarta - Indonesia	
Hidayat	Asep

LABORATORIUM BAHAN TEKNIK
DEPARTEMEN TEKNIK MESIN SEKOLAH VOKASI
UNIVERSITAS GADJAH MADA

HASIL PENGUJIAN KEKUATAN TEKAN

No.	Variasi Waktu Pengelasan	Pmax (KN)	Rata-Rata (MPa)
1	5 Cycle_1	11.39	8.72
2	5 Cycle_2	6.27	
3	5 Cycle_3	8.50	
4	6 Cycle_1	12.46	10.51
5	6 Cycle_2	10.92	
6	6 Cycle_3	8.16	
7	7 Cycle_1	12.93	11.22
8	7 Cycle_2	11.47	
9	7 Cycle_3	9.26	
10	8 Cycle_1	16.24	14.09
11	8 Cycle_2	10.61	
12	8 Cycle_3	15.41	

Keterangan:

1. Pengujian dilakukan tanggal 30 Maret 2024
2. Pengujian menggunakan Universal Testing Machine (TN 20 MD)

Identitas Penguji :

Nama : Muhammad Akbar Setyawan
NPM : 6422600092
Institusi : Teknik Mesin Universitas Pancasakti Tegal

Yogyakarta, 30 Maret 2024
Staf Laboratorium Bahan Teknik

Dr. Liliek Dwi Setyana, S.T., M.T
NIP. 19770831 2002121002