

**DETERMINATION DEFECT AND MECHANICAL PROPERTIES OF
CARBON PLATE WITH DIFFERENT CURRENT VALUE USING SMAW
PROCESS**

MAZURI BIN MOHAMED

B041210320

BMCS

Email: mazurimohamed@yahoo.com

**Draft Final Report
Projek Sarjana Muda II**

Supervisor: PUAN ANITA AKMAR BINTI KAMAROLZAMAN

**Faculty of Mechanical Engineering
Universiti Teknikal Malaysia Melaka**

MEI 2015

SUPERVISOR DECLARATION

“I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering (Structure and Material)”

Signature :
Supervisor : PUAN ANITA AKMAR BINTI KAMAROLZAMAN
Date :

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MAZURI BIN MOHAMED

**This Report for “Projek Sarjana Muda 1” is submitted to
Faculty on Mechanical Engineering,
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(Structure and Material)**

**Faculty Mechanical Engineering
University Technical Malaysia Melaka**

MEI 2015

DECLARATION

“I hereby declare that the work in this thesis is my own except for summaries and quotations which have been duly acknowledged.”

Signature :

Author : MAZURI BIN MOHAMED

Date :

Especially to my
Beloved Father and Mother
My respectful Lecturers,
Also my faithful friends

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ABSTRACT

During manufacturing operation joining carbon steel in joined using several welding technique and joints welding. In every welding there are several factor involve to determine strength of butt joint such as electrode, angle of welding, speed of welding and current. Defect like discontinuities and flaw might occur during welding and it will affect the properties and the performance of the material. The focus of this project is to investigate the defect on butt joint welding on plate using SMAW with different current and to produce a standard procedure for SMAW on butt joint for plate based on the parameter used. In this project, the detection of the crack or discontinuities on the welded sample is done by non-destructive test such as visual inspection (VI), magnetic particle inspection (MPI), liquid penetrant testing (PT), and ultrasonic testing (UT). Visual inspection and liquid penetrant testing is performed to determine defect on the surface of the sample. Liquid penetrant testing method can increase the seeability of small flaw that the human eye might not be able to detect and easy method to use in nonporous surface. Magnetic particle inspection is to detect on the surface and subsurface of the welded sample. In this project used wet magnetic particle method to detect any discontinuities occurs on surface and the subsurface of the sample. Ultrasonic testing is one the Non-destructive testing that used to detect the flaws location inside the weldment based on the pulse echo produce on Cathode Ray Tube (CRT) screen. This project also use mechanical testing on the welded sample to the analysis the effect of welding parameter on mechanical props such as hardness testing, impact testing and bend test. Hardness test is performed to justify the hardness of welded sample by using Rockwell hardness test machine. Lastly, for this project use bend test to measure the ductility and soundness of a welded sample by using bend test machine.

ABSTRAK

Semasa operasi pembuatan menyertai keluli karbon yang digunakan dengan teknik kimpalan seperti sambungan temu. Dalam setiap kimpalan terdapat beberapa faktor melibatkan untuk menentukan kekuatan sambungan temu seperti elektrod, sudut kimpalan, kelajuan kimpalan dan arus. Kecacatan seperti ketakselajaran dan kecacatan mungkin berlaku semasa kimpalan akan memberi kesan kepada ciri-ciri dan prestasi bahan. Fokus kajian ini adalah untuk menyiasat kecacatan pada kimpalan temu bersama di atas kepingan dengan menggunakan SMAW berbeza arus. Dalam kajian ini, untuk mengesan retak atau tidak berterusan pada sampel dikimpal menggunakan ujian bukan pemusnah seperti pemeriksaan visual (VI), pemeriksaan zarah magnet (MPI), ujian penusukan cecair (PT), dan ujian ultrasonik (UT). Pemeriksaan visual dan ujian penusukan cecair melaksanakan untuk menentukan kecacatan pada permukaan sampel. Cecair kaedah ujian penusukan boleh meningkatkan keupayaan melihat daripada kecacatan kecil yang mata manusia tidak mungkin dapat mengesan dan kaedah mudah untuk digunakan di permukaan rata. Pemeriksaan zarah magnet adalah untuk mengesan di permukaan dan bawah permukaan sampel yang dikimpal. Dalam projek ini digunakan basah kaedah zarah magnet untuk mengesan sebarang kecacatan berlaku di permukaan dan bawah permukaan sampel. Ujian ultrasonik adalah satu ujian yang Tidak merosakkan yang digunakan untuk mengesan lokasi kelemahan di dalam hasil kimpal berdasarkan hasil gema nadi pada Katod Ray Tube (CRT) skrin. Dalam projek ini juga menggunakan ujian mekanikal pada sampel yang dikimpal untuk analisis pada parameter kimpalan zarah seperti ujian kekerasan, ujian impak dan ujian bengkok. Ujian kekerasan dilakukan untuk mewajarkan kekerasan sampel dikimpal dengan menggunakan mesin Rockwell ujian kekerasan. Akhir sekali, untuk projek ini ujian penggunaan bengkok untuk mengukur kemuluran dan kekukuhan sampel yang dikimpal dengan menggunakan mesin ujian bengkok.

TABLE OF CONTENTS

CHAPTER	INDEX	PAGE
	SUPERVISOR DECLARATION	
	DECLARATION	iii
	ABSTRACT	vi
	ABSTRAK	vii
	TABLE OF CONTENT	viii
	LIST OF TABLE	xii
	LIST OF FIGURE	xiii

LIST OF ABBREVIATION	xvi
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LIST OF APPENDIX	xvii
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CHAPTER 1 INTRODUCTION

1.0 Introduction	1
1.1 Background	2
1.2 Problem Statement	4
1.3 Objective	5
1.4 Scope	5

CHAPTER 2 LITERATURE REVIEW

2.1 Welding	6
2.1.1 Welding Defect	6
2.1.2 Shielded Metal Arc Welding (SMAW)	7
2.1.3 Operation Of SMAW Welding	8
2.1.4 SMAW Welding Equipment	9
2.2 Non- Destructive Method (NDT)	9
2.2.1 Visual inspection	10

2.2.2 Magnetic Particle Inspection (MPI).	11
2.2.3 Dry Particle Inspection.	13
2.2.4 Wet Particle Inspection	14
2.2.5 Ultrasonic Testing	15
2.2.6 Ultrasonic Basic Principle.	16
2.2.7 Advantage And Disadvantages	16
2.2.8 Transducers	17
2.2.9 Calibration standards	19
2.2.10 Instrumentation	19
2.2.11 Liquid Penetrant Testing	20
2.2.12 Penetrants	21
2.2.13 Developer	21
2.3 Hardness test	22
2.3.1 Rockwell hardness testing	22
2.4 Bend Test	23

CHAPTER 3 METHODOLOGY

3.1 Introduction	25
3.2 Flow Chart	26
3.2.1 Sample Preparation	27
3.2.2 Shielded metal arc welding process	28

3.2.3 Non-Destructive Testing Method	30
3.2.4 Visual inspection	30
3.2.5 Magnetic Particle Inspection (MPI)	30
3.2.6 Wet magnetic particle inspection preparation	31
3.2.7 Ultrasonic Testing inspection (UT)	32
3.2.8 Standard procedure used ultrasonic testing	35
3.2.9 Liquid penetrant Testing	36
3.2.10 Liquid penetrant equipment	36
3.2.11 Procedure liquid penetrant testing	36
3.3 Rockwell hardness test	39
3.3.1 Procedure Rockwell hardness testing	39
3.4 Bend test	41

CHAPTER 4 RESULT AND DISCUSSION

4.1 Introduction	42
4.2 NON-DESTRUCTIVE TEST RESULT	43
4.2.1 Visual Inspection Result	43
4.2.2 Visual Inspection Analysis	43
4.2.3 Magnetic Particle Inspection Result	44
4.2.4 Penetrant testing result	46
4.2.5 Ultrasonic testing result	47

4.2.6 Plotting card analysis	48
4.2.7 Type of Defect Analysis using Ultrasonic Testing Inspection.	52
4.2.8 Defect occur in welded sample 2	52
4.2.9 Defect occur in welded sample 3	53
4.3 Rockwell Hardness Test Result	54
4.3.1 Analysis sample hardness using Rockwell hardness test	55
4.4 Bend test result	56
4.5 Discussion	56
4.5.1 Uneven Bead Size and More Spatter	56
4.5.2 Undercut	58
4.5.3 Porosity	60
4.5.4 Lack of Fusion	61
CHAPTER 5 CONCLUSION AND RECOMMENDATION	
5.1 Conclusion	62
5.2 Recommendation	63
REFERENCES	64
APPENDIX	68

LIST OF TABLES

NO.	TITLE	PAGE
Table 3.1	Current setting with a terminal voltage in SMAW	29
Table 4.1	Ultrasonic Testing data location of defects sample 2	50
Table 4.2	Ultrasonic Testing data location of defects sample 3	51
Table 4.3	Average Rockwell hardness test value (HRB) in the three welded sample with different current and voltage.	54
Table 4.4	Show the maximum load in the three welded sample and Flexure stress at Maximum Flexure load	56
Table 4.5	Brinell hardness values for the low carbon steel welds research by J. O. Olawale	57
Table 4.6	Result of bend test with porosity level research by R. F. Ashton	60

LIST OF FIGURES

NO. FIGURE	TITLE	PAGE
2.1	An overview of different defects that may occur in newly constructed welds	7
2.2	Basic circuit of arc welding	8
2.3	SMAW assembly equipment.	9
2.4	Type of visual aids	11
2.5	Magnetic particle inspection test principle	12
2.6	Effect of flux direction	13
2.7	Crack detected by dry particle inspection	14
2.8	Crack detected by wet particle inspection	15
2.9	UT transducer application	18

2.10	Type of calibration block	19
2.11	Rockwell hardness testing	23
2.12	Bend test schematic	24
2.13	Guided bend test jig	24
3.1	Welded sample	27
3.2	Sample preparation dimension	27
3.2	Milling machine	29
3.3	The operation of this process beveling	28
3.4	SMAW welding technique for butt joint	29
3.5	Permanent York	30
3.6	MAGNAVIS® 14AM Black Visible Magnetic Particle Wet Method Prepared Bath and SPOTCHECK® SKC-S Solvent Cleaner	31
3.7	Apply magnetic particle on the welded sample	32
3.8	Schematic view of technique for inspection, butt welds with shear wave.	33
3.9	V2 calibration	34
3.10	Angle beam probe 45°, 60° and 70°	34
3.11	Ultrasonic couplant	35
3.12	cleaner, developer, penetrant	36
3.13	Apply cleaner on the sample.	37
3.14	Apply penetrant at the sample	37

3.15	Apply developer at the welded sample	38
3.16	Rockwell hardness test machine	39
3.17	Bend test machine	41
4.1	Visual inspection for the welded sample 3	43
4.2	Magnetic particle inspection of sample 1	44
4.3	Magnetic particle inspection of sample 2	44
4.4	Magnetic particle inspection of sample 3	45
4.5	Inspection use penetrant testing on welded sample 1	46
4.6	Inspection use penetrant testing on welded sample 2	46
4.7	Inspection use penetrant testing on welded sample 3	47
4.8	Angle beam probe in Ultrasonic testing for the welding inspection.	48
4.9	Plotting card and florescent paper Ultrasonic Testing inspection	49
4.10	Schematic diagram location of defect in sample 2	50
4.11	Schematic diagram location of defect in sample 3	51
4.12	Lack of fusion signal in sample 2	52
4.13	Undercut signal in sample 3	53
4.14	The porosity signal produce in UFTD machine at welded sample 3	53
4.15	Bar chart the sample hardness test value	54
4.16	The schematic diagram point location for the Rockwell hardness test measurement	55

4.17	Growth and Brake Away of Gas Cavities at the Phase Border	57
4.18	Line chart the comparison with hardness and current	58
4.19	Indication defect occurs at sample plate 3	59
4.20	Welded sample 3 fracture at the undercut	59
4.21	Schematic diagram show location of defect	61
4.22	Line chart the comparison with maximum load and current in bend test	62

LIST OF ABBREVIATION

ASTM	=	American Society of Testing and Material
NDT	=	Non-Destructive Testing
UT	=	Ultrasonic Testing
SMAW	=	Shielded Metal Arc Welding
ASME	=	American Society of Mechanical Engineer
MPI	=	Magnetic Particle Inspection
UT	=	Ultrasonic Testing
VT	=	Visual Testing
RT	=	Radiographic Testing
UTFD	=	Ultrasonic Flaw Detector
CRT	=	Cathode Ray Tube

LIST OF APPENDIX

NO	TITLE	PAGE
1	Beveling the sample used milling machine	69
2	Bending sample used instron machine	69
3	Ultrasonic testing on the welded sample 2	70
4	Gant chart psm 2	71

CHAPTER 1

INTRODUCTION

1.0 INTRODUCTION

Shipbuilding industry was moving ahead to be an important industry in Malaysia. During each year, many companies are taking forwarding steps to improve the quality of each vessel issued. Each piece is designed to be adjusted to reduce defects, especially when it comes to welding. Welding is very important in the shipbuilding industry. Many types of welding were applied in shipbuilding industry such as shielded metal arc welding (SMAW), submerged arc welding, gas metal arc welding (GMAW), gas tungsten arc welding (GTAW) and oxyacetylene welding (OAW) (Eda TURAN, et al, 2011). Welded plate is essential in process permanent joint between each part. This is because welding can make a connection that lasts longer, stronger and acceptable range of the standard by manufacturing. Other than that, welding is an easy method to use and considerably safe to be used in tough parts. Distortion during welding can be considered an a major problem since welding defects can lead to detrimental damage to the whole structure or ship parts (P. L. Moore, 2009). Periodic inspections using Non- destructive test (NDT) are essential to give basic assurance of quality in the process of ship contractions.

Non-destructive test inspection is one of the most effective methods to determine the discontinuities for welding plate without having to damage the welded part. This is due, to versatility of Non- destructive test (NDT) techniques that can be applied in all parts including the hard part and can measure defects such as size, shape and orientation. There are lots of Non-destructive tests (NDT) methods

available such as Dye Penetrant Testing (PT), Magnetic Particle Inspection (MPI), Eddy Current (EC), Ultrasonic Testing (UT), Visual Inspection (VI), and Radiography Testing (RT). Besides that, NDT is suitable in any material to inspect for example, carbon steel, mild steel, aluminum and Perspex.

Non-destructive test very important to ensure that all goes according to plan in the project. Non-destructive test not only used at the end of the project, but it is used at all stages from raw material to complete the project. Non-destructive test is also used for routine control of various parts during operations.

1.1 BACKGROUND

In this research, the specimen is carbon steel plates with normally 1.65% manganese and 0.6 percent for copper and silicon. Welding machines used for this study are shielded metal arc welding (SMAW). Arc welding is a welding process that procedure joint for the metal through the application of heat from electric arc which is maintained between the tip electrodes. Advantage shielded metal arc welding (SMAW) is high quality weld, welds can be done in any position, simple and easy to use, and suitable in any tough part. Welding joining used is butt joint, this is because butt joint is result weld in a uniform surface, strength and simple to set up and weld (John R. Walker, 2003). Generally, each weld defects will occur if there is a change in the parameters when welding and cause to weld performance and longevity. There are many types of defect that may occur in welding, such as cracking, porosity, spatter and incomplete fusion that will minimize the strength of welding joint. The quality of the resultant joint achieved by welding is influenced by several factors, namely angle of welding, speed of welding, type of electrode, voltage and current used.

Non-destructive test (NDT) methods will be used for investigating the defect on the butt joint with different parameter using Dye Penetrant Testing (PT), Magnetic Particle Inspection (MPI), Ultrasonic Testing (UT), and Visual Inspection (VI). Each method of Non-destructive testing (NDT) has the standard procedure to identify defects. Visual inspection (VI) depends on the detection of surface imperfections using eye. Typically used without using any additional equipment. VI

can be improved by using aids such as a magnifying glass to enhance the effectiveness and scope. Magnetic Particle Inspection (MPI) is used to detect surface and sub-surface slightly discontinuities or defects in ferromagnetic materials. If the magnetic particles used for this surface, they will be held in place by a leakage flux to provide a visual indication. Liquid penetrant examination (PT) revealed surface flaws by the “bleed-out” of a penetrant medium against a contrasting background. Liquid penetrant after better seebility to the discontinuity on the surface compared to visual inspection. This is done by applying colored penetrate to the surface, allowing it to be drawn into the surface crack before any excess is removed. The developer will attract the trapped Penetrant back to the surface for inspection. Lastly, Ultrasonic Testing (UT) is using ultrasonic sound entered the material linearly and at a constant speed, until it reaches the crack surface. Before being reflected and capture by the receiver. Total energy delivered can be detected and provide information about the size of the reflector. In this UT, have several types of transducer specific principle, such as dual element, normal beam, angle beam, delay line and immersion transducer (Laea, Vienna, 2001). For this research, using normal beam and angle beam to inspect crack surface welding. Angle beam transducer uses the principle of refraction and mode conversion to produce shear or longitudinal waves in test material. Normal beam testing uses a sound beam that is introduced at 90 degrees to the surface. The choice between the two is made based on the orientation of the feature of interest so that the sound may produce the largest reflection from the feature and obstruction on the surface of the specimen that must be avoided (Laea, Vienna, 2001).

Lastly, for investigating the strength of welding and joint with the different parameters using mechanical testing. In the research, have the several types, mechanical testing to be used such as Bend Testing and Hardness test.

1.2 PROBLEM STATEMENT

Welding technology has obtained access to virtually every branch of manufacturing such as building construction, aircraft and automobiles. Welding is one process to join two metals through localized coalescence resulting from combination of temperature, pressure and metallurgical conditions suitable (R. Sathish, et al, 2012). The life time of weld joint depends on many factors such as

welding technique, geometric shape, design of welding piece, and the nature of the applied stress (Prof. DR. Muna Khethier Abbas). There are various types of defects that can occur in weld due to several factors such as human error and wrong selection of welding parameter. These defects are known to alter the mechanical properties of the weld joint, such as its strength, toughness and resistance of the welded piece to failure. Undetected defect may lead to detrimental damage dosing in-service application and should be avoided at any cost (B. L. Luk). Nondestructive testing (NDT) is used to inspect without changing the surface morphology or destroy the surface to be inspected. Some of the most common NDT is Visual Inspection (VI), Liquid Penetrant Testing (PT), Magnetic Particle Inspection (MPI) and Ultrasonic Testing (UT). However, only with proper procedure that we can ensure all the indication of defect is detected during inspection (A. Pradeep)

This project in going to the examination or evaluation of defect in plate based on investigating using VI, PT, MPI, UT as well as Bend Testing and Hardness test to effect of work on the in current using SMAW.

1.3 OBJECTIVE

1. To perform the butt joint welding on plate using SMAW with different current.
2. To investigate the defect on the butt joint plate using NDT (VI, PT, MPI, UT).
3. To study mechanical properties butt joint using bend test and hardness test.