



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

INVESTIGATION OF SPOT WELDING FATIGUE

PROPERTIES IN DISSIMILAR MATERIAL

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Mechanical Engineering Technology (Maintenance) with Honours.

by

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APPROVAL

This report is submitted to the Faculty of Mechanical and Manufacturing Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (Maintenance) with Honours. The member of the supervisory is as follow:

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ABSTRAK

Kimpalan rintangan titik biasanya digunakan dalam industry pembuatan dan automotif kerana kelebihan kimpalan ini seperti kelajuan yang tinggi dan hasil pengeluaran yang tinggi, kesesuaian untuk automasi, mudah diproses dan berkos rendah. Secara amnya, percubaan dan kaedah kesilapan pengetahuan dan pengalaman pengimpal telah digunakan secara meluas oleh industri untuk pemilih kekuatan tertinggi di dalam sifat keletihan untuk mencapai kimpalan yang berkualiti. Projek ini berkait dengan pengkajian tentang sifat keletihan di dalam kimpalan rintangan titik bagi bahan yang berbeza. Objektif utama projek ini untuk menyiasat bilangan kitaran 2 lapisan tapak kimpalan bahan yang berlainan, untuk menentukan had ketahanan keletihan bahan berbeza di kimpalan tempat dan untuk mengenal pasti tegangan tegangan tegangan beban dengan menggunakan lengkung ketegangan tekanan di kimpalan tempat. Kajian terhadap sifat keletihan terdiri daripada dua ujian; mesin ujian tegangan dan Universal Testing Machine (UTM). Kesimpulannya, hasil menunjukkan bahawa arus kimpalan memainkan peranan penting dalam menentukan kekuatan tegangan maksimum.

ABSTRACT

Resistance Spot Welding (RSW) is commonly used in manufacturing and automotive industry because of their advantages such as high speed and high production, suitability for automation, easy to process and low cost. Generally, the “trial and error” method based on the knowledge and experience of the welder has been widely adopted by the industry for the selection the higher strength of fatigue properties in order to achieve a good quality of welds. This project deals with the investigation of fatigue properties spot welding in dissimilar material. The main objective of this project to investigate the number of cycle of 2 layer spot weld of different material, to define the fatigue endurance limit of dissimilar material in spot welding and to identify the maximum load due tensile stress by using stress strain curve in spot welding. The studies of fatigue properties are consists by using two test; tensile test machine and fatigue machine. In the conclusion, the result shows that the weld current plays an important role in determining the maximum tensile strength.

DEDICATION

To my beloved father Mr. Hasnan Bin Amatermin and my beloved mother
Mrs. Hani Binti Haron.

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Alhamdulillah, finally I can finish my final year project. In preparing this paper, I have engaged with many people in helping me completing this project. First, I wish to express my sincere appreciation to my main supervisor Mr Mohd Harris Fadhilah Bin Zainudin, for encouragement, guidance, advices and motivation. Without his continued support and interest, this thesis would not have been the same as presented here.

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LIST OF SYMBOLS, ABBREVIATIONS AND NOMENCLATURE

RSW	-	Resistance Spot Welding
AHSS	-	Advanced High Strength Steels
ISO	-	International Standard Organization
UTM	-	Universal Testing Machine
SPCC	-	Clod Roller Commercial Grade
SEM	-	Scanning Electron Machine
Mm	-	Milimeter
ST	-	Squeeze Time
WT	-	Weld Time
HAZ	-	Heat Affected Zone
TRIP	-	Transformation Induced Plasticity
DP	-	Dual Phase Steel
CP	-	Complex Phase Steel
PSB	-	Persistent Slip Bands
WMT&R	-	Westmoreland Mechanical Testing & Research
HCF	-	High Cycle Fatigue
LCF	-	Low Cycle Fatigue
MMM	-	Metal Magnetic Memory

CHAPTER 1

INTRODUCTION

1.1 Introduction

Investigation of spot welding fatigue properties in dissimilar material depends on the type of material used. In the automobile industry, fatigue is the one important amongst the most significant component that should be concerned though the durability of spot weld depends on the fatigue characteristic for material utilized. This chapter present the framework of the undertaking as objective and scope of the task.

1.2 Background Of Project

As the time passed, a considerable measure of change has been done towards the welding technology these days. Exceedingly request of this sort of joining strategy influence it to wind up across the board. There are a lot of welding process and joining technique that have been utilized for different reason particularly in industries, for example, construction, electrical, mechanical and shipbuilding.

Plus, there used the welding process in the making of an equipment such as highway equipment, institution equipment and many more.

Among the kind of welding process or joining strategy that have been utilized broadly, Resistance Spot Welding (RSW) are one of them. This kind of joining technique is broadly utilized as a part of the car ventures for the making of an auto body. Figure 1.1 beneath demonstrates the standard of the resistance spot welding. (Tumuluru et al., 2011).

According to the research, resistance spot welding are one of the most established system that was being utilized since this sort of joining strategy is anything but difficult to deal with, solid for large scale manufacturing. Furthermore, it doesn't require filler metal, different with other joining method (Nasir et al., 2016). Also, resistance spot welding are utilized for joining numerous kind of ferrous and non-ferrous combination which is carbon steels, high strength alloy steels, stainless steel, aluminum and light alloys, nickel alloys and galvanized sheet and numerous more sort of metal sheet.(Sensor et al., 2012).

Be that as it may, in spite of the fact that this sort of joining method is quick and proficient. It can be powerless or disfigured if the technique isn't being utilized appropriately. It is worry that the spot weld mechanical properties is firmly identified with the immediate effect on a fatigue durability and crashworthiness (Library et al., 2012). In this way, exhaustiveness in car body building is vital component that should be concerned.

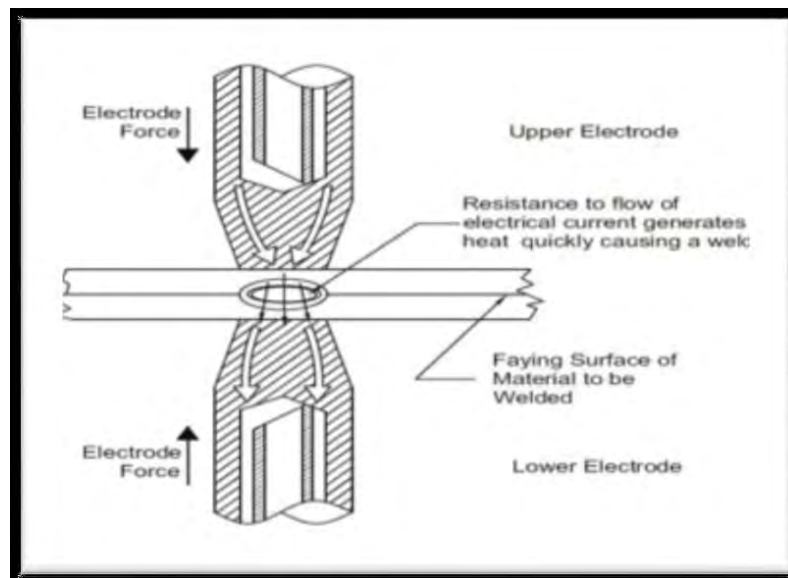


Figure 1.1: Principle of Resistance Spot Welding

(Nasir et al., 2016)

1.3 Problem Statement

Fatigue is known where the progressive, confined and perpetual auxiliary change because of fluctuating burdens and strains which causes splits or crack after a satisfactory number of fluctuations. Fatigue fracture is caused by the promptly activity that is known cyclic pressure, tensile pressure, and plastic strain whereby this activity came about towards fatigue cracking.(Boyer et al., 1986). In other clarification, fatigue failure can be comprehend where, when a material was subjected to the repeated load fracture will happen because to stress level that is much lower than fracture stress (Brnic et al., 2016).

Even though the truth that resistance spot welding (RSW) is outstanding in an auto lifting weights particularly in the car industry, yet there is still a considerable measure of overhauling that should be finished. Devarasiddappa D et al.,(2014), the maker are concentrating on a lighter yet solid vehicle. This prompt the necessity of inventive welding process. The mix of another material for auto body parts would be fundamental for an advancement of another welding systems. Keeping in mind the end goal to reduce weight, enhance vehicle safety, higher quality of the material is connected to every one of the new generations in vehicle manufacturer.(Sensor et al., 2012)

Accordingly, failure of spot weld of high hardness and fragility of this weld during a crash test for high and ultra-high quality steels have turned into a basic issue in car industries.(Sensor et al., 2012). The quality of spot welds in auto body structure relies on a few factors which are structure of parent sheet material and temperature-subordinate physical, in addition to mechanical properties.(Systems et al., 2010). Likewise, there is the additional factor that originates from welding parameter, for example, mechanical characteristics, welding current, electrode movement, crushing, welding and holding process duration and so on, the greater part of this factor is firmly identified with the weariness conduct that influences the strength of spot weld in an auto body structure. (Frameworks et al., 2010).

Material selection is an imperative stage to design the vehicle for reduction of vehicle mass however in the meantime have high mechanical strength. It has been seen because of expanding requirements for passenger safety, vehicle performance, and fuel economy. As the named in Advanced High Strength Steels (AHSS), the reaction of steel industry to the new difficulties is a quick development of higher strength steels, (Kuziak et al. 2008).

An expanded awareness to the energy saving and environmental make an impact popular for lightweight vehicles. Industry automotive has considered being utilized advanced high strength steel sheet into a automotive part with a specific end goal to diminish the weight and crashworthiness improvement (Liu et al. 2014). Because of lightweight itself, the utilization of fuel is automatically reduced. AHSS have better execution in a crash contrasted with established high quality steel with advanced work solidifying time and high flow stress (Kuziak et al. 2008).

1.4 Objective

The aim objective of this research according to the title of investigation of spot welding fatigue properties in dissimilar material:

- i. To investigate the number of cycle of 2 layer spot weld of different material in spot welding.
- ii. To define the fatigue endurance limit of dissimilar material in spot welding.
- iii. To identify the maximum load due tensile stress in spot welding.

1.5 Project Scope

In order to achieve the objective, several scopes have been determined:

- i. Compare the number of cycle of mild steel + galvanized steel and mild steel + AHSS.
- ii. Compare the fatigue endurance limit of mild steel + galvanized steel and mild steel + AHSS.
- iii. Compare the maximum load due to tensile stress of mild steel + galvanized steel and mild steel + AHSS.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter is an explanation of a application of the spot welding, the principle of Resistance Spot Welding (RSW), the type of material used in spot welding. Plus, is the explanation about the fatigue characteristics, fatigue behavior and all possible that related to fatigue testing.

2.2 Types of resistance welding

In welding technology, metal sheets and components that commonly used for joining in a car manufacturing industry are named resistance welding. The joining is prepared by directing a solid current all the way through the metal mix to warm up lastly dissolve the metals at limited position fixed by the outline of the anodes as well as the work pieces to be weld.