UNIVERSITI TEKNIKAL MALAYSIA MELAKA

THE EXPERIMENTAL INVESTIGATION OF FATIGUE TEST FOR SPOT WELDED STRUCTURAL JOINT

This report submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Manufacturing Process) with Honours.

by

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2015

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: The Experimental Investigation Of Fatigue Test For Spot Welded Structural Joint

SESI PENGAJIAN: 2015/16 Semester 1

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Engineering Technology (Manufacturing Process) (Hons.). The member of the supervisory is as follow:

…….

(Mr. Mohammad Khalid Bin Wahid)

ABSTRACT

The experimental investigation of fatigue test for spot welded structural joint is a study about joining using the resistance spot welding and been testing using fatigue machine. This study more focuses on using of different type of material and different thickness that using aluminium and galvanized iron with thickness 1 mm and 0.5 mm each. The parameter for the resistance spot welding and fatigue machines is constant for each specimen used. The S-N curve is obtained from the fatigue testing for each specimen. The result shows that the combination of aluminium-galvanized iron with thickness 1 mm each is easy to fail and have low number of cycle. Furthermore, the aluminium thickness 1 mm and 0.5 mm joining shows that the specimen failures at number of cycle 58 with fatigue stress 2.71 MPa while for galvanized iron material fail at number of cycle 8409 with fatigue stress 2.28 MPa. It shows that the joining of galvanized iron material more strong than the aluminium material joining.

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ABSTRAK

Penyiasatan eksperimen ujian keletihan untuk bersama struktur dikimpal ini adalah kajian tentang bergabung dengan menggunakan kimpalan setempat rintangan dan telah menguji menggunakan mesin kelesuan. Ini mengkaji tumpuan lebih banyak menggunakan pelbagai jenis material dan ketebalan berbeza yang menggunakan aluminium dan besi Tergalvani dengan ketebalan 1 mm dan 0.5 mm masing-masing. Parameter untuk rintangan tempat kimpalan dan mesin kelesuan adalah malar bagi setiap spesimen yang digunakan. Lengkung S-N diperolehi daripada kelesuan setiap ujian spesimen. Hasil menunjukkan bahawa gabungan aluminium-besi tergalvani dengan ketebalan 1 mm adalah mudah untuk gagal dan memiliki bilangan kitaran yang rendah. Selain itu, ketebalan aluminium 1 mm dan 0.5 mm yang menyertai menunjukkan bahawa kegagalan spesimen pada bilangan kitaran 58 dengan ricih tekanan 2.71 MPa manakala bagi bahan besi tergalvani gagal pada bilangan kitaran 8409 dengan tegasan ricih 2.28 MPa. Ia menunjukkan bahawa kekuatan bahan besi tergalvani lebih kuat daripada bahan aluminium yang lain.

DEDICATIONS

To my father & my mother,

Mr. Mohammed Sufian Bin Abdul Ghani & Mrs. Norridah Binti Rahim

All my friends and relatives

All the lecturers especially Mr. Mohammad Khalid Bin Wahid
Thousand thank and appreciate for your support,
encouragement and understanding

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CHAPTER 1
INTRODUCTION

1.0 Introduction

Spot welding is a broadly employed method to join sheet metals for body and cap structure in the automotive industry. The strength of the spot welds in the unibody vehicle structure decides the integrity of the structural performance during the vehicle operations. Most spot welds generally carry only shear forces however spot welds can likewise experience a significant amount of peel force or the force normal to the spot weld in certain stacking conditions. The mix of the stress states and geometric shapes of the spot welds lead to stress concentration that can bring in fatigue crack initiation around the spot weld. The presence of fatigue cracks can degrade structural performance and increase noise and vibration of the vehicle structure. Subsequently, comprehension of the fatigue strength for the spot welds is very critical in automotive component design. (Rahman M. , 2009)

Spot resistance welding is made by a combination of heat, pressure, and time. As the name resistance welding implies, it is the resistance of the material to be welded to current flow that causes a localized heating in the part. The required amount of time current flows in the joint is determined by material thickness and type, the amount of current flowing, and the cross-sectional area of the welding tip contact surfaces. There are parameter need to be control in spot welding that is welding time, welding current and electrode force.

The main motive of this project is to study about the fatigue testing of spot welding joint with using different type of material and different thickness of material. It is also want to know at what cycle the joint will be break using the fatigue testing machine and study the effect of using different type and thickness material.

Figure 1.1: Resistance Spot Welding Machine

1.1 Problem Statement

Resistance spot welds are significant to the automotive industry since the regular car body contains around a thousand spot welds joining a mixture of metal material types and sheet thickness. The corrosion resistance of the steel sheets is vital in car bodies and hence galvanized steel and austenitic stainless steel sheets take the spot of the uncoated steel sheets in automotive industries. One of the significant concerns in the spot weld industry is fatigue, because these joints are presented to variable loads in the vehicles structures. The fatigue crack starts at the inside surface of welded sheets in the heat affected zone (HAZ). It is imperative to know crack growth rate in the spot welded part and thus focus the serviceability of the spot weld before rupture. (Vural M. A., 2006)

The problem in this experiment is to know the effect of spot welded joining using different type and thickness of material whether the joining is strong to support the load. This type of joining is important to be test because it has been using to assembly the component of the car. It is use in daily life of the human and involves the life.

Besides, other problem in this joining is to know the strength the spot welded joining with analyze the number of cycle using S-N curve. Each specimen will undergo fatigue testing and the result will be calculated using formula to plot the S-N curve. The S-N curve is "S" stands for stress and "N" stands for the number of cycle to failure.

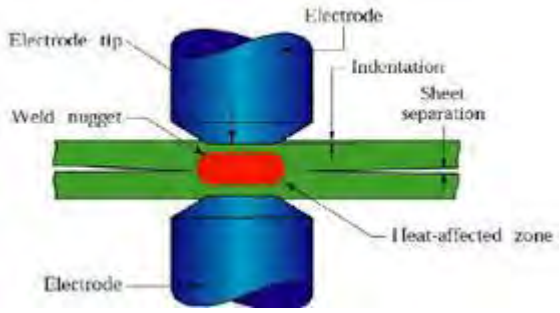

Figure 1.2: Weld Nugget

Furthermore, destructive testing is applied to test the spot welded joint and fatigue machine will be used in this experiment. In fatigue testing, a specimen is subjected to occasionally differing consistent amplitude stress. The applied stress may interchange between equivalent positive and negative value from zero to maximum positive or negative value, or between equivalent positive and negative value or between unequal positive and negative value.

1.2 Objective

The objectives of this project are:

i. To study the joining strength with different material and thickness from dynamic force
ii. To define the number of cycle using fatigue testing for spot welded joint

1.3 Scope

There are several scopes to be considered:

i. Type of joint
ii. Spot welding machine
iii. Fatigue machine
iv. Type of material
v. Parameter of spot welding

1.4 Flow Chart Planning

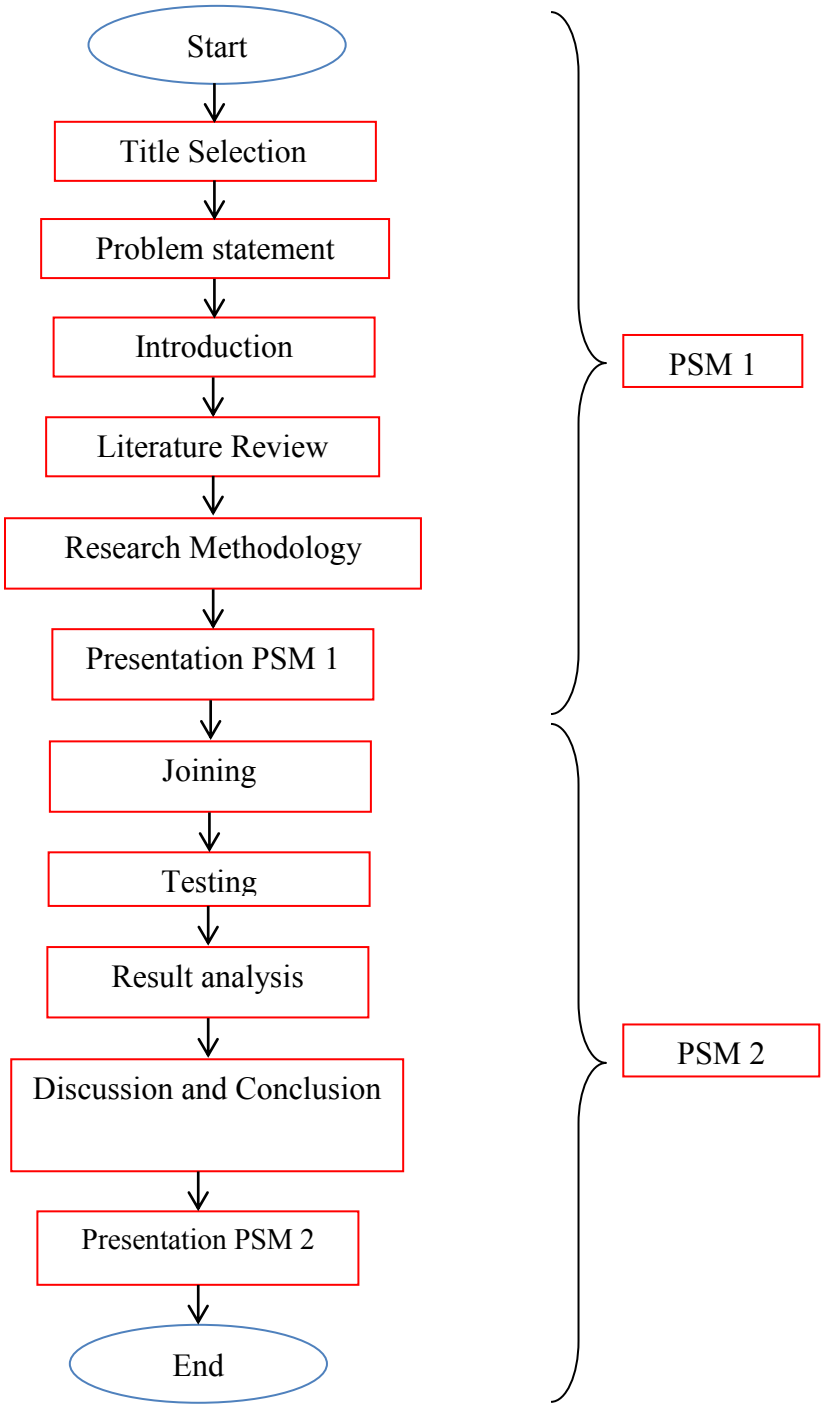

Figure 1.3: Flow Chart

CHAPTER 2
LITERITURE REVIEW

2.0 Introduction

One of the requirement task when conducting a research study is to gain understanding by reviewing the existing literature on the topic and use it in construction of own study. It is a tool to broaden our knowledge base in our research, focus to our research problem and bring clarity.

Meanwhile, previous study can improve our methodology and help us contextualize our findings. It is crucial in order to benchmarking our findings with others and add a body of knowledge thus developing a theoretical framework for our own study by following simple procedure where we search the literature in our area of interest and review the selected studies.

2.1 Material Properties

The material that used in this testing are aluminium and galvanized iron with thickness 1 mm and 0.5 mm each. Each material have their own material properties:

a) Aluminium

Aluminum is low density and therefore low weight, high strength, superior malleability, easy machining, excellent corrosion resistance and good thermal and electrical conductivity are amongst aluminum's most important properties. Aluminum is also very easy to recycle.

i. Strength

Aluminum alloys commonly have tensile strengths of between 70 and 700 MPa. The range for alloys used in extrusion is 150 – 300 MPa. Unlike most steel grades, aluminum does not become brittle at low temperatures. Instead, its strength increases. At high temperatures, aluminum's strength decreases. At temperatures continuously above 100°C, strength is affected to the extent that the weakening must be taken into account.

ii. Joining

Features facilitating easy jointing are often incorporated into profile design. Fusion welding, Friction Stir Welding, bonding and taping are also used for joining.

iii. Corrosion resistance

Aluminum reacts with the oxygen in the air to form an extremely thin layer of oxide. The layer is self-repairing if damaged. Anodizing increases the thickness of the oxide layer and thus improves the strength of the natural corrosion protection. Aluminum is extremely durable in neutral and slightly acid environments. In environments characterized by high acidity or high basicity, corrosion is rapid.

b) Galvanized Iron

i. Strength and Ductility

The galvanizing process has no effect on the tensile, bend or impact properties of any of the structural steels investigated when these are galvanized in the "as manufactured" condition.

ii. Embrittlement

The occurrence of embrittlement depends on a combination of factors. Under certain conditions, some steels can lose their ductile properties and become embrittled. Several types of embrittlement may occur but of these only strain-ages embrittlement is aggravated by galvanizing and similar processes.

iii. Fatigue Strength

The fatigue strength of certain steels, particularly silicon killed steels may be reduced, but any reduction is small when compared with the reductions which can occur from pitting corrosion attack on ungalvanized steels, and with the effects of welds. For practical purposes, where design life is based on the fatigue strength of welds, the effects of galvanizing can be ignored. Fatigue strength is reduced by the presence of notches and weld beads, regardless of the effects of processes involving a heating cycle such as galvanizing.

2.2 Welding

2.2.1 Welding Definition

Weld is defined by the American Welding Society (AWS) as a "localized coalescence (the combination or growing together of the grain structure of the materials being welded) of metals or non-metals method either by heating the materials to the required welding temperatures, with or without the utilization of pressure, or by the application of pressure alone, and with or without the use of filler materials". In less technical language, a weld is made when separate pieces of material to be joined combine and form one piece when enough heat is applied to raise the temperature sufficiently enough to cause softening or dissolving and the pieces flow together enough pressure is used to force the pieces together so that the surfaces coalesce, enough heat and pressure are utilized together to force the different pieces of material to combine and form one piece. A filler material may or may not be added to the joint to form a completed weld joint.

2.2.2 Application of Welding

Modern welding techniques are employed in the construction of numerous products. Ships, buildings, bridges, and recreational rides are fabricated by welding process. Welding is often used to produce the machines that are used to manufacture new products. Welding has made it possible for airplane manufacturers to meet the design demand of strength-to-weight ratios for both commercial and military aircraft.