AN EXPERIMENTAL STRENGTH OF COACH PEEL RIVETS JOINING SIMILAR AND DISSIMILAR SHEET MATERIALS

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ABSTRACT

The multi-materials structure has been applied as one of the methods in weight reduction especially in automotive industry. In this thesis, tensile test were performed in order to analyze the strength of similar and dissimilar sheet material joins connected rivets. It is used aluminum and steel sheet materials. Besides that, it is to study the fundamental phenomenon of tensile strength acted on coach peel riveted joints under similar and dissimilar sheet materials. Both materials are combined together to obtain the best comprise between weight reduction and the strength of the structure. The specimens of riveted joining was evaluated with tensile test in order to find the elastic of modulus (E), ultimate strength (σ_{ut}), yield strength (σ_y), proportional limit (σ_{pl}) and the fracture point (ε_f) from stress-strain diagram. The tensile strength for similar specimens is 22.25 MPa. While for the dissimilar sheet materials is 22.20 MPa. The percentage of difference between both specimens is very small, 0.22%.

ABSTRAK

Struktur multi-bahan telah diaplikasikan sebagai satu kaedah dalam pengurangan berat bahan terutama dalam industri automotif. Di dalam tesis ini, ujian tegangan telah dilaksanakan di atas arahan untuk menganalisis kekuatan sama jenis dan tidak sama jenis sambungan paku sumbat. Ia adalah mengunakan bahan kepingan aluminum dan besi. Selain daripada itu, ai adalah untuk mempelajari fenomena asas kekuatan tegangan yng bertindak ke atas sambungan paku sumbat pada sampel berbentuk L bagi sampel sama jenis dan tidak sama jenis kepingan bahan. Kedua-dua bahan adalah disambungkan bersama bertujuan untuk mendapatkan terrdiri daripada yang bagus diantara pengurangan berat bahan dan kekuatan struktur. Sampel sambungan paku sumbat telah dinilai dengan ujian tegangan di dalam arahan untuk mencari modulasi anjalan (E), kekuatan terakhir (σ_{ut}), kadar hasil kekuatan (σ_y), tahap keseimbangan (σ_{pl}) dan titik putus (ε_f) daripada gambar-rajah tegasan-tegangan. Kekuatan tegangan untuk sama jenis bahan sambungan paku sumbat adalah 22.25 MPa. Sementara itu, kekuatan tegangan tidak sama jenis bahan pula adalah sebayak 22.20 MPa. Peratusan perbezaan untuk kedua-dua bahan adalah sangat kecil iaitu 0.22%.

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%	*Percentage*
F	*Force*
ε	*Total strain, Bandwidth parameter*
σ	*True stress, local stress*
σ_{ut} @ S_u	*Ultimate Tensile Strength*
F_t	*Capacity of the joint in tensile*
σ_{ta}	*Allowable stress in tension*
A_t	*Net tensile area*
w	*Width of plane*
N	*Number of holes at the section of interest*

D_{II}	*Hole diameter (D_{II} = D+ 1/16 in @ D+1.6 mm)*
t	*Thickness of plate*
F_b	*Capacity of the joint in bearing*
σ_{ba}	*Allowable bearing stress*
A_b	*Bearing area*
L_t	*Total length*
L_g	*Grip to grip length*
L_h	*Length of horizontal section*
W	*Half plate width*
t_1	*Thickness of the plate at the rivet head side*
t_2	*Thickness of the plate at the rivet button side*
D	*Rivet hole diameter*
A_0	*Original cross-section area*
L_0	*Original gage length*

δ @ ΔL	*Elongation*
σ_y	*Yield Strength*
σ_{pl}	*Proportional Limit*
E	*Elastic of Modulus (Young's Modulus)*
ε_f	*Fracture Point or Breaking Point*

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Mechanical fastening is one of the major methods for joining structural components and its use will continue in the future despite a number of disadvantages and alternatives such as welding and bonding. (Calvin Rans, Paul V.Straznicky & Rene Alderliesten; 2007). With active pursuit of lightweight vehicle structures in the automotive industry, there is an increasing interest in developing new joining technology as a replacement for sport welding in lightweight metals such as aluminum alloys. Spot welding is primary method of joining steels body panels.

Although spot welding is considered a satisfactory joining method for aluminum body panels, the difficulty of sport welding thin aluminum sheet is well recognized. The reasons for difficulty of sport welding are due to its high thermal conductivity, low melting range and propensity to form oxide surface film(which contaminants the copper sport welding electrode tip and reduces the tip life).

Adhesive bonding, weld-bonding, riveting and clinching are some of the alternative joining techniques considered for aluminum alloys. Rivets are considered to be permanent fasteners. Riveted joints are therefore similar to welded and adhesive joints. When considering the strength of riveted joints similar calculations are used as for bolted joints (Maofeng Fu, P.K. Mallick; 2002).

Rivets have been used in many large scale applications including automotive industry, shipbuilding, boilers, pressure vessels, bridges, building. There are strict standard and codes for riveted joints in used for structural/ pressure vessels engineering but the standard are less rigorous for using riveted joints in general mechanical engineering.

A rivet is a cylindrical body a called a shank with head. It consists of smooth cylindrical shaft with a head on one end. The end opposite the head is called the buck-tail. On installation the rivet is placed in a pre-drilled hole. To distinguish between the two ends rivets, the original head is called the factory head and the deformed end is called shop head or buck-tail.

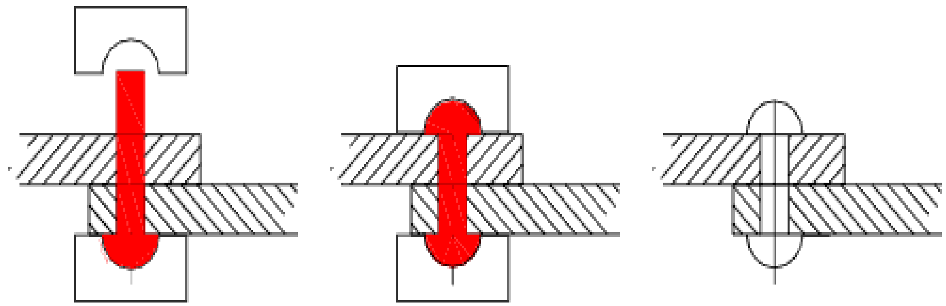

Figure 1.0: Process of rivets.

The selection of the number of rivets used for joint and the array is simply to ensure the maximum strength of the rivets and the plates. If ten small arrayed rivets on the lap joint were replaced by three large rivets across a plate the plate the plate section area (in tension) would clearly be significantly reduced.

There are a number of types of rivets, designed to meet different cost, and strength requirements. These include solid rivets, blind rivets, multi-grip rivets, peel type blind rivets, self-pierce rivets, plastics rivets and tubular rivets.

1.2 IMPORTANCE OF RESEARCH.

This research is significant because:

1. It investigates the effects of materials combination in riveted joining that especially applied in automotive materials industry.

2. It provides to manufacturing engineers to the effects of different manufacturing parameters on the tensile strength for various rivet joining.

1.3 PROBLEM STATEMENT

With active pursuit of automobile materials industry, there are increasing interests in developing new technology as a replacement for spot welding lightweight metals such as steel and aluminum alloy. Rivet is some of the alternative joining techniques considered for these materials. Both materials are combined together to obtain the best comprise between weight reduction and the strength of the structure. With the trend to combine dissimilar materials in automotive industry, a reliable strength of the joining method must be developed and be evaluated. In this context, tensile test on the riveted joint under similar and dissimilar sheet material will be evaluated.

1.4 OBJECTIVES

The overall objectives for this project were:

- To analyze tensile strength of coach peel riveted joints under similar and dissimilar sheet materials which are aluminum and steel sheet materials.
- To study the fundamental phenomenon of tensile strength acted onto coach peel riveted joints under similar and dissimilar sheet materials (aluminum and steel sheet).

1.5 SCOPES OF RESEARCH

This project concentrates on the tensile strength of the rivets joining similar and dissimilar of sheet materials using coach peel specimens. The load (N), displacement (mm), stress (MPa) and strain (mm/mm) are main parameters in this experiment.