"I hereby declared that I have read through this report and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Mechanical Engineering (Material Structure)"

Signature : ……

Supervisor's Name : PROF. DR. MD. RADZAI SAID

Date : 18 MAY 2009

THE STUDY OF RINGS UNDER QUASI-STATIC LOADING

AISHATUL RODHIAH BINTI MOHAMAD

This report is submitted

to partial fulfillment of term for

Bachelor of Engineering Mechanical (material structure)

Faculty of Mechanical Engineering

Universiti Teknikal Malaysia Melaka

MAY 2009

"I hereby declared this report is mine except summary and each quotation that I have mentioned the resources"

Signature : …….....

Author's name : AISHATUL RODHIAH BT MOHAMAD

Date : 18 MAY 2009

To my beloved father, Mohamad B. Mat Rejab,

my beloved mother, Hamidah Bt Ismail.

ACKNOWLEDGEMENT

Thanks to almighty because give me a chance to finish my 'Projek Sarjana Muda (PSM) I & II' report without any problem. I would like to thanks Prof. Dr. Mohd

Radzai Said as my PSM supervisor. He had given me a guidance and clear explanation on writing my report.

Beside that, I also want to thanks to all technicians that give full cooperation in helping me doing the experiment and workshop.

Lastly, I would like to thanks to lecturers and all my friends that involve in this report.

ABSTRACT

Recently the number of car accident in our country increased tremendously. One of the factors causing injury to the drivers and the passengers was the lack of the ability of the material to absorb energy when subjected to impact. This study was conducted in order to evaluate the mechanical properties of mild steel ring and its ability in absorbing the energy when subjected to impact. The ability of mild steel ring to absorb the energy will determine the applicable of this material in the area that involve with impact. In this research, the mild still ring was used to study its ability to absorb energy. Compression test is performed to check the ability of the material in absorbing the energy and the mechanical properties of the material was determined by hardness test (Rockwell). The hardness test shows that the ultimate stress is higher than the yield stress which indicates that the mild still ring is suitable to be used as efficient energy absorption material. This research will show the differences between multiple layer circular rings and single circular ring in order to absorb energy. Graph of compression test also can show the value of collapse force and displacement collapse for the both type of circular ring. From that graph, state that the multiple layer circular rings has high value in collapse force and it is also has high value of energy absorbing where the value of the energy absorb for multiple layer circular ring is double compare to the single circular ring. Besides that, this research also contain of the theoretical analysis that use ABAQUS Software. The theoretical result will compare to the experimental result.

ABSTRAK

Sejak akhir-akhir ini kadar kemalangan kenderaan dalam negara kita meningkat ke tahap yang membimbangkan. Salah satu faktor yang menyebabkan kecelakaan pada penguna kenderaan adalah kurangnya kebolehan bahan menyerap tenaga apabila dikenakan hentakan/hentaman. Justeru itu, kajian ini dilakukan untuk mengkaji sifat-sifat mekanikal gegelang 'mild steel' dan keupayaannya menyerap tenaga (energy absoption) apabila dikenakan daya hentaman keatasnya. Keboehan penyerapan tenaga oleh gegelang 'mild steel' ini membolehkan ia digunakan di dalam aplikasi yang melibatkan daya hentakan atau hentaman. Di dalam kajian ini, gegelang 'mild steel' berbentuk bulat digunakan untuk mengkaji kebolehannya menyerap tenaga. Ujian hentaman digunakan untuk menunjukkan tahap penyerapan tenaga bahan ini dan sifat-sifat mekannikal bahan ini diberikan oleh ujian kekerasan (Rockwell). Ujian mampatan menunjukkan tegasan unggul (ultimate stress) lebih tinggi dari tegasan alah (yield stress) dan ini menunjukkan bahawa gegelang mild steel berbentuk bulat mempunyai kekuatan yang membolehkan ia digunakan sebagai bahan penyerap tenaga yang efisen. Ujikaji ini juga menyatakan perbezaan antara gegelang lapisan berganda dan gegelang tunggal dalam penyerapan tenaga. Graf yang diperolehi dari hasil krja makmal dapat menunjukkan nilai daya musnah bagi kedua-dua jenis gegelang. Graf tersebut juga menunjukkan bahawa gegelang lapisan berganda mempunyai daya musnah yang tinggi dah juga nilai penyerapan tenaga yang tinggi berbanding dengan gegelang tunggal. Di akhir ujikaji ini menyatakan bahawa gegelang lapisan berganda mempunyai nilai penyerapan tenaga berganda dari gegelang tunggal. Selain itu, ujikaji ini juga merangkumi analisis teori yang mana ia akan dilakukan menggunakan perisian ABAQUS. Keputusan yang diperolehi dari analisis teori akan dibandingkan dengan keputusan yang diperolehi melalui ujikaji makmal.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

D	=	Indenter diameter, mm
d	=	Indentation diameter, mm
F	=	Applied force, N
t	=	Thickness, mm
L	=	Length, mm
σ	=	Stress, N/m^2

LIST OF APPENDICES

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Background

Absorbing device nowadays is important for vehicle, lift and others when happen collision. Impact energy absorbers are important element in this research. From some resource impact energy absorber are expendable mechanical structural elements which are brought in to action in the event of an unwanted collision. In this research quasi-static axial and lateral compression tests were conducted on circular ring. Circular in Wikipedia means circle, or something in the shape of a circle [1]. Ring is some shape in thin of the thickness. This ring used in this research is mild steel. Carbon steel is sometimes referred to as 'mild steel' or 'plain carbon steel'. Typically carbon steels are stiff and strong. This material has advantages that are wide variety available with different properties, high stiffness and important thing that it cheap [2].

1.2 Problem statement

Nowadays have much energy absorbing device where it have in many shape like rectangular tube, circular tube, and others. This research is to identify the energy absorption in ring shape. It will show the result where it better than other shape or not in absorb the energy when get an impact.

1.3 Objective

The objective of this research is to study experimental and theoretical load-displacement curves on single circular rings. It also studies about the load-displacement curve trend, the comparison between undeformed ring with deformed also compared/study as well as the collapse load.

1.4 Scope

Based on the objective, this scope of research is also to determine the mechanical properties by performing the hardness test. The ring are cut from round tube, and then slowly compressed on single ring. Hardness testing is performed to determine the material properties. The result from the experiment is validated by FEA. The time schedule for my Projek Sarjana Muda I (PSM I) can be seen in appendix A.

1.5 Chapter Outline

Chapter 1 of this research paper will discuss the objective on this paper. Besides that, this chapter also will discuss about problem statement, scope and others.

Chapter 2 discusses about literature review that related to the research. In this chapter also includes the important information such as the introduction methodology or method to prepare the specimen, parameter that could involve in this research and also the test required in order to achieve the objective of this research.

Chapter 3 covers the methodology of this research where this chapter actually consists of all process that involves to this research either experimentally or theoretically such as compression test and ABAQUS software.

Chapter 4 discusses more about experimental result where in this chapter consist of graph and table for experimental work. From this chapter also, the curve trend of compression test will discuss and the energy absorption can define.

Chapter 5 also discusses the result but in theoretical. This chapter will show the trend of deformation from computer simulation. The graph of energy also can be defined and will compare to the experimental result.

Chapter 6 compares the experimental result with the theoretical result in order to know the similarity of both types of performance. In this chapter also will compare the circular ring result and the triangular ring result in order to know where is better in energy absorption.

Lastly is chapter 7, where this chapter concludes the result from this research and some suggestion to improve this research.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

In this chapter will discuss about Train-to-Train Impact Test of Crash Energy, Finite Element Analysis of Collapse of Metallic Tubes, impact force, about the hardness test and others. All this will give more understanding about energy absorption and the mechanical properties of the material. In this chapter also includes the important information such as the introduction methodology or method to prepare the specimen and also the test required in order to achieve the objective of this research.

To start any analysis, all variable aspect has to store up. All information in this research got from journal and internet.