UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN AND ANALYSIS OF A JIG TESTING FOR AUTOMOTIVE COIL SPRING STATIC

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

by

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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 (Automotive) with Honours. The member of the supervisory is as follow:

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ABSTRAK

Pegas gegelung bertindak sebagai kusyen penyerap hentakan semasa kenderaan melalui jalan yang tidak rata. Untuk meningkatkan prestasi dan mengelakkan pegas gegelung dari kegagalan ketika beroperasi, pengeluar perlu melakukan ujian bagi menguji keupayaan pegas gegelung. Jenis ujian yang dijalankan adalah ujian mampatan dengan menggunakan Mesin Penguji Universal, tetapi jig untuk menempatkan pegas gegelung ketika ujian dijalankan tidak disediakan pada mesin tersebut. Tujuan penyelidikan ini adalah untuk merekabentuk, menganalisis dan fabrikasi jig bagi gegelung pegas automotif statik. Jig merangkumi dua bahagian iaitu jig atas dan bawah. Setiap jig mempunyai tiang sebagai pemegang jika berlaku kegagalan pada pegas gegelung atau patah apabila ujian mampatan dilakukan. Perisian Catia V5 digunakan untuk mereka bentuk kedua-dua jig dalam 3D. Reka bentuk produk, dipilih keluli sebagai bahannya. Beberapa penambaikan dan peningkatan pada reka bentuk telah dilakukan untuk mencapai pengurangan berat produk. Jig mempunyai tiga reka bentuk dan reka bentuk yang ketiga diluluskan sebagai reka bentuk akhir sebelum analisis. Analisis terhadap reka bentuk jig dilakukan dengan menggunakan Catia Analisis Struktur Generatif dan dipilih sebagai analisis statik untuk menentukan nilai maksimum jig melalui von mises stress (nilai nod). Apabila penentuan produk analisis dicapai, ia membolehkan prosedur fabrikasi melibatkan memotong, kimpalan dan proses akhir untuk jig. Untuk selongsong ia melibatkan proses membengkok dan menggerudi. Ujian sebenar jig pada mesin UTM dilakukan bagi menentukan tekanan dan ketegangan untuk pegas gegelung dengan menggunakan ujian mampatan. Hasil pemerhatian pada ujian mampatan menunjukkan jig tidak gagal seperti lenturan atau patah pada mana-mana bahagiannya.

ABSTRACT

Coil spring is the main part on suspension system to act as a cushion to absorb the shock when bumping on the road. To increase performance of coil springs and avoid spring failure when running on the road, manufacturer needs to perform test. Type of test performed is compression test. By using Universal Testing Machine this type of test may be perform but there is no jig to place coil spring when compression test. Focused on this research to design, analysis and fabricate jig testing for automotive coil spring static. The jig was involve in designing include two part which is upper and lower jig. Each jig has a pole act as holder if spring failure or fracture when compression test. Catia V5 software use to design both jig in 3D. The product design, assigns as steel. Some refinement and improvement on the design was done to achieve weight reduction. The jig has three design and third design approved as a final design before analysis. The analysis of design performed by using Catia Generative Structure Analysis selected static analysis to determine jig maximum value of von mises stress (nodal value). The determination of analysis product is achieved, that allow fabrication procedure involves cutting, welding and finishing process for jig. For casing it involve bending and drilling process. Actual test of jig on UTM machine was perform to determine stress and strain for coil spring by using compression test. The result of observation on compression test show the jig did not failure such as bending or fracture.

DEDICATION

This thesis is dedicated to all my family members, lecturers and fellow friends. To my beloved parents Mr. Mohd Said Bin Yahaya and Madam Norlida Bt Mohamed who keep on supporting me to achieve until this level and always be there whether I am in difficult or happy state. Their unconditional love reminds me that I could not easily disappoint them and even strive to be success. To all my respected lecturers that always patient and passion in order to give me a lot of knowledge during I am studying at UTeM. To all my fellow friends are deserved to be my companion in my success of the project especially my classmates. They have provided me a lot of favours and spirits which make me to become a better person.

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LIST OF ABBREVIATIONS

UTM	Universal Testing Machine
ISO	International Organization for Standardization
ASTM	American Society for Testing and Materials
DIS	Draft International Standard
BSI	British Standards Institution
IEC	International Electrotechnical Commission
DIN	Deutsches Institut für Normung
ANSI	American National Standards Institute
AFNOR	Association Française de Normalisation
ISA	International Federation of the National Standardization Association

CHAPTER 1

INTRODUCTION

1.1 Research Background

The coil spring is the main part in suspension system to act as a cushion to absorb the shock when bumping on the road. The spring stored the energy of movement. Some of coil spring having a failure when running on the road. This situation may affect the performance of suspension system.

To increase the performance of coil spring, the manufacturers need to perform a test. Usually the machine to perform the coil spring test is come out with the jig and it can perform various type of coil spring. In UTM machine it also can do compression and tensile test for spring, but the UTM machine did not have a jig to place the coil spring.

This project is focused to produce a jig that can place the coil spring when running the experiment using UTM machine. This product must be fitted into a various type of coil spring. So, the design of this jig need to considers a diameter and type of end the coil spring. The manufacturers produce various type of end coil spring to counter the performance problem.

1.2 Problem Statement

In laboratory or workshop session, subject of suspension system commonly need to run test for coil spring. Some of student and teaching engineer need to perform a test on coil spring using UTM machine but there is no jig or base to place coil spring when running the experiment.

The focused on this project is produce a jig which is be able to help them using UTM machine when running coil spring compression test. This is because UTM machine is available for tensile and compression test. This testing equipment was design due to the available type of coil spring in market.

Method to design the product is using CAD software which is CATIA and analysis. The analysis will identify the problem of material and designing stress and force. When analysis process was completely successful, then there is fabrication process to produce the product that may be able to use on UTM machine.

1.3 Objective

Thus in this research, the parameters of coil spring and UTM machine need to be consider. Then the identified parameter will determine the output of product design and related to the objective. The following objectives are as follow:

1. To study standard testing for coil spring
2. To design and fabricate a testing equipment to perform standard testing
3. To test the spring as a sample for testing measurement

1.4 Scope

The main consideration of parameter to perform this project is the type of coil spring and dimension of base UTM machine. So, the design and output of product was determined by parameter that state below:

1. Type of end and diameter of coil spring
2. The dimension of UTM machine (top and bottom plate base)
3. Designing of product due to the analysis that can achieve the objective
4. The fabrication process to produce the jig product

CHAPTER 2

LITERATURE REVIEW

2.1 History of Spring

There are two main types of spring that a non-coiled and spring coiled. A great example of a spring that non-coiled is the bow and arrow. Bow and arrows are there to help with food and shelter. This is one of the earliest spring technologies. Anytime the string is tightened to make a bounce, which can be considered a "spring". In the year 1300 there was a spring technology used in the car. The car has a spring system and a complex suspension, which helps give more miles. R. Tradwell in 1763 invented the first coil spring. The revolutions of coil spring begin from the leaf spring types. (Coiling technologies, 2012).

In automotive industry, modern vehicles use a number of different types of spring medium, but the most popular is the coil spring. Coil springs used in vehicle suspension system are made from round spring-steel bars. The heated bar is wound on a special former and then heat-treated to obtain the correct elasticity (springiness). The coil spring can withstand any compression load, but not side thrust. It is also difficult for a coil spring to resist braking or driving thrust. Suspension arms are used to resist these loads (Denton, 2011).