UNIVERSITI TEKNIKAL MALAYSIA MELAKA

PERFORMANCE INVESTIGATION OF SPROCKET AND CHAIN USING FINITE ELEMENT METHOD

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

MUHAMMAD IZZUL BIN ZAHARI
B071510825
940410115653

FACULTY OF MECHANICAL AND MANUFACTURING ENGINEERING TECHNOLOGY

2018

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

Tajuk: PERFORMANCE INVESTIGATION OF SPROCKET AND CHAIN USING FINITE ELEMENT METHOD

Sesi Pengajian: 2019

Saya **MUHAMMAD IZZUL BIN ZAHARI** mengaku membenarkan Laporan PSM ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan laporan PSM ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. **Sila tandakan (X)

☐	SULIT*	Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia sebagaimana yang termaktub dalam AKTA RAHSIA RASMI 1972.

☐ TERHAD* Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan.

☒ TIDAK TERHAD

Yang benar,

.....

Muhammad Izzul Bin Zahari

Alamat Tetap:
LOT 735 TAMAN SRI KEDONDONG
KADOK 16450 KETEREH
KELANTAN.

Tarikh:

Disahkan oleh penyelia:

.....

Profesor Madya Ts. Dr. Muhammad Zahir Bin Hassan

Cop Rasmi Penyelia

Tarikh:

*Jika Laporan PSM ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh laporan PSM ini perlu dikelaskan sebagai SULIT atau TERHAD.

DECLARATION

I hereby, declared this report entitled PERFORMANCE INVESTIGATION OF SPROCKET AND CHAIN USING FINITE ELEMENT METHOD is the results of my own research except as cited in references.

Signature: ……

Author : Muhammad Izzul Bin Zahari

Date:

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

Signature: …….

Supervisor : Profesor Madya Ts. Dr. Muhammad Zahir Bin Hassan

Signature: …….

Co-supervisor: Mr. Saiful Naim Bin Sulaiman

ABSTRACT

This research proposes to investigate the study of the strength and shape change of the sprocket and the chain on a 150cc speed motorcycle. The sprocket and chains actually depend on the material used on the sprocket and the chain and it is also according to the suitability of motorcycles that are more focused on engine speed, load and vehicle. Therefore, to save costs existing software such as SolidWorks was used to conduct studies on strengths and changes in the shape of the sprocket and chains in the form of simulation. In this study, the chain used is different in terms of the thickness of the chain itself to obtain the suitability of the chain thickness with the pressure applied. To run the simulation itself it is necessary to know and study the power of the engine and to study where to put pressure on each tooth sprocket and the chain. Additionally, it is important to select the appropriate material to determine whether the material is suitable or not with the pressure given by the engine power. Meshing the sprocket and chain using type fine mesh. Run a simulation and then get a result. After getting results, it can make comparisons of strengths and changes in design between the differences of the material and choose which materials are suitable for use on a 150cc speed motorcycle. Material suitability, "sprocket" design and chain size are very important to be used for proper motorcycles to avoid fracture or break chain when motorcycles are fast, uphill and when to start a movement.

ABSTRAK

Penyelidikan ini bertujuan untuk menyiasat kajian kekuatan dan perubahan bentuk pemacu dan rantai pada motosikal kelajuan 150cc. Pemacu dan rantai sebenarnya bergantung kepada bahan yang digunakan pada pemacu dan rantai dan juga sesuai dengan kesesuaian motosikal yang lebih tertumpu pada kelajuan enjin, beban dan kenderaan. Oleh itu, untuk menjimatkan kos perisian sedia ada SolidWorks yang digunakan untuk menjalankan kajian keatas kekuatan dan perubahan dalambentuk pemacu dan rantai dalam bentuk simulasi. Dalam kajian ini, rantai yang digunakan adalah berbeza dari segi ketebalan rantai itu sendiri untuk mendapatkan kesesuaian ketebalan rantai dengan tekanan yang digunakan. Untuk menjalankan simulasi, adalah perlu untuk mengetahui dan mengkaji kuasa enjin dan untuk belajar di mana tempat itu harus memberi tekanan pada setiap gigi pemacu dan rantai. Di samping itu, adalah penting untuk memilih bahan yang sesuai untuk digunakan sebagai kajian untuk menentukan sama ada bahan itu sesuai atau tidak dengan tekanan yang diberikan oleh kuasa enjin. Rangkaian pada pemacu dan rantai adalah jenis halus. Jalankan simulasi dan kemudian dapatkan hasil. Selepas mendapat keputusan, ia dapat membuat perbandingan kekuatan dan perubahan rekabentuk antara perbezaan bahan dan memilih bahan yang sesuai untuk digunakan pada motosikal kelajuan 150cc. Kesesuaian bahan, rekabentuk pemacu dan saiz rantai sangat penting untuk digunakan pada motosikal yang sepatutnya untuk mengelakkan fraktur atau rantai akan putus apabila motosikal laju, mendaki dan ketika memulakan pergerakan.

DEDICATION

To my beloved parents and supervisor thanks for the incredible support and encouragement as I began to feel stressed with spirit given I can feel the lack of pressure is reduced and I can do this task well Alhamdulillah. I would like to thank you to supervisor for helping me from various facets to complete this task. For my co-supervisor also help me to use the software thank you very much.

ACKNOWLEDGMENTS

First and foremost, I would like to grab this chance to express my sincere gratitude to my supervisor, Profesor Madya Ts. Dr. Muhammad Zahir Bin Hassan from Faculty Of Engineering Technology Mechanical And Manufacturing, University Technical Malaysia Melaka(UTeM) for this essential guidance, support and encouragement towards the completion of the final year project report.

In addition, I would like to thank for Mr. Saiful Naim Bin Sulaiman, the lecturer for teaching me using the software, Faculty Of Engineering Technology Mechanical And Manufacturing sincerely.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS

D, d	-	Diameter
F	-	Force
g	-	Gravity = 9.81 m/s
I	-	Moment of inersia
1	-	Length
m	-	Mass
N	-	Rotaional velocity
P	-	Pressure
Q	-	Volumetric flow-rate
r	-	Radius
T	-	Torque
Re	-	Reynold number
V	-	Velocity
w	-	Angular velocity
x	-	Displacement
z	-	Height
q	-	Angle

CHAPTER 1

INTRODUCTION

1.1 Overview introduction of Analysis sprocket and chain

Generally, the sprocket is using for any wheel involving the chain passing over it. It is distinguished from a gear in that sprockets are never meshed together directly, and different with pulley because the sprocket has teeth and pulley no teeth and pulley moving smoothly compared to the sprocket. Sprocket can be applied in a variety of material and style, depending on application and severity of service requirement. The material selection for sprocket is depending on the strength and service condition (Suthar, 2017).

The chain is the one of the commonly used drive train to transfer the power from the engine. The chain assembly consists of driven sprocket and driving sprocket. The driving sprocket connected with the engine output shaft, which transfers the power to the driven sprocket. After that, driven sprocket transfer the power to the drive shaft (Nikam and Tanpure, 2016).

1.2 Research Background for sprocket and chain

This research is about performance investigation of sprocket and chain using the FEA. The material for sprocket is stainless steel and alloy steel depend on type motorcycle. The front sprocket connecting with the engine and it will supply the power from engine and chain contact with sprocket to rotate the rear wheel. So, the rear

sprocket hasforce at each of teeth. Actually, the first 10 teeth have more compared to others teeth at sprocket.

1.3 Objective

- To study the effect of sprocket and chain parameter such as material properties and the effect of load.
- To investigate the structural deformation of the sprocket chain that contributes to structural integrity.

1.4 Aim

- To propose a better solution high performance of sprocket and chain used in motorcycle
- To understand the structure of deformation of the sprocket and chain assembly.

CHAPTER 2

LITERATURE REVIEW

2.1 Overview of Sprocket and chain system

This research is about to analysis the strength and deformation of sprocket and chain. The strength comes from the power of engine motorcycle and with the strength imposed to the sprocket driven and driving transmit by the chain will be effective to the sprocket and chain. After that, the material used in the sprocket and chain main role in strength and deformation because best material will give the strength for sprocket and chain and will decrease the deformation for sprocket and chain. Therefore, should find the strength and deformation to give a good strength for the sprocket and chain.

2.2 Performanceof sprocket and chain using FEA

According to (Nikam and Tanpure, 2016)**,** the force of each tooth should be know because the each of tooth is not same force. The Table 2-1 below shows the maximum of chain tension will be act on the first teeth and until the 10 teeth. After that, the force will be decrease continuously and negligible after the 10 teeth. When meshing for static analysis as indicated in Figure 2-1for will be charged on the teeth surface with direction to pitch circle of sprocket teeth. The analysis process at Ansys Workbench. Stress was charged on sprocket at von-mises stress based on figured below is 179.08Mpa. For mild steel, the maximum value for stress is less than the yield stress, which the result in a factor of safety is greater than 1. Difference with deformation process when the maximum is obtained 0.01831mm shown Figure 2-2.It can be seen on

the figure below for deformation plot the maximum deformation appears at point depend to maximum force. The Table 2-2 shows the frequencies of each teeth at the sprocket. As we can see the frequency is increase and at the 6 teeth have more frequency compared to others. It is means rate of swing and vibrate regularly at 6 teeth.

Table 2-1: Force (Nikam and Tanpure, 2016)

Tooth number	Force (Newton)
T1	1177.9
T2	1251.9
T3	846.16
T4	567.99
T5	381.27
T6	255.9
T7	171.79
T8	115.31
T9	77.4
T10	51.96

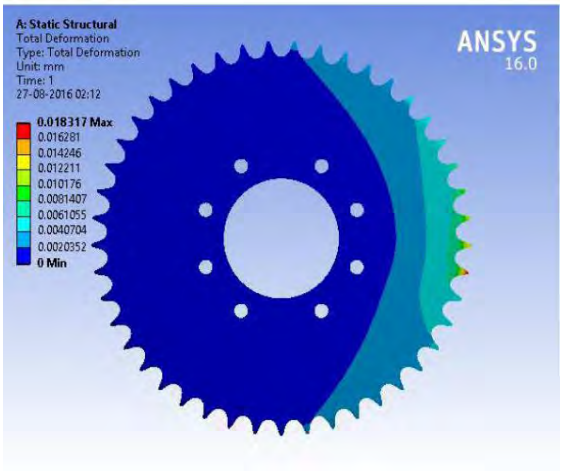

Figure 2-1: Static Analysis (Nikam and Tanpure, 2016)

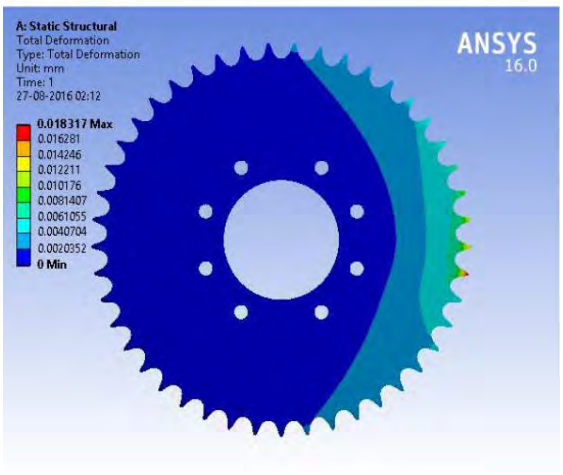

Figure 2-2: Deformation (Nikam and Tanpure, 2016)

Table 2-2: Natural Frequency (Nikam and Tanpure, 2016)

Frequency	Sprocket(Hz)
1	1665.5
2	1679
3	1774.5
4	1883.5
5	1970
6	2492.6

(Suthar, 2017) investigate the effect of sprocket strength using a finite element analysis method. The material for sprocket should be good material. In manufacturing, the steel is a familiar matter to manufacture the sprocket its good wearing properties. To reducing the weight and noise, the material used in manufacturing is characterized as non-metallic material like wood, compressed paper and plastics like nylon, Acrylic, and Polycarbonate, which is also widely used for gear. This overcomes the traditional used of present product which is made from cost reduced material such as steel is for sprocket material. The disadvantages of the steel are due to the fact that it's despite the capabilities for fatigue extremely useful and flexing not lead to critical failure. The material selection is used mild steel. The Chemical composite of mild steel is (- 0.23%, Mn-1.5percentage, S-0.05percentage, P-0.05percentage, Si-0.4%). In pre-processing draw, the sprocket design, save in format IGS file, and after that imported to meshing to HyperMesh 12.0. After import the sprocket chain, all dimensions can measurable. The best meshing to use is the tetrahedral element. Static analysis is used for analysis. The

boundary condition for a reference point to calculate the result of the analysis. Have to force acting on sprockets such as force acting on sprocket due to tension in the tight side of chain (Torque at rear sprocket) and the Gravitational force acting at the center of the sprocket (in this case neglected).From the boundary condition software calculated, the deflection with boundary condition applied and then computed the strain. After the strain calculated, we can know the modulus of elasticity and we can compute the stress. The calculation of stress depends on the failure theory suitable for analysis. The table below shows Von-Misses stress for sprocket (Carbon Fiber) the stress value is 371.13 N/mm2. So this is well because of the below of critical value. The deformation of the sprocket is 0.091. The material used is steel and carbon fiber.

Table 2-3: ComparisonOf Material Properties (Suthar, 2017)

Material	Mild Steel	Carbon Fiber
Young's Modulus (E)	210 GPa	E1-190 Gpa, E2- 7.7 Gpa
Poisson's Ratio(υ)	0.3	0.35
Density (ρ)	7850 kg/m3	1600 kg/m3
Yield Stress	290 MPa	-
Ultimate Tensile Stress	390 MPa	2000 MPa
Mass (m)	0.847 Kg	Kg 0.173 Kg