FAILURE ANALYSIS OF INPUT SHAFT

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SUPERVISOR'S DECLARATION

We hereby declare that we have checked this project and in our opinion this project is satisfactory in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering.

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STUDENT'S DECLARATION

I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged. The thesis has not been accepted for any degree and is not concurrently submitted for award of other degree.

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LIST OF SYMBOL

FEA	Finite Element Analysis
AISI	American Iron and Steel Institute
Kt	Stress concentration factor
S_f	Fatigue strength
ε	Fatigue ductility
E	Young's modulus
N	Number of cycles to failure
ω	Angular velocity
σ_{YM}	Von Mises stress

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ABSRTACT

Power transmission system of vehicles consist several components which sometimes encounter unfortunate failures. In this thesis, the objective is to investigate the failure analysis of the input shaft in terms fatigue and stress. Two materials which are AISI 1045 and AISI 4145 is common material used in designing against fatigue behavior. Fatigue test were carried out on fatigue testing machine and S-N curve both materials show that when increasing load will decreased number of rotation, N. As a result, AISI 4145 is better endurance limits. In stress analysis, good estimation of the required strength of the structure, different methods can be employed to calculate stresses at these several points. For this thesis, one of the most powerful numerical technique known as “finite element method” is used to analyze a complex structure such as the input shaft. The analysis is divided by two ways which is analysis at teeth of gear and shaft. As a result, different load versus displacement of teeth and stress was carried out. The analysis for shaft also carried out according Richard Von Mises, the statement that the part not fail if $\sigma_Y > \sigma_{VM}$. The shaft which is rotating in gearbox is safe in terms design.

ABSTRAK

Sistem pemindahan kuasa kederaan terdiri daripada beberapa komponen yang sering mengalami kegagalan. Dalam thesis ini, objectif utamanya ialah untuk mencari punya kegagalan batang masuk dalam segi kelesuan dan tekanan. Dua jenis bahan dipilih iaitu AISI 1045 dan AISI 4140 adalah bahan biasa digunakan dalam mereka sesuatu melawan kegagalan kelesuan. Ujian kelesuan dijalankan menggunakan kelesuan ujian tester dan kecerunan S-N untuk kedua-dua bahan menunjukkan penambahan tekanan menyebabkan bilangan pusingan berkurangan,N. Kesimpunlannya, AISI 4145 mempunyai tahap kelesuan yang tinggi. Dalam ujian tekanan, anggaran yang bagus untuk sesuatu rekaan, pelbagai cara boleh dilakukan untuk mengira tekanan untuk sebarang bahagian dalam sesuatu rekaan. Dalam thesis ini, salah satu cara numerical teknik iaitu “cara unsur terbatas “digunakan untuk mengalisis struktur kompleks seperti batang masuk ini.Ujian ini dibahagikan dua cara iaitu mengalisis pada gigi gear dan batang. Keputusannya, pelbagai tekanan melawan jarak gigi dan tekan dihasilkan. Ujian juga diteruskan dengan mengalisi mengikut kata-kata Richard Von Mises iaitu setiap rekaan itu tidak akan gagal jika $\sigma_Y > \sigma_{VM.}$ Maka batang jelas menunjukkan bahawa rekaan itu adalah selamat untuk digunakan.

CHAPTER 1

INTRODUCTION

1.1 PROJECT MOTIVATION

In modern century, mechanical part usually used in anywhere in machines in factory, in transport, sport, etc. Due to important parts, mechanical parts hopefully can works at all time without failure, or broken. But there are some limitations. From there, it is important to know how mechanical parts can collapse or when their broken. This is because time will cause a lot of money run. In other side, the important thing is to determine the cause of a failure and how to prevent it from recurring.

Besides that, modernization demand to improve the old system also important decision in new technology world. In this case, to avoid failure in mechanical parts, before the manufacturing produces their product, there must have a test product first to determine whether in good condition or not. If the new product is in good condition, the manufacturing will start their process the product.

In this project, failure analysis will take action in input shaft in gearbox which is applied in most transportations model. In the gearbox, there are two types of manual-transmission and transaxle troubles are noise and improper operation. The cause of either of these may be internal or external. Three general types of noise may come from

manual transmission. The type of noise provides information about what taking place inside the cases to make that noise. The sound of a periodic clunk indicates broken gear teeth. A growl or whine indicates a defective bearing or worn teeth. A detective bearing usually produces a rough growl or gating noise rather than whine, which is typical of gear noise. Gear clash during shifting often indicates a worn or defective synchronizer. [1]

Difficulty in shifting into gear, transmission sticks in gear, transmission jumps out of gear and gear clash when shifting is example failure in gearbox. [1]

Further research on input shaft in gearbox very important to avoid this problem occurs again.

1.2 PROJECT BACKGROUND

Firstly, gears are essential machine elements designed to transmit motion and power from one mechanical unit to another. There hardly exists any engineering machine that operates without gears. Besides that, a gear is different from a pulley in that a gear is a round wheel which has linkages that mesh with other gear teeth. In this case, a gear allowing forces to be fully transferred without slippage. The forces transmitted between meshing gears supply torsional moments to shaft for motion and power transmission and create force and moments that affect the shaft and its bearings. [2]

Depending on their construction and arrangement, gearing devices can transmit forces at different speeds, torques, or in a different direction, from the power source. Gears are a very useful simple machine. Various types of gear have been developed to perform different functions. The major types are spur gears, helical gears, straight, spiral bevel gears and hypoid gears. The gear type and the specific design features determine the operating characteristics of a gear. [2] For examples, spur gears generally form is a cylinder or disk. It also has teeth parallel to the axis of rotation and is used to transmit motion from one shaft to another shaft. For this reason, it’s usually used to develop the primary kinematic relationship of the tooth form. [3]

In addition to transmitting the motion, input shaft are often used to increase or reduced speed, or changing direction of motion from one shaft to the other. It is extremely common for the output of mechanical powers sources, such as electric motors and engines, to be rotating at mush greater speeds than the application requires. [4]

In respect to the fracture of the input shaft connected to an extruder in an packaging company, the causes the fracture of the gear shaft is necessary to be worked out to guide the future operation of the extruder to prevent the gear shaft from fracture. The economic loss then can be prevented.

Input shaft is usually subject to high torsional moment, additional bending moment as well as cyclic stress which may cause fatigue in the shaft. All these factors may contribute to the rupture of the stress concentrated area and lead to the fracture of input shaft. Therefore, the fractured input shaft will be investigated in both test and numerical analysis to find the cause of the fracture of the input shaft. [5]

Moreover, failure of gears can occur because of various reasons. There are various types of gear failures and they are classified in four major groups: wear, surface fatigue, plastic flow and breakage. Each of these general classes of failure is subdivided for more accurate and specific identification. A detailed description of the mechanisms of gear failures can be found in the literature [2]. It is reported that fatigue, impact, pitting, spalling, crushing, scoring, and scuffing account for more than 75% of the gear failure; tooth bending fatigue and surface contact fatigue being the two most common modes of failure. [5]

For example, aircraft gearboxes are generally robust and reliable. Most of the failures in these gearboxes occur due to application errors, of which, misalignment is probably the most common single cause of failure [6].

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