UNIVERSITI TEKNIKAL MALAYSIA MELAKA

IMPROVEMENT ON PUMP FOOTING SYSTEM FOR MISALIGNMENT CORRECTION.

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Manufacturing Process) (Hons.)

by

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BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **Improvement on Pump Footing System for Misalignment Correction**

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ABSTRACT

This project proposes the improvement on pump footing system for misalignment correction that come up from the soft foot phenomena. The soft foot occurs when there is a gap between a machine foot and the foundation. Shaft misalignment can be grouped into two segments which is offset misalignment, and angular misalignment. It is for the most part concurred that appropriate alignment is critical to the life of the machine and coupling wear, bearing failures, bowed rotors, in addition to bearing housing damage are all regular consequences of poor alignment. It also has been discovered that loads on mechanical parts, for example, bearing, seals, and couplings, diminish with improved alignment. The problem statement and the objectives of this research have been identified. Other than that, the scoped of the study, alongside the outline has been reviewed and discussed. The journals and information of the academicals that related to the research are explained in the literature review section. An improvement on pump footing system for misalignment correction has been design in order to overcome soft foot and misalignment correction. Methodology, section explained about complete step to design and development of the motor pump footing system. All the design and development tools that use to generate and select the best design of the product has been applied in this section. The product then analyzed to study their functionality and performance in real situation. The new improved pump footing system should be able to provide new foundation that do not relies on shims in alignment of machinery.

ABSTRAK

Projek ini membincangkan mengenai penambahbaikan ke atas sistem tapak asas motor pam untuk penjajaran aci yang terhasil dari fenomena “soft foot”. “soft foot” berlaku apabila terdapat jurang antara kaki mesin dan tapak asas. Ketidak jajaran aci boleh dibahagikan kepada dua segmen iaitu salah jajaran “offset” dan salah jajaran sudut. Sebahagian besar bersependapat bahawa penjajaran aci yang baik adalah sangat penting untuk meningkatkan jangka hayat mesin dan kehausan kapling yang membawa kepada kegagalan bearing berfungsi, rotor bengkok. Tambahan itu, kerosakan perumah bearing adalah akibat dari penjajaran aci yang tidak betul. Kajian juga telah mendapati bahawa beban di bahagian-bahagian mekanikal, sebagai contoh, bearing, penutup bearing, dan “coupling” berkurang selari dengan penjajaran aci yang lebih baik. Kenyataan masalah dan objektif kajian ini telah dikenal pasti. Selain daripada itu, skop kajian, bersama – sama garis panduan projek telah dikaji semula dan dibincangkan. Jurnal dan maklumat daripada akademik yang berkaitan dengan penyelidikan diterangkan dalam bahagian kajian literatur. Penambahbaikan pada sistem tapak asas motor pam untuk pembetulan salah jajaran aci telah di reka bentuk untuk mengatasi masalah “soft foot” dan pembetulan salah jajaran aci. Metodologi, bahagian ini menjelaskan tentang langkah yang lengkap untuk mereka bentuk dan membangunan sistem tapak asas pam moto. Semua alat untuk mereka bentuk dan membangunkan produk digunakan untuk menjana dan memilih reka bentuk yang terbaik untuk menghasilkan produk terakhir. Produk ini dianalisis untuk mengkaji fungsi dan prestasi mereka dalam keadaan sebenar. Tapak asas yang diperbaharui ini harus dapat menyediakan asas baru yang tidak bergantung kepada “shims” semasa process penjajaran aci pada motor pam.

DEDICATION

To my beloved parent,

Zin bin Asiban,

Aishah Bt Aziz,

My Supervisor,

Dr Mohd Shahir bin Kassim

My friends and technician that involve in this study,

May Allah ease our journey and bless all of us.

InshaaALLAH

ACKNOWLEDMENT

Primarily, all praises to The Almighty as for His mercy and grace, I was able to complete Final Year Project just in time. I would like to seize this opportunity to thank all parties who have contributed along the process of the completion of Final Year Project.

I would like to express my sincere appreciation to my final year project Supervisor Dr Mohd Shahir bin Kasim for his constant supervision, guidance and encouragement, without which this project would not have been possible. I am truly grateful for his unwavering support through the whole period of this final year project. Taught all the manufacturing knowledge and share experience to me and also taught me how to handle work in proper manner.

I would like to express my gratitude to all the lectures and staff for their immense interest in my topic of project, for providing me material and helping me to solve problem that I could not possibly have discovered on my own. Also which really spends their time to teach me a lots of knowledge regarding to the design development.

To my family, who raised and taught me that all the knowledge of life that we cannot get from school. To get the best knowledge that can teach us is by learning through our own mistake. All the mistakes that has been done by us can make us stronger and turn us to wise person. It not easy to learn something that new for us, learning can be hard sometimes but with hard and strong perseverance, nothing can stop us learn and gain experience.

Last but not least, I would like to thanks my friend and colleagues for their encouragement and moral support which lead to completion of my Final Year Project.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURES

2D	-	2 Dimension
3D	-	3 Dimension
CAD	-	Computer Aided Design
CNC	-	Computer Numerical Control
dB	-	Decibel
FEA	-	Finite Element Analysis
HP	-	Horse Power
Kg	-	Kilogram
mm	-	Millimetre
N	-	Newton
NC	-	Numerical Control
PSD	-	Positioning Sensing Detector
PSM	-	Projek Sarjana Muda
RM	-	Ringgit Malaysia
rpm	-	Rotation per minute
US$	-	United State Dollar

CHAPTER 1
INTRODUCTION

This section describes the background, objectives, problem statement and scope of the project. Finally, this section ends with an overview about the end of the reporting year. The background is discussing about the misalignment of the shaft and the fundamental knowledge about it. Lastly, the objective explained on the goals to be achieved for this subject and scope encompasses everything what should have been done in this project.

1.1 Background

Over the past few years, billions of dollars were loss by industry worldwide due to misalignment of machinery problem. Rotating shaft and motor are widely uses in industry to produce steel, glass, petroleum, electrical, the food we eat, and also our transportation. Besides, everything around us are being influenced by rotating dynamic machinery. It has been revealed that shaft alignment appears to have taken a more crucial role during installing and servicing machinery. Proper alignment of the shaft ensures smooth, efficient delivery of power to the motor-driven equipment (Piotrowski, 2006).

Studies have been revealed that misalignment or also known as soft foots slowly damage the machinery over a certain period of time. Misalignment also leads to premature machinery failures such as noise, vibration, shaft failure, bearing temperature increase, coupling wear and shaft failure. This critical problem caused a huge amount of financial loss due purchasing the new machine part and loss of production (Ahmed et. al., 2010) .

The aim of this studies is to examine the effect of soft foots on the shaft alignment and to do improvement of shimless footing system in rotating machinery industry. Small improvement in motor pump can cause high impact result on the performance of rotating machinery (Jesse et al., 1970). The study begins with chapter one which include the overview of the study, problem statement, and the objective of the study. Then, proceed with the scope of the study, research methodology and the organization of the report.

1.2 Problem Statement

Angular misalignment, in particular in motor and pump can cause severe damage to the driven equipment and the motor. They would cross one another, as opposed to superimpose or keep running along a typical centerline (Tsiafis et al., 2015).

The alignment specialist needs more broad learning and skill than basically swinging reading the dial indicator and shimming machine feet, however adjusting shaft to be coaxial is a decent place to begin (Wowk, 2001).

The operation still possesses many challenge, although latest generation of tools is used to maintain the best alignment conditions. The neediest to accurately fine-tuned the degree of shaft alignment vertically and horizontally between a pump and its driven motor are difficult and almost impossible to be done.

The current manual alignment by using shim are difficult due to pre-cut shim only come with standard sizes and the tolerances are different according to it manufacture. Moreover, no permanent correction can be achieved because shim correction doesn't match up with the actual alignment correction reading due to limited shim thickness. Only three shim can only be stepped per feet since to many shims under a machine foot prompts expanded risk of soft foot (Luedeking, 2013).

Casanova (2008), state that if machining alignment can be improved, the rate of failure decline significantly. Failure of equipment is a lead to major maintenance expense and have numerous incidental or associated costs. Truth be told, the expense of parts and work to repair the machine can be one of the expenses. Lost production, consequential damages, contractual penalties, and liability for injury can lead to more expensive than the repair itself.

The shaft support and machine frame structure both together influenced the shaft vibration response and its location in the frequency range, additionally the machine support. Assembly frame, and its foundation influence the shaft vibration response and the consequence of the natural frequencies of the foundation in the machine operational range may bother the operation and ought to be covered in the machine design (Leso et al., 2011).

1.3 Research Objectives

i. To design and develop improved footing system that eliminate soft foot.
ii. To produce a device that can do fine tuning during the shaft alignment process.
iii. To validate the functionality of product.

1.4 Scope

This paper focus on the main scope of study, which is to study and analyses the effect of soft foot during the alignment process. It also reviews the fundamental of shaft alignment process that will be improved the understanding of the shaft alignment and its problem. Moreover, this paper describes the important steps in the design and development the improved footing system which must realize and identify the problems that might occur during the construction of the footing system. Finally, to analyse the effectiveness of current unit compared with conventional shim to correct problems of misalignment.

1.5 Chapter Overview

PSM I cover five chapters consist of introduction, literature review and methodology. Chapter 1 is all about introduction of the project, problem statement related to current issues, object, scope of the study and the significant of the study.

Chapter 2 is the literature review section. Literature review are normally based on the gathered of references from various information sources such as journals, books, website etc., it will discuss about the current finding, method use and result of the related topic that found in the journal paper, books or articles.

Chapter 3 is discussing about of research methodology review which is the planning approach to achieve the research. Next, chapter 4 is more about results that will analyse and discuss in detail about the approach that been use to develop a product. Last but not lease, chapter 5 is about conclusion and future work that can be done to improve the specification of the product.

CHAPTER 2
LITERATURE REVIEW

The main focus of this study is to do an improvement on the footing system for misalignment correction. This chapter review and explained about the past studies that is done. Literature review is virtually examining respectively to the source and described to justify the statement with proof of research or study in related field.

2.1 Shaft Alignment

Shaft Alignment is a process where two or more machines such as motors and pumps are located such that at the point of transfer of power from one shaft to another, the axis of rotation of the two shafts to be aligned when the engine is running under normal conditions (Prüftechnik, 2010). Acceptable shaft alignment marked bearing arrays, with a particular position in the vertical direction, providing a satisfactory distribution of load bearing, under all working conditions (Low & Lim, 2004). Figure 2.1 shows the correct shaft alignment under normal working condition.

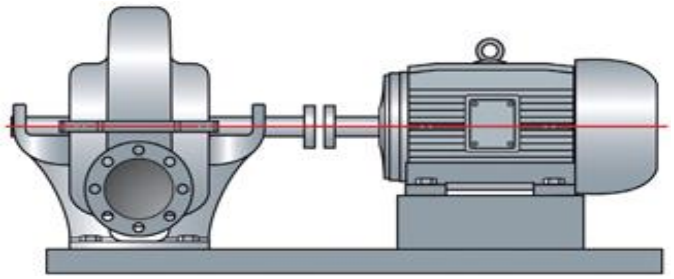

Figure 2.1 : Correct Shaft Alignment (Service, 2015).

Perfect alignment is crucial to the working life of the rotating part. Bearings, mechanical seals, packing, and couplings are straightforwardly influenced by the alignment of shaft center lines. The objective of the alignment procedure is to make a straight line through the coupling. The two coupled shafts are thought to be splendidly adjusted when their middle lines are coaxial in the working condition (Services, 2015). D.Keane (2014), in his journal stated that the correct shaft alignment is very important for these vessels as exceptional bending moments or shear forces are directly transferred to the rear of the engine bearings as shown in Figure 2.2. Depending on the deflection of the body and engine bearings sagging bed-plates can be unloaded and moved them to the front bearing load at the front.

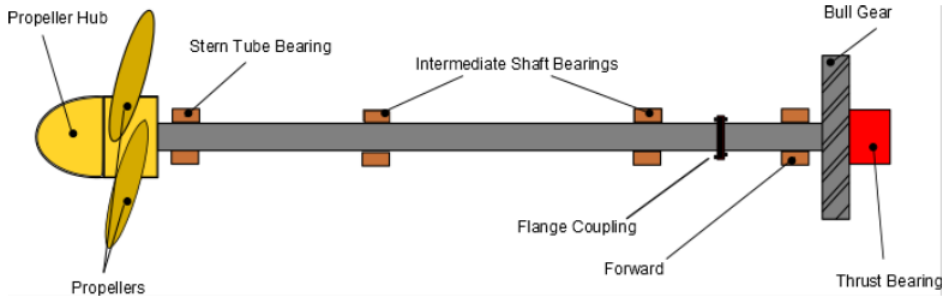

Figure 2.2 : Shaft alignment on the vessel (Keane, 2014).

2.2 Misalignment

Shaft misalignment is the deviation of relative shaft position from a collinear axis of revolution measured at the purposes of force transmission when gear is running at typical working conditions (Lifetime & Solutions, 2015). Piotrowski J (2006), explained that the misalignment force will start to twist the axis, not flutter them around like the tail of a fish. Static forces brought on by misalignment act in one direction only, which is very not quite the same as the dynamic powers that produce vibration. Poor establishment and intemperate shaft misalignment will significantly diminish seal life.

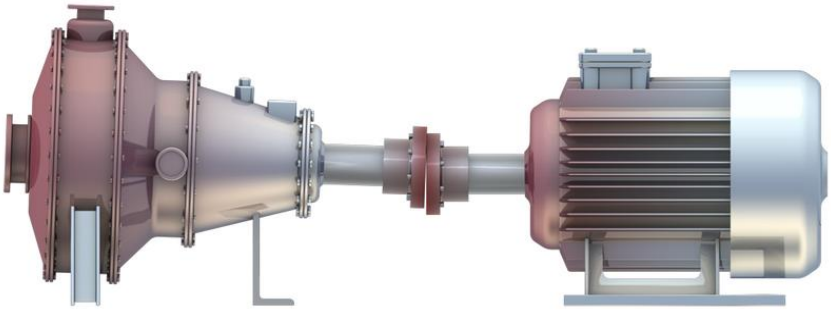

Figure: 2.3 : Example of Misalignment (ThermAlign, 2014).

It is not generally simple to identify misalignment on machining that is running. The radial force that is transmitted from shaft to shaft are hard to quantify remotely. Figure 2.3 shows that misalignment error at the coupling transmission planes, where conceivable this system process to be discouraged for other dial or laser routines for arrangement (Prüftechnik, 2010).

2.2.1 Type of Misalignment

There are two fundamental types of misalignment: parallel (offsets) and angular. Both sorts can be found in the vertical and flat planes. Normally, a combination of offset and angular misalignment is found in both directions. To achieve the objective, both sorts of misalignment in each direction must be corrected.

2.2.1.1 Angular Misalignment

Angular misalignment occurs when the motor is set at an angle to the driven components. Angle or mislaid can occur to one side or the right, or below the beneath. On the off chance that the centerline of the engine and the driven shaft is extended, they would cross one another, instead of superimpose or keep running along a typical centerline. As shown in Figure 2.4, angular misalignment can bring about serious harm to the driven component and the motor (Advanced Manufacturing, 2012).

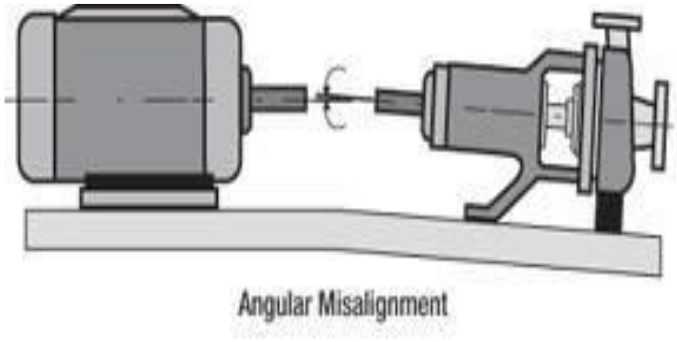

Figure 2.4 : Angular Misalignment (Metal, 2015).

2.2.1.2 Offset Misalignment

Offset misalignment, some of the time alluded to as parallel misalignment, is the separation between the shafts center of rotation measured. Figure 2.5 shows common offset misalignment that occurs in machinery. Parallel misalignment happens when the two shaft centerlines are parallel. However, it not occurs in the same line. There are two planes of parallel misalignment as shafts may be offset horizontally where it dislodged to one left side or right, vertically where situated at different heights, or both. Parallel misalignment is measured in mm (Tsiafis et al., 2015).