UNIVERSITI TEKNIKAL MALAYSIA MELAKA

IMPROVEMENT OF SHIMLESS FOOTING SYSTEM

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

by

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I hereby, declared this report entitled “Improvement of Shimless Footing System” is the results of my own research except as cited in references.

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APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Manufacturing Design) with Honours. The member of the supervisory committee is as follow:

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ABSTRACT

This project propose the design of shimless footing system to overcome the misalignment arise from the soft foot. An analysis of the effectiveness of the shimless unit will be compared to conventional shim in rectifying misalignment problem. The soft foot happened when there is a gap between a machine foot and the foundation. The machine frame will actually distort from its resting position as the hold- down bolts are tighten to secure the machine in place. Soft foot also creates stress lines in the frame as a short foot is pinned to the foundation by the hold-down bolt. A classic example of the soft foot is; bar table with one short leg; which occurs when the machine naturally rests on three legs and the fourth leg is short. If it does properly corrected before beginning the actual alignment, it is difficult or impossible to achieve acceptable results. A shimless footing system will be design in order to overcome the soft foot problem. Solidwork were used in the designing stage. By using SolidWork, a shimless system can be easily developed to make sure that it will able to overcome the soft foot problem. The system should be able to provide a new foundation that does not relies on shims in alignment machinery. Then, after a system has been designed, an analysis is done to study the effect on soft foot during the alignment process. It will observe whether the system is effective by comparing to the conventional shim. The design should make the alignment process easier and overcome the soft foot problem arise. There are two basic methods to identified soft foot, which are frame distortion index and the laser soft foot locator. It is predicted that the soft foot problem can be eliminated as the misalignment will not happen again.

ABSTRAK

Projek ini bertujuan untuk mengkaji masalah ‘soft foot’ yang menyebabkan susunan system pam mesin menjadi tidak lurus. Setelah itu, sebuah peningkatan rekaan sistem kaki yang tidak ber’shim’ akan dipertingkatkan untuk mengatasi masalah ‘soft foot’ ini. ‘Soft foot’ ini terjadi apabila ada jarak di antara kaki pam mesin dan tapak asasnya. Pam mesin ini akan bergerak dari kedudukan asalnya walaupun nat telah diketatkan untuk mengelakkannya. ‘Soft foot’ juga menghasilkan garis tekanan pada mesin kerana kaki yang pendek diikat pada tapak asa dengan menggunakan nat. sekiranya ia tidak diperbaiki, hasil yang dihasilkan menjadi tidak berkualiti. Proses rekaan ini akan menggunakan CAD, iaitu Solidwork. Dengan menggunakan perisian ini, sistem tidak ber’shim’ ini dapat dihasilkan dan diperhatikan untuk memastikan ia boleh mengatasi ‘soft foot’. Sistem ini juga perlu mempunyai tapak asas supaya ia tidak lagi bergantung pada ‘shim’ untuk meluruskan system pam mesin. Rekaan ini memudahkan proses pelurusan dan masalah ‘soft foot’ dapat dikurangkan. Kemudian, selepas system ini telah reka, ia akan di analisis untuk mengkaji kesannya ke atas ‘soft foot’ ketika proses meluruskan. Pemerhatian akan dibuat sama ada system ini berkesan ataupun tidak dibandingkan dengan ‘shim’ biasa. Ada dua cara asas untuk mengesan ‘soft foot’ akan digunakan iaitu ‘frame distortion index’ and ‘the laser soft foot locator’. Ia meramalkan yang masalah ‘soft foot’ boleh dihapuskan dimana ‘misalingment’ tidak akan berlaku lagi.

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DEDICATION

To my parents,
My PSM supervisor,
My family and all of my friends
that involve in this study.

Thank You.

ACKNOWLEDGEMENT

I would like to thank for god as give me strength and patience during completion of this study until it successfully completed. Not forget to say thanks to my parent for encouraging me especially when I struggle to complete this study. Their encouragements as a spiritual to me along the duration of this thesis were done. For my supervisor lecturer and examiner that guide me along PSM 1 and II to give support, and giving me some recommendation to overcome problem faced during the PSM. I and II appreciated and dedicated for Mr. Hassan bin Attan, Mr Mohd Shahir bin Kasim and Mr. Zulkarnain Marjom for their kindness to help me as I faced problem in this project. Their knowledge and experience really inspired and spurred myself. I truly relished the opportunities given in working with them. Lastly, I would like to say thanks to my classmates that give me encouragement and supporting me to complete this project.

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LIST OF ABBREVIATIONS, SYMBOLS, SPECIALIZED NOMENCLATURE

CAD	-	Computer Aided Design
USA	-	United State of America
PSM	-	Projek Sarjana Muda
CNC	-	Computer Numerical Control
UTeM	-	Universiti Teknikal Malaysia, Melaka
FDM	-	Fused Deposition Modeling
AMC	-	Advanced Manufacturing Center

CHAPTER 1

INTRODUCTION

1.1 Introduction

Over the past twenty years, the level of awareness concerning the importance of accurate and precise shaft alignment has increased dramatically. In would therefore appear that shaft alignment seems to have taken a more important role when installing and maintaining machinery. Poorly aligned shafts are responsible for many machine problems, studies have shown that incorrect alignment is the cause for around half of machine breakdowns.

The aim of the study is to do improvement of shimless footing system in manufacturing industry. The study started with chapter one which contained the overview of the study, problem statement, and the objective of the study. Then, it has been continue with the scope of the study, significant of study, research methodology and the organization of the report.

1.2 Overview of the study

In very broad terms, shaft misalignment occurs when the centerlines of rotation of two or more machinery shaft are not in line with each other. So, this study will be discovering the shaft alignment and footing system in industry.

This study is an improvement of shimless footing system. So, in this study supposedly will discover the shaft alignment and soft foot. With Solid Work software and Rapid Prototyping Machine, the new product design will be fine out.

1.3 Problem statement

The alignment technician needs to have more general knowledge and skill than simply swinging readings and shimming machine feet, but aligning shaft to be coaxial is a good place to start. (Victor Wowk, 2001).

The other definitely limitation or disadvantages of shim such as material properties that using to construct the shim. Regarding to material properties, influence corrosion factor is very important to keep up the material strength in good condition. Stated that not all type of materials can be used for shimmed the pump.

The bottoms of the machine feet shall rest on the base or foundation with 90 percent contact of the footprint (Victor Wowk , 2000). A 0.003 inch thick shim shall not penetrate under any foot with all hold down bolts loose. This is an unforeseen condition and will require more time to correct (Victor Wowk, 2000). Resonant foundations or bases are dynamic structural defects. This will cause high vibration at specific speeds. Resonances are not detectable during static alignment measurements.

There are some advantages of alignment, such as seal and bearings last longer, shaft and couplings do not fail as often, vibration levels are lower and machines run cooler, by using less energy in the process.(Evan, Galen; 1999)

1.4 Objective of the study

i) To study the shaft alignment and existing shimless footing system.
ii) To make an improvement on the current shim footing system design.
iii) To propose suitable design and materials.
iv) To give the recommendation and suggestion based on the new product.

1.5 Scope of the study

i) To study the current design of shimless footing system
ii) To produce conceptual design.
iii) To select the best conceptual design by using appropriate methodology
iv) To produce detail design of the selected concept and design specification.
v) To test and collect data based on the new design developed.

1.6 Significant of the study

The author has found the shaft misalignment occurred when the centerlines of rotation of two or more machinery shaft are not in line with each other. In industry, the shim will be used to perform correction of shaft alignment but in this case, a new design product will be produced to maintain shaft alignment.

1.7 Research methodology

In this study, the author used the previous product is used to identify the problem statement. Improvement is made to the product by sketching some new design ideas. Then, a selected design will be draw by using Solid Work software. From the drawing, a model will be produced by using Stratasys Machine. In spite of that, analyzing using Cosmo Express also used to explained more about load can used for the new product. In this part, author will explain properly about new product design and it will helping in

giving the recommendation. The recommendation based on the result and discussion and it supposedly achieve the objective of this study.

1.8 Organizations of reports

The organization of this report is begun with the Chapter 1 which is introduction of the study. It should briefly describe the overview and the flow of the study. Then, it continues with the Chapter 2. In Chapter 2, author has inserted all the literature from the journals, books, and other resources to elaborate each part of the study. Then, the study continues with Chapter 3. Chapter 3 is describing the research methodology. Research methodology is the flow or step that used by author to make this study from the beginning to the finalize step such as material and product design. The analyzing method and prototyping process also are included in the Chapter 4. In the Chapter 5, explained about result and analyzing by using Cosmo Express Analysis. The report consists with discussion and conclusion on the work that have been done in the Chapter 6.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The purpose of this study is to improve of shimless footing system. In this chapter, reviews and summarization of past studies will be discussed. This literature review shall highlight related arguments, theories, explanations, findings and methodologies from previous research done by researcher worldwide. The sources of this literature review are more come from journal, articles, books, and thesis written by those researchers.

2.2 Shaft alignment

Alignment is generally thought of as shaft to shaft alignment of coupled machines which a driver machine and a driven machine. The driven machine produces useful results, either generating power or moving fluids, and could be a generator, a pump, or a fan. The driver machine provides the rotating mechanical power to the driven machine via a coupling. The driver is most often an electric motor, but could also be a turbine or a reciprocating engine.

The objective in aligning shafts is to get their centerlines coaxial when rotating together under operating conditions. This orientation is presumed to be the one that crates the least amount of distortion in the coupling and the least amount of the undesirable bending in the shafts. This would be a fair assumption if the mechanical components all had perfect geometry.

Advantages of laser alignment

a) The alignment task has become highly automated so that all mechanics can achieve somewhat consistent results. The data from the detectors are streamed directly into a computer, which then proceeds to calculate the movement required. The mechanic does not need to read dial indicators and transfer the values to paper or keyboard. Confusion associated with bar sag, direction conventions, and positive or negative needle swings is eliminated. Less skill is required of the mechanic. The same results could be achieved with electronic gages connected to a computer.
b) Bar sag is eliminated. Alignment measurements are possible over longer spans.
c) Lasers are the most useful when establishing a line of sight, such as bore alignment, when the rotors are removed and bearings are to be set collinear. Optical tooling can do the same thing with greater accuracy.
d) Lasers or optics are the most useful in measuring growth changes from cold to hot running. This is done by fixturing a source on one machine housing, and fixturing a detector on the other machine housing or bearing across the coupling. The display is zeroed prior to machine startup. After startup, any immediate changes are mechanical, and slow changes after that are thermally caused.
e) The time for alignment can be significantly reduced if setup time is dominant. The laser fixture can be set up on the shafts and readings taken faster than with dial indicators. If no movement is to be done, then the laser is definitely faster for a proficient operator. In a quality-assurance mode, where only measurements are to be taken, the laser systems have a time advantage. However, the measurement and calculation are a small part of the total task if the machine must be moved. If

difficulties are encountered, like bolt bound or pipe strain, then the laser provides little or no time advantage.

f) Acceptability criteria. All laser systems have resident in their computers some kind of acceptability criteria that let the mechanic know when the results are good enough and it is time to stop. This also can be done with dial indicators taking the measurements and a computer used for the calculations.

Disadvantages of laser alignment

a) Cost. Laser alignment systems are typically ten times the initial purchase price of dial indicator mechanical systems.

b) Maintainability. The annual calibration fee for laser system is easily $1000. a complete dial indicator alignment system can be purchased for that. Is a laser head is dropped onto a concrete floor and breaks, it could cost approximately $3000 to replace. Forty three dial indicators can be purchased for that cost, at $70 each. Alignment experts agree that it is difficult to recover the initial cost of a laser system, but this maintainability issue makes them reject a laser system even if it is given away for free. Dial indicators can be replaced readily worldwide when in remote locations, and no batteries are required.

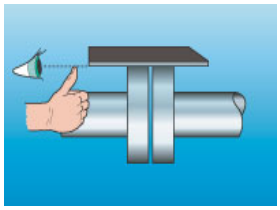
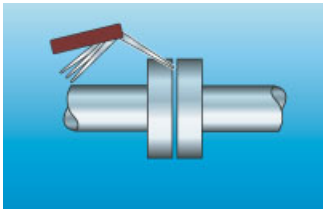
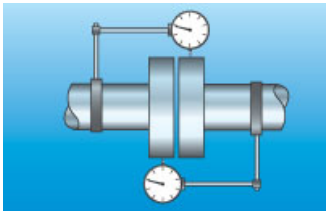
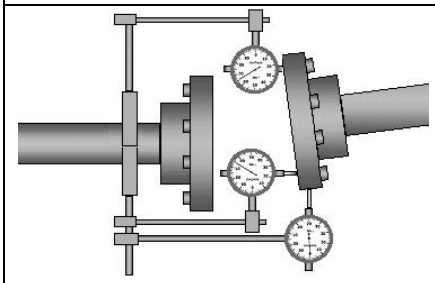
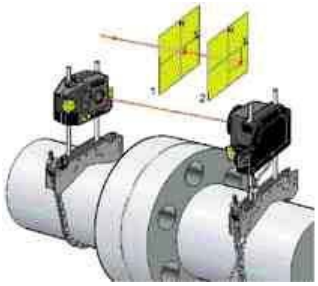
c) Safety. Staring directly into the beam can cause permanent eye damage. Also lasers are not intrinsically safe in explosive atmospheres. Since they are an electronic device with an electrical energy source, they could spark an ignition. Dial indicators, however, are intrinsically safe.

d) Both shafts must be rotated together. If one machine cannot be rotated, there are ways of using lasers with sliding brackets, but a dial indicator measurement is superior using the face and rim method.

e) Limited usefulness. Lasers cannot be used for other alignment tasks like shaft runout, soft foot checks, horizontal move monitors, and bearing alignment checks. They cannot be used to do face and rim alignment, which is the other major alignment method, and cannot fit into some tight places. Bright sunlight requires shading. Dial indicators, with proper styles and fixturing, can do all of the above measurements and have none of the limitations.

f) Credibility. There is always a resident suspicion of electronic measurements and digital displays. It is possible, easily with some keystrokes, to deceive an observer and produce false reports. Technical experts do not trust laser alignment systems because of the three levels of abstraction which optical measuring, reverse indicator method, and computerization. There is an urge to verify with dial indicators, and for quality assurance prior to startup, dial indicator measurements are sometimes required to prove the truth of pervious laser alignment. Dial indicators provide a direct mechanical display of a measured mechanical parameter. They are relevant, tangible, and believable.

Table 2.1 : Comparison correction alignment method

<table>
<tr><td>Straight gauge alignment</td><td>Alignment with filler gauge</td><td>Dial Gauge Alignment (Reverse Indicator Method)</td></tr>
<tr><td>  </td><td>  </td><td>  </td></tr>
<tr><td colspan="2">The traditional form of alignment is by eyesight using straightedge and feller gauges. Fast and simple, but too inaccurate for many machines due to resolution of the human eye is limited and varied.</td><td>Precise and Improve alignment practice, but requires a high level of experience and is time-consuming.</td></tr>
<tr><td colspan="2">Dial Gauge Alignment (Rim and Face Method)</td><td>Laser Alignment</td></tr>
<tr><td colspan="2">  </td><td>  </td></tr>
<tr><td colspan="2">Precise and Improve alignment practice, but requires a high level of experience and is time-consuming.</td><td>Use of laser beams and the reverse indicator principle achieves a greater accuracy but the cost is too expensive.</td></tr>
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