UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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AN INVESTIGATION OF BEARING FAULTS USING VIBRATION METER

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

By

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

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ABSTRACT

This report is designed to study vibrations generated from bearing vibrations. The bearings used are of different defects except for Bearings A. Bearings B, C, D, E and F has defects. The envelope analysis method is used and the time-frequency domain of the data is analyzed using MATLAB software. The signal generated by the machine contains information about the health of the machine. Researchers used these techniques to study defective machines and their relationship to the vibration generated.

DEDICATION

To my family,

For the love and financial support especially my mother, aunty and grandmother.

To my lectures

Ts Dr Mohd Irman for guidance to finish this research. Also Mr Azazi for the time spend and knowledge. Mr Mohd Khairul bin Hassan lab technologies for assistance.

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In the name of Allah, the Most Gracious, the Most Merciful, Praise to Him the Almighty that in his will and given strength, to finish and successfully completed this final year project entitle, An investigation of bearing faults using vibration meter.

This project can not be completed and succeed without the help and guidance from Ts Dr Mohd Irman Bin Ramli, who are very supportive and easy to communicate with. Also to mention Mr Azazi for his skill and knowledge that help to polish this project until succeed. The author also thanks Mr Mohd Khairul bin Hassan for his assistance and time to help this project successful. Without all the name mention above,this project will not be as good as it should have.

To Universiti Teknikal Malaysia Melaka, for providing the lab facilities to done the research.

LIST OF FIGURES

LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

Root Mean Square Amplitude	-	RMS
Inner ring fault	-	f_i
Outer ring fault	-	f_o
Balls faults	-	f_r

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

1.0 Introduction

This research is about investigation of bearing defects using SO analyser with Vibpilot and computerized vibration analyser .The investigation analyse the type of damage with the vibration signal its produce. The research will focus on bearing that widely use in machinery . According to Peter Sulka et al. / Transportation Research Procedia 40 (2019) 511–518, bearings is design to minimize friction cause by power and energy when force transmit between moving and fixed parts of mechanical systems.

1.1 Background of Problem

Modern machinery nowadays consist of many parts and elements of rotary is one of them. From big machine in factory come along the simple yet useful small machine that help men's in their daily basics. The monitoring of health for bearing is important to avoid damage and cause breakdown to rotary machine. The bearing is part of the rotary machine that provide relative motion of two moving parts for rotation or linear movement. Vibration analysis can detect potential problems that cause by bearing. One of the reasons machine performance decline can be trace back to the condition of the bearing. Instead letting the wear rates of bearing to progress to a unfix stage, monitoring the bearing health is the best option to reduce unscheduled downtime. To maintain the durability and keep the bearing in optimal condition is crucial as its life cycle may vary depends on usage and condition of rotating parts. The bearing sometime overlook to maintenance and user tend to ignore the possibility of damage bearing . Machine component faults generally cause a change in the normal vibrations of the device. The movement can be measured by mounting sensors on the system.

1.2 Problem Statement

Every rotating machines has the element of bearing and the performance of the machine is depend from the bearing conditions. According to Stanisław Adamczak et al. / Procedia Engineering 192 (2017) 971 – 975, the vibrations produce by the bearings have a compelling effect on the machinery and overall mechanical quality, durability and reliability. The bearings vibrations contribute to the level of loudness to the machine which is consider as unintended effects.

1.3 Objective of the study

The objectives of the study are :

1. To study and analyse the vibration signal produce by the bearings.
2. To compare envelope analysis and time-frequency domain method.

1.4 Scope of the study

- Bearing vibration frequency detection using computerized vibration analyser and Vibpilot.
- Data interpret using Matlab.
- Study the envelope analysis and time-frequency domain.

CHAPTER 2

LITERATURE REVIEW

BEARINGS

2.0 Introductions

In the modern era of industrial age, bearing consider as the fundamental of all machine when involving motion. The bearings provide smoothen for motion and help to lessen friction that can cause energy losses. The used of bearing can be trace back during ancient time when man start to invent simple tools to help in daily routine. Bearing also involve in building some of historic structure known to men.

2.1 History of bearing

The twentieth-century precision rolling-element bearing is a result of challenging engineering and advanced science. It is simple in form and principle, yet in a wide range of machinery it is so effective in reducing friction and wear. The construction and design is documented before its widely use during industrial era. During that time bearing demand its very high. The usage of bearing has longer history and its influent the development of modern bearings. Its start with aiding worker to move heavy object such as stone blocks, timber to transportation. Later on 19th century

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begin to understand and study the essential of bearing and around 20th century the bearing expend and accredit to be the vital most important in machine component. The availability of conventional ball and roller bearings has had a tremendous impact on the development of the system throughout the century.

Bearing become subject of study for many engineers and scientist to develop new and improve bearing as the component is demanding. New and enhanced materials or advanced design concepts have extended the life and ease of use of ball bearings, but much remains to be done in other ways to understand the remarkable operating characteristics of bearings that have served our technological age so well for nearly a century. The ball bearing's basic assemble and notion is clear. If loads are to be transmitted between surfaces in relative motion in a machine, when rolling elements are interposed between the sliding members, the action can be facilitated in the most effective way. The frictional resistance encountered in sliding is then largely replaced by the much smaller resistance associated with rolling, although in the restricted regions of effective load transmission, the arrangement is inevitably affected by 2 high stresses.

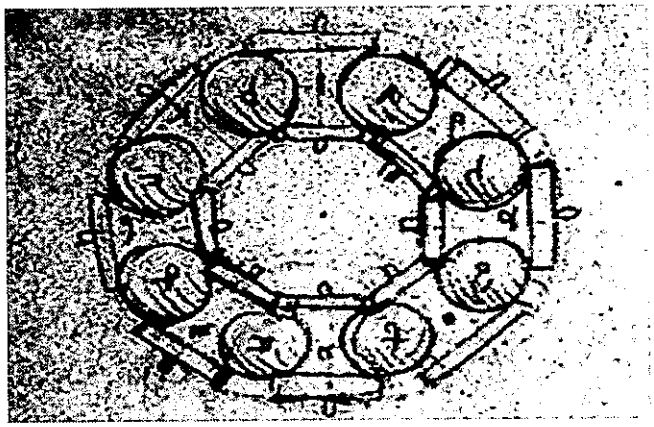

Fig 2.0: bearing early development.

The development continue to getting better from recorded history that give ideas to take a new steps to design new bearing. Begin from moving heavy object to progressing in wheel. It took along time before it came to most important part in machine.

2.2 Early civilization

Early in civilization it is believe that man used roller to move heavy objects but there is no evidence of using woods and stone. In cave that been found believe to be early civilization, no drawing of using any kind of roller but some argue that at that time rolling motion is discover and take advantage of it.

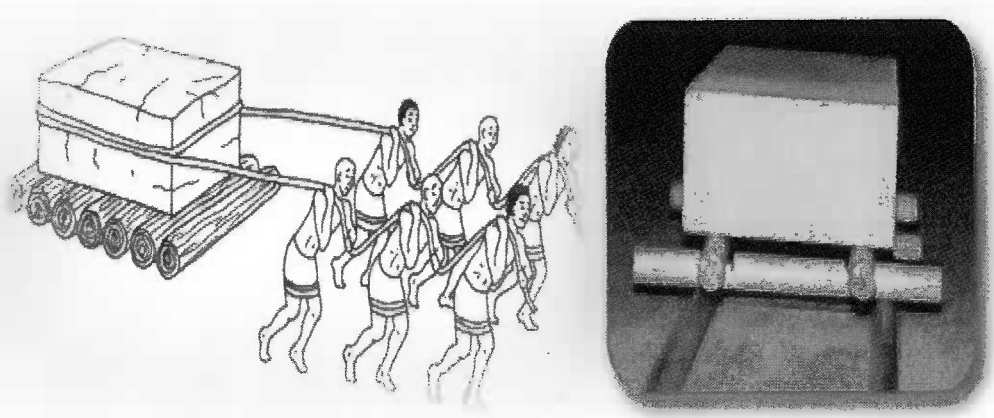

Figure 2.1: concept of roller in early civilization.

About 3200 B.C, Mesopotamia of Persian gulf there in manuscript about using wheel and at the same era Egypt and China also have evidence of using wheel. The Ancient Egyptians are using a type of roller bearings to help move huge bricks during pyramid building. In Nineveh, Sir A. H. Layard (1849, 1853) was said to represent the first recorded use of rollers for the transport of building blocks and stone carvings. For nearly 9,000 years, man has used sledges to carry heavy objects, but if Layard's analysis of the Nineveh proof is accurate, it seems that man has realized the advantages of rolling over sliding motion in Assyria some 2700 years ago.

2.2.1 Early wheel

From rolling log civilization to wheel vehicle from almost 5000 years, in the middle east Chinese discover wheel and took many years to invent to fully sophisticated wheel from solid wheel that heavy and lots of friction. Its hard to find wooden wheel to research as wooden has short state of decay.

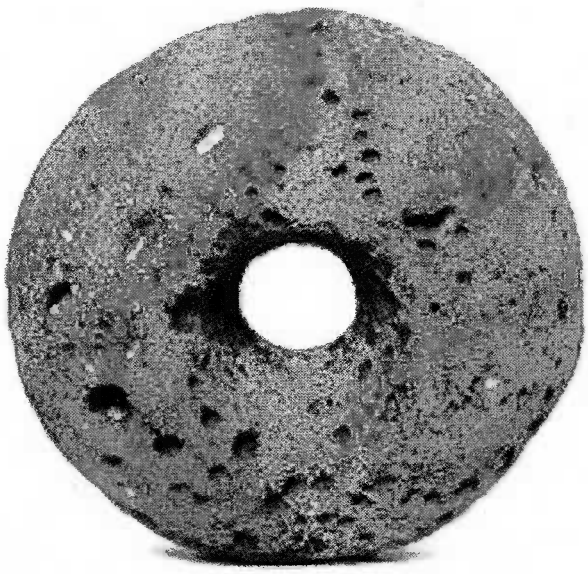

Figure 2.2 : wheel used by early civilization

In the Middle East, the early wheels were solid and tripartite. Three planks were duplicated and mortised together, and battens of wood or even copper were used to keep together the constructed frame. Often the rims are tightly lined with copper nails. Some early evidence indicates that the wheels have been spinning on stationary axles, and this practice has continued for road but not for rail vehicles throughout the ages.

2.2.2 Industrial Age

During industrial age, With the advent of advanced metal forming methods at the start of the industrial age, it was determined that bearings made of steel were in their work much better than bearings made of wood or bronze. Philip Vaughan was

granted a patent for a ball bearing in 1794 and his design became the basic design for the modern ball bearing.

Figure 2.3: Industrial age

A dramatic reduction in friction resulted in far more productive machines, which were responsible for far greater output of goods, leading to the establishment of factories. Bearings were also used in smaller devices such as watches, where sapphire bearings allowed more precise timekeeping. Water mills also used sophisticated bearings to make it easier to draw water from the well.

2.2.3 Present day

Jules Suriray received a patent in 1869 for the configuration of a radial ball bearing in metal bicycles. The success of the improved design led to the development of several new types of metal ball bearings, all with different designs specifically developed for a relevant machine. Later, Sven Winquist had invented a self-aligning ball bearings concept that sets a new design standard. From the wire race bearing to the vee groove bearing, a quick burst of innovations emerged within the field. Improvements in bearings have been associated with important developments in the automobile, industrial machinery and military industries.

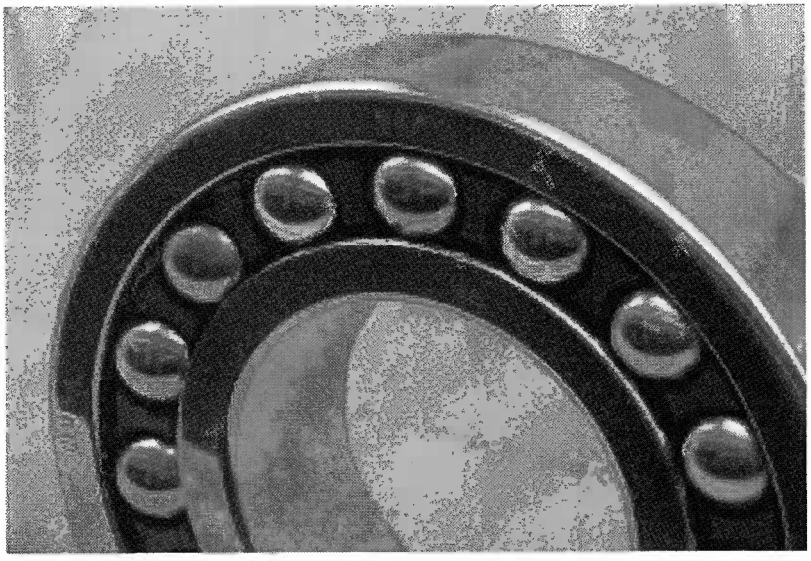

Figure 2.4: Sven Winquist self-aligning bearing

As humanity's understanding of chemistry increased, metallurgical processes improved, leading to harder, more wear-resistant materials. Improved lubricants made

process at high speeds and temperatures possible for bearings. Today, new and improved bearings are used in a variety of machines, large and small, from dental drills to the spaceship Mars Rover.

2.3 Bearing construction and design

Basic bearing construction are consist of two disk or rings, a cage housing and rolling elements. There are distinct between two basic type , radial and thrust that depend on the direction of load. Bearing also classified roller bearing or ball bearing, each as specific build and different purpose depend on needed.

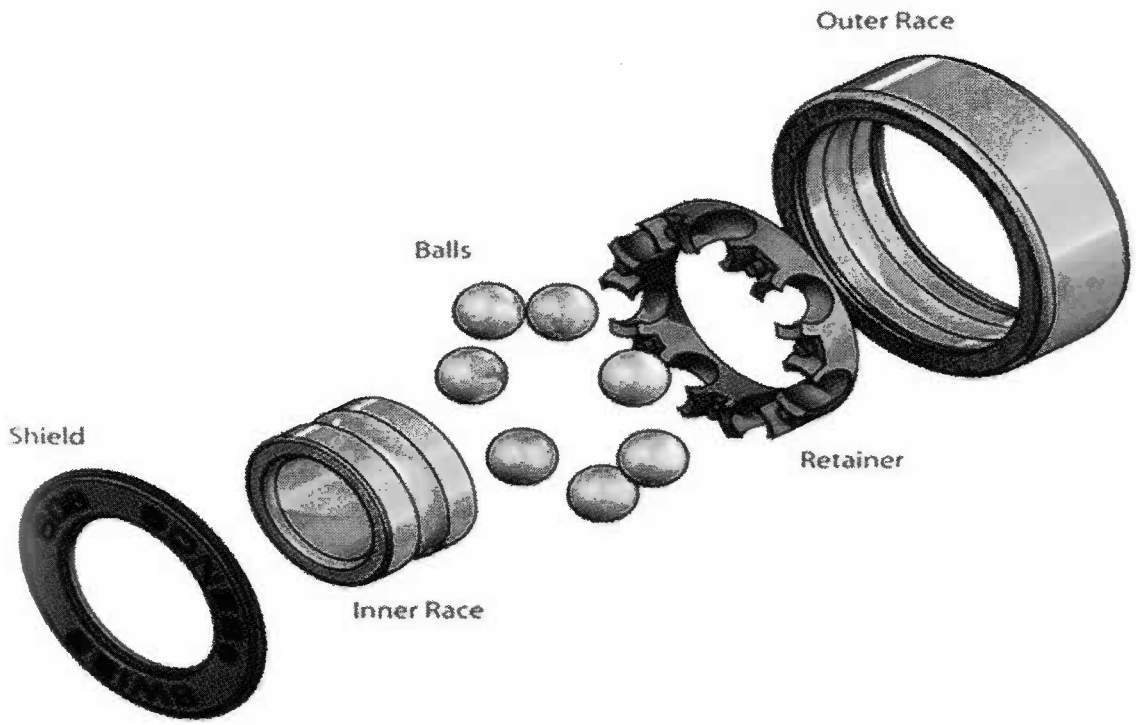

Figure 2.5: basic construction of bearing

Bearing made from smooth outer and inner metal surface for roll against each other . Bearing allows two part to move rotationally also in linear movement while reducing friction and save energy. The balls help to distribute the load to make rolling machine function efficiently.

2.3.1 Type of bearings

Plain bearing

Simplest bearing design consist of bearing surface with no rolling elements. Compare to other it is the cheapest and has longer life spent depending on material use it was made of.

Description	Friction	Bearing stiffness	Velocity	Life span
Use pump lubricant and surface need lubricant	Depend on material example PTFE has 0.0.5-0.35 coefficient of friction.	Good and low wear	Low to very high	Depends on application.