UNIVERSITI TEKNIKAL MALAYSIA MELAKA

INVESTIGATION ON THE PERFORMANCE MILD STEEL IMPACT TEST VIBRATIONAL ANALYSIS USING MATLAB

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

by

MUHAMAD SHAHIRMAN BIN HASSAN

B071410455

950610-03-6211

FACULTY OF ENGINEERING TECHNOLOGY

2017

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **INVESTIGATION ON THE PERFORMANCE MILD STEEL IMPACT TEST VIBRATIONAL ANALYSIS USING MATLAB**

SESI PENGAJIAN: **2017/18 Semester 1**

Saya **MUHAMAD SHAHIRMAN BIN HASSAN**

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 (✓)

☐	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	

Disahkan oleh:

Alamat Tetap:

LOT 1522 –C KG
CHEMPAKA.PENGKALAN CHEPA,
16100 KOTA BHARU,
KELANTAN

Cop Rasmi:

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 Investigation on the Performance Mild Steel Impact Test Vibrational Analysis Using Mat LAB is the results of my own research except as cited in references.

Signature	:	
Author's Name	:	Muhamad Shahirman bin Hassan
Date	:	19 December 2017

APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor's Degree in Mechanical Engineering Technology (Maintenance Technology). The member of the supervisory is as follow:

……

(MOHD IRMAN BIN RAMLI)

ABSTRAK

Kertas kerja ini memberikan gambaran keseluruhan kaedah untuk mengesan, mencari, dan mencirikan kerosakan dalam sistem struktur dan mekanikal dalam keluli lembut dengan memeriksa perubahan dalam tindak balas getaran diukur.

Penyelidikan dalam pengenalan kerosakan berdasarkan getaran telah berkembang pesat sejak beberapa tahun yang lalu. Idea asas di sebalik teknologi ini adalah bahawa parameter modal (frekuensi semulajadi, bentuk mod, dan nisbah redaman) adalah fungsi ciri-ciri fizikal struktur (massa, redaman dan kekakuan). Oleh itu, perubahan sifat fizikal akan menyebabkan perubahan dikesan dalam sifat modal. Motivasi untuk pembangunan teknologi ini dibentangkan. Sifat bahan termasuk nisbah Poisson, modulus Young dan modulus ricih. Kaedah juga diterangkan secara umum termasuk masalah yang berkaitan dengan pelaksanaan mereka dan keputusan mereka. Aplikasi semasa dan masa depan yang dirancang kepada sistem kejuruteraan sebenar diringkaskan. Isyarat getaran menggunakan kaedah analisis statistikal I-kaz 4D diaplikasikan bagi mendapatkan bacaan impak dan pemadanan dilakukan untuk perbandingan ciri mekanikal "mild steel"

ABSTRACT

This paper provides an overview of methods to detect, locate, and characterize damage in structural and mechanical systems in mild steel by examining changes in measured vibration response. Research in vibration-based damage identification has been rapidly expanding over the last few years. The basic idea behind this technology is that modal parameters (natural frequencies, mode shapes, and damping ratio) are functions of the physical properties of the structure (mass, damping, and stiffness). Therefore, changes in the physical properties will cause detectable changes in the modal properties. The motivation for the development of this technology is presented. The material properties include the Poisson's ratio, Young's modulus and shear modulus. The methods are also described in general terms including difficulties associated with their implementation and their fidelity. The current and future-planned applications of this technology to actual engineering systems are summarized. Vibration signals using the I-kaz 4D statistical analysis method were applied to obtain impact reading and matching for the comparison of the mechanical properties of 'mild steel'

DEDICATION

Most Elevated Exceptional Grateful To Both My Loving Father and Mother

Hassan bin Dollah

&

Rahimah bte Mat

Also

To My Beloved Brothers and Sisters

ACKNOWLEDGEMENT

Firstly, millions of thankful wishes to Allah S.W.T because with his permission, I am able to complete my Final Year Project Report.

In setting up this paper, I have drawn in with numerous individual helping me finishing this project. Firstly, I wish to thanks to my main thesis supervisor Mohd Irman bin Ramli for support, direction, give guided, advices and inspiration for me in finishing my thesis.

Exceptional appreciation to my beloved parents Hassan bin Dollah and Rahimah bte Mat for their prayer and steady backing. It is a pleasure to thanks all my siblings for encouragement and their support from the day I started this project.

Lastly, thankful with also all lectures, all my friends were giving spirit and support. Their undivided love and support during tough times will never be forgotten.

Thank you.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1
INTRODUCTION

1.0 Introduction

In this chapter, a general overview of the study is given. The chapter also discusses the objectives and the motivation behind the research and presents a literature review and highlights the author's contribution towards the overall research.

1.1 Background of the Project

Good maintenance to guarantee an asset which can provide satisfactory returns. Assets must be maintained more effectively and professionally to obtain best value for money. The maintenance of an effective requires an approach which is more strategic and comprehensive.

Assets will not provide a satisfactory return if proper maintenance is neglected or maintenance made only upon the occurrence of serious damage or when there is a complaint from users which the asset does not reach the required level. This reactive approach will disserve many parties from time to time. Damage is often up to the optimum level / new excuses and this could be improved can disrupt productivity.

Maintenance can be a combination of technical work and administration that aims to preserve or restore the asset which can able to fulfill the desired function. Two things can be taken from this definition is maintenance involving repairs and maintenance also involves preserving the asset. Repair in maintenance can be regarded as repairing or replacing the damaged components while preserving more focused on preventing the occurrence of damage.

To improve the structure of the specimen of a substance, the test should be done first. So, the nature of the mechanical structure such as hardness, tensile, ductility can be improved further identified. There are two test which are destructive test (DT) and non-destructive test (NDT).

To determine the mechanical properties characteristic, destructive test (DT) methods are use. But in this methods, it's has some disadvantage. Its needs to make specimens simulating in the same process which cannot be reused once have been tested again. Therefore, the cost to run this method will be costly due to the changes of damage specimen during test. Examples of destructive test are bending test and tensile test. So that, to get the same result but different in method, non-destructive tests (NDT) method are uses in this experiment.

Equipment that used in a test can determine the name of the test method. NDT methods are high acclaim from around the world and increasingly becoming popular in structural engineering. There are many method examinations which are liquid Penetrant testing (PT), Magnetic Particle testing (MT), radiographic testing (RT), Thermal / Infrared testing (IR), Ultrasonic testing (UT), Vibration Analysis (VA) and Visual testing (VT) (Carvalho, Rebello, Souza, Sagrilo, & Soares, 2008).

(Sim & Chau, 1995) to make an effective means of vibration analysis (VA) in non-destructive testing, vibration stress been added to the real-time laser speckle shearography. Mechanical vibration analysis is in a position to predict the potential vibration problems and make solutions to problems using mathematical tools for

modeling designs. Therefore, the design can be modified to reduce problems such as vibration if a problem can be predicted.

1.2 Problem Statement

The estimation of mechanical properties of specimen can be carried out by several methods, destructive test (DT) and non-destructive test (NDT). It is necessary to test the specimen structures to determine whether the specimen properties are suitable for its designed use. Ideally, a few testing should be done without damaging or destroying the specimen (Österberg & Osterberg, 2000). The suitable test available for testing specimen range from completely non-destructive test, where there is no damage to the specimen. This non-destructive test will prevent the structure of specimen from being damage (Scott & Scala, 1982). Non- destructive test or method like ultrasonic test and hammer test do not damage the specimen and allow having an inventory of structure and conditions. Therefore, this non-destructive test is simple and easy to use and always economically advantageous.

Non-destructive test are very suitable for determine or taking measurement with continuous measurement. This because in this test, the specimen will not being destroy and it can be used in many times or repeatedly to do the testing. This non-destructive test is associated with each other to improve diagnosis and at the same time to reduce number of test (Breysse, 2012).

For destructive test (DT), the inspection activities carried out on the substance of a matter and it will result in damage to the material. This test is important to determine the mechanical properties of a material such as hardness, strength, durability and elasticity. This test is to determine the quality of a substance.

For large objects, destructive testing is a very convenient and economical, because the cost to destroy a small number of pieces of sample is ignored. This is

because the sample will be placed under different load and pressure. At the end, we can analyze and determine at the test point it will gives up and cracks.

In addition, to use this test in the field, these tests require a lot of complicated equipment is not available for use. But in the second, there are also tests that can be performed in astana without complicated equipment. Among its tests are free to bend, bend-test missiles, and nick-break test.

Besides, why this test is not recommended because this test needs the specimen simulating the same process (surface preparation, environmental conditions, and product adhesive system) with the original and the test specimen which has been used cannot be reused when tested again. (Gupta, Member, & Gebremedhin, 1990) this destructive test cannot identify more clearly the status of the adhesion in the joint binding.

1.3 Objectives

The objective is:

1. To determine the time domain and frequency domain of impact signal.
2. To obtain mild steel material properties.

1.4 Project Scope

The study is subjected to the following scope:

1. To determine the natural frequency of mild steel by using piezoelectric film sensor as a sensor together with mild steel that are being applied certain forces to get the signal.
2. To obtaining the mild steel material properties by using Signal Express software to get the frequency data and using MATLAB software.

CHAPTER 2
LITERATURE REVIEW

2.0 Introduction

This chapter will discuss mainly on the theory/ literature review about vibration, theory, parameter vibration, types and feature material, type of testing and theory testing.

2.1 Introduction to Vibration

Vibrations are an oscillation that occurs in mechanical dynamic systems. Vibration also can be the oscillation of motion of bodies and the forces that associated together. The vibration or oscillation is called an interval of time after any motion will repeats itself (―Fundamentals of Vibration," 1948) For the system, it can oscillate when it is applied forced. The term vibration also can be related in mechanical engineering. Therefore, the vibrations in mechanical engineering, is often associated with a system that can swing freely without the applied force. Sometimes this vibration can lead to minor problems that can cause serious and threatened security in the engineering system. As an example is the plane. When the plane is flying in the air, the plane's wings will vibrate excessively. This will cause passengers will be comfortable with this situation, especially when the frequency of vibration in accordance with the original frequency in the human body and organs. In fact, if this had not prevented vibration it can cause serious internal injury to the

passenger. Also please note that the current cost of designing high-performance aircraft are to exposure to vibration (Clevenson, Dempsey, Leatherwood, Clevenson, & Dempsey, 1978)

2.2 Principle of Vibration

Displacement, velocity, or acceleration can be measured by reference to the vibration amplitude. For vibration amplitude, it can measure whether a relative or absolute. That one which is relative to the free space can be said as an absolute vibration measurement. And to measure absolute vibration anyway, its needs be created by the seismic vibration transducer. Seismic vibration transducers are including transducer swing coil, velocity transducers, accelerometers and velometers. It can say that a fixed point on the machine is a relative to relative vibration measurement. Therefore, the relative vibration measurements can be generally limited to displacement measurements, the displacement of the bearing.

2.2.1 Displacement

In term of displacement, the measurement is calculated or determine from the distance or amplitude which moved from a resting position. For distance, the SI unit is in meter (***m***). To measure the vibration displacement of an object, usually the measurements using displacement eddy current transducers.

2.2.2 Velocity

It can be said that, the velocity is the rate of change of displacement related to the change in time. Due to rate of change of displacement with time, its SI unit is meter per second (***m/s***). Generally, the measurements to

measure the velocity vibration are using either swing coil velocity transducers or acceleration transducers.

2.2.3 Acceleration

For acceleration, it is relation between velocity and time. So, the acceleration is a rate of change of velocity against time. For acceleration the SI unit is meters per second2 (***m/s2***) due to the velocity against time. For measuring vibration acceleration, usually accelerometer will be used

2.3 Vibration Analysis

2.3.1 Introduction to Modal Analysis

Modal analysis is an activity or process to get and to determine the dynamic characteristics of the structure which is natural frequency, damping ratio and mode shape by use the value of mathematically model the dynamic behavior. This modal analysis can solve for natural tendencies of the structure in the form of motions and frequencies (Ramli, Nuawi, Abdullah, & Seng, 2017).

Modal Analysis is derived originally from Equation of Motion which stated that every motion occurs is incorporated with vibration alongside it. Modal analysis also identified as learning dynamic properties under vibration test. This indicates that the modal analysis is very closely related to the nature of the dynamic properties of a structure (Fleming, Andrew J, 1967). This can be seen when a load or displacement is imposed, all the physical structure will behave dynamically. By with it, modal analysis is very useful to everyone. It allows us to know the dynamic properties that can prevent

damage to a structure. Thus, this will increase the safety of the structure and consumers in the future.

For modal analysis methods, there are a few types which is can be categorized into two which is operational modal analysis (OMA) and experimental modal analysis (EMA). Modal analysis can be understood or recognized by the computer building capital through a computer breakdown. Therefore, it is important to know the ways of the experimental modal analysis (OMA).

To identify structural modal parameter tests, OMA can be considered a good technique. It is done by using only data structure in response. In OMA, power is only available at mode shape at each node. Therefore, to obtain natural frequencies and mode shapes that are required, the OMA methods should to be done (Of, Techniques, Mode, & In, 2015). OMA is also one of the time domain analyses.

And for EMA, impact hammer or shaker method will be used which aims to generate a test structure specimen. There are several disadvantages associated with this type of excitation. First, the output quality can vary as a place can become nodal point's excitation test structure and the ratio of the output signal-to-noise can be quite low. In addition, the test should be repeated a few times with the location of the different tests on the specimen in order to really understand the dynamic characteristics of the structure. Consequently, this test will take some time (Xu & Zhu, 2013).

2.3.2 Modal Analysis Testing

Modal analysis testing is an experimental technique or activities it will involve three phases, starting with the preparation of constituent tests, measuring the frequency response and modal parameter identification.

2.3.3 Hammer Impact Test

Mechanical tests often involve for deformation or breakage of samples of material. Impact hammer testing is often known as test mode. Impact hammer testing is a method of determining and calculating dynamic characteristic of the testing structure. (Chandrashekhar J Shende, 2015) The frequency response of a structure can be found by measuring the input and response. By counting the number of times at certain locations, data that obtained can be used to predict the dynamic analysis of structures.

The difference in potential energy of the hammer is the impact of energy will be produced or obtained before and after the interesting specimens. When the specimen was given load as tested, calibrated special machine will read the fracture energy in units of N-m or J directly from the indicator that shows the angle of rotation of the pendulum (Brown, Allemang, & Phillips, 2005). This test is easy and does not require high cost to prepare the specimen. Therefore, it can say that the impact hammer test is widely used in vibration testing to get the frequency response function.

In this test, the structure will be given effect under test with a perfect impulse so that the machine can read the dynamic characteristics of the structure. This process will take only a short time, which will cause constant amplitude in the frequency domain. Of course, in real life we will have the contact time is known. It is unlikely such a boost. This time period is directly linked to the frequency of the applied force. Typical hammer with load cells to be used in this test hammer test is to measure the force impact.