UNIVERSITI TEKNIKAL MALAYSIA MELAKA

PERFORMANCE ANALYSIS OF BRASS SHEET UNDER VIBRATION IMPACT TEST BY USING MAT LAB

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

by

MOHAMAD DZUMALIN FAISAL BIN MUSA

B071410117

920816075251

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

……

(MOHD IRMAN BIN RAMLI)

ABSTRAK

Laporan ini adalah kajian tentang bagaimana untuk mengesan, melaksanakan dan menganalisis ciri spesimen tembaga dalam sistem struktur dan mekanikal dengan mengkaji perubahan tindak balas getaran. Penyelidikan dalam pengenalpastian masalah berasaskan getaran telah berkembang pesat sejak beberapa tahun kebelakangan ini. Banyak vektor ciri telah dibangunkan selama bertahun-tahun dan didokumentasikan dengan baik dalam kajian kepustakaan. Yang tidak jelas dari kajian kepustakaan adalah perincian yang berkaitan dengan setiap ciri supaya hasilnya konsisten di kalangan pengguna. Idea asas mengenai teknologi ini adalah untuk mendapatkan domain domain dan domain kekerapan masa dan menggunakan perisian iaitu *I-Kaz 4D* untuk mentafsirkan data ciri-ciri fizikal struktur. Elemen tersebut akan ditentukan dalam kajian ini dengan menggunakan spesimen tembaga. Ujian impak akan dilakukan untuk mendapatkan parameter modal dan untuk menganalisis sifat material spesimen yang mana merangkumi modulus young, modulus ricih, kekuatan tegangan dan kekuatan mampatan spesimen tembaga. Daya yang ditetapkan akan dikenakan ke atas spesimen untuk mewujudkan getaran dan data parameter modal akan dicatat serta dianalisis.

ABSTRACT

This report is a study about how to detect, performing and analyze of the characterize of brass specimen in structural and mechanical system by examining changes in vibration response. Research in vibration-based damaged identification has been rapidly expanding over the last few years. Many feature vectors have been developed over the years and are well documented in the literature. What is not clear from the literature is the details associated with each feature so that the results are consistent among users. The basic ideas over this technology is that to get time domain and frequency domain properties and be using a software namely as *I-Kaz 4D* to interpret the data of physical properties of the structure. Those things will be determine in this study by using a brass specimen. An impact test will be conducted in order to get the modal parameter and to analyze the material characteristic of the specimen which is has Young modulus, Shear modulus, Tensile strength and Compressive strength of the brass specimen. A certain force will be applied to the specimen in order to created vibration and the modal parameter data will be recorded and analyze.

DEDICATION

To my beloved parents that the most exceptional person

Musa Bin Ismail

&

Roslinah Binti Maslan

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Foremost, I would like to express my sincere gratitude to my supervisor En. Mohd Irman bin Ramli for the continuous support of my bachelor study, for his patience, motivation, enthusiasm and immense knowledge. His guidance helped me in all the time of research and writing of this report. I could not have imagined having a better advisor and mentor for my bachelor study.

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AE	-	Acoustic Emission Testing
ADC	-	Analog-To-Digital
DSA	-	Dynamic Signal Analyzers
ET	-	Electromagnetic Testing
ETC	-	Et Cetera
FM	-	Freqeuncy Modulation
FFT	-	Fast Fourier Transfer
FRF	-	Frequency Response Function
IR	-	Thermal/Infrared Testing
ICP	-	Inductively Coupled Plasma
IEPE	-	Integrated Electronics Piezo Electric
MATLAB	-	Matrix Laboratory
MFL	-	Magnetic Flux Leakage
MHz	-	Megahertz
MT	-	Magnetic Particle Testing
Mv	-	Medium Voltage
NDT	-	Non-Destructive Test
PT	-	Liquid Penetrant Testing
PC	-	Personal Computer
RT	-	Radiographic Testing
SISO	-	Single Input And Single Output
TM	-	Tympanic Layer
TFM	-	Transfer Function Model
UT	-	Ultrasonic Testing
VT	-	Visual Testing

VA	-	Vibration Analysis
mm	-	Millimiter
°C	-	Celcius
m / s^2	-	Meter Per Second Square
4D	-	4 Dimensional

CHAPTER 1
INTRODUCTION

1.0 Background

The law of nature has been states that everything has a vibration. Can be say that mostly of the engineering structures and machines experience vibrations to some of degree and their design usually requires consideration of their oscillatory motion. Before this, to do research on related to the vibration a destructive test has be conducted where the test has a lot of disadvantage such as could lead to higher cost and to complete the test it required a long time. To prevent this from happening a new method has been used by using Non-Destructive Test (NDT) method which can do those test without destroying the material.

Basically, the process of *NDT* are involving of evaluating materials, testing or assemblies or inspecting the components for discontinuities, without destroying the serviceability of the system or part or in a simplest word is the part or component still can be used without damaging or having a defect on it after completing the testing. There are several *NDT* testing that be using nowdays such as Electromagnetic Testing (ET), Acoustic Emission Testing (AE), Liquid Penetrant Testing (PT), Visual Testing (VT), Radiographic Testing (RT), Thermal/Infrared Testing (IR), Magnetic Particle Testing (MT), Magnetic Flux Leakage (MFL), Vibration Analysis (VA) and Ultrasonic Testing (UT). However, in this study will be focused on a Vibration Analysis Method.

NDT implementation is important in order to describe what should be found and what to reject. A totally immaculate production is never conceivable. Consequently testing particulars are key. These days there exist an extraordinary number of measures and acknowledgment regulations. Often which specific *NDT* method has to be used even though it has a limit between good and bad conditions.

In addition, there a lot of reason or advantages to do Non-Destructive Test compare to the destructive testing method. The advantages of implementing the *NDT* is Cawley's stated that, a vibration technique for non-destructively evaluating the integrity of structures is described and applied to components fabricated and the method uses measurements of changes in the lower structural natural frequencies, which can be made at a single point in the structure, in conjunction with a dynamic analysis of the system to detect, locate and roughly to quantify damage (Cawley, 1979). Besides that, with just one test it can have more variety of result mechanical properties characteristic and it also easy to find the natural frequency for a given material. Non-Destructive Test (NDT) it is method that refers to the type of equipment that penetrates the material used to perform the test.

Furthermore, *NDT* tests result can prevent in to the replacement or repair of machine before malfunction can occur. For an example, oil spill a reliable non-destructive testing of the cement seals and blowout preventers on the Deepwater Horizon could have meant an incalculable amount of money that will be saved. *NDT* technique testing is more reliable than *DT* technique due to the variety of available and complementary options. *NDT* technique also can eliminate the risk of inaccuracy or oversight. After all of these advantages that's why the *NDT* technique is choosen for this study. By doing this study the result that obtained will be compare with the result of Destructive Test value to know the material properties on a material.

1.1 Problem Statement

Vibration is one of the most important things in life, it can be on anywhere. Besides that, vibration also important in maintaining process. Previously, in order to perform the vibration test, a Destructive Test method should be done in order to get the value which could lead to high costs for doing experiments. According to (Miller, 1994), a destructive testing is a technique whereby the application is made in order to fail in an uncontrolled manner to find the point of failure and also to test of the robustness application. In addition, destructive testing also performed under

severe operating conditions and it is continued until the application breaks. In order to determine the service life of the product or to determine the design weaknesses if any which may not show up under normal working conditions those two reason are main purpose why destructive test is needed.

However, destructive testing (DT) has a lot of disadvantages compare to the *NDT* technique such as there are many flaws in the high cost of manufacturing machinery and equipment, and also there is a universal testing machine that are available on the market use only one test at a testing method results only which could lead to wasting time. By doing destructive test also the material or part that being used for the testing cannot be used anymore and if the testing is fail it need to do it again and again until it reach the result that wanted thus this could increase cost for the manufacturer.

Furthermore, to set up the experiments also quite complicated and requires a relatively long time to complete the experiment and it will take time. Besides that, the destructive test also only can detect certain test for example tensile test or hardness test and the test only valid for one time only. To overcome this problem a (NDT) Non-Destructive Test has been selected as it has the advantage of as the method requires no great skill and is easy to understand that any individual can do this test. By using this method it can save time whereby with just one software it can make different test at the same time. In addition, this technique also can saving time whereby the test can do for a several testing.

1.2 Objective

The objective for this study is stated below whereby this study contain two objective which is:

- To determine the time domain and frequency domain of impact signal.

- To obtain its material properties characteristic of brass material.

1.3 Scope

The process will start with the preparation of the sample. The sample that will be used is from the piece of brass material that in a square shape with a dimension of 300 *mm* length and 300 *mm* height with the thickness is 1.5 *mm* (300 *mm* X 1.5 *mm* X 300 *mm*). An impact test will be conducted where the force applied is between a certain force range with ten (10) reading of the brass material and will be using piezoelectric sensor film as a sensor and vibration will be created by using an impact hammer and the reading of this test will be recorded in order to get the natural frequency of the brass. Then, by using a Lab View software a frequency data can be obtained. Next, by using a MATLAB software to get the behaviour of the brass such as time domain, frequency domain, mode shape and the material properties characteristic and lastly to make a comparison between Non-Destructive Test value and Destructive Test value to see the either both testing has similarity or not.

CHAPTER 2
LITERATURE REVIEW

2.0 Introduction of Vibration

In simplest terms, any movement that more than once itself after an interim time is called vibration. The simplest example is on Figure 2.1 whereby it shows the swinging of a pendulum and the movement of a plucked string. Theory of vibration manages the investigation of oscillatory movement of bodies and strengths related with them. Kelly (2012) stated that, vibrations are occur in many structural and mechanical systems but, if it is uncontrolled, the vibration can lead to catastrophic situations whereby the vibrations that exist at the machine tools or machine tool chatter can lead to improper machining of parts. Besides that, during earthquakes or even wind-induced vibration the structural failure can happen due to the large dynamic stresses developed.

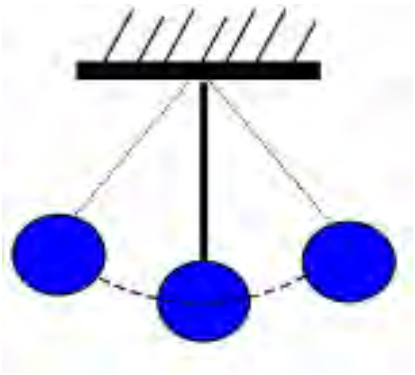

Figure 2.1: Swinging of the pendulum (Kelly, 2012)

2.1 Type of Vibration

Engineers nowadays may encounter one of the most difficult things that need to be resolved during the time which is the problem are vibration. There are many different types of vibration, but if the vibration are classified in the wrong place it will be terrible for machines. For example, the vibration will cause a machine to breakdown and causing the machine to make louder noise when running. In addition, a major structure such as a bridge, if the wrong type of vibration occur it can cause a damage that could lead to fatal. There are many types of vibration that have developed over the years.

2.1.1 Free Vibration

Rohal' and Ilkiv (2012) stated that, free vibration happens when a mechanical system are energized by the beginning condition, for example, a velocity, acceleration or displacement and along these lines enabling it to vibrate freely without proceeded continued force interaction. In addition, the examples of this type of vibration are like on a tuning fork and after that let the ring pull back the tyke on a swing and letting go. The mechanical framework vibrates at least one of its regular frequencies and damps down to motionless.

2.1.1.1 Free Vibration With Damping

At the point when a viscous damper is being included into this model the outputs of force that is proportional to the velocity of the mass. The damping is called viscous on the grounds that it displays the impacts of a liquid within an object. The damping force that is proportional to velocity by a constant *b*. Then, the displacement is being measured by *q(t)* and add a viscous damper with the constant *b* to the representation. This is represented

schematically is shown by Fig. 2.2 whereby it is free vibration of a point mass with viscous damping.

$$Fb = b\frac{d \cdot q(t)}{dt} = b \cdot q(t)$$

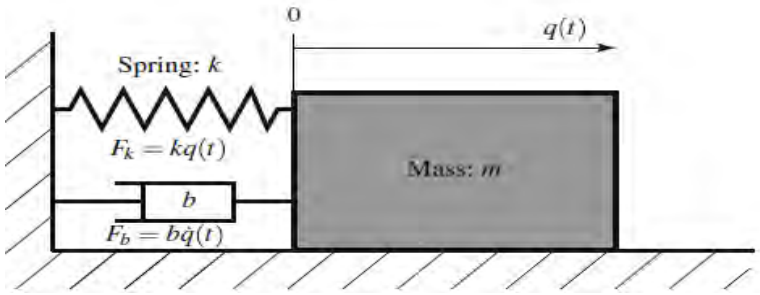

Figure 2.2: The free vibration of a point mass with viscous damping (Rohal' and Ilkiv, 2012)

2.1.1.2 Free Vibration Without Damping

Based on Rohal'-Ilkiv (2012), a system that had been show in Fig. 2.2. Shows that the damping is not being used and there are no external force acting on it. For the vibrating mass, it is often to be referred as a simple harmonic oscillator, however it is sliding on a frictionless surface and has a mass of *m*. The position of the mass is signified by dependent coordinate, *q (t)*. In the meantime, the mass are connected with the surface with a linear spring and have the spring constant *(k)*.

$$Fm = m\frac{d2q}{dt2} = m \cdot q(t)$$

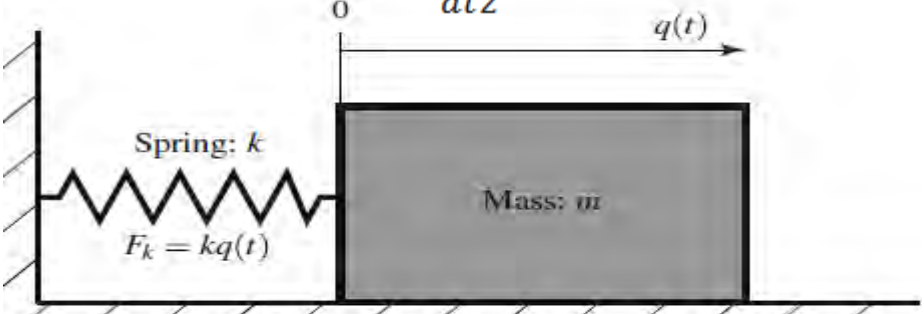

Figure 2.3: Free vibration of a point mass without damping (Rohal' and Ilkiv, 2012)

2.1.2 Forced Vibration

Forced vibration in a simplest definition is the vibration that happens under the excitation of outer force. Blake (2010) stated that, all real systems have some damping, even though it is often very small. However, a small damping forces also can affect the forced response around resonance, this can be helpful to be able to merge them into theoretical model and investigate damped forced vibration. The examples of this forced vibration include car vibration caused by an engine, a shaking clothes washer because of an irregularity, or vibration of a building cause by an earthquake.

2.1.3 Damped Vibration

According to Blake (2010), at the point when the vitality of a vibrating system is step by step it will be annihilated by grinding and other resistance, so the vibrations are said to be damped. Moreover, the vibrations slowly change or being lessen in recurrence and the framework will be rests in its equilibrium position.

2.2 Vibration Analysis

Based on Beards (1995), vibration analysis (VA) is to enables the user to assess the state of gear and along these lines the failures can be kept away from. Maintenance personnel can limit spontaneous downtime by scheduling required repairs amid typical support shutdowns. In order to monitor the situation there are several types of approaches that can be using such as monitoring of the heat, chemical monitoring and bearing vibration monitoring. Vibration analysis is being solved into several groups as sinusoidal versus random vibration, free versus forced vibration or linear versus rotating induced vibration.