

A NON-DESTRUCTIVE CRACK DETECTION TECHNIQUE USING
VIBRATION

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To beloved mother

Puan Zainab Binti Ismail

My siblings

Other family, male friend and female friend

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ABSTRAK

Kajian ini dilakukan adalah untuk mengkaji peretakan yang berlaku ke atas bahan dengan menggunakan teknik getaran. Objektif utama kajian ini adalah untuk mengkaji kesan daya tindakan luar yang bertindak ke atas bahan dan tempoh masa daya tindakan luar, kesan komposisi bahan terhadap struktur bahan, dan mengesan peretakan yang berlaku ke atas bahan serta sifat-sifat peretakan. Spesimen yang dipilih adalah jenis tembaga dan keluli lembut. Ujian kekerasan dilakukan untuk menentukan sifat kedua-dua bahan yang dipilih. Teknik mengesan peretakan yang berlaku ke atas permukaan spesimen dilakukan dengan menggunakan teknik ujian tanpa musnah iaitu teknik getaran. Daya tindakan dikenakan ke atas permukaan spesimen untuk mendapatkan data daya hentakan. Kajian ini akan membuat perbandingan dari sudut anjakan impact force dan juga menggunakan FFT analyzer untuk membuat perbandingan frekuensi tabii antara spesimen rujukan yang tidak mempunyai sebarang peretakan dengan spesimen yang mempunyai peretakan. Selepas itu, ujian pengesanan peretakan ke atas permukaan spesimen dilakukan secara visual dengan menggunakan kanta pembesar. Kajian ini diteruskan melalui perbandingan dengan ujian ultrasonik. Semua keputusan dicatat dan kajian terperinci dilakukan terhadap kedua-dua jenis spesimen.

ABSTRACT

This project is carried out to study about crack detection on the material by using vibration technique. Main objective of this study to find out the effect of impact force to the different material and contact time, identify effect of composition material to the structure, trace the crack location and behavior of crack on the specimen. The specimens that will be used in this study are copper type and mild steel type. Both types of specimens will be test with hardness tester machine to obtain the characteristic material that was chooses. Crack detection technique by using non destruction method namely vibration will be applied to the specimens. Impact force will be applied to the specimen to obtain the impact force data. This study will make comparison between a good specimen as reference and crack specimen in edge of displacement of impact force and FFT analyzer also will be used to make comparison in edge of natural frequency. After that, visual inspection to the specimen will be carrying out by using magnifying glass. This study is follow by comparison with the result from ultrasonic testing. All the results both types of specimens will be discuss in depth.

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LIST OF SYMBOL

N_f	=	Fatigue Life
Hz	=	Hertz
σ	=	Average stress, Nominal stress, Poison's Ratio
F	=	Force, N
A	=	Area, m ²
CPM	=	Cycle per Minute
RPM	=	Rotation per Minutes
mV	=	millivolts
μm	=	micrometer
μs	=	microsecond
F_{max}	=	Maximum Force, N
MPA	=	Megapascal
L	=	Length, m
W	=	Width, m
T	=	Thickness, m
N/m	=	Newton per meter
θ	=	Angle, °
Sa	=	Sound path
SD	=	Surface distance

LIST OF ABBREVIATION

NDT	=	Non Destruction Test
FFT	=	Fourier Fast Transform
ASME	=	American Society of Mechanical Engineer
ASTM	=	American Standard Test Material
SEM	=	Society for Experimental Mechanics
AISI	=	American International Supply Inc
MPI	=	Magnetic Particle Inspection
UT	=	Ultrasonic Testing
PDCA	=	Plan, Do, Check, Action
U.T.S	=	Ultimate Tensile Strength

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CHAPTER I

INTRODUCTION

1.1 Background of Study

All structure or mechanical component that has been invented, have a lifetime and weaknesses. Because of that, this study is aiming to identify the best material and find out solution to increase lifetime of material.

This study is carried out to trace crack as an experimental specimen of non-destruction test (NDT). There are includes identified structure of material and analyzed the factors that maybe give crack effect to the structure material from the impact force data we will be have in the non-destruction test (NDT). The FFT analyzer also will used to identify the natural frequency of the specimens.

Crack is divided to many kinds. There are included surface crack, haggard crack, and others. Actually, crack at the component cannot give the direct effect to our safety but can give big effect when the crack is growing up into the certain size and very difficult to overcome the problem. Consequently of that, we should know to identify the factors that maybe give effect to the crack and try to retain or eliminate the crack to increase the lifetime of material.

First of all, this study will conduct by find out characteristic of specimens used by tested with hardness tester. The next step, this study will analyses the specimen by using vibration. Before trace any crack, vibration method will be used

to identify condition of specimen. Comparison between good result of specimen and damage result of specimen will be carried out. The damage specimen will be analyses and detail inspection will be implementing to the specimen. Any result will be note and the best solution for the damage will be found out.

This study will be proof by using ultrasonic testing. This study will compare result by vibration experiment and ultrasonic testing.

1.2 Problem Statement

Crack is a major problem in the engineering field especially in the forging structure. Effect of crack, the structure of material cannot coherent for along time and decrease it lifetime. This occurred maybe from the fatigue and stress in the material and the others factor. However, crack on the structure of material can be overcome to increase the lifetime of the material by making right choose material and we know the suitable matrices of material used without any wasting. By controlling the crack, it will give good effect in the engineering field because it can be increase the lifetime of material, improved performance of material and also give benefit of economizing.

1.3 Objective of Study

This study is carried out by experimental analyses and also by theory through the non-destruction test (NDT) from the impact force data, FFT analyzer and ultrasonic testing of the virgin structure to construct and display damage location and it damage behaviors. There are objectives to accomplish in this study:

- i. Identify effect of impact force to the different material and contact time
- ii. Identify effect of composition material to the structure
- iii. To trace the crack location and behavior of crack

1.4 Important of Study

This study has several importances especially in the engineering field. Many people did not know how to solve the problem of structure crack and it is very difficult to identify the crack and its type by the direct sight. Consequence of that, this study will give detail explanation about the crack. There are importances of this study:

- i. Can identify location of crack and identify potential causes of crack
- ii. To reduce or even try to find out the best solution to eliminate the crack and improve lifetime of material
- iii. To control growing of crack and we can analyze machine operation before severely damage occurred

1.5 Scope of Study

- i. Literature study by journal, article, academic books and others related references
- ii. Trace the crack specimen through vibration experiment and ultrasonic testing
- iii. Study on crack cases in the material
- iv. The assembling of the structural mass and stiffness matrices of the plate structure is carried out using Hardness Tester
- v. The plates will be tested in vibration tests using impact force and also FFT analyzer to obtain the natural frequency of specimen