UNIVERSITI MALAYSIA PAHANG

BORANG PENGESAHAN STATUS TESIS♦

JUDUL: **THE EFFECT OF CHATTER ON CUTTING TOOL IN CNC MILLING MACHINE**

SESI PENGAJIAN: **2009/2010**

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THE EFFECT OF CHATTER ON CUTTING TOOL IN CNC MILLING MACHINE

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Thesis submitted in fulfilment of the requirements
for the award of the degree of
Bachelor of Mechanical Engineering with Manufacturing

Faculty of Mechanical Engineering
UNIVERSITI MALAYSIA PAHANG

NOVEMBER 2009

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LIST OF SYMBOLS/ABBREVIATIONS

mm	Millimeter
N	Newton
rpm	Radial per minute
SLD	stability lobes diagram
V	cutting speed
CNC	Computer numerical control
DOE	Design of experiment
D	depth of cut
F	feed rate
x, y	determined experimentally
CAD	computer-aided design
IGES	Initial Graphics Exchange Specification
IMECS	International Multi Conference of Engineers and Computer Scientists

ABSTRACT

This study focuses on chatter analysis after undergone milling process. The first objective of this project is to get the value of chatter using DYNO-METER on the CNC milling machine. After getting value of chatter, the second objective is to analyze the chatter using ALGOR software. The output that needs to get is in term of stresses. Minitab software also was performed to analyze the parameters involved in the experiment. In this project, Master Cam software will be used to design the work piece that will be used throughout this study. This software also will be used to simulate and generate the G-code to help user to operate with CNC milling machine. The work piece material that will be used was high carbon steel (AISI-D12) and its parameter is 100x100x50 mm. From the results obtained after machining, the most significant factor for the chatter were depth of cut and spindle speed. This means whenever the depth of cut is too depth and the spindle speed is slow, the maximum chatter will occurred with high cutting force applied. From the Algor analysis, the results showed that the different forces will result in different value of stresses. It is obvious that when cutting force is higher, the value of stress is also higher. The depth of cut also influences the chatter in this study. Spindle speed and feed rate should have an appropriate setting in to reduce the chatter. Based on this study, the analysis showed that higher chatter tends to increase the tool wear or tool breakage.

ABSTRAK

Tesis ini tertumpu pada analisis gegaran selepas permesinan giling dilakukan. Tujuan pertama daripada projek ini adalah untuk mendapatkan nilai gegaran menggunakan Dyno-METER di CNC mesin giling. Setelah mendapatkan nilai daripada gegaran, yang kedua ialah mencapai tujuan adalah untuk menganalisis gegaran di perisisan ALGOR. Output yang perlu didapatkan adalah tekanan. Perisian Minitab juga dilakukan untuk menganalisis parameter yang terlibat dalam percubaan. Dalam projek ini, Master Cam juga perisian yang akan digunakan untuk merancang kerja potongan. Pada saat yang sama, software ini akan melakukan simulasi dan menghasilkan G-kod untuk membantu pengguna untuk mengoperasikan CNC mesin giling. Keluli karbon quality (AISI-D12) dipilih sebagai bahan dan parameter ialah 100x100x50 mm. Dari keputusan eksperiman, faktor yang paling signifikan bagi gegaran berlaku adalah kedalaman potong dan kelajuan spindle yang kurang. Dari analisis Algor, hasilnya menunjukkan bahawa kekuatan-kekuatan yang berbeza menunjukkan nilai yang berbeza dari segi tekanan. Jelas bahawa ketika gaya pemotongan lebih tinggi nilai tekanan yang lebih tinggi. Nilai pemotongan mempengaruhi gegaran pada mesin.Oleh itu, eksperimen ini harus mempunyai parameter yang sesuai untuk menjalankan proses penggilingan. Kedua-dua analisis membuktikan teori bahawa gegaran yang lebih tinggi cenderung meningkatkan kerosakan pada alat pemotongan.

CHAPTER 1

INTRODUCTION

1.1 PROJECT BACKGROUND

The research work in this thesis involves an experimental and theoretical investigation of chatter during machining AISI 12 carbon steels. Experimental runs will be carried out to determine the chatter of the machine. The result will show how the properties of the material will affect the cutting tool of the machine. A device known as DYNO-METER will be used for this project. The purpose is to measure how strong the vibration will be produced during machining.

The theory is the bigger of the vibration will caused the cutting tool take several damages such as tool wear. The important thing is the result of the product. Instability in cutting process causes chatter which generally diminishes the quality of products and therefore has to be detected, prevented and eventually also predicted.

Various techniques have already been proposed for this purpose and mainly based on the spectral analysis of the cutting tool and force vibrations. Beside this, the oscillating signal shape and various statistical characteristics have also been used for identification of chatter.

1.2 OBJECTIVE

The objective of this project is to get the value of chatter using DYNO-METER on the CNC milling machine. After getting value of chatter, the second objective need to achieve is to analyze the chatter using ALGOR software in term of stress. Minitab software also will be used to analyze the parameters involved in the experiment.

1.3 SCOPE

In this project, CNC milling machine will be used to perform the machining process on material AISI D12. At the same time, DYNO METER will be used to get the response in term of cutting force from each milling process. From the response, ALGOR analysis will be performed to analyze stress. Then Full Factorial analysis will be carried out using Minitab software to predict the parameter that affects the value of chatter during the milling processes.

1.4 PROBLEM STATEMENT

Usually designer or engineer facing problem in material selection for their products. This is the most important part in manufacturing process. This is the responsibility for person who called engineer to handle this task. Here the result of this project will help to decide whether material AISI D12 is necessary to apply in products for example car parts and the body of an aircraft.

Chatter vibration is an unfavorable phenomenon encountered in various machining processes. Its occurrence in grinding can be particularly critical, since it affects the geometrical form accuracy and surface finish of the ground work pieces. Automatically also effect the cutting tool. These are the two main objectives of milling as designing and finishing operation. Reliable and early detection of chatter is therefore one of the most important features of monitoring systems for milling process.

1.5 SOLUTION

To overcome these problems, for the problem, the project will help to specify on AISI D12 carbon steels. A further research needs to be done to avoid the chatter during machining.

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