I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of the Bachelor's degree of Mechanical Engineering (Thermal-Fluids)

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THE EVALUATION OF MACHINABILITY AND SURFACE FINISH IN CNC MILLING MACHINE

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in partial fulfillment of the requirements for the award of Bachelor's degree of
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December 2005

"I hereby the author, declare this report entitled "THE EVALUATION OF MACHINABILITY AND SURFACE FINISH IN CNC MILLING MACHINE" is my own except for quotations and summaries which have been duly acknowledged"

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Date : 10 / 12 / 2005

Dedicate to my parents and loving family.

And also to my lovely friends.

Thank you for all your support.

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ABSTRACT

This project (PSM) is carried out with the purpose of studying the suitable cutting parameters when using machining process on workpiece. The scope of this study chose a CNC milling operation for machining process and spindle speed, and feed rate for cutting parameters. The workpiece were used in this project are aluminum, brass, and copper and High Speed Steel (HSS) as the cutting tools. When the process machining is finish, the surface roughness of the workpiece will be measured and analysis on it. The relationship surface roughness between spindle speed and feed rate is will be show by graph plotted, where surface roughness (Ra) versus spindle speed and feed rate (Rmax). From the experimental results, it can show that's a particular spindle speed, and feed rate produced the different surface finish.

ABSTRAK

Projek (PSM) ini dijalankan adalah untuk mencari dan mendapatkan parameter pemotongan yang sesuai semasa proses pemesinan dilakukan ke atas bahan kerja. Skop bagi projek ini memilih operasi *CNC* pengisaran untuk proses pemesinan dan kelajuan pengumpar dan kadar suapan sebagai parameter pemotongan. Bahan kerja yang akan digunakan dalam projek ini ialah seperti aluminium, tembaga dan loyang dan *'High Speed Steel'* sebagai perkakas pemotongan. Apabila proses pemesinan selesai dilakukan, kekasaran permukaan bahan kerja diukur dan dilakukan penganalisaan. Perhubungan diantara kekasaran permukaan dengan kelajuan pengumpar dan kadar suapan akan ditunjukkan melalui graf yang diplot, dimana kekasaran permukaan (Ra) melawan kelajuan pengumpar dan kadar suapan (Rmak). Dengan itu, ia akan menunjukkan bahawa kelajuan pengumpar dan kadar suapan akan menghasilkan kekemasan permukaan yang berlainan.

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LIST OF SYMBOL

D	Depth of cut
F	Feed Rate
Vc	Cutting Speed
N	Spindle Speed
Ra	Surface roughness average
Rmax	maximum surface roughness (peak-to-peak height)
μ	$1x10^{-6}$

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CHAPTER 1

INTRODUCTION

1.1 Objective Project

The objectives in this study are to analysis the machinability and surface roughness of materials of High Speed Steel cutting tool with CNC milling machine.

1.2 Scope project

The scope for this study is used Computer Numerical Control (CNC) milling machine for evaluation the machinability and surface texture with high speed steel cutting tool. For this project, the material that will be used are *alumnum, brass and copper* .The machinability cutting are as feed rate, cutting speed, cutting force and depth of cut. The surface texture of workpiece that we get has to measure and must do analysis. The results of the surface that we get will be doing by the comparison through the graph, picture and its surface texture.

1.3 General Introduction

Milling is the process of cutting away material by feeding a workpiece past a rotating multiple tooth cutters. The cutting action of the many teeth around the milling cutter provides a fast method of machining. The machined surface may be flat, angular, or curved. The surface may also be milled to any combination of shapes. The machine for holding the workpiece, rotating the cutter, and feeding it is known as the Milling machine.

Before any milling job is attempted, several decisions must be made. In addition to selecting the best means of holding the work and the most appropriate cutters to be used, the cutting speed and feed rate must be established to provide good balance between rapid metal removal and long tool life. Proper determination of a cutting speed and feed rate can be made only when the following six factors are known:

- Type of material to be machined
- Rigidity of the set-up
- Physical strength of the cutter
- Cutting tool material
- Power available at the spindle
- Type of finish desired

Several of these factors affect cutting speed only, and some affect both cutting speed and the feed rate.

1.4 Problem statement

Among several in industrial machining processes, the quality of the surface plays a very important role in the performance of machining as a good-quality surface significantly improves fatigue strength, corrosion resistance, or creep life. Therefore, the desired finish surface is usually specified and it appropriate processes are selected to reach the required quality surface.

1.5 Problem analysis

Base on the problem we have, we must evaluate the fitness of machining parameters such as feed rate or spindle speed to get a good quality of surface finish. For this project, the materials that will be use are *aluminum, brass and copper* with the different speed and feed rate and from that we can measure and analyze the ideal speed to use. From that, with the different material also, we can obtain the optimum good surface.

CHAPTER 2

LITERATURE REVIEW

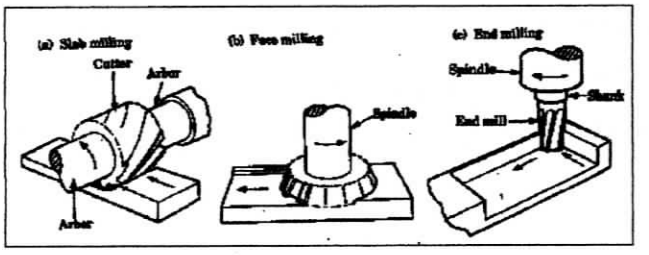
2.1 Classification of Milling

By using *Serope Kalpakjian and Stevan R.schmid* concepts, have a three basic in milling operations: -

(a) Peripheral milling,
(b) Face milling,
(c) End milling

2.1.1 Peripheral Milling

In peripheral (or slab) milling, the milled surface is generated by teeth located on the periphery of the cutter body. The axis of cutter rotation is generally in a plane parallel to the workpiece surface to be machined.



(Kalpakjian S., Introduction to Manufacturing Processes)

Figure 2.1: Types of milling operation

2.1.2 Face Milling

In face milling, the cutter is mounted on a spindle having an axis of rotation perpendicular to the workpiece surface. The milled surface results from the action of cutting edges located on the periphery and face of the cutter.

2.1.3 End Milling

The cutter in end milling generally rotates on an axis vertical to the workpiece. It can be tilted to machine tapered surfaces. Cutting teeth are located on both the end face of the cutter and the periphery of the cutter body.

In the manufacturing field, Numerical Control technology has caused something of revolution and it also found their special place in the machine shop. Numerical Control can be defined as an operation of machine tools by the means of specifically coded instruction to the machine control system. The instructions are combinations of the letters of alphabet, digits and selected symbols.

2.2 NC and CNC Technology

Perform Rick Payne and Ron Smith theory, the NC stands for the older and original *Numerical Control* technology, where by the abbreviation CNC stands for the newer *Computerized Numerical Control* technology, a modern spin – off of its older relative. However, in practice CNC is the preferred abbreviation.

Figure 2.2: Types of CNC Milling

2.2.1 NC Technology

In NC system, it uses a fixed logical function, those that are built in and permanently wired within the control unit. The programmer or the machine operator cannot change these functions. Because of the fixed wiring of the control logic, the NC control system is synonymous with the term 'hardwired'.

The system can interpret a part program, but it does not allow any changes to the program, using the control itself. All required changes must be made away from the control, typically in an office environment. Also, the NC system requires the compulsory use of punched tapes for input of the program information.

The NC codes are the "language" that is recognized and understood by the computer controlling the machine. This language, like any language, has a specific structure to insure accurate communication. The NC code structure consists of characters, words, blocks, and programs.

2.2.1.1 A Character

There are 9 charter types used in CNC programming:

1. letters A thru Z
2. a number or combination of numbers 0 thru 9
3. + plus sign
4. - minus sign
5. . decimal or period
6. : colon
7. ; semi-colon
8. / slash
9. % percent

2.2.1.2 A Word

Is a series of characters arranged in a specified order that provides a specific command to the machine. A word consists of an address (discussed later) followed by numbers and/or symbols. Here are some examples - but not all - of the typical words: