UNIVERSITI TEKNIKAL MALAYSIA MELAKA

PARAMETER SELECTION FOR MACHINING VARIOUS TYPE OF MATERIAL IN MILLING MACHINE

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

by

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BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **PARAMETER SELECTION FOR MACHINING VARIOUS TYPE OF MATERIAL IN MILLING MACHINE**

SESI PENGAJIAN: **2014/15 Semester 2**

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I hereby, declared this report entitled “Parameter Selection for Machining Various Type of Material in Milling Machine” is the results of my own research except as cited in references.

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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 Engineering Technology (Product Design). The member of the supervisory is as follow:

…….

(Project Supervisor)

ABSTRACT

Surface finish is a surface texture also knows as characteristics of surface. The quality of surface finish is very important because is able to effect the quality of product. Thus, selection of correct machining parameters are able to produce high quality of surface finish when machined workpiece. This project is to analysis the machining parameters effect on surface roughness for different types of material for face-mill process in milling operation. The machining parameters that will give effect on surface roughness consist of cutting speed, feed rate, and depth of cut. The material used are mild steel AISI 1018 and Aluminium 1100. Machining trial was conducted at different cutting parameters using carbide cutting tool. After milling process, surface roughness value was measure using the Mitutoyo Surface Roughness Tester SJ-410. The result of surface roughness will be analysed using Variance of Analysis (ANOVA) software. The main aim of this project is to determine the parameter that capable to produce smooth and good surface finish with use computer numerical control (CNC) vertical milling machine. Hopefully the result analysis can helpful student as reference during operation the CNC milling machine at available in Manufacturing Technology Engineering (FTK) Laboratory.

ABSTRAK

Kekemasan permukaan ialah texture permukaan atau di kenali juga sebagai ciri-ciri permukaan. Kualiti kemasan permukaan adalah sangat penting kerana ia akan memberi kesan kepada kualiti produk yang dihasilkan. Oleh itu, pemilihan parameter pemotongan yang sesuai mampu menghasilkan kualiti kekemasan pemukaan yang baik pada bahan kerja yang dimesin. Projek ini adalah untuk menganalisis parameter pemesinan yang memberi kesan kepada kekemasan permukaan untuk pelbagai jenis bahan dengan mengunakan pengisaran muka dalam operasi pengisaran. Terdapat tiga parameter pemesinan yang memberi kesan kepada kekasaran permukaan iaitu kelajuan pemotongan, kadar suapan dan kedalaman pemotongan. Bahan yang digunakan dalam projek ini adalah keluli lembut AISI 1018 dan aluminum 1100. Pemesinan akan dilakukan pada parameter pemotongan yang berbeza menggunakan alat pemotong karbida. Selepas operasi pengisaran dilakukan, nilai kekasaran akan diukur menggunakan penguji kekasaran permukaan, SJ-410. Hasil kekasaran yang diperolehi akan dianalisis mengunakan perisian analisis varian (ANOVA). Tujuan utama projek ini adalah untuk menentukan parameter pemesinan yang mampu untuk menghasilkan kekemasan permukaan yang lincin dan baik dengan mengunakan kawalan komputer berangka (CNC) pengisaran. Semoga keputusan analisis ini dapat membantu pelajar sebagai rujukan semasa mengunakan mesin pengisaran yang terdapat di makmal mesin di Fakulti Teknologi Kejuruteraan Pembuatan.

DEDICATIONS

I dedicate this report to my loving parents, Mr Saad bin Othman and Madam Kalsom bt Kamis, whose words of encouragement and support towards my studies. I also dedicate this research to my sibling for their support towards me since ever I was further study. Without their support, I may not come out with a successful research. May Allah always bless of them.

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In the name of Allah, the most Gracious and most Compassionate

Praise to God for His help and guidance that I am able to complete the task of this Bachelor Degree Project. A special thanks to my supervisor, Mr. Abd Khahar Bin Nordin that had guided me throughout this study from the beginning until the end. Besides, his had given me invaluable advices that empower my spirit and passion toward the job and the tolerance of my silly mistakes. I would like to take this chance to thank his for the support and encouragement whenever I faced any problems while completing this study. I am very thankful for the time that his had been spent with me for the study and correcting my mistakes even though his had a busy working schedule.

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LIST OF SYMBOLS AND ABBREVIATIONS

AA	=	Arithmetic Average
AL	=	Aluminium
ANOVA	=	Analysis of Variance
ANSI	=	American National Standard Institute
CLA	=	Center Line Average
CNC	=	Computer Numerical Control
Cu	=	Copper
DIN	=	German National Standard
F-test	=	Fisher Test
HSS	=	High Speed Steel
ISO	=	International Standard
JIS	=	Japanese Industrial Standards
mm	=	Millimetre
QC	=	Quality Control
Ra	=	Average Roughness
Rev/min	=	Revolution per Minute
Rp	=	Smoothing Depth
RPM	=	Millimeter per Revolution
Rq	=	Root mean square
SFM	=	Surface feet per minute
TiNC	=	Titanium Carbide
µm	=	Micrometre

CHAPTER 1
INTRODUCTION

1.0 Introduction

Surface finish is a surface texture also knows as characteristics of surface. The quality of surface finish is very important because is able to effect the quality of product. Thus, selection correct machining parameters are able to produce high quality of surface finish when machined workpiece. Cutting parameters like cutting speed, spindle speed, feed rate, and depth of cut is important in material remover. Surface roughness influences some functions of work piece like contact causing surface friction, fatigue resistance, wearing, heat transmission, and coating (Daud, Ng, Sivakumar and Selamat, 2015). According to Suleiman, Usman and Apasi (2011), cutting parameter selected based on the workpiece material, cutting tool material and tool size will be used. This project is analysis the effect of cutting parameters like cutting speed, feed rate, and depth of cut on surface roughness for different type of material using CNC milling machine. This chapter will explain about project from introduction, objectives, problems statement, project scope and project outline.

1.1 Background

The quality of the machined part are main challenges during milling machine. Selection of cutting parameters is very important for type of material used because their most significant effect on surface finish of workpiece. This research was made to analysis the effect of cutting parameters like cutting speed, feed rate and depth of cut on the surface finish. The machining and collecting data process was made in detail using a CNC milling machine that is found in workshop manufacturing technology.

Two different type of material is used for doing this project, it is Aluminum 1100 alloy and Mild Steel AISI 1018. The flat shape of material is selected and machining in form of flat surface. The cutter and the path of that cutter used to evacuate material from the work piece is the face milling operation. The correct cutter material is very important to tool life in order to avoid tool wear. Cutting tool material to machining the remover surface is carbide insert. After milling process, surface roughness value were measured using a portable surface roughness SJ-410. The result of surface roughness were analyses using the Minitab software. Minitab software was performed to identify the effect of cutting the effect of cutting parameters on surface finish.

This parameter will be studied and do the machining to produce data that can used as references to new user that want to learn the milling process. These parameter will used as guidelines to machinist in selecting the correct parameter of cutting tool to the type of material being cut.

1.2 Problem Statement

Surface roughness and tolerances are most critical quality measures in product. The quality of surface finish can affect the functionality of product, appearance and reliability. Thus, the selection of correct cutting parameter is very important for control the required surface quality. One of the ways to solve is problem is using a correct cutting parameters for workpiece material. Therefore, it can improve the quality surface roughness of the product. This project are study and analyses the suitable cutting parameter for aluminum 1100 alloy and mild steel AISI 1018 in milling operation.

1.3 Project Objective

The objective of this project are:

i. To study the effect of cutting parameter such as cutting speed, depth of cut and feed rate on surface roughness for milling operation.
ii. To finding the correct cutting parameter to the type of material being cut.
iii. To analyses the result of cutting parameter for materials used.
iv. To produce sample, recommendation and references for new comes student in machining technology (milling).

1.4 Scope of Study

To ensure that all project objectives are achieved, the following are few important elements that must be followed. This project involved the experiment and analysis. This experiment is conducted using a CNC milling machine (DMC 635 V ecoline) vertical milling that available in laboratory manufacturing technology. For machining process, the face milling operation and carbide insert as cutting tool are used. The common material that available in the laboratory is mild steel and aluminium, so the material was selected is aluminium 1100 alloy and mild steel AISI 1018 for do machining to determine the surface roughness. The variable cutting parameter like cutting speed, feed rate and depth of cut is used to machining the material, it is to determine the pattern that will be evaluated in order to select the suitable cutting parameter to be used together with purpose to produce a smooth and good surface finish. After finish the milling process, Surface Roughness Tester SJ-410 at the Metrology Lab is used to measure the value of surface roughness on the workpiece.

1.5 Project Outline

The parameter selection for machining various type of material in milling machine for PSM project is a combination of 5 chapters overall that contains and explain the topics such as the introduction, literature review, methodology, result and discussion, and lastly conclusion and recommendation.

Chapter 1: Introduction of the project. This chapter will concentrate about the project and objectives of the project will be elaborated. It is followed by the explanation of scope project, problem statements and project outline.

Chapter 2: This chapter will concentrate about the literature review. This chapter will be explain with some of basic information about the milling machine and CNC milling machine. Next, the surface roughness is reviewed together with milling cutting parameter and cutting tool that play an important role in determining the surface roughness material. Some literature reviews of current existing projects based on effect of cutting parameter on surface finish are also be discussed.

Chapter 3: Methodology of the project. This chapter is consists of the procedure that is used to conduct the whole research experiment from the beginning until the end of project.

Chapter 4: Result and Discussion. The results obtained from this experiment will be discussed. A graphs will be represent to shows the relationship between the parameters and surface roughness it produced by different machining parameters like cutting speed, feed rate and depth of cut. The factor that effect the result obtained will be discussed.

Chapter 5: Conclusion and recommendation. In this chapter will concentrated on the conclusions and further recommendations to improve this study in the future.

1.6 Planning Project

Table 1.6(a): Gantt chart for PSM 1

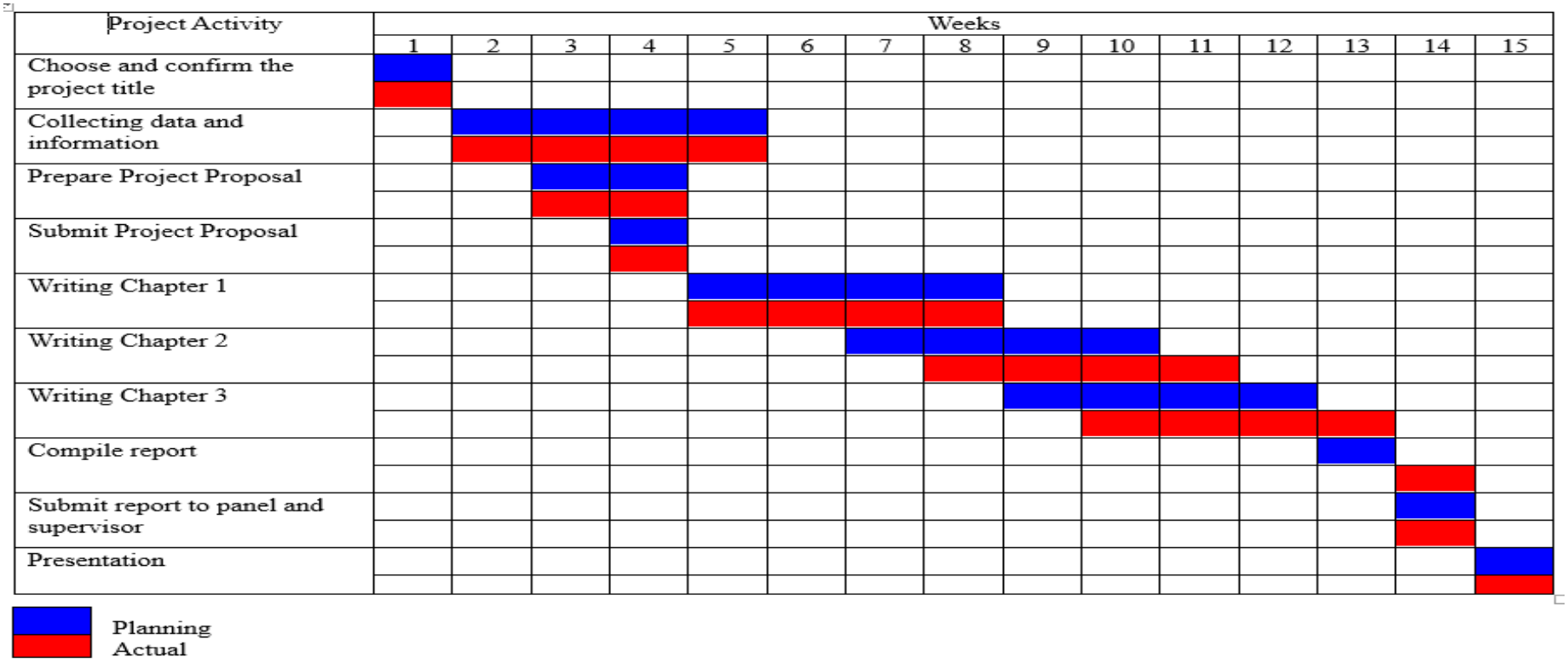

Table 1.6(b): Gantt chart for PSM 1

Project Activity	Weeks														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Conforms the parameter															
Prepare material															
Machining process															
Measure surface roughness															
Data analysis															
Writing Chapter 4															
Writing chapter 5															
Compile report															
Submit report to supervisor and panel															
Presentation															

Planning

Actual

CHAPTER 2
LITERATURE REVIEW

2.0 Introduction

The demand for high quality and fully automated production focuses on the surface condition of the product, primarily of the machined surface roughness, because of its effect on appearance, product function, and reliability. For this reasons is important to maintain consistent tolerances and surface finish. Preferable selections of cutting parameters is important to produce components with good quality and high tolerance. (Mohammed, Montasser, and Joachim, 2007). Biswajit, Susmita, Rai and Saha (2014) state the surface roughness depends on few factors such as the geometry of the cutting tool, tool material, work piece material, machine tool rigidity and few cutting requirement such as cutting speed, feed rate and depth of cut. Several factors such as wear of the cutting tool, chip formations and properties of the cutting tool, and work piece material are uncontrollable parameter in real machining. According to Kadirgama, Noor, Rahman, Rejab, Haron and Hossein (2009), surface finish can be characterized by several parameters such as average roughness (Ra), maximum peak-to-valley height (Rt), root mean square (Rq), and smoothing depth (Rp) that when the cutting speed is added, productivity can be maximized, meanwhile, surface quality can be improved. The Minitab Software is technique be used to show the relationship of cutting parameter with the surface roughness measurement.

2.1 Milling Machine

Milling machine is most versatile and useful machine tools because they are able performing a variety type of cutting operations. First milling machines was built in 1820 by Eli Whitney (1765 to 1825). Now, many selection of milling machines with various features are available. Kalpakjian and Schmid (2010) state the numerous machines and operations are now being with computer control and machining centre. But, manually controlled machines it is still widely used, particularly for small production run because it's cheap.

According to Joshua, David and Ismail (2015) milling is one of the common removing processes or metal cutting. It is a process that of generating machined surfaces with progressively removing a predetermined total of material or stock from the work piece at a relatively slow rate of movement or feed with a milling cutter rotating at a rather high speed. One other word, Bawa (2004) state the milling is a material remover process, that is used for machining curve, flat, and irregular surfaces by feeding the work piece against a rotating cutter that contain several cutting edges. Axis of rotation the cutting tool perpendicular to the direction of feed, whether perpendicular or parallel to machined surface. There are various types of milling machines available in the market and has its own characteristics.

According to Kalpakjian and Schmid (2010), milling machine can be classified based on their construction, specification and operation. Most of milling machines are constructed of column and knee structure, it is used for General Purpose milling operations with the spindle on which the milling cutter is mounted possible horizontal for slab milling and vertical for face milling and end milling. Furthermore, fixed bed type machines is the worktable is mounted directly on the bed that replaces the knee and can moving only longitudinally. This machines is not versatile like other types, but they have high stiffness and usually are used for high production work. The spindle may be vertical duplex, horizontal, or triplex types with two or three spindle, respectively for the simultaneous machining of two or three work piece surface. The planer-type milling machines is similar with bed type machine, it also equipped with cutters and few heads mill different surface. It is used for heavy work pieces and more efficient than simple planer when used for similar purpose.

Now, various milling machine component are being replaced rapidly with computer numerical control (CNC) machines. This machine are versatile and are capable of milling, drilling and boring with repetitive accuracy. For this project, the CNC vertical milling machine was used to machining the surface roughness.

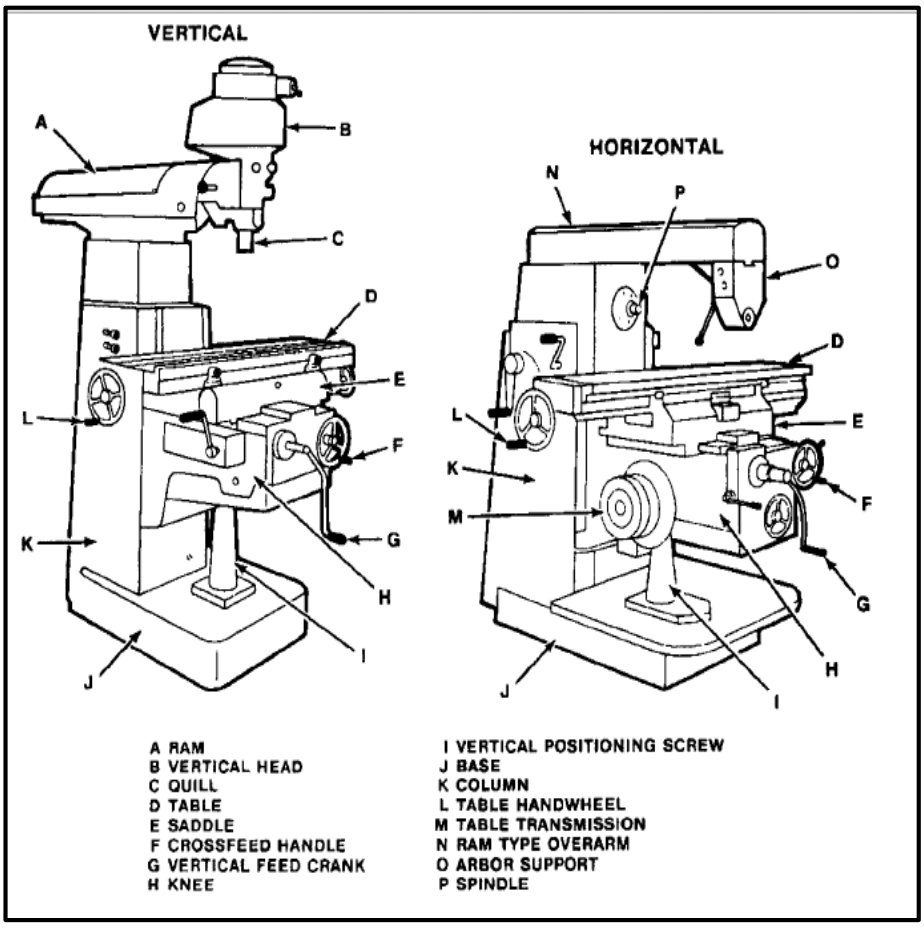

Figure 2.1: Type of milling machine

2.2 Computer Numerical Control (CNC) Machines

Computer numerical control (CNC) milling machines also known as machining centres. It was invented in the early 1970's. Before its invention, routing, drilling, milling, and other types of machinery operated by numerical control (NC), that required manual manipulation. According to Mwinuka, T.E., Mgwatu, M.I. (2015) the CNC machine tool consists of three basic system that is part program, machine control