



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**DESIGN AND ANALYSIS OF LONG CYLINDRICAL
WORKPIECE FIXTURE USING FINITE ELEMENT ANALYSIS**

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

by

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FACULTY OF MANUFACTURING ENGINEERING

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ABSTRACT

In the manufacturing industry on this day, design plays an important role in gaining competitive advantages. This project is designed the fixture system for holding, clamping and supporting the long cylindrical workpiece with diameter 10-50 mm during cutting or drilling in conventional milling machine. V-Block is designer to clamp long cylindrical workpiece to ensure the workpiece securely during machining process. Beside that, this clamping system have been designed for maximum force and would be less finishing treatment, so finally the operators have no rework. The advantages of this project, the productivity of product would faster and reduces defect. As a result, the optimize value of von misses stress and the deformation for the cylindrical fixtures. Deformation of cylindrical fixture parts was observed through the visual resultant when analysis have been successful done by using Nastran/Patran. In addition, the safety factor of cylindrical fixtures part has been determined as safe area.

Keywords: Fixture, clamping, cylindrical workpiece, milling machine, Finite Element Analysis.

ABSTRAK

Dalam industri pembuatan pada hari ini, pereka memainkan peranan penting dalam mendapatkan kelebihan persaingan. Projek ini direkapi untuk sistem 'fixture' bagi memegang, mengapit dan menyokong bendakerja yang berbentuk silinder yang mempunyai garis pusat 10-50 mm semasa memotong atau menggerudi pada mesin kisar konvensional. 'V-block' direkapi bagi memudahkan penggunaannya untuk mencengkam bendakerja panjang yang berbentuk silinder. Di samping itu, sistem pengapit juga telah direka untuk menampung daya yang tinggi, dan mengurangkan proses kemas. Jadi, operator tidak perlu memperbaiki kecacatan pada saat akhir. Kelebihan projek ini termasuklah mempercepatkan produktiviti dan mengurangkan kecacatan ke atas produk. Keputusannya, nilai optimum (von mises stress) dan penghasilan 'fixture' bagi memegang bendakerja berbentuk silinder dapat dihasilkan. Penghasilan 'fixture' ini dilakukan setelah mendapat keputusan yang memberangsangkan menerusi penganalisis Nastran/ Patran menerusi 'resultant' visual. Tambahan pula, faktor keselamatan 'fixture' ini telah selamat dipraktikkan.

Kuncikata: Fixture, mengapit, bendakerja panjang berbentuk silinder, mesin kisar konvensional, kaedah Finite Element Analysis

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LIST OF ABBREVIATIONS

FEA	-	Finite Element Analysis
HSS	-	High Speed Steel
CAD	-	Computer-aided designer
CADD	-	Computer-aided design and drafting
FEM	-	Finite Element Method
PDE	-	Partial differential equations
WBS	-	Work breakdown structure
CNC	-	Computer Numerical Control

CHAPTER 1

INTRODUCTION

1.1 Background of project

The manufacturing industry on this day, design plays an important role in gaining competitive advantages. Almost 99 percent design use in manufacturing industry. Nowadays consumer markets experience an ever increasing demand for better design and safety to use on the product. Also in value, the cheapest product will get attraction from market already. It is widely accepted that the design of a product is generally thought of as the ability to fulfill specific needs and ideally exceed, customer needs or expectations.

The advantages of the fixtures during operation machine are the productivity product faster and reduce defect. So that, fixtures will reduce cost because the fixtures will make the higher production, reduction in scrap, easy assembly for operator and saving in labor costs result of substantial reduction and workpiece produced. Beside that, the advantage of the fixtures is skill reduction. Jigs and fixtures are simplified locating and clamping of the workpiece. Tool guiding basics ensure accurate position of the tools with respect to the workpiece (Joshi, 2003).

In this project, the produce fixtures will be used in conventional milling machine. A fixtures system is very important in order to hold, support, and clamp workpiece during machining. This is because, during the operation machine there is a lot of impact at the long cylindrical workpiece. By producing these fixtures, the damage at the long cylindrical workpiece can be avoidable.

This project is used the raw material is mild steel. It is because mild steel is cheapest and easy to shape. Mild steel also economical to make parts that are not subjected too much wear and it not need to highly stressed.

This project is to carry out the design and analysis fixtures for long cylindrical workpiece in conventional milling machine. This fixture will examine the current problem in conventional milling machine, particularly to reduce the workpiece production in term of time and cost. In addition, this fixture will guide the operator more productive and reduces waste of workpiece produced.

1.2 Problem Statement

In milling machine, a fixtures system is very important in order to hold, support, and clamp workpiece during machining. One of the problems with long cylindrical workpiece fixtures is difficult to clamp in milling machine conventional when to surface finish and drilling the workpiece. Today, the fixtures have already will produce the workpiece defect when to clamp. In this project, the result is to apply the fixtures system for holding, supporting, and clamping the long cylindrical workpiece securely during machining.

At the moment, there are obstacles to hold and support for long cylindrical workpiece in conventional milling machine, because defect on surface the long cylindrical workpiece to clamp will fewer. And then, if the fixtures very difficult to clamp, it also difficult for operator to used the fixtures for clamp the cylindrical workpiece. Beside that, if the clamp is very strong, the workpiece will damage for further finishing, and then the operator will have many works to rework. This project will improve the application the fixtures with new the design the fixtures for long cylindrical workpiece.

1.3 Objectives of project

The objectives of this study are:

- (a) to investigate the design parameters of long cylindrical workpiece fixtures.
- (b) to design the long cylindrical workpiece fixtures.
- (c) to analysis the long cylindrical workpiece fixtures using Finite Element Analysis.

1.4 Scope of project

This project describes the design and analysis of fixtures application for long cylindrical workpiece. The purpose of this project is to study and improve the new design of the fixtures for long cylindrical workpiece. The fixtures will to use at conventional milling machine for hold, clamp and support the long cylindrical workpiece. The fixtures will move follow standard angles of such as thirty, forty-five or ninety degrees. This fixture will support, clamp and hold the long cylindrical workpiece for 10-50 mm diameter and 120 mm long only. This project used the mild steel raw material because it is cheaper and easy to shape.

Beside that, the product will to analysis using FEA (Finite Element Analysis). FEA consists of a computer model of a material or design that is stressed and analyzed for specific results. Using software ANSYS CFX 10 and Nastran/ Patran, the safety factor for the parts will be calculated. The factor of safety is used to provide a design margin over the theoretical design capacity to allow for uncertainty in the design process. The uncertainty could be any one of a number of the components of the design process including calculations, material strengths, duty, and manufacture quality. The value of the safety factor is related to the lack of confidence in the design process.

1.5 Gantt chat for PSM 1 and PSM 2

Figure 1.1 shows Gantt chat for PSM 1 and figure 1.2 shows Gantt chat for PSM 2.

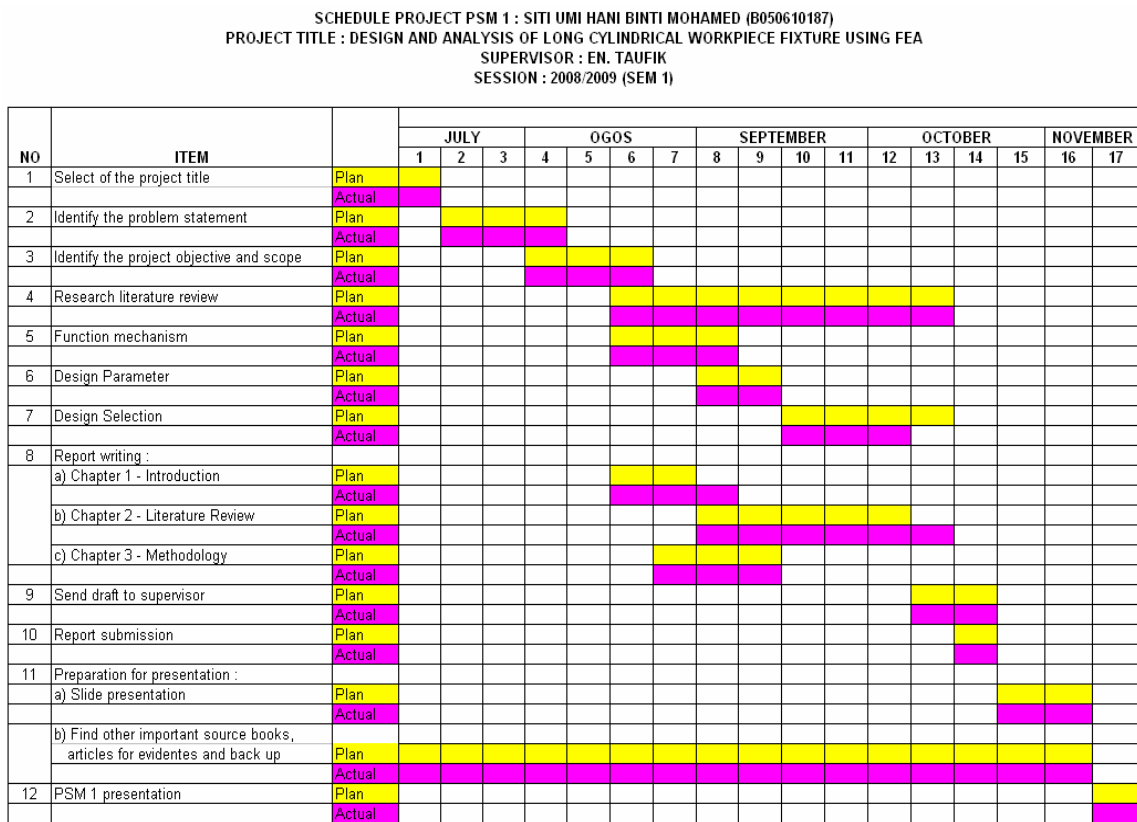


Figure 1.1: Gantt chat for PSM 1

SCHEDULE PROJECT PSM 2: SITI UMI HANI BINTI MOHAMED (B050610187)
PROJECT TITLE : DESIGN AND ANALYSIS OF LONG CYLINDRICAL WORKPIECE FIXTURE USING FINITE ELEMENT ANALYSIS
SUPERVISOR: EN. TAUFIK
SESSION : 2008/2009 (SEM 2)

NO	ITEM																								
			DICEMBER				JANUARY				FEBRUARY				MAC				APRIL				MAY		
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1	Project work continue																								
	a) Testing	Plan	■	■	■	■	■	■	■	■	■	■													
		Actual	■	■	■	■	■	■	■	■	■	■													
	b) Analysis	Plan	■	■	■	■	■	■	■	■	■	■													
		Actual	■	■	■	■	■	■	■	■	■	■	■												
2	Fabrication	Plan											■	■	■	■	■	■	■	■	■	■	■		
		Actual											■	■	■	■	■	■	■	■	■	■	■		
3	Project Improvements	Plan																							
		Actual																							
4	Prepare for Final Report	Plan	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
		Actual	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
5	Presentation	Plan																						■	
		Actual																						■	

Figure 1.2: Gantt chat for PSM 2

1.6 Project outline

Chapter 1

Describe the introduction of this project about the background of the study, problem statement, project objective, scope of the project and Gantt chart for PSM 1 and PSM 11.

Chapter 2

Describe the fixtures system include the application of clamping, holding and supporting. And study about milling machine and FEA analysis.

Chapter 3

Define the methodology in designing of long cylindrical workpiece fixtures and briefing explanation of the each process.

Chapter 4

Describe the result. The data was analyzed using FEA tools to identify quality related problems.

Chapter 5

Provide a general discussion on the design, the result of the study and implication of the finding of the study.

Chapter 6

Define the conclusion on the study. Suggestions for future study are included in this section.

CHAPTER 2

LITERATURE REVIEW

This chapter will present the literature reviews relevant to this project. It includes fixtures, conventional milling machine, the method of FEA (finite element analysis), and the software used to design the new fixture. The entire thing in this chapter must be considered to develop this project.

2.1 Fixture

A fixture is a manufacture tool that locates, holds, and supports the work securely so the necessary machining operations can be performed. Fixtures hold the workpiece securely in the correct position with respect to the machine or cutter during operation. There is sometimes a provision in the fixtures for setting the tool with respect to the workpiece or fixtures. But the tool is not guided as in a jig. And then the fixtures are often clamped to the machine table (Joshi, 2003).

Fixtures should be securely fastened to the table of the machine upon which the work is done. Through largely used on milling machines, fixtures are also designed to hold work for various operations on most of standard machine tools. Beside that, the fixtures vary in design from relatively simple tools to expensive, complicated devices. The fixtures also help to simplify metalworking operations performed on special equipment (Hoffman, 2004).