



DESIGN OF AUTOMATIC FIXTURE FOR SCANTOOL DRILLING MACHINE

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering
(Robotics and Automation) (Hons.)

by

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FACULTY OF MANUFACTURING ENGINEERING

2017

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: Design Of Automatic Fixture For SCANTOOL Drilling Machine

SESI PENGAJIAN: 2016/2017 Semester 2

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APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of Universiti Teknikal Malaysia Melaka as a partial fulfilment of the requirements for the degree of Bachelor of Manufacturing Engineering (Robotics and Automation)(Hons.).

The members of the supervisory committee are as follows:

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ABSTRACT

This project report presents the work done on the design of an automatic fixture for SCANTOOL drilling machine. This is a bench type drilling machine that is used in Fabricating Workshop at Block B of Faculty of Manufacturing Engineering, Universiti Teknikal Malaysia Melaka (UTeM). The machine is still using conventional power screw workpiece clamp vise that is required a lot of force applied by the operator to clamp the workpiece. If the clamping force applied toward the workpiece is not enough, the work piece could come out from the vise and could cause an injury to the operator or anybody nearby the machine. The objectives of this design project are to design and developed soft prototype of an automatic fixture for SCANTOOL drilling machine. To achieve the objectives, a flow chart was developed as a guide line to be followed. This project focusing on fully-automatic fixture that needs to customize to suite with the SCANTOOL drilling machine. Several designed ideas are generated and presented in this report. The listing of all parts need to be designed and fabricated, and the standard parts are also presented. SolidWorks software is used as designing tool and Automation Studio as a stimulation platform to animate the design. Finite Element Analysis (FEA) that available in SolidWorks has been used to analyse the design to make sure that the good design is produced. As a result, it was discovered that the design is strong enough to withstand the maximum drilling thrust force given to the surface of workpiece and factor of safety (FOS) of this design is greater than value of two as the minimum value. Suggestion for further work is also included in this report.

ABSTRAK

Laporan projek ini menerangkan tentang hasil kerja reka bentuk lekapan automatik untuk mesin penebuk SCANTOOL. Mesin penebuk ini adalah salah satu jenis mesin dipasang di atas lantai yang terdapat di Bengkel Fabrikasi Blok B Fakulti Kejuruteraan Pembuatan, Universiti Teknikal Malaysia Melaka (UTeM). Mesin ini masih menggunakan ragam bahan kerja lazim yang memerlukan daya yang banyak daripada pengendali mesin untuk meragum bahan kerja. Jika daya ragam yang dikenakan tidak mencukupi, bahan kerja akan tercampak keluar dari ragam dan boleh menyebabkan kecederaan kepada pengendali mesin atau sesiapa yang berdekatan dengan mesin. Objektif reka bentuk projek ini adalah reka bentuk dan menghasilkan prototype secara maya lekapan automatik untuk mesin penebuk SCANTOOL. Bagi mencapai objektif ini, carta alir telah dihasilkan sebagai garis panduan yang perlu diikuti. Projek ini tertumpu kepada lekapan automatik sepenuhnya yang disesuaikan untuk mesin penebuk SCANTOOL. Beberapa idea telah dihasilkan dan dipaparkan di dalam laporan ini. Kesemua senarai bahagian-bahagian yang perlu difabrikasi dan bahagian-bahagian asas juga dipaparkan. Perisian SolidWork telah digunakan sebagai alat untuk mereka bentuk dan perisian Automation Studio sebagai platform simulasi menganimasi reka bentuk ini. Finite Element Analysis (FEA) yang disediakan di dalam perisian SolidWork telah digunakan untuk menganalisa reka bentuk ini bagi memastikan reka bentuk yang dihasilkan adalah baik. Keputusannya, melalui analysis yang dijalankan reka bentuk ini mampu untuk menampung daya maksimum yang dikenakan ke atas permukaan bahan kerja melalui proses penebukkan dan nilai faktor keselamatan (FOS) bagi reka bentuk ini lebih besar dari nilai dua sebagai nilai minimum untuk faktor keselamatan. Cadangan untuk kajian selanjutnya juga disediakan di dalam laporan ini.

DEDICATION

Only

My beloved father, Raja Dziauddin Bin Raja Dziauddin

My appreciated mother, Faridaton Hanim Binti Md Amin

My adored Brothers, Raja Mohd Firdaus and Raja Mohammad Zulfakar

For giving me moral support, money, cooperation, encouragement and also understandings

Thank You So Much & Love You All Forever

ACKNOWLEDGEMENT

In the name of ALLAH, the most gracious, the most merciful, with the highest praise to ALLAH that I manage to complete this final year project successfully without difficulty.

My respected supervisor, Prof Dr. Bashir Mohamad Bin Bali Mohamad for the great mentoring, advice and guidance as well as exposing me with meaningful experiences throughout the study.

Last but not least, I would like to give a special thanks to my best friends who gave me much motivation and cooperation mentally in completing this report especially to, Ahmad Zahin for permission of using his references, Mohammad Fikri Shah for permissions using Printer equipment. They had given their critical suggestion and comments throughout my project. Thanks for the great friendship.

Finally, I would like to thank everybody who was important to this FYP report, as well as expressing my apology that I could not mention personally each one of you.

TABLE OF CONTENT

Abstract	i
Abstrak	ii
Dedication	iii
Acknowledgement	iv
Table of Contents	v
List of Tables	ix
List of Figures	x
List of Abbreviations	xiii
List of Symbols	xiv

CHAPTER 1: INTRODUCTION

1.1	Background of The Project	1
1.2	Problem Statement	2
1.3	Objectives	3
1.4	Scopes	3

CHAPTER 2: LITERATURE REVIEW

2.1	Definition of Fixture	5
2.2	Introduction of SCANTOOL Drilling Machine	6
2.3	Work holding Device for Drilling Operation	7
2.4	Type of Clamping System	8
2.4.1	Conventional Power Screw Clamp	8

2.4.1.1	Type of Thread of Power Screw Clamping System	9
2.4.2	Strap Clamp	10
2.4.3	Toggle Clamp	11
2.4.4	Intelligent Clamping System (Pneumatic Clamp)	12
2.4.5	Hydraulic Clamp	13
2.5	Locating and Supporting Points	13
2.6	CAD/CAM software	17
2.6.1	SolidWorks	17
2.6.2	Pro/Engineering	17
2.6.3	AutoCAD	18
2.6.4	CATIA	18
2.7	Finite Element Analysis	19
2.7.1	SIMULIA (CATIA V5)	19
2.7.2	SolidWorks Simulations	20
2.7.3	Pro/Mechanica	20
2.7.4	Autodesk Algor Simulation	21
2.8	Sensing Devices in Fixture	22
2.8.1	Force and Pressure Sensors	22
2.8.2	Proximity Sensors	24
2.8.2.1	Inductive Proximity Sensors	24
2.8.2.2	Capacitive Proximity Sensors	24
2.8.2.3	Ultrasonic Proximity Sensors	25
2.8.2.4	Optical Proximity Sensors	26
2.9	Summary	26

CHAPTER 3: METHODOLOGY

3.1	Flow Chart	28
3.2	Gantt Chart of the Project	30
3.3	Design Ideas	30
3.4	Selection of the CAD/CAM software	34

3.5	Selection of Power Drive System	35
3.6	Analysis tests	36
	3.6.1 Stress Analysis	36
	3.6.2 Factor of Safety	38
	3.6.3 Simulation Analysis with Automation Studio	39
3.6	Conclusion	40

CHAPTER 4: DESIGN, ANALYSIS, RESULT AND DISCUSSION OF AUTOMATIC FIXTURE FOR SCANTOOL DRILLING MACHINE

4.1	Automatic Fixture Design	41
	4.1.1 Main Base Plate	42
	4.1.2 Fixture Base	42
	4.1.3 Pneumatic Cylinder	43
	4.1.4 Linear Guideway and Rail	44
	4.1.5 Bridge Handle	45
4.2	Full Assembly of Automatic Fixture	46
4.3	List of Standard Parts	47
4.4	List of Assembly Parts	49
4.5	Analysis on Automatic Fixture for SCANTOOL Drilling Machine	49
	4.5.1 Analysis the Assembly of Fixture Base	50
	4.5.1.1 Applied Load From Drilling Process	50
	4.5.1.1.1 Maximum Drilling Thrust Force	52
	4.5.2 Analysis of Control System for Positioning and Clamping	55
	4.5.2.1 Result from pneumatic cylinders analysis	58
	4.5.2.1.1 Mathematical model of cylinder	58

4.5.2.1.2	Graph on pressure in chamber of cylinder	62
4.6	Sustainability	65
4.7	Conclusion	66
CHAPTER 5: CONCLUSION AND SUGGESTION FOR FURTHER WORK		
5.1	Conclusion	67
5.2	Suggestion for Further Work	68
REFERENCES		69
APPENDICES		72
APPENDIX A		73
APPENDIX B		74
APPENDIX C		75
APPENDIX D		76
APPENDIX E (1/2)		77
APPENDIX E (2/2)		78

LIST OF TABLES

2.1 Dimension of Morse Taper (mm)	7
3.1 Bill of Materials (BOM) of Idea 2	32
3.2 Step 1 of AHP	32
3.3 Pairwise comparison matrix for the capability	32
3.4 Pairwise comparison matrix for the simplicity	33
3.5 Pairwise comparison matrix for the cost	33
3.6 Pairwise comparison matrix for the ease of development	33
3.7 Pairwise comparison matrix for the maintenance	33
3.8 Pairwise comparison matrix with respect to the goal	33
3.9 Ranking process for CAD/CAM software	35
3.10 Ranking process for Pneumatic and Hydraulic	36
4.1 List of standard parts	47
4.2 List of assembly parts	49
4.3 The independent factor value	51
4.4 Result for Von Mises Stress	53
4.5 Result for Factor of Safety	54

LIST OF FIGURES

1.1	SCANTOOL Drilling Machine in FKP	1
1.2	SCANTOOL Drilling Machine with Conventional Power Screw Vise	3
1.3	The Drill Chuck of SCANTOOL Drilling Machine	3
2.1	End of Morse Taper Spindle	6
2.2	Basic Square Thread Form	9
2.3	Basic Acme Thread Form	10
2.4	Basic Buttress Thread Form	10
2.5	Strap Clamp Illustration	11
2.6	Illustration of Toggle Clamp	11
2.7	Example of automated Fixture	12
2.8	Illustration of Hydraulic Clamp System	13
2.9	Possible degree of freedom of a solid body	14
2.10	Arresting all DOF of a blank in a fixture by first angle projection illustration	14
2.11	Locating by (a) flat surfaces, (b) types of pins used	15
2.12	Deflection due to force for wide gap between supports	16
2.13	Recess in long span supporting	16
2.14	Example analysis by SIMULIA V5	19
2.15	Example analysis by SolidWorks Simulation	20
2.16	Example analysis using Pro/Engineering Mechanica	21
2.17	Example of frame of analysis by using Autodesk Algor Simulation	22

2.18	Typical Metallic Strain Gauge Pattern	23
2.19	Inductive Proximity Sensor	24
2.20	Capacitive Proximity Sensor	25
2.21	Ultrasonic Proximity Sensor	25
2.22	Optical or Infrared Proximity Sensor	26
3.1	Flow Chart of the project methodology	29
3.2	Idea 1	31
3.3	Idea 2	31
3.4	Types of forces applied to part or shape	37
3.5	Axial stress-strain experimental result	38
3.6	Block diagram of automatic fixture	39
4.1	Isometric view of main base plate	42
4.2	Isometric view of fixture base	43
4.3	Isometric view of pneumatic cylinder	44
4.4	Isometric view of rodless cylinder	44
4.5	Isometric view of linear guideway and rail	45
4.6	Isometric view of bridge handle	46
4.7	Isometric view of full assembly	46
4.8	Assembly of fixture base	52
4.9	The Graftet of the automatic drilling system	56
4.10	The ladder diagram of automatic drilling system	57
4.11	The pneumatic circuit of automatic drilling system	58

4.12	Pressure of cylinder, A1	62
4.13	Changing of pressure in both chamber of cylinder, A1	63
4.14	Changing pressure in both chamber of cylinder A2 during move to right side	63
4.15	Changing pressure in both chamber of cylinder A2 during move to original side	64
4.16	Changing pressure in cylinder A1 during retract position	65

LIST OF ABBREVIATIONS

UTeM	-	Universiti Teknikal Malaysia Melaka
FKP	-	Fakulti Kejuruteraan Pembuatan
CAD	-	Computer Aided Design
CAM	-	Computer Aided Manufacturing
AE	-	Ampere Single-Phase
AT	-	Ampere Three-Phase
ATF	-	Ampere Three-Phase Feet (Floor Model)
MT	-	Morse Taper
DOF	-	Degree of Freedom
2D	-	Two Dimensional
3D	-	Three Dimensional
NCL	-	NCAR Command Language
AHP	-	Analytic Hierarchy Process
FOS	-	Factor of Safety
PLC	-	Programmable Logic Control
CNC	-	Computer Numerical Control
SFC	-	Sequential Function Chart
PID	-	Proportional-Integral-Derivatives

CHAPTER 1

INTRODUCTION

1.1 Background of the Project

A drill machine (also known as a pedestal drill, pillar drill or bench drill) is a fixed style of drill that may be mounted on a stand or bolted to the floor or workbench. (Wikipedia.2016). It is manually operated unlike the CNC machine which is controlled by a coding systems that enables it to be operated with minimal supervision. There are many parts and components of SCANTOOL Drilling Machine include a fixture that is focusing for this project. (Scantool-Group.dk.2016). Figure 1.1 shows the SCANTOOL Drilling Machine that was installed in Fabricating Workshop at Block B of Faculty of Manufacturing Engineering, UTeM (FKP).



Figure 1.1 SCANTOOL Drilling Machine in FKP

Fixture is a component that holds, supports and locate the workpiece for a specific operation without guiding the cutting tool. (Scribd, 2016). Example of simple fixtures are vises clamp and chuck. The clamping system of the fixture and the locating point should be strong enough to withstand the forces developed during the operation. Furthermore, the clamping force during tighten the workpiece should not dent or damage the workpiece.

1.2 Problem Statement

The SCANTOOL Drilling Machine that was installed in Fabricating Workshop at Block B of FKP is still using conventional power screw workpiece clamp. The operator need to use a lot of energy to clamp or release the workpiece due to chips of workpiece is sticked at the power screw if no maintenance and cleaning conducted by operator. Meanwhile, if not enough the clamping forces applied to the workpiece, the workpiece may be slipped out of the clamped and hit the operator or someone stand close to the machine and causes injury. It also need a lot of time and energy to load and unload the workpiece to the power screw clamp. An initiative to properly design the automatic fixture for drilling machine is taken to solve this problem by adding some locating pins or surfaces followed the workpiece given by lecturer for subject Manufacturing Practise to replace the conventional power screw clamp of SCANTOOL Drilling Machine. Figure 1.2 shows the SCANTOOL Drilling Machine with Conventional Power Screw vise and Figure 1.3 shows the Drill Chuck that will hold the drill bit.



Figure 1.2 SCANTOOL Drilling Machine with Conventional Power Screw vise



Figure 1.3 shows the drill chuck of SCANTOOL Drilling Machine

1.3 Objectives

- i. To design an automatic fixture for SCANTOOL Drilling Machine.
- ii. To develop a soft prototype of the designed automatic fixture.

1.4 Scopes

- i. To design an automatic fixture that is to be focused only on locating and clamping rectangular shape workpieces.
- ii. Maximum dimension of rectangular workpieces:

Part A:

- a. Width: 45 mm
- b. Length: 30 mm
- c. Thickness: 8 mm

Part B:

- a. Width: 45 mm
 - b. Length: 35 mm
 - c. Thickness: 8 mm
- iii. The fixture will be designed based on the size of the drilling machine table which is 345 mm x 406 mm.
- iv. Materials of workpieces to be clamped are Steel, and Aluminium.
- v. To develop a soft prototype of the designed an automatic fixture using suitable Computer Aided Design and Manufacturing (CAD/CAM) software; SolidWorks software.

CHAPTER 2

LITERATURE REVIEW

This chapter presents the review on SCANTOOL Drilling Machine, workpiece holding devices for drilling operation, types of clamping system and the sensors that will be used to detect the presence of workpiece and force sensor for determine required clamping force, CAD software and a bit of locating pin and supporting that might be suitable for automatic fixture. All these information are obtained from journals, articles, and others source of information.

2.1 Definition of Fixture

Fixture is a production tool which is mainly used to locate, hold and support the workpiece firmly to the table (Kundu, 2014). Automated fixture design means a process in which without human interaction. An appropriate fixture is designed based on given workpiece (Retfalvi, 2013).

2.2 Introduction of SCANTOOL Drilling Machine.

SCANTOOL Group is the largest and most experienced producer of drill and grinding machines in Europe. They have intended for both home workshop and industrial use. Nielsen's family was start up SCANTOOL with its own production in 1980. Since that he capable to take over several company such as KEF-MOTOR, Trige Titan and even their biggest competitors HM Machinery A/S in Thisted, Denmark to be as SCANTOOL Group (Scantool.dk, 2016).

They have been produced three main drill machine which are Magnetic Drill machine, V-belt Drill machine with five model 16AE/16AT/16ATF/25A and Geared Head Drill machine with two model SB 30 and SB 40 (Scantool.dk,2016). Hence I will focus on V-Belt Drill machine model 25A which UTeM have been used in Blok B at FKP. The table dimension of this drill machine is 475 mm x 425 mm. The output power of this machine produce is 1 ½ Horsepower (HP) and consist of twelve speed adjustment with using Spindle type of Morse Taper (MT) 3 (Scantool.dk,2016). Morse Taper is type of spindle standard according the International

Organization for Standardization (ISO) 296. Figure 2.1 shows that the drawing of end of Morse Taper type spindle. Table 2.1 shows the dimensions of Morse Tapers type in millimetre (mm) (Wikipedia,2016).

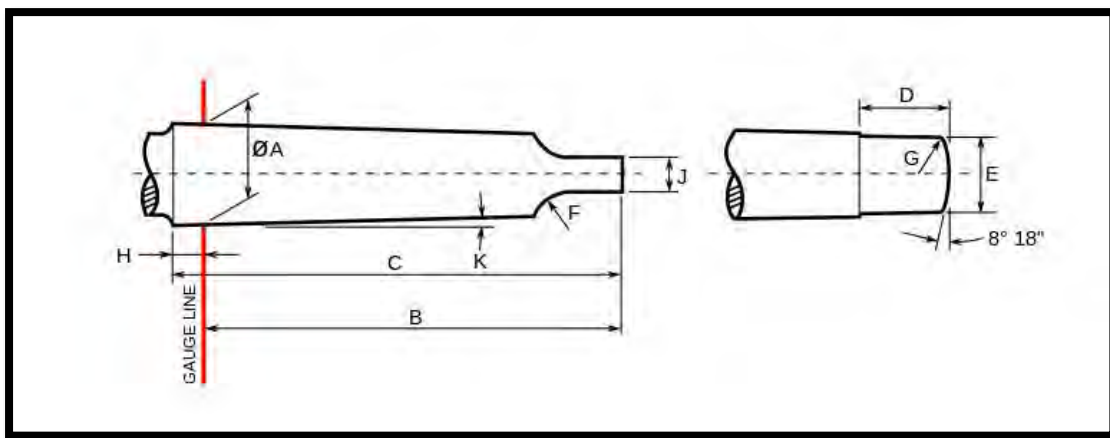


Figure 2.1 End of Morse Taper Spindle (Wikipedia.2016)

Table 2.1 Dimension of Morse Taper (mm)

Morse Taper number	Taper	A	B (max)	C (max)	D (max)	E (max)	F	G	H	J	K
0	1:19.212	9.045	56.5	59.5	10.5	6	4	1	3	3.9	1° 29' 26"
1	1:20.047	12.065	62	65.5	13	8.7	5	1.2	3.5	5.2	1° 25' 43"
2	1:20.020	17.780	75	80	16	13.5	6	1.6	5	6.3	1° 25' 50"
3	1:19.922	23.825	94	99	20	18.5	7	2	5	7.9	1° 26' 16"
4	1:19.254	31.267	117.5	124	24	24.5	8	2.5	6.5	11.9	1° 29' 15"
5	1:19.002	44.399	149.5	156	29	35.7	10	3	6.5	15.9	1° 30' 26"
6	1:19.180	63.348	210	218	40	51	13	4	8	19	1° 29' 36"
7	1:19.231	83.058	285.75	294.1	34.9	-	-	19.05	-	19	1° 29' 22"

2.3 Work holding device for Drilling Operation

A clamp is a fastening device used to hold or secure objects tightly together to prevent movement or separation through the application of inward pressure (Wikipedia,2016). This work holding device used in industry as to increasing the productivity and accuracy in mass production. Generally, workpiece is held by fixture and fixture is arranged in such a way that can easily loading and unloading the workpiece. To achieve this aim will concern on fastening of the fixture. Meanwhile, SCANTOOL Drill Machine at Block B in FKP used a drill press vise as clamping device which slotted base for easy installation and positioning. This is a type of conventional power screw clamp which used human power to drive the screw to tighten the vise. In this case to change the conventional Power Screw Clamp or vise to the automation fixture we will consider several requirements to achieve the goal.

- Type of clamping system
- Type of supporting and locating points
- Sensors to be used
- Drawing Software