

FABRICATION OF SILICONE RUBBER MOULD FOR VACUUM CASTING  
MACHINE FOR VARIOUS PART GEOMETRIES

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This report is to be present as criteria to fulfill a part of bestowal stipulation for  
Bachelor's Degree of Mechanical Engineering (Design & Innovation)

Faculty of Mechanical Engineering  
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

MARCH 2008

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work and in opinion of me / we\* this work was  
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## ACKNOWLEDGEMENT

First of all, I would like to state a massive gratitude to the God Al-Mighty Allah s.w.t and the true idol of ours; Rasulullah s.a.w. who gave me the will to follow this report until it finished, the courage to hold on to my thoughts, and the wisdom to think wisely whenever I need it the most. I also want to devote a special gratitude to my lovely parents whose always stand by my side and keep encouraging and cheering me until the end of whatever I am doing in my life. Special thanks also to my respected supervisor Mr. Hambali Bin Boejang for his ideas of making this project as something can be touched and observed physically, not just being expressed by imagination. His guidance, experiences and method of teaching and supervising was really useful for me in the future and I without doubt think that it will somehow affect my opinion in a very positive way, indeed. I also want to say thanks to all my friends especially sebel 1as for their helps and opinions that truly help me. Optimistically this report will meet the standard and worth to be observed by others because somehow, the attempt to finish this task was something I desire it to be significance my solely exertion.

## ABSTRACT

This report presents the study on fabrication methods of various part geometries using silicone rubber mould for vacuum casting machine. The techniques used in this project are Rapid Prototyping (RP) and Rapid Tooling (RT). This project starts with the literature study, followed by designing test models using the Computer Aided Design (CAD) software, generate the master patterns using RP machine and fabricate the Room Temperature Vulcanization (RTV) silicone rubber mould for vacuum casting machine. The particular strength of this project is in manufacturing methods used to fabricate RTV silicone rubber mould of two test models with different part of geometries for vacuum casting machine.

## ABSTRAK

Laporan ini bertujuan untuk mempelajari kaedah-kaedah fabrikasi untuk membentuk kepelbagaian komponen geometri dengan menggunakan acuan berasaskan getah silikon untuk mesin 'vacuum casting'. Teknik-teknik yang digunakan di dalam projek ini adalah Rapid Prototyping (RP) dan Rapid Tooling (RT). Projek ini bermula dengan kajian ilmiah, diikuti dengan merekabentuk dua model ujikaji dengan menggunakan Computer Aided Design (CAD), menghasilkan model asas menggunakan mesin RP dan fabrikasi acuan berasaskan getah silikon Room Temperature Vulcanization (RTV) untuk mesin 'vacuum casting'. Fokus utama projek ini adalah kaedah pembuatan yang digunakan untuk fabrikasi acuan berasaskan getah silikon RTV untuk dua model ujikaji yg berbeza komponen geometri untuk mesin 'vacuum casting'.

## TABLE OF CONTENTS

<b>CHAPTER</b>	<b>CONTENT</b>	<b>PAGE</b>
	<b>ACKNOWLEDGEMENT</b>	i
	<b>ABSTRACT</b>	ii
	<b>ABSTRAK</b>	iii
	<b>TABLE OF CONTENT</b>	iv
	<b>LIST OF TABLE</b>	viii
	<b>LIST OF FIGURE</b>	ix
	<b>GLOSSARY</b>	xiv
 <b>CHAPTER I</b>	 <b>INTRODUCTION TO THE PROJECT</b>	 1
	1.1 Project Background	1
	1.2 Objective of Project	2
	1.3 Scopes of Project	2
	1.4 Project Flow Chart	3
	1.5 Outline	4
	1.6 Problem Statement	4
	1.7 Problem Solving	4
 <b>CHAPTER II</b>	 <b>LITERATURE SEARCH</b>	 5
	2.1 Introduction of Literature Search	5
	2.2 Fused Deposition Modeling (FDM)	7
	2.2.1 Overview of FDM	7
	2.2.2 Type of FDM machine	8



<b>CHAPTER</b>	<b>CONTENT</b>	<b>PAGE</b>
	2.2.3 Commercial Application	12
	2.2.4 Advantages of FDM	12
	2.2.5 Disadvantages of FDM	13
2.3	Vacuum Casting	13
	2.3.1 Overview of Vacuum Casting	13
	2.4.2 Advantages of Vacuum Casting	14
	2.4.3 Disadvantages of Vacuum Casting	14
2.4	Computer Aided Design (CAD)	15
	2.4.1 Introduction of CAD	15
	2.4.2 Benefits of CAD	15
	2.4.3 CAD system for RP	16
<b>CHAPTER III</b>	<b>RAPID PROTOTYPING</b>	<b>17</b>
3.1	An Introduction to Rapid Prototyping	17
3.2	Type of Rapid Prototyping Machine	18
	3.2.1 3D System's Stereolithography Apparatus (SLA)	18
	3.2.2 Fused Deposition Modeling (FDM)	19
	3.2.3 Z Corporation's Three-Dimensional Printing (3DP)	20
3.3	A Quick Comparison of RP Techniques	21
3.4	Principle of the Rapid Prototyping Process	22
	3.4.1 CAD Model	22
	3.4.2 CAD Design System	23
	3.4.3 Pre-processing (STL file format)	23
	3.4.4 Slicing the File	24
	3.4.5 Fabrication (machine build)	24
	3.4.6 Post-processing	25
3.5	Advantages of Rapid Prototyping	25

<b>CHAPTER</b>	<b>CONTENT</b>	<b>PAGE</b>
	3.6 Disadvantages of Rapid Prototyping	25
	3.7 Application	26
<b>CHAPTER IV</b>	<b>RAPID TOOLING</b>	28
	4.1 An Introduction of Rapid Tooling	28
	4.2 Method	29
	4.3 Cast resin tooling	29
	4.4 RTV Silicone Rubber Mould	30
	4.5 Advantages of Rapid Tooling	31
	4.6 Disadvantages of Rapid Tooling	32
<b>CHAPTER V</b>	<b>METHODOLOGY</b>	33
	5.1 Introduction	33
	5.2 Literature Search	35
	5.3 Design Test Model	35
	5.3.1 Design for the Normal Model	36
	5.3.2 Design for the Complicated Model	37
	5.4 CAD Data Verification	39
	5.5 Producing the Master Patterns	40
	5.5.1 Prototype Pre-processing	40
	5.5.2 Magics RP Processing	41
	5.5.3 Insight Processing	44
	5.5.4 Prototype Processing	47
	5.6 Fabricating the RTV Silicone Rubber Mould	52
<b>CHAPTER VI</b>	<b>DISCUSSION</b>	59
	6.1 Analysis of the Project	59
	6.2 STL File Problems	60

<b>CHAPTER</b>	<b>CONTENT</b>	<b>PAGE</b>
	6.3 Comparison between CAD Data and Existing Prototype from RP	61
	6.4 The Discussion on Fabrication of Silicone Rubber Mould	63
	6.5 Calculating the Required Quantity of Silicone	64
<b>CHAPTER VII</b>	<b>CONCLUSION</b>	66
	<b>REFERENCES</b>	67
	<b>APPENDICES</b>	70

**LIST OF TABLE**

<b>NO.</b>	<b>TITLE</b>	<b>PAGE</b>
2.1	Specification of FDM machine [2]	11
3.1	A quick comparison of RP techniques [13]	21
6.1	The dimension taken from the CAD data	61
6.2	The dimension of the existing prototype from RP	61
6.3	The difference between CAD data and RP	62

**LIST OF FIGURE**

<b>NO.</b>	<b>TITLE</b>	<b>PAGE</b>
1.1	Flow chart for PSM1	3
1.2	Outline of the project	4
2.1	FDM Prodigy Plus [2]	8
2.2	FDM Vantage [2]	9
2.3	FDM Titan [2]	9
2.4	FDM Maxum [2]	10
3.1	Schematic of SLA process [3]	18
3.2	FDM machine process [12]	19
3.3	Three Dimensional Printing (3DP) process [12]	20
3.4	Schematic diagram of RP process chain [13]	22
3.5	Schematic diagram of triangle tessellation of STL file [13]	24

<b>NO.</b>	<b>TITLE</b>	<b>PAGE</b>
3.6	Stair-stepping [13]	26
3.7	An application of an RP model for Surgical Planning in Orthopaedic Surgery [14]	27
3.8	An application of an RP model for Lincoln new wheel [15]	27
4.1	Example of RTV Silicone Rubber Mould [19]	30
4.2	Schematic of RTV Silicone Rubber Mould Process [20]	31
5.1	Method flow	34
5.2	Design test model for the normal part	36
5.3	Design test model for the complicated part	37
5.4	The gear knob body	38
5.5	The insert part	38
5.6	The test part	39
5.7	Transferring CAD data to STL file	40
5.8	The sequence process using Magics RP software	41

<b>NO.</b>	<b>TITLE</b>	<b>PAGE</b>
5.9	The properties of the part	42
5.10	All parts are nested into the same platform	43
5.11	All parts are merged	43
5.12	All parts are become same in colour	44
5.13	Sequence process of Insight Software	44
5.14	Opening the merge part in the Insight software	44
5.15	Checking the plane	45
5.16	Model processing	45
5.17	Clicking the <i>Build</i> button	46
5.18	Estimate builds time	46
5.19	The operation in Prodigy Plus	47
5.20	The display on Prodigy Plus	47
5.21	Removing support from parts	48
5.22	Part immerse in the WaterWorks Solution	49
5.23	Stratasys WaterWorks Solution	49

<b>NO.</b>	<b>TITLE</b>	<b>PAGE</b>
5.24	Washing the removed part	50
5.25	Sanding the part's surface	50
5.26	Painting the part using spray paint and drying the paint inside the oven	51
5.27	The painted parts	51
5.28	Sequence of fabricating RTV silicone rubber mould	52
5.29	Master models are embedded in modeling clay	52
5.30	Making wavelike shapes on the modeling clay	53
5.31	Taping the plywood with brown tape	53
5.32	The moulding frame glued with the glue gun	54
5.33	Weighing the components	54
5.34	Mixing the silicone	55
5.35	Primary de-gassing of the silicone	55
5.36	Filling in the silicone	56
5.37	Secondary de-gassing of the silicone	56



<b>NO.</b>	<b>TITLE</b>	<b>PAGE</b>
5.38	Hardening the silicone mould in the oven	57
5.39	Silicone gate, first half of the mould	57
5.40	Making the second half of the mould	58
5.41	The silicone mould is ready for the first cast	58
6.1	General flow of the project	59
6.2	Dimension from CATIA	61
6.3	The material not fills completely	62
6.4	Failure on the thread part	63
6.5	Measuring the moulding frame	64

## GLOSSARY

<b>SYMBOL</b>	<b>DEFINITION</b>
3DP	Three Dimensional Printing
ABS	Acrylonitrile Butadiene Styrene
BASS	Break Away Support System
CAD	Computer Aided Design
FDM	Fused Deposition Modeling
FKM	Fakulti Kejuruteraan Mekanikal
PPSF	Polyphenylsulfone
RP	Rapid Prototyping
RT	Rapid Tooling
RTV	Room Temperature Vulcanization
SLA	Stereolithography Apparatus
STL	Standard Triangulation Language
UTeM	Universiti Teknikal Malaysia Melaka
UV	Ultraviolet

## CHAPTER I

### INTRODUCTION TO THE PROJECT

#### 1.1 Project Background

'Projek Sarjana Muda' (PSM) is a must to the final year students in UTeM in order to complete their degree in the engineering course. PSM allows the students to do research and project based on the subjects learned in the classes, the experience they get during the industrial training and any cases related with the project.

This project focuses on how to fabricate the silicon rubber mould using rapid prototyping (RP) and rapid tooling (RT) techniques. In this project, two parts will be tested where the first part will be a normal part of geometry while the other part is a complicated part of geometry. The project will start from literature search, followed by Computer Aided Design (CAD) software to design test models, rapid prototyping by creating the master parts using Fused Deposition Modeling (FDM) machine and then rapid tooling to produce the mould using vacuum casting machine.

Since the vacuum casting machine is still new in the rapid prototyping laboratory, the project was chosen to expose the application of this machine to all the FKM's student here. This project also describes the advantages and disadvantages of this vacuum casting machine.

## 1.2 Objective of Project

The objective of this project is to carry out the study on fabrication methods of various part geometries using silicone rubber mould for vacuum casting machine.

## 1.3 Scopes of Project

The scopes of project are as follow:

- i. To study about Rapid Tooling and Rapid Prototyping
- ii. To design master parts that will be use to fabricate silicone rubber mould for vacuum casting machine
- iii. To study the industries that using vacuum casting
- iv. To study the application of vacuum casting
- v. To study the advantages and disadvantages of vacuum casting
- vi. To do test models for normal and complicated designs
- vii. To understand how to use the Fused Deposition Modeling Machine (FDM) and Prodigy Plus system
- viii. To produce the detailed drawings
- ix. To fabricate the master parts
- x. To fabricate the silicone rubber mould for vacuum casting machine using the master parts

## 1.4 Project Flow Chart

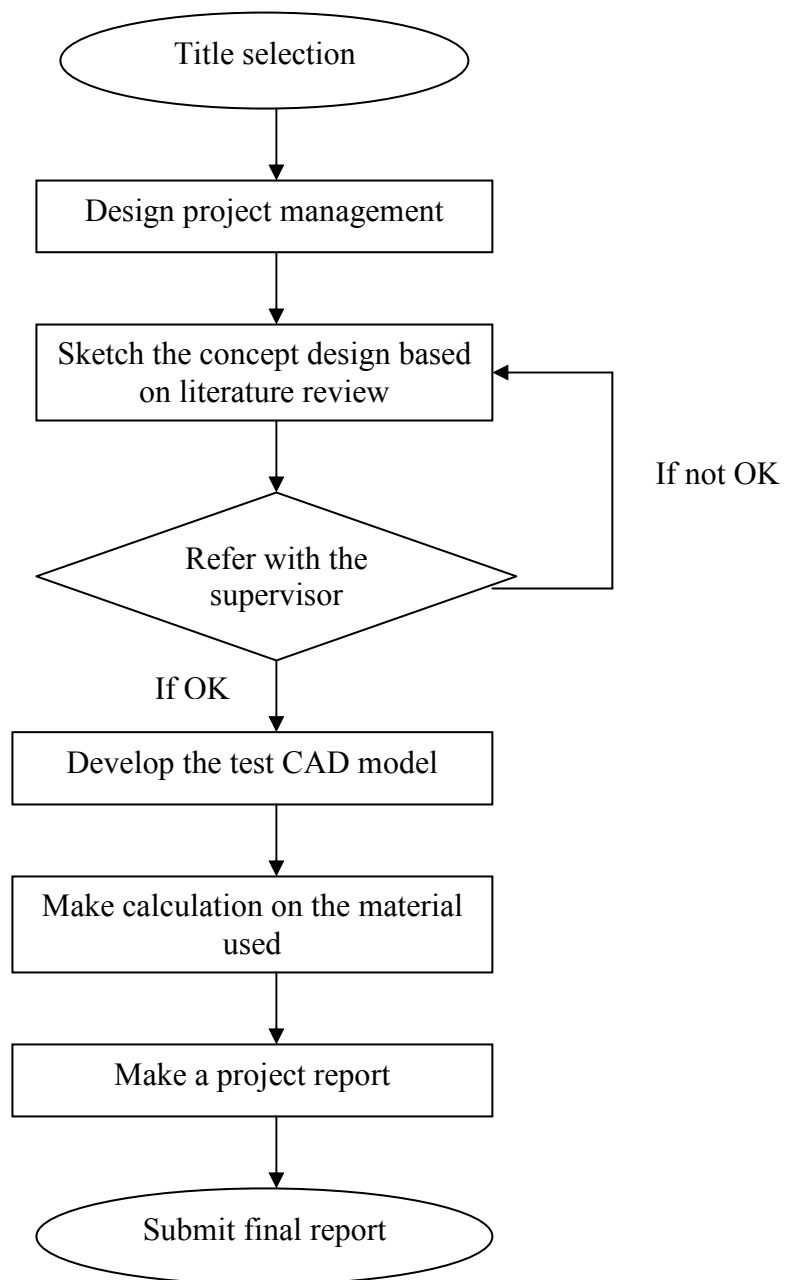


Figure 1.1: Flow chart for PSM1

## 1.5 Outline

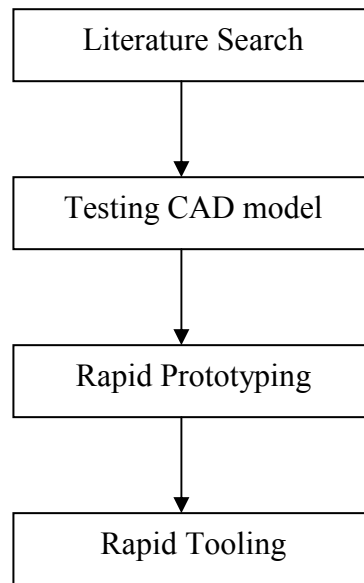


Figure 1.2: Outline of the project

## 1.6 Problem Statement

Vacuum casting machine is still new in the rapid prototyping laboratory and most of the FKM's students are not familiar with this machine. Students also do not know how the fabrication methods and the capability of this machine in producing multiple prototypes with shorter lead time by using silicone rubber mould. Furthermore, the using of rapid prototyping machine among FKM's students is quite rare.

## 1.7 Problem Solving

To see the potential of this rapid tooling machine, two test models will be tested in this project. One is for the normal part of geometry and another one is a complicated part of geometry. The master patterns of both parts will be fabricated by rapid prototyping process and after that the mould will be generated with vacuum casting process.

## CHAPTER II

### LITERATURE SEARCH

#### 2.1 Introduction of Literature Search

Literature search is the most important step to gain as much information as possible with regard to the discussed topics. It can be done by searching the information from the internets, journals, books and other sources such as attending any seminars or courses offered outside or inside the university.

According to this project title, the literature search will focus more on how to fabricate a silicone rubber mould for vacuum casting machine for any parts with normal and complicated designs. The parts have been chosen are a model of an ashtray and a gear knob.

The first step to do is making a master pattern of the each part by using the RP technique. There are many types of RP machines such as Stereolithography Apparatus (SLA), Fused Deposition Modeling (FDM) and Three-dimensional Printing (3DP). The RP machine used in rapid prototyping lab here is FDM Prodigy Plus made by Stratysis from United State of America (USA). In order to make the master pattern, creation of a Computer Aided Design (CAD) model should be done first using any CAD software.

After completing the master pattern, the process will turn to the rapid tooling where the state method for this project is vacuum casting. From this method, the master pattern will be used to make a silicone rubber mould. The mould will be made using the Room Temperature Vulcanization (RTV) silicone rubber molding process.

This chapter includes the overview of FDM, vacuum casting machine and Computer Aided Design (CAD) while rapid prototyping and rapid tooling will be discussed in the next chapter.