DESIGN AND DEVELOPEMENT OF SEMI AUTOMATIC CANTING TOOL (BODY DESIGN AND MECHANISM)

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Thesis submitted in fulfillment of the requirements
for the award of the degree of
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SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Engineering Manufacturing or Bachelor of Manufactuirng Engineering

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Date **:** 12 JUNE 2012

STUDENT'S DECLARATION

I declare that this thesis entitled Design and Developement of Semi Automatic Canting Tool (Body Design and Mechanism) is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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Dedicated to my beloved family

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ABSTRACT

This thesis deals with the design and developement of new tool for making batik. The process of making batik are of two method, batik canting (hand drawn batik) and batik "chop" (batik stamp). Conventionally, in batik canting process, the molten wax are drawn onto fabric using a wooden, copper sprout tool which known as the "canting" or "tjanting". Since Malaysia government are serious in promoting the industry of batik internationally, and there is need to strengthen the Small and Medium Industry (SME) of Malaysia, this project then is carried on. The main purpose of the project are to design and develop a new semi automatic canting tool. The term semi automatic is subjected to the combination of several processes in batik making process into a single tool. The idea is to have tool that enable the electrical heating and the drawing process done simultaneously. This will eliminate the process of conventional heating process using stove and the process of transferring the molten wax into the canting tool before the drawing process started. This study started by collecting all the information related to batik making process such as the canting tool, the steps on producing batik, and also the raw material related to batik making process. The information are collected through visit and also interview session. After all informations are sufficient enough, then the initial idea and design are developed. Throughout the project, SolidWork 2012 are used to do design and also simulation analysis on the tool. Prototyping of the tool are for functionality testing which evaluate the ergonomic design and drawing ability of the tool. The results are then analyze to see if the tool are well function or not. The findings are then summarized with some recommendations suggested to improve the tool.

ABSTRAK

Tesis ini berkaitan dengan reka bentuk dan pembangunan alat baru untuk membuat batik. Proses membuat batik terbahagi kepada dua kaedah, batik canting dan batik "cop" (batik setem). Dalam proses membuat batik canting, lilin cair dilukis ke atas kain menggunakan alat pelukis kayu yang mempunyai muncung tembaga yang dikenali sebagai pencanting. Memandangkan kerajaan Malaysia serius dalam mempromosikan industri batik di peringkat antarabangsa, dan kepentingan untuk mengukuhkan Industri Kecil dan Sederhana (PKS) di Malaysia, maka projek ini dijalankan. Tujuan utama projek ini adalah untuk merekabentuk dan membangunkan alat baru separa automatik untuk melukis batik. Istilah separa automatik merujuk kepada gabungan beberapa proses dalam proses membuat batik ke dalam satu alat tunggal. Idea projek ini adalah untuk menghasilkan alat yang membolehkan pemanasan elektrik dan proses lukisan dilakukan secara serentak. Ini akan menghapuskan proses pemanas konvensional yang menggunakan dapur dan proses memindahkan lilin cair ke dalam alat pencanting sebelum proses lukisan bermula. Kajian ini bermula dengan mengumpul semua maklumat yang berkaitan tulis hingga proses membuat seperti alat canting, langkah-langkah untuk menghasilkan batik, dan juga bahan mentah yang berkaitan dengan proses membuat batik. Maklumat – maklumat yang diperlukan diperolehi melalui lawatan dan juga sesi temuduga dengan pembuat batik. Setelah semua maklumat yang diperlukan mencukupi, maka idea awal dan reka bentuk dibangunkan. Sepanjang projek ini, SolidWork 2012 digunakan untuk melakukan reka bentuk dan juga analisis simulasi pada alat pencanting. Prototaip alat dilakukan untuk menguji keberkesanan alat iaitu dengan menilai reka bentuk ergonomik dan keupayaan lukisan alat. Keputusan yang diperolehi kemudian dianalisis untuk melihat sama ada alat canting berfungsi atau tidak. Hasil kajian daripada projek ini kemudiannya diringkaskan dengan memberi beberapa cadangan untuk penambahbaikan alat canting.

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LIST OF ABBREVIATION

SME	Small Medium Industry
mm	Milimeter
N	Newton
ABS	Acrylonitrile butadiene styrene
Hz	Hertz
W	Watt

CHAPTER 1

INTRODUCTION

1.1 PREFACE

This chapter wills discuss the background and rationale for the study. This chapter emphasis on research background which is significantly related to the problem statement, research scope, research objective, and also significant of research.

1.2 BACKGROUND OF PROJECT

The exact origin of batik making process is lost to history. Recent research show that early proof of batik have been found from Far East up through Central Asia, Middle East, and also Africa. The origin of batik may be uncertain, but if we look at the word "Batik" is of Indonesian word which in Indonesia, the process of making batik was developed into one of the great art form. (The Art of Batik)

As in Malaysia, the origin of Batik also is not easy to trace. However, the states of Kelantan, Terengganu, and Pahang, are places where Batik are produce most in Malaysia. Back in the 18^{th} century, it is believe that batik in Malaysia have Chinese, Indian, and also Javanese influence, and the Sultans were mainly responsible in expanding and promoting the Batik industry in this two states. (World Batik Council)

Traditional way of Batik making mainly can be divided into two types: Batik canting and batik "chop". These two types of making batik are of traditional, ancient tools and still be used widely in the modern times. The batik canting is labour intensive which requires high skills and creativity of Batik artisan to produce high quality and inspiring pattern of Batik. The process can take up to weeks depending on the complexity of pattern to be drawn, which is why canting batik is highly valued. (Fine Batik). Batik "chop" or block printed batik is done by metal block made by several strips of metal which are welded together to produce particular pattern. (World Batik Council).

In Malaysia, batik industries today are growing rapidly and most of the industries are of East Peninsula of Malaysia, which is Kelantan, Terengganu, and Pahang. Malaysia government is doing very good effort in order to keep the industries flourish. The Handicraft Board is taking steps by organizing Workshops and Expos for the batik artisan to promote and also improve the quality of batik produced. (Malaysia: Thriving Batik Industry, 2007)

In conjunction with "Piala Seri Endon", which is named after the late Tun Endon Mahmood, wife of former Malaysia Prime Minister Tun Ahmad Badawi, batik are known internationally. This event aim to discover and provide for support, recognition, and encouragement of Malaysia's batik – making talent.

Malaysia government now promoting Malaysia batik as national dress to every level of general population in line with the "1 Malaysia" on – going program. Government even makes it compulsory for government officials to wear batik in order to show support to Malaysia batik industries. (Surat Pekeliling Perkhidmatan Bil. 1, 2008)

As Malaysia government is serious in promoting the batik industries, many research have been done from process optimization, material improvement, to computer simulation and development of new tools in order to modernize and improve the batik industries.

1.3 RESEARCH PROLBLEM

Canting or “tjanting” is a traditional tools for making Batik canting, or hand – painted batik. It is a tool of small, copper spouted cup used to draw hot wax across the fabric. This traditional way of making batik had been used long time ago, and even nowadays in modern times, this traditional, conventional canting method still being applied in batik industry.

Small and Medium Enterprise (SMEs) are increasingly a force for national economic growth and Malaysian Government have been aggressively promoting for the development of these Small and Medium Enterprise. Even SME business incubation centres, and SME Bank has been established to meet needs of the SMEs.

Since Batik industries are of Small and Medium Enterprise, and government are to introduce batik internationally, there is need for improving the tools for making batik. Design and development of new semi – auto canting tools seems to be very relevant to the industry of Malaysia Batik.

Traditionally, the process of heating or melting the material was done using the stove and then the melting wax transferred into the canting tool before drawing onto the fabric. One problem is that the temperature of the stove could not be controlled precisely increasing the possibility of the melting wax to be overheated.

Another thing is that sometime the melting wax can stuck in the vessel of the canting tool causing an influent flow of the wax during drawing process. This is due to reduction in temperature at the canting tool which result the wax to be

Considering the development of semi – auto electrical canting, a lot of consideration also need to be taken into account. The overall weight, the mechanism, and the design concept should never trouble the batik artisan.

1.4 PROJECT SCOPE

The design and development of new semi automatic canting tools focusing only one of the two types of batik which is Batik canting since only this type of batik are using canting tools. This project will be carried on by two persons. One will concentrate on the design and concept and the other will be more on electrical aspect and material. As the title of the research is Design and Development of Semi Automatic Canting Tools: Design Concept and Mechanism, the research is more to ergonomic design of the new tools.

Since batik are popular in states of peninsula Malaysia, mostly in Terengganu and Kelantan, but the research is mainly in Pahang states where the batik industry are also developing.

1.5 OBJECTIVES

The specific objectives of this research are as follows:

1. To develop a new semi – automatic canting tools.
2. To design canting tool that using plastic material.
3. To design an ergonomic design of canting tools.
4. To apply Product Development Processes in designing new product.

1.6 SIGNIFICANT OF PROJECT

Based on the problem encountered in research problem section earlier, it is essential to developed new tools for batik canting, which is more convenient, efficient, ergonomic, yet maintaining the low cost as part of improving Malaysian batik industries.

This new development can be very useful not only to batik artisan but everyone who want to learn doing batik. This new tools enable users to draw and melting the wax simultaneously and continuously on just one tool. This on the other hand, brings the industry of Malaysia batik to another level in term of technology.

1.7 DEFINITION OF TERMS

Batik	: A method (originally used in Java) of producing coloured designs on textiles by dyeing them, after having applied wax on region to be left undyed.
Canting	: A wooden tool with copper bowl and tip used to apply wax onto textile.
Wax	: A material used in batik canting process.
Semi – auto	: Partially automatic (no manual control) and partially manual.

1.8 SUMMARY

Batik has become a part of Malaysian living of tradition for many years. Batik is rich of motifs which have aesthetic meaning behind it which makes the batik highly valued. Today, most of batik makers are still maintaining the traditional way of making batik using traditional tools.

Although batik now has been promoted aggressively both locally and internationally, there are still no much efforts on developing, or improving the batik making process. Mostly they are focusing on improving design and motif of the batik itself.

By introducing this new semi – auto batik canting tools design hopefully can help those who have involved in batik industry.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter will discuss in detail about literature used in order to run this research. The main reason for literature review is to identify concept and also definition which is related to the research title. It must be remembered that researcher need to understand the concept and definition so that the key to the research problem can be easily discover and to achieve the objectives of this research.

The literature review on definition of the research title will come from several of secondary resources such as books, online journal, and related websites.

2.2 MALAYSIA BATIK

The industry of batik in Malaysia has already been existed in the year of 1921 (Wan Hashim, 1996). Throughout the years of its existence, the industry had been contributes to the Malaysian economic growth by first, creating jobs and business opportunities in rural areas (Wan Hashim, 1996). And second, by producing products that able to attract tourists and hence support the performance of Malaysian tourism industry (Leigh, 2000).

Of the high valued heritages among Malaysian culture, Malaysian batik is the one. Malaysian Batik mostly produced in the east coast of Malaysia such as Kelantan, Terengganu and Pahang. As to avoid the interpretation of human and animal images as idolatry, in accordance with local Islamic doctrine, so the motifs used for Malaysian batik mainly are flower and leaves (Journal of Arts, Science & Commerce). As for today, batik clothes are not only worn by Malays, but it has become the national identity and even the government made it compulsory for government employee to wear Batik on Thursday.

2.2.1 Batik Processes

It will perhaps be a good plan to give a description of the necessary tools and their management, wax, and various other essential requirements before going into the details of the actual batik process. The tools used actually are the native instrument called the "tjanting," the brush, and the optional wax pencil. Of these three things, the tjanting and the brush are most generally used, the wax pencil being a some-what clumsy affair and hard to handle.

The "tjanting" used in America is a modification of the Javanese instrument, it is a little cup-shaped tool with a handle set at right-angles to the base on one side and on the other is a fine spout arrangement. Through this spout the hot wax is drawn by capillary attraction when the point is brought in contact with the material. In the best type of "tjanting" the spout is tapered toward the point; this shaping is in order that the volume of wax, small though it is, will hold the heat longer than if the entire length of the tube were as minute as the hole through which it is finally drawn. (Pieter Mijer)

In batiking with the tjanting the wax is scooped out of the pot in which it is being kept hot and the instrument is wiped off carefully before it is brought near the fabric. It does not do to take a chance on having a drop of wax fall on the work as it is next to impossible to remove it entirely. Some people hold their tjanting directly over a flame to re-heat cooling wax, but it is a very unwise practice as there is a grave danger of hurting the spout and a likelihood of the wax becoming charred. If the wax does get too cold to work with, or the spout gets stopped up with chilled wax, hold the bowl of the tjanting in the hot wax in the melting pot and it will be found that the trouble is remedied instantly. If you have been unlucky enough to get grit or some other clogging sub-stance in the spout, the insertion of a fine hair wire will usually clear it; this is almost a major operation though and should be performed most carefully as it is a delicate instrument you are handling and it costs money to repair it even if you are in the neighbourhood of some one who is able to re-solder it. (Oldandsold.com)

The spout openings come in various sizes and with the finest almost hair-lines can be produced. The wax when ready to flow forms an infinitesimal globule which will run freely when just touched to the material and skimmed as lightly as possible over the surface. A heavy hand will drop the point so that it touches the fabric; the moment it does this the hole is automatically sealed and the wax cannot flow.

For waxing, bees-wax with a mixture of white paraffin wax is used by most batikers, the pro-portion varying according to the brittleness de-sired. This of course is best worked out to suit the individual batiker's requirements and after a little experimenting one soon learns to get a satisfactory mixture. One part paraffin to five parts of bees-wax will give the consistency of medium to produce the crackle surface so popular with many artists in America. Pure bees-wax cracks very little and will stand the highest temperature when in the dye-bath, and inversely the larger proportion of paraffin used the more the medium will crackle and the cooler the dye-bath must be used if .

To complete the outfit one also needs a small agate pan in which to melt the wax, one about four inches deep will answer best and some sort of heating apparatus. A kerosene stove should not be used unless one is willing to blacken one's utensils and most probably one's self. Gas or an alcohol lamp with an adjustable burner are more satisfactory than an electric attachment as the ability to regulate the heat makes for great comfort when one wants to keep the wax at an even temperature. Of course if necessity demands it, any heat producer available can be used; an electric flat-iron turned upside-down can even be pressed into service although the inconvenience of having to keep one eye on the melting pot is great, when one wishes to give all one's attention to the design; but if it is not watched the result may be a most uncomfortable "smoking-out." Work in a warm room or near the stove and it will be found that the wax when in the tjanting will chill less quickly and will consequently be more manageable. These little hints may seem of small importance, but it is as well to take advantage of everything that will make the actual tool handling easier. There are likely to be troubles and misadventures enough with the rest of the process.

A great many people seem to be under the impression that the ordinary household dyes that are on the market are not good enough to use in batik work. There is a strong prejudice against Diamond dyes, but there is no reason for it, as these dyes when used according to directions, produce admirable results and are most practical for the beginner who is not in need of large quantities. For any one going extensively into dyeing, it is rather an expensive way of working and it is better to buy the dyes in bulk direct from the manufacturer. Rubber gloves will give some protection to the hands when handling materials in the dye-bath, but if, in spite of care, the hands or clothing become stained, soda or ammonia in the washing water will prove helpful. Lava soap is very good for removing stains from the skin.

Batik can be done on all kinds of woven material, such as cotton, silk, velvet, wool, mixed goods or leather. It is rather difficult to get satisfactory results on cotton owing to the fact that cotton dyes have to be boiled in order to attain any degree of brilliancy, and of course boiling is not practical when one is dealing with waxed material. Japanese habutai silk is perhaps the easiest fabric to use and best for beginners' experiments, as the wax penetrates easily And it takes colour well. This applies to chiffon and similar sheer materials, but of course their delicacy makes them harder to handle. Fibre silks, being composed of both animal and vegetable matter, should be dyed in "mixed goods dyes," or should be first dipped in a bath of cotton dye, and then immersed in a dye for silk, of a similar shade. Very heavy silks and velvets are magnificent when batiked, but they should be sent to the professional finishers to be treated when the piece is completed as it takes a great deal of effort and considerable skill on the part of the amateur to finish a large heavy silk panel or to raise the flattened pile of velvet. Taffeta silk and very heavy satin are not good fabrics for the batik process, owing to the loading used in their manufacture.

In short, the process of making batik starts with preparation of clothes, dyes, waxes, chemical (natrium silicate, sodium carbonate), and the equipment related to batik making which are canting tool and stove. Then the process continues with applying the wax onto the fabric by using the canting tool. Then, the dying process takes over before boiled in water to remove the wax. The clothes then are being dried (National Geographic Traveller). The traditional process of making batik is shown in Figure 2.1.

Figure 2.1: Traditional Process of Making Batik

2.2.2 Canting tool

Tjantings are tools used in creating batik patterns. (Batik is a wax resist decorative technique used on fabric.) They hold and dispense hot wax in such a way that the artist can control the pattern laid down by the wax with a great deal of precision.

Tjanting tools probably originated in southeastern Asia and are still used in the creation of traditional batik fabrics, notably in Indonesia. They are also used by other batik artists and artisans world-wide, from the traditional to the contemporary.

Basically, there are two type of batik which used different type of tool. One is batik canting which use the canting (tjanting) tools and another one using “cop”. Malaysian batik is known to be famous with the batik canting. The canting tool is very simple. It is a small tool, wooden handled, with a small thin wall spouted copper container which is connected to the wooden handled. (Figure 2.2)

Figure 2.2: Traditional canting tools

In the modern days, there are some research regarding the improvement of batik industry, from the design of the batik itself until the improvement and development of new tool. Figure 2.3 and figure 2.4 shows various type of canting tools.

Figure 2.3: Various type of Canting tools

Figure 2.4: Electrical canting tool

Figure 2.4 show the electrical canting tool available in the market. These tools are made from a high quality German electrical soldering iron, of which the point of the soldering iron is replaced by a tjanting batik cup. The wax melts in the batik cup, takes approx. 3 min., and allows a consistent and continuous line. The moment the spout touches the working surface the wax is flowing, this prevents the wax from dropping to undesirable places. After use you should pull the power plug. These tools are 20 watts and do not require temperature regulators.

2.3 NEW PRODUCT DESIGN (NPD)

Basically, in engineering, or even in business, new product development (NPD) is the term used to picture the complete process of bringing a new product to market. There are two parallel paths involved in the NPD process which is involves the idea generation, product design and detail engineering and the other mostly involves market research and marketing analysis. New product development is the first stage in generating and commercializing new products. Depending on the company, industry, and sometimes even the product, the stages may be in a different order, or even parallel instead of sequential. The major stages in new product development are Idea development, Idea screening, Concept development and testing, Marketing strategy development, Business analysis, Product development, Test marketing, and Commercialization. (Richard Velazquez, 2011)

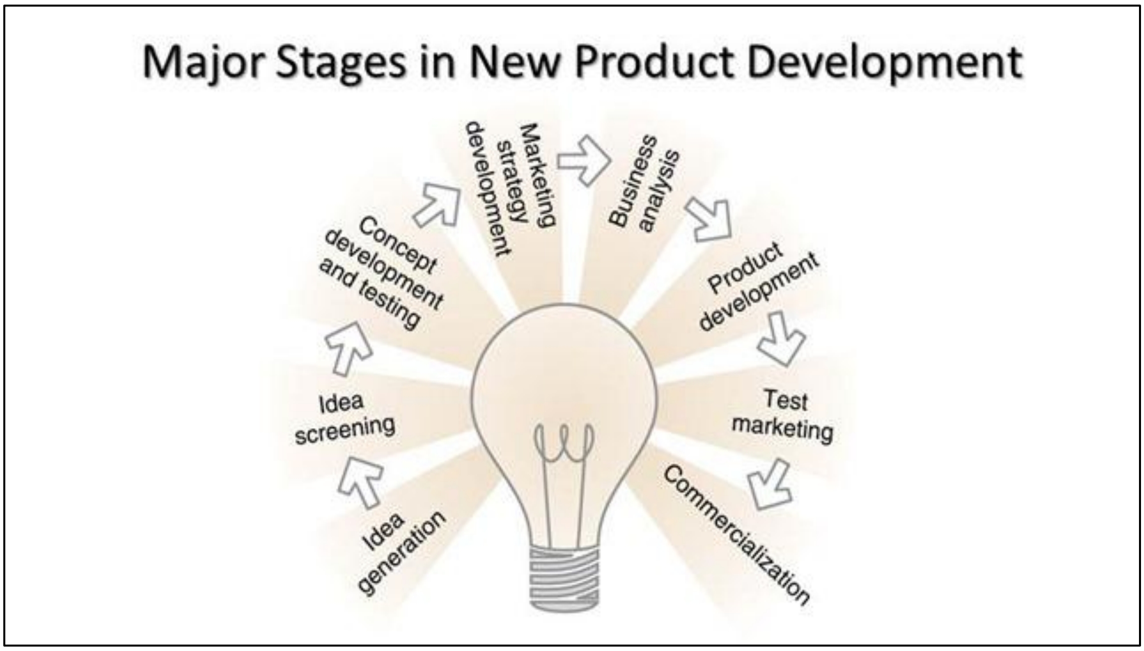


Figure 2.5: Steps in the product design process

In designing a new product also need to have a design program approach. The approach is important in order to have a successful design of a product.

Example of a product design program approach follows:

1. Define the function of the product with performance requirements.
2. Identify space and load limitations of the product if they exist.
3. Define all of the environmental stresses that the product will be exposed to in its intended function.
4. Select several materials that appear to meet the required environmental requirements and strength behavior.
5. Do several trial designs.
6. Evaluate the trial design on cost effectiveness and performance.
7. Determine the appropriate fabricating process.
8. Based on preliminary evaluation, select the best choices of design and do detailed design of the product.
9. Based on detailed design, select the probable final product design, material, and process.
10. Make a prototype products and test products to determine if they meet the required function.
11. Redesign the product if necessary based on the prototype testing.
12. Retest.
13. Finalize design.

2.3.1 Fallo Approach

Conditions that **are** important in making plastic products the success it has worldwide are summarized using Fallow. All designs, processes, and materials fit into this overall FALLO (Follow ALL Opportunities) approach flow chart that produces products meeting required performance and cost requirements. Designers and processors, needing to produce qualified products at the lowest cost have used the basic concept of the FALLO approach. This approach makes one aware that many steps are involved to be successful, all of which must be coordinated and interrelated. It starts with the design that involves specific the plastic and specifying the manufacturing process. The specific process (injection, extrusion, blow molding, thermoforming, and ***so*** forth) is an important part of the overall scheme.

2.4 PLASTIC MATERIAL

Plastics are essential materials of modern day life. Technological advances improving our quality of life through telecommunications, computers, transport, health, sanitation, recreation, education, housing, shopping, banking, clothing, food, water and energy – to name but a few - have been made possible by the unique forming, electrical, thermal, tensile and insulation properties of thermoset and thermoplastic materials.

2.4.1 Acrylonitrile butadiene styrene (ABS)

ABS is derived from acrylonitrile, butadiene, and styrene and carbon. Acrylonitrile is a synthetic monomer produced from propylene and ammonia; butadiene is a petroleum hydrocarbon obtained from the C4 fraction of steam cracking; styrene monomer is made by dehydrogenation of ethyl benzene — a hydrocarbon obtained in the reaction of ethylene and benzene. The advantage of ABS is that this material combines the strength and rigidity of the acrylonitrile and styrene polymers with the toughness of the polybutadiene rubber. The most important mechanical properties of ABS are impact resistance and toughness.

A variety of modifications can be made to improve impact resistance, toughness, and heat resistance. Two major categories could be ABS for extrusion and ABS for injection moulding, then high and medium impact resistance. Generally ABS would have useful characteristics within a temperature range from 10 to 80 °C (50 to 176 °F).Even though ABS plastics are used largely for mechanical purposes, they also have electrical properties that are fairly constant over a wide range of frequencies. These properties are little affected by temperature and atmospheric humidity in the acceptable operating range of temperatures. Figure 2.5 show the properties of material Acrylonitrile butadiene styrene (ABS).

PHYSICAL	ASTM / Method	Units	Polifil® RP-ABS
Reinforcement Content	TPG WI	%	
Specific Gravity	D 792	-	1.05
Melt Flow (230/3.8)	D 1238	g/10 min	2-10*
Water Absorption, 24 Hours	D 570	%	0.2
Mold Shrinkage – 1/8" Specimen	D 955	in/in	0.005
MECHANICAL @ 73°F			
Tensile Strength	D 638	psi	6400
Elongation @ Yield	D 638	%	4
Elongation @ Break	D 638	%	20
Tensile Modulus	D 638	kpsi	290
Flexural Modulus (tangent)	D 790	kpsi	360
Flexural Strength	D 790	psi	9500
Izod Impact (notched)	D 256	ft-lbs/in	3.5
Gardner Impact (1/2" tup)	D 5420	in-lbs	100
Rockwell Hardness	D 785	R-Scale	98
THERMAL			
Deflection Temperature, 66psi	D 648	°F	205
Deflection Temperature, 264psi	D 648	°F	195

Figure 2.6 Datasheet of the ABS

2.5 HOT GLUE GUN OVERVIEW

A hot glue gun is a tool for applying melted glue to a workpiece. The gun typically has an electric heating element for receiving a cylinder of solid glue. The solid glue is melted by the electric heating element as it passes through a heating chamber before being forced out of a nozzle for application to a workpiece. As the glue on the workpiece cools, the workpiece is secured to another object.(Wikipedia)

Mechanisms which advance the glue through-the heating chamber and out of the nozzle are of two general types. The first type is that of a constant-pressure gun. In this mechanism a resilient element, typically a spring, applies a constant force to one end of the stick of glue. A valve in the nozzle prevents the glue from flowing through the nozzle until the valve is opened.

The second kind of mechanism is an intermittent-pressure mechanism. This type of gun usually employs a trigger which must be squeezed to apply a force to advance the glue through the heating chamber and out of the nozzle. (Belanger, Richard A and Melendy, Peter S)

Figure 2.7: Hot Glue Gun

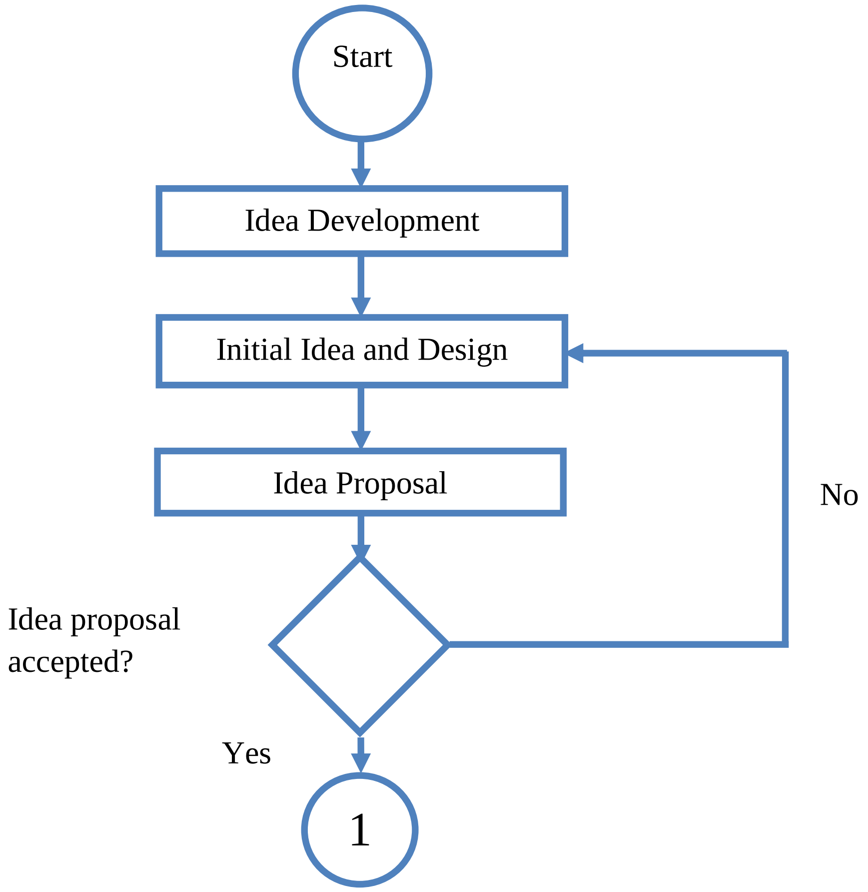
CHAPTER 3

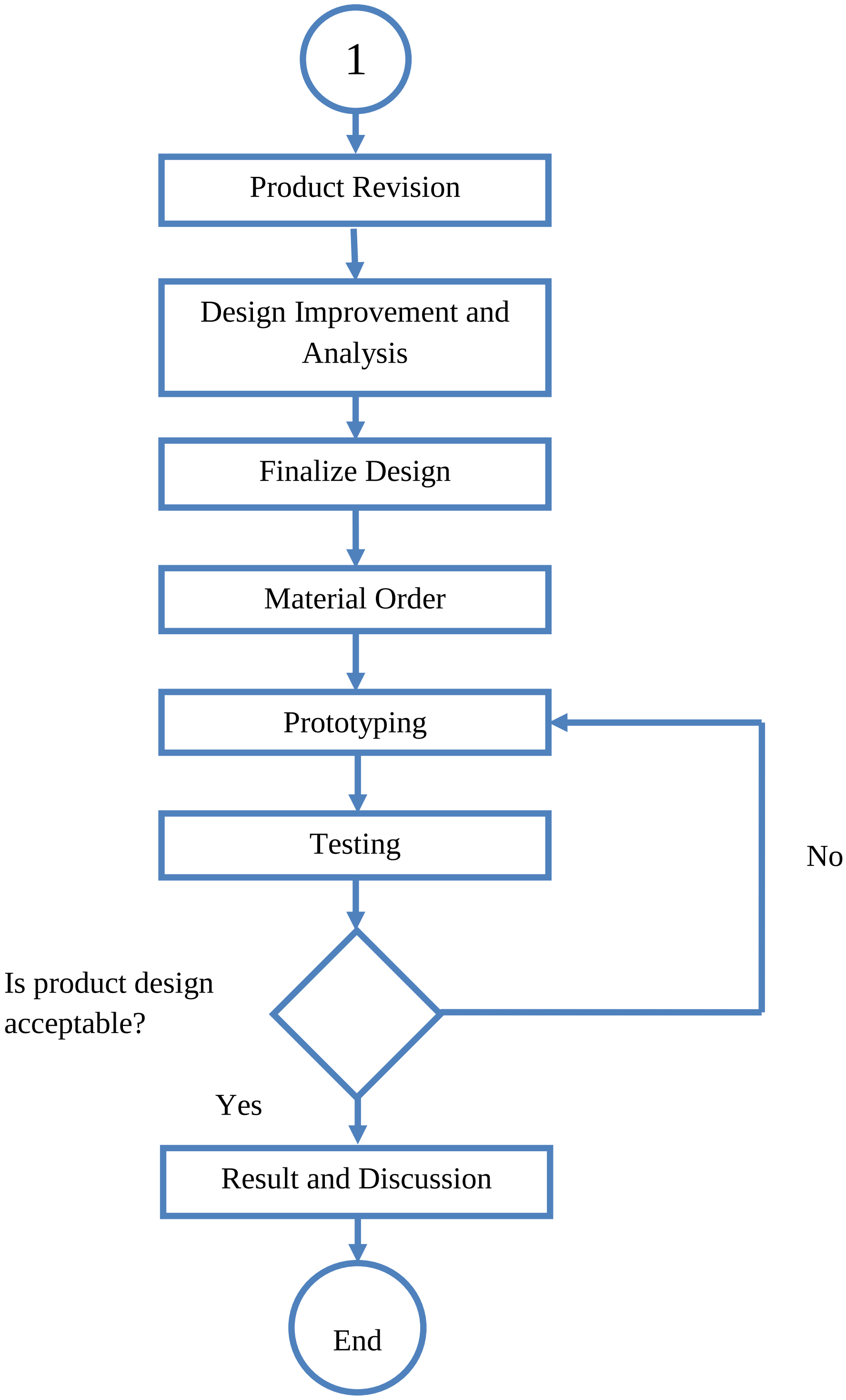
METHODOLOGY

3.1 INTRODUCTION

This chapter will briefly discuss the research approach and methodologies used in gathering data and formulate the findings throughout the research. It is very important to apply suitable methods as it will reflect the finding of the research.

3.2 FLOW CHART




1
Product Revision
Design Improvement and Analysis
Finalize Design
Material Order
Prototyping
Testing
No
Is product design acceptable?
Yes
Result and Discussion
End

3.3 IDEA DEVELOPMENT

This is the first stage of the flow of the project. The idea of the product will be generated in this stage. In this phase, the ideas are generated from various sources, customer, competitors, or even suppliers. Mind mapping and brainstorming ideas are used in this phase. New Product Development is used throughout the project.

The major stages in new product development are Idea development, Idea screening, Concept development and testing, Marketing strategy development, Business analysis, Product development, Test marketing, and Commercialization. For development of this Semi Automatic Canting Tool, the process chosen consists of four stages.

3.3.1 Stage 1 : Idea development

In this phase, the ideas are generated from various sources, customer, competitors, or even suppliers. Mind mapping and brainstorming ideas are used in this phase.

3.3.2 Stage 2 : Product Screening

The idea of the product design will be evaluated in this stage. There are certain things that need to be considered such as operations, and financial requirement.

3.3.3 Stage 3 : Preliminary Design and Testing

The prototyping of the product design will be built. Then, testing procedure will be carried out and the design will be refined.

3.3.4 Stage 4 : Final design

After all the stages above completed, then we will have the final product specifications and ready to be manufactured.

3.4 DESIGN AND ANALYSIS OF PRODUCT

Designing a new products nowadays involved Computer – aided design (CAD). Computer – aided design (CAD) uses the mathematical and graphic processing power of the computer to assist the mechanical engineer in the creation, modification, analysis, and display of designs.

3.4.1 SolidWorks

SolidWorks is a 3D mechanical CAD (computer-aided design) software which is widely used by million engineers and designers worldwide. This research used SolidWork for designing the new improved canting tool.

There are mainly three different section of the part designed using this software. The three sections are :

1. The body (left and right side)
2. The trigger (consist of four child part)
3. The heating element (consist of two child part)

The assembly of drawing takes place after each of the single part drawing is done. At this stage, the overall product view can be seen and simulation of product proceeds next. The functionality of the product can be simulated by enabling the Collision detection or Physical dynamics feature.

3.4.2 SolidWorks Simulation Analysis

Analysis of design can be determined by using Solidworks COSMOSX Express Analysis and SolidWork Simulation. Two test are set to be carried on:

1. Static load on different area of part
2. Drop test

In the static load analysis, the design analysis is started by defining all the parameter, unit, and the material used. Then, the constrain and load is defined. Setting for mesh is also very important. Using fine mesh to get better view of load and stress distribution hence it is more accurate but required some time. Coarse mesh is used for fast analysis.

For drop test analysis, the analysis is started by defining all the parameter, i.e. the height of the part to be dropped and area of contact. The part is then meshed before the analysis started.

3.5 RAPID PROTOTYPING

The next stages of semi automatic canting tool development are prototyping process by using Rapid Prototyping Machine (RP). Rapid Prototyping (RP) is an additive process used for building physical models, prototypes, tooling components and finished production parts from 3D computer-aided design (CAD) data. Product file that already saved in STL file format will be imported to the Rapid Prototyping machine then the parameter for the process will be setup. It will take several hours for prototyping process completely done. The prototype product next will be douse in ultrasonic liquid for product refinement purpose. Figure 3.1 shows the rapid prototyping machine used for the project which is in fuse deposition (FDM) type of prototyping machine.

Figure 3.1: Fortus 360mc Rapid Prototyping Machine

3.6 PRODUCT TESTING

Product functionality testing is the final stages of the project before the discussing the result and recommendation. The product which is already assembled is test by drawing the wax onto the fabric. The flow of the molten wax and the ergonomic of the process will be observed. The result and observation on the testing process will be discussed in the next phase.

CHAPTER 4

RESULT, ANALYSIS AND DISCUSSION

4.1 INTRODUCTION

This chapter will briefly discuss on the result, analysis, and discussion regarding on the project. The data and findings collected throughout the project will be discussed.

4.2 PRODUCT DESIGN AND VIEW

The basic concept of the new canting tool is to have material (wax) loaded and heating and melting the wax taken place in the tool which enable batik artisan to draw wax easily on fabric. Figure 4.1 show the overall view of semi automatic canting tool.

Figure 4.11: Overall view of Semi Auto Canting Tool

Summary of the product design:

The product has a gun shape design. It has a trigger that function to push the material (wax) into the heating element. On each side of the tool, there are holes located at the area of the heating element functions as the heat ventilation in order to control the temperature inside the tool. The tool is electrically power and connected to the electric source using the 2 – pin power plug. The product mainly consists of three main sections:

1. The Body : Consist of left and side of the body
2. The trigger : Consist of four child part
3. The heating element : Consist of two child part: The heating part and the plastic insulation.

Table 4.1 Product general specification

General Specification of Semi – Auto Canting tool	
Dimension	100 x 110 x 20 mm
Weight	300gram
Material (Body)	ABS
Material (Heating element)	Aluminium
Power	AC 110 - 240V 50Hz/60Hz 60W

Advantages of the product:

1. Convenience : Need not much tools for melting wax
2. Light weight : Material used is ABS plastic which is light
3. Small : The overall design is small. It is easy for operation.
4. Semi auto : Direct wax melting process

4.2.1 The Body (Left and Right Side)

The main body is of two parts. The right side and the left side which joined together by the screw type of fasteners. The thickness of the part is 2mm. The thickness is very suitable as it provide rigid structure and easy for manufacture in term of manufacturing the plastic part.

4.2.2 The trigger

The trigger functions to load material into the heating chamber. It consists of four child part. The child parts are connected to each other by snap and fit joint. The plastic material for these four parts is Acrylonitrile butadiene styrene (ABS).

4.2.3 The heating

The canting tool uses the aluminium material for the heating part. The tip of the tool is a long small sprout shape which functions to allow the flow of the molten wax.

Figure 4.2 show the exploded view of the new canting tool.

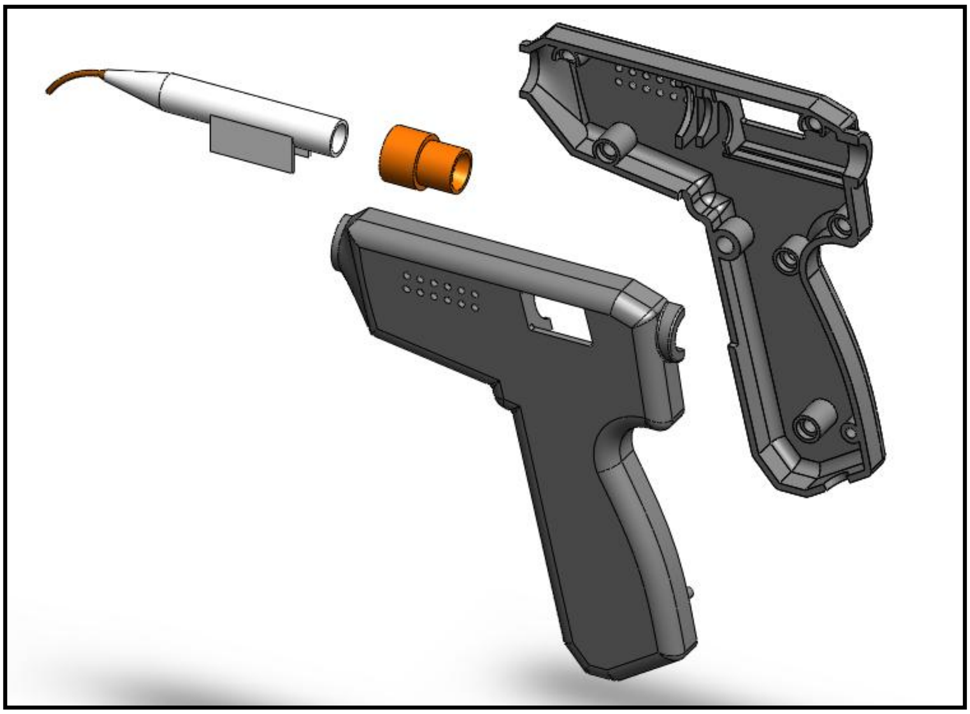


Figure 4.12: Exploded view of canting tool

4.3 DESIGN ANALYSIS

Analysis of the structure is done using SolidWorks COSMOS Xpress. From the analysis, there are several information that can be determine: mass, volume, density, weight of single part, tensile strength, and static load. In addition to that, the SolidWork Simulation enable us to perform drop test.

4.3.1 Meshing the part

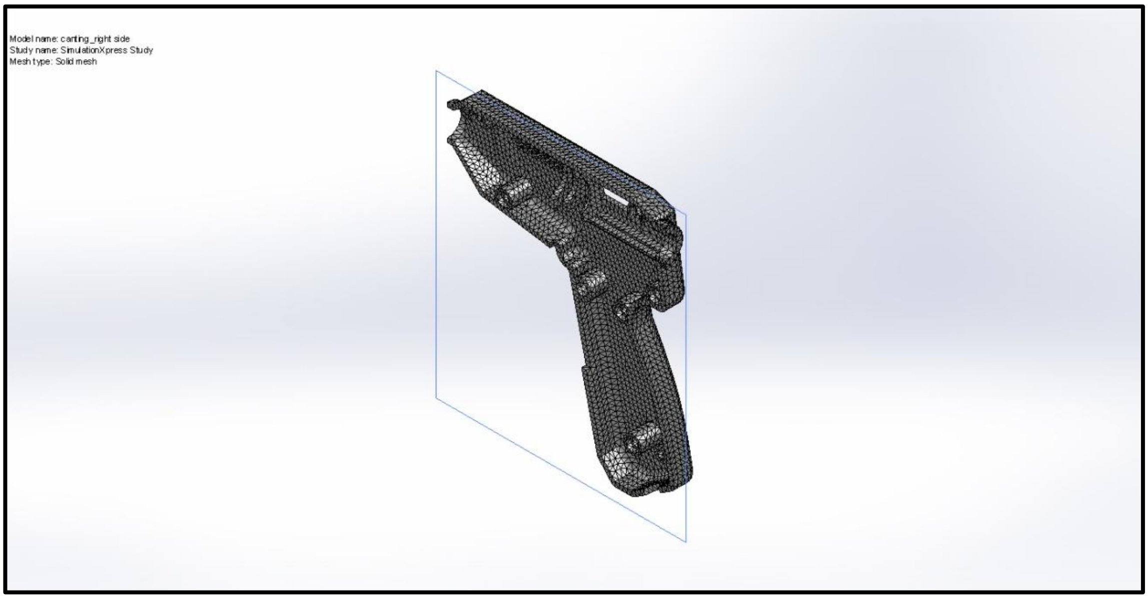


Figure 4.13: Mesh of Canting tool body

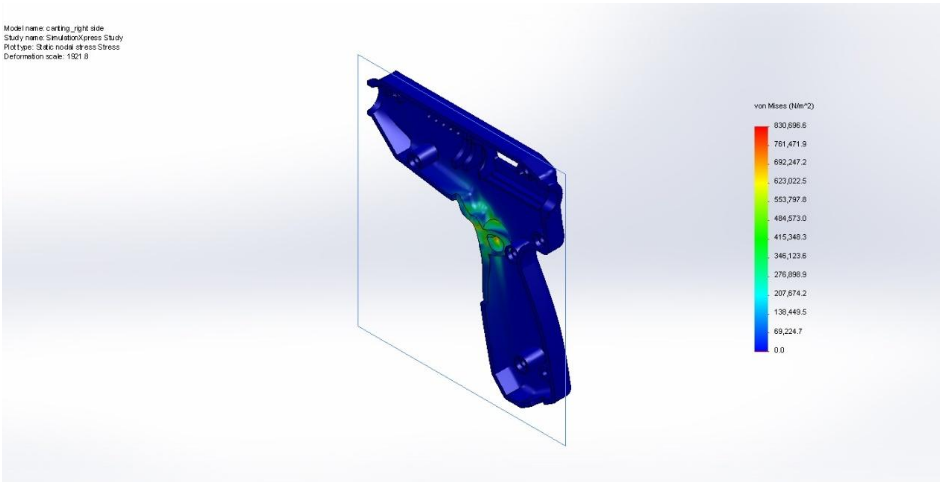
Meshing the part is an important step before proceed with the analysis. Figure 4.31 show the mesh of canting tool body. The mesh can be set to high or low quality of mesh. A high value will result in more accurate result compare to setting low quality of mesh. For this analysis, high quality of mesh is preferable although it will result in more process time.

Problem also occurs when meshing with tight angle and smaller radius. In this condition, the meshing of the part should be set in the high quality mesh. If the mesh is set to coarse quality, meshing of the part cannot proceed.

4.3.2 Static load analysis

Static load analysis is done to determine if the part would fail when certain amount of load applied to the part. Figure 4.3 shows the distribution of stress with given load and area of action. Given the load of 10N apply at the bosses which hold the trigger. The load of 10N is an assumption of the load of pressing the trigger by hand. The result of the analysis shows that the minimum stress acting to the selected area is 0.00934 N/m^2 and the max stress exerted by the 10N load is 0.83N/mm^2. This shows that the design is acceptable.

Name	Type	Min	Max
Stress	von Mises Stress	0.00933652 N/m^2 Node: 3201	0.830697 N/mm^2 Node: 37261

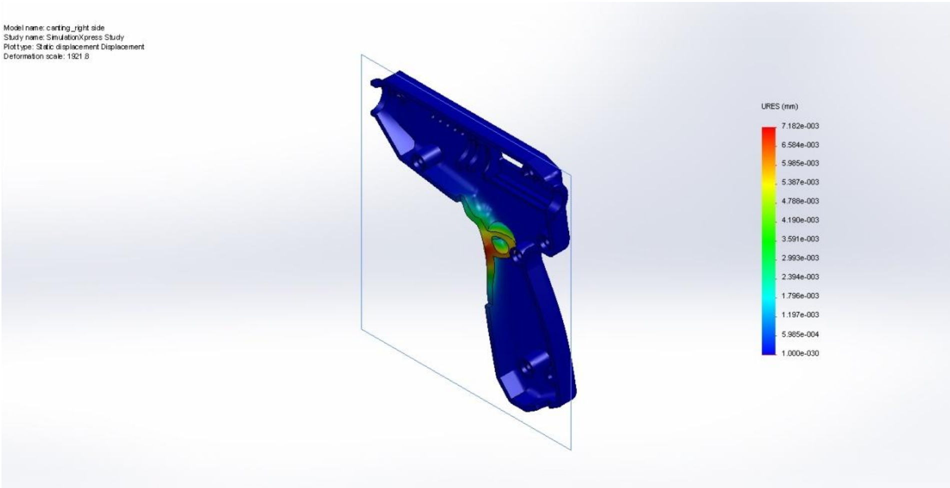


canting_right side-SimulationXpress Study-Stress

Figure 4.14: Stress study of Canting body right side

The resultant displacement result is shown in Figure 4.4 below. The applied load of 10N results in some displacement to the structure of the product. The maximum displacement is 0.00718 mm. This shows that the load of 10N is small enough to bring destruction or damage to the part.

Name	Type	Min	Max
Displacement	Resultant Displacement	0 mm Node: 102	0.00718201 mm Node: 1442



canting_right side-SimulationXpress Study-Displacement

Figure 4.15: Resultant Displacement

Another analysis carried out for this part, but the different is that the 10N load applies on the outer surface of the part. The result of the stress study and the resultant displacement are shown in figure 4.5 and figure 4.6 respectively.

Name	Type	Min	Max
Stress	von Mises Stress	75.3661 N/m^2 Node: 8931	663146 N/m^2 Node: 31587

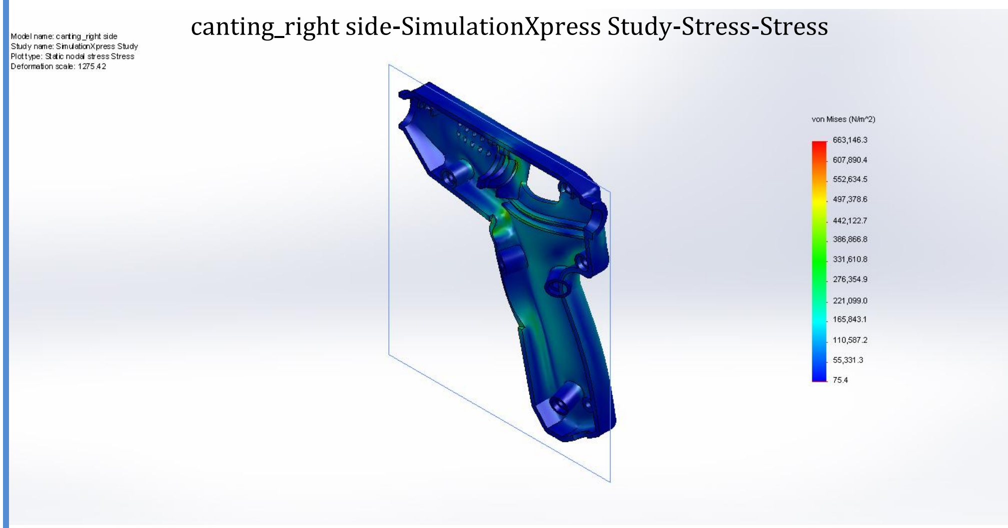


Figure 4.16: Stress study of Canting body right side 2

Name	Type	Min	Max
Displacement	Resultant Displacement	0 mm Node: 15	0.0091904 mm Node: 18272

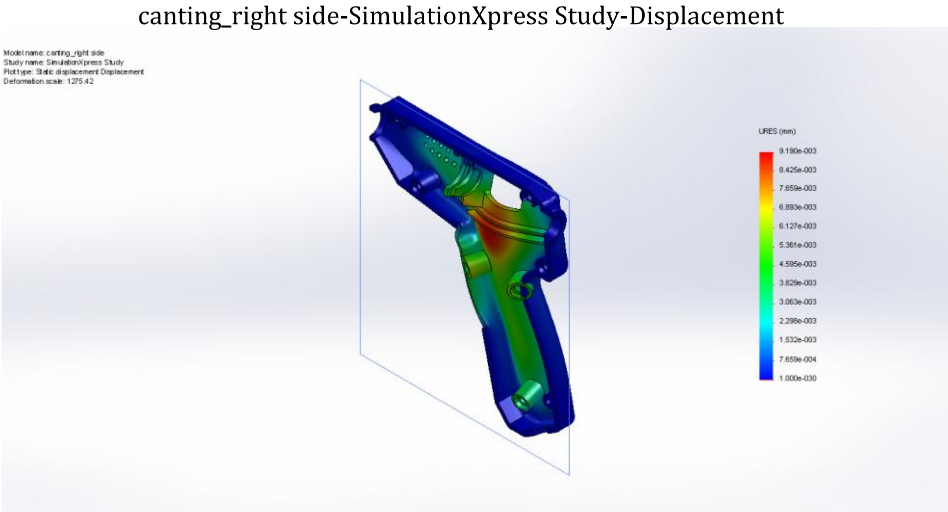


Figure 4.17: Resultant Displacement 2

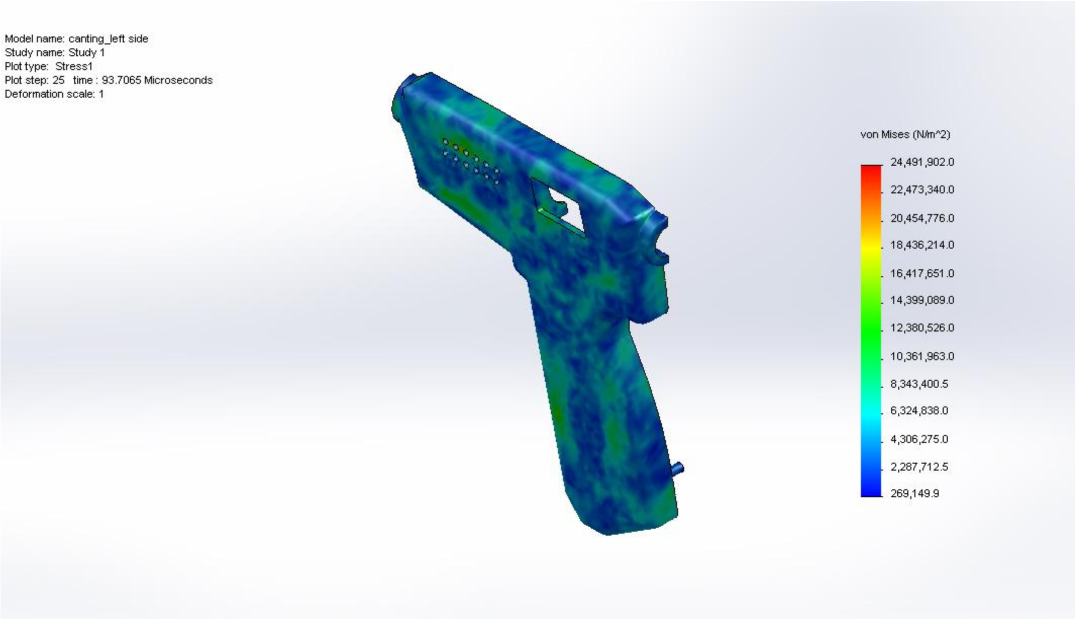
The result of the stress analysis shows that the minimum stress acting to the selected area is 75.3661 N/m^2 and the max stress exerted by the 10N load is $0.66N/mm^2$. The applied load of 10N results in some displacement to the structure of the product. The maximum displacement is 0.0092 mm. This shows that the load of 10N is small enough to bring destruction or damage to the part and it is acceptable.

4.3.3 Drop test analysis

Drop analysis is done stimulatingly by SolidWork Analysis. The simulation is started by determining all of the parameters. The height of the part to be dropped which is 1m, assuming that the working environment of batik canting is using 1m height table. The direction of the fall, and the area of contact are all determined.

Figure 4.18, figure 4.19, and figure 4.20 below shows the result of the drop test done by solidWork Simulation.

Name	Type	Min	Max
Stress1	VON: von Mises Stress	269150 N/m^2 Node: 19646	2.44919e+007 N/m^2 Node: 18417

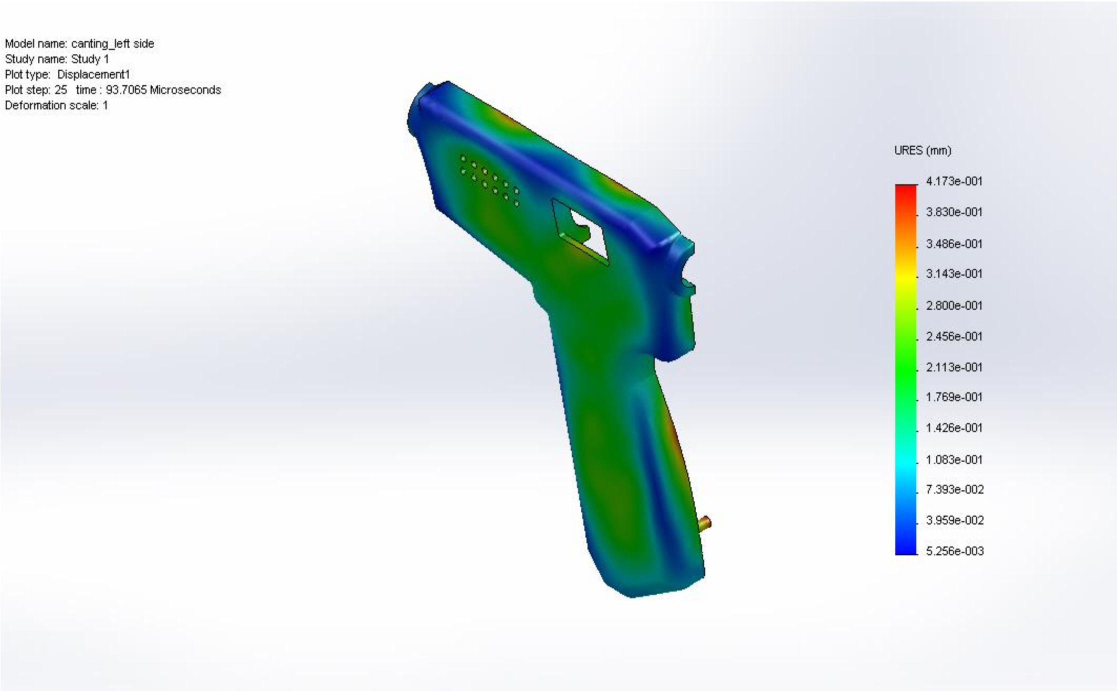


canting_left side-Study 1-Stress-Stress1

Figure 4.18: Stress distribution from drop test

From figure 4.18, we can see that the maximum stress is approximately $2.45e^7$ N/m^2. The maximum stress is found in the circled area above, which is at the air ventilation area of the body.

Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0.00525574 mm Node: 4707	0.417322 mm Node: 382



canting_left side-Study 1-Displacement-Displacement1

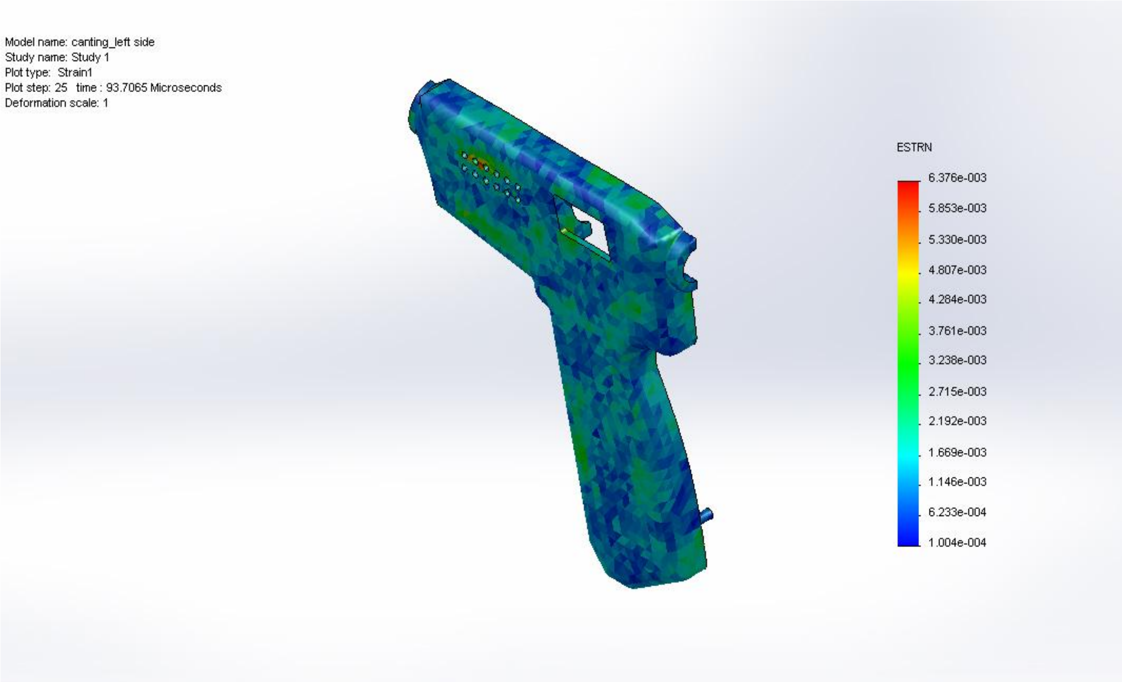
Figure 4.19: Resultant displacement from drop test

In figure 4.19 above, the resultant displacement of the canting tool body from the drop test simulation are determined. We can see the maximum displacement of the part is around 0.42mm. We can see that the maximum displacement occur at the edge of the part.

From the test also, we can determine the equivalent strain of the part after the drop test simulation, see figure 4.20 below. The maximum equivalent strain is approximately 0.006 which is very small value.

So, we can conclude that, the canting tool is tough enough to withstand loads or stress when dropped from 1m of height.

Name	Type	Min	Max
Strain1	ESTRN: Equivalent Strain	0.000100391 Element: 529	0.00637586 Element: 6649



canting_left side-Study 1-Strain-Strain1

Figure 4.20: Equivalent strain

4.4 MECHANISM

The mechanism for the canting tool can be summarized into three stages. The lever/trigger is pulled, then the wax was forced into the heating element, and the melting wax comes out from the tip of the tool. This is the feeding mechanism that makes the tool function. When the trigger being pulled, the trigger will hold the part and push the material forward into heating area.

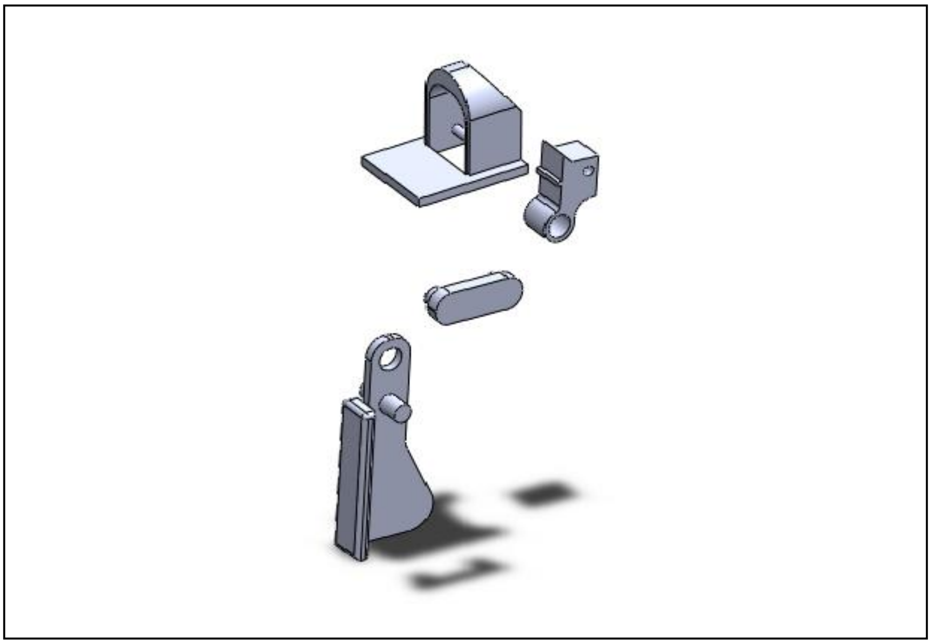


Figure 4.21: Exploded view of the feeding mechanism

4.5 PROTOTYPING

Prototyping of the body are by rapid prototyping machine. Material for prototyping is Acrylonitrile butadiene styrene (ABS). In the prototyping process, it is important to have the best orientation of the part to prevent longer prototyping time. In addition to that when doing prototyping, the orientation also needs to be proper so that less support material used. When support material used are less, the time need to remove the support material also reduced. Figure 4.9 shows the prototype of the canting body.

Figure 4.22: Prototyping of the canting body

4.6 PRODUCT ASSEMBLY

After all of the components are ready, the next step will be the assembly of the product. For assembly, the parts are:

1. Body (left)
2. Body (right)
3. Heater (electrical componenets)
4. The trigger

Figure 4.21 and figure 4.22 show the product assembly and inside view of the product respectively.

Figure 4.23: Assembly of canting tool

Figure 2.24: Inside view of canting tool

4.7 FUNCTIONALITY TEST

The testing on functionality is carried on in order to see if the new developed canting tool is good enough to be used by the Batik industry. The test is carried out by trying to draw the molten wax onto the fabric using the new semi – auto canting tool. Figure 4.8 show the result of the wax drawn on fabric.

Figure 4.25: Wax drawn on fabric

The result shows that the flows of the molten wax are not smooth. When drawing the wax onto the clothes/fabric, the flows of the wax from the tip of the tool are not consistent resulting in a little difficulty in the drawing process. The possible causes of the problem are identified. The possible causes are:

1. The feeding mechanism is not good enough to ensure the continuity of the molten wax flow.
2. No reservoir for the molten wax.

4.8 FABRICATION

Since the new semi auto canting tool are of plastic material, the manufacturing process involved will be plastic injection molding.

In injection molding process, the raw material in the form of pallet will be injected into the mold. The injection process are by reciprocating screw and along the injection unit, there are heaters which function to melt the plastic material before being injected into the mold.

The mold for the canting tool needs to be designed. Basically, there are two type of mold, two – plate mold and three – plate mold. The three – plate mold are more complicated in design and mechanism. For the canting tool, it is strongly recommended to use the two – plate mold type. The mechanism is simple and the very important point is that it does not need much money to design and to fabricate the mold.

To optimize the design and the quality of the product to be produced, it is important to use software for simulation. Moldflow Insight is one of the software that can be used. The simulation enables us to identify the problem related to the design of the product and also the mold. The plastics injection defect such as warpage, air traps, burnmark, all can be analyze by the Moldflow Insight.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 INTRODUCTION

This chapter will briefly discuss on the conclusion that can be made in the end of the project. The success of every objectives stated in the early stage of the project also will be review. Any improvement on the result and analysis also will be discussed for recommendation.

5.2 CONCLUSION

The project of development of semi – automatic canting tool had achieved its overall target. There are four main objectives stated in the early stage of the project. The first objective is to develop a new semi – automatic canting tools and the objective is achieved. The new tool for batik canting had been developed with semi automatic feature, heating and melting wax are done automatically, and the process of drawing batik is still done manually.

The second objective which is to design canting tool that made of plastic material also had been achieve. The new canting tool is of Acrylonitrile butadiene styrene (ABS). The ABS material is lightweight and has very good thermal properties which make it suitable to operate under high temperature.

The last objective is to apply Product Development Processes (NPD) in designing the new semi – automatic canting tool. This objective also had been achieved. From the early stage of the project, the NPD are already implemented. This manufacturing tool is very important in order to ensure the smoothness of the project.

Although the overall objective of the project had been achieved, there are still rooms for improvement of the tool. In Chapter 4, Result, Analysis and Discussion, drawback of the tool had been detected. The flows of the molten wax which come out from the tip of the tool are not smooth and consistent result in some difficulty in drawing process.

The problem which been discussed in the previous chapter is come from the mechanism of the feeding system. When the trigger being pulled, certain amount of wax is fed into the melting area and the drawing process started. The flow of the molten wax is based on the action of pulling the trigger and it is difficult to maintain the consistency of the flow as we keep pulling the trigger for melting process.

5.3 RECOMMENDATIONS

There are several recommendations in improving the canting tool. The first thing is to design the tool with reservoir. The reservoir is designed to have molten wax to be stored in certain volume as backup and support for the drawing process. This will ensure the continuity and smoothness of the flow of the molten wax during the drawing process.

Another recommendation is to have changeable tips. In batik canting process, there are lots of types of the tip with different sizes. Therefore, it is better to have one tool with several types of changeable tips. We will have less cost in buying the changeable tips rather than buy the new tool for each type of tips.

6.0 REFERENCES

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8. Belanger, Richard A.: "*Force transmitting mechanism for glue gun*", Europian Patent Application, 1984.

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10. R. **Velazquez: "**New Product Development Lecture – Overview", *http://richardvelazquez.wordpress.com/2011/03/08/new-product-development-lecture-overview/*

7.0 APPENDICES

Simulation of canting_left side

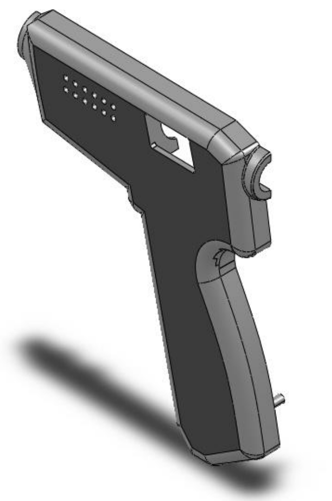
Date: Tuesday, May 29, 2012
Designer: Mohammad Muaz Nordin
Study name: Study 1
Analysis type: Drop Test

Table of Contents

Description

Drop Test Simulation

Model Information



Model name: canting_left side
Current Configuration: Default

Solid Bodies			
Document Name and Reference	Treated As	Volumetric Properties	Document Path/Date Modified
Extrude23 	Solid Body	Mass:0.0196358 kg Volume:1.92508e-005 m^3 Density:1020 kg/m^3 Weight:0.192431 N	C:\Users\Acer\Desktop\muaz_PSM\Canting01\canting_left side.SLDPRT May 29 02:01:22 2012

Study Properties

Study name	Study 1
Analysis type	Drop Test
Mesh type	Solid Mesh
Large displacement	On
Result folder	SolidWorks document (C:\Users\Acer\Desktop\muaz_PSM\Canting01)

Setup Information

Type	Drop height
Drop Height from Centroid	1000 mm
Gravity	9.81 m/s^2
Gravity Reference	Face<1>
Friction Coefficient	0
Target Stiffness	Rigid target
Critical Damping Ratio	0

Result Options

Solution Time After Impact	93.71 microsec
Save Results Starting From	0 microsec
No. of Plots	25
No. of Graph Steps Per Plot	20
Number of vertex	0

Units

Unit system:	SI (MKS)
Length/Displacement	mm
Temperature	Kelvin
Angular velocity	Rad/sec
Pressure/Stress	N/m^2

Material Properties

Model Reference	Properties		Components
	Name: Model type: Default failure criterion: Tensile strength: Elastic modulus: Poisson's ratio: Mass density: Shear modulus:	**ABS** **Linear Elastic Isotropic** **Unknown** **3e+007 N/m^2** **2e+009 N/m^2** **0.394** **1020 kg/m^3** **3.189e+008 N/m^2**	**SolidBody 1(Extrude23)(canting_left side)**
Curve Data:N/A			

Mesh Information

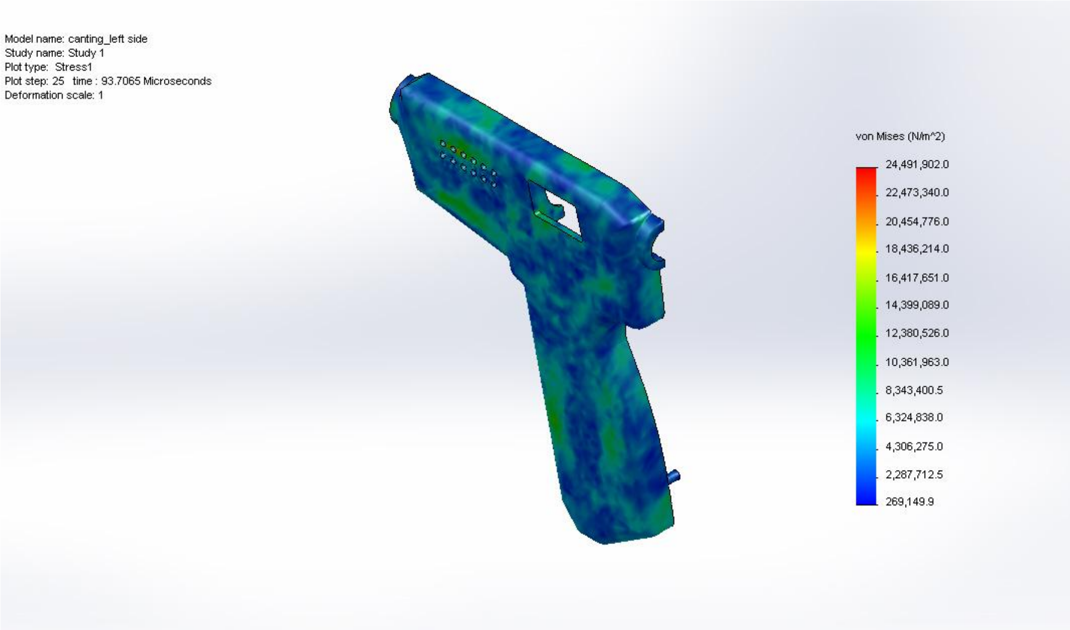
Mesh type	Solid Mesh
Mesher Used:	Curvature based mesh
Jacobian points	4 Points
Maximum element size	0 mm
Minimum element size	0 mm
Mesh Quality	High

Mesh Information - Details

Total Nodes	21700
Total Elements	24901
Maximum Aspect Ratio	13.934
% of elements with Aspect Ratio < 3	84.5
% of elements with Aspect Ratio > 10	0.074
% of distorted elements(Jacobian)	0
Time to complete mesh(hh;mm;ss):	00:00:20
Computer name:	ACER-PC

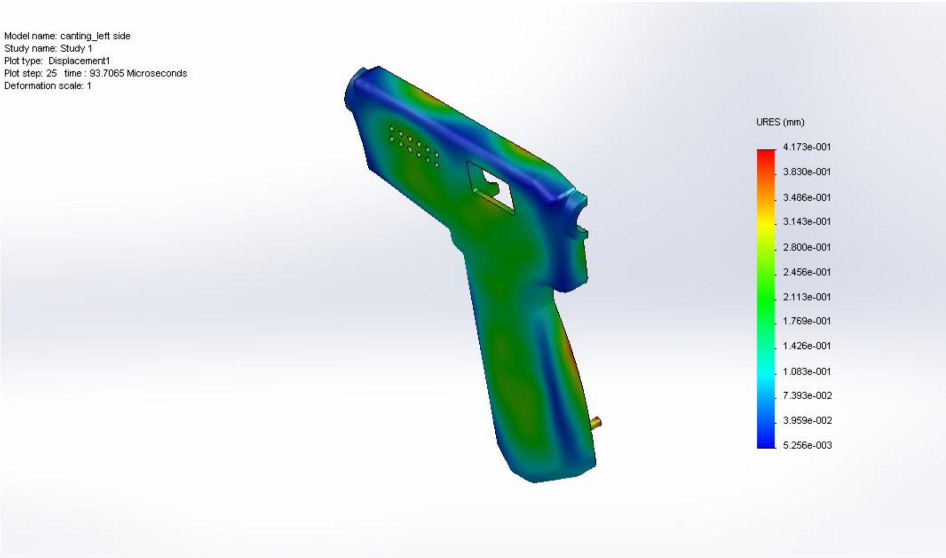
Study Results

Name	Type	Min	Max
Stress1	VON: von Mises Stress	269150 N/m^2 Node: 19646	2.44919e+007 N/m^2 Node: 18417



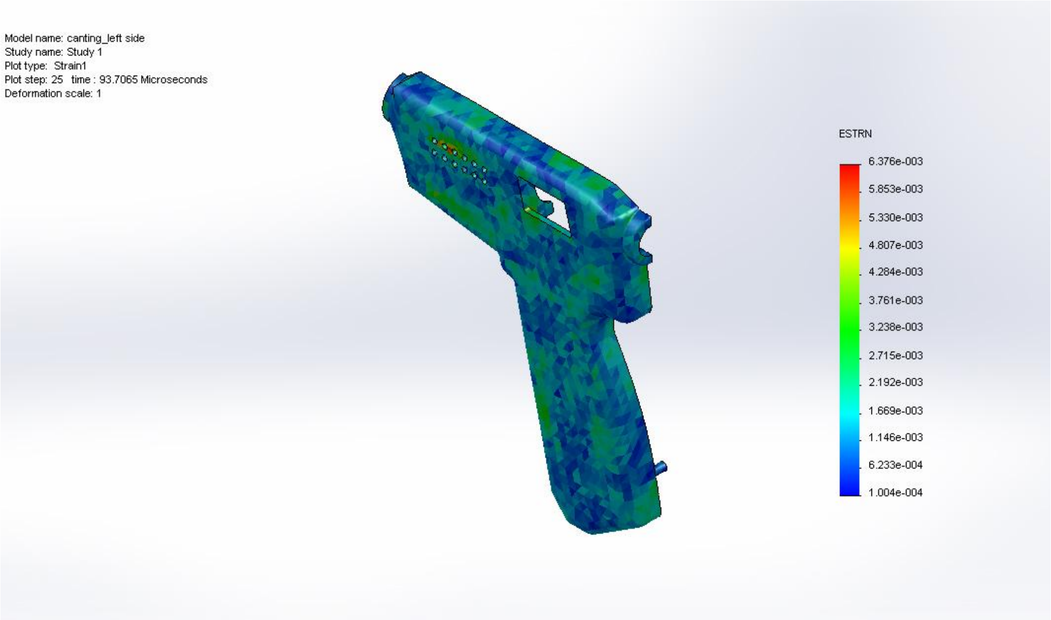
canting_left side-Study 1-Stress-Stress1

Name	Type	Min	Max
Displacement1	URES: Resultant Displacement	0.00525574 mm Node: 4707	0.417322 mm Node: 382



canting_left side-Study 1-Displacement-Displacement1

Name	Type	Min	Max
Strain1	ESTRN: Equivalent Strain	0.000100391 Element: 529	0.00637586 Element: 6649



canting_left side-Study 1-Strain-Strain1

Simulation of canting_right side

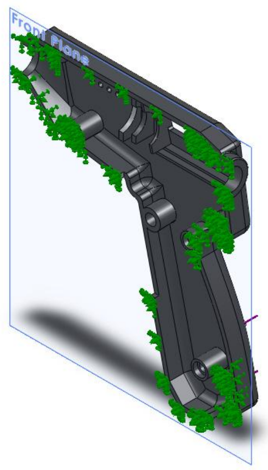
Date: Monday, 30 April, 2012
Designer: Mohammad Muaz Nordin
Study name:SimulationXpress Study
Analysis type:Static

Table of Contents

Description

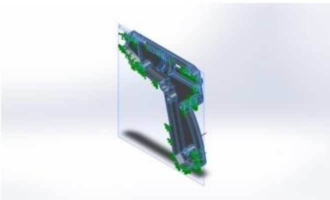
Developement of semi automatic canting tool

Model Information

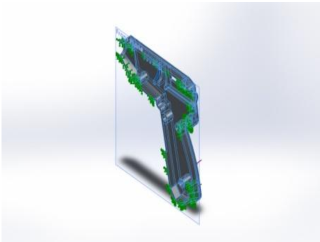


Model name: canting_right side
Current Configuration: Default

Solid Bodies

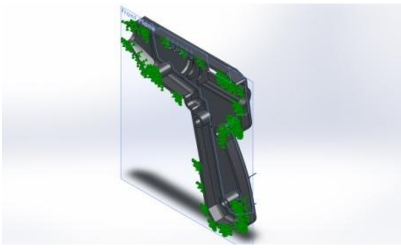
	Treated As	Volumetric Properties
Extrude31 	Solid Body	Mass:0.0197107 kg Volume:1.93242e-005 m^3 Density:1020 kg/m^3 Weight:0.193165 N

Material Properties

Model Reference	Properties	Components
	Name: **ABS** Model type: **Linear Elastic Isotropic** Default failure criterion: **Unknown** Tensile strength: **3e+007 N/m^2**	**Body 1(Extrude31)(canting_right side)**

Loads and Fixtures

Fixture name	Fixture Image	Fixture Details
Fixed-2		**Entities:** **4 face(s)** **Type:** **Fixed Geometry**

Load name	Load Image	Load Details
Force-2		**Entities:** **1 face(s)** **Type:** **Apply normal force** **Value:** **10 N**

Mesh Information

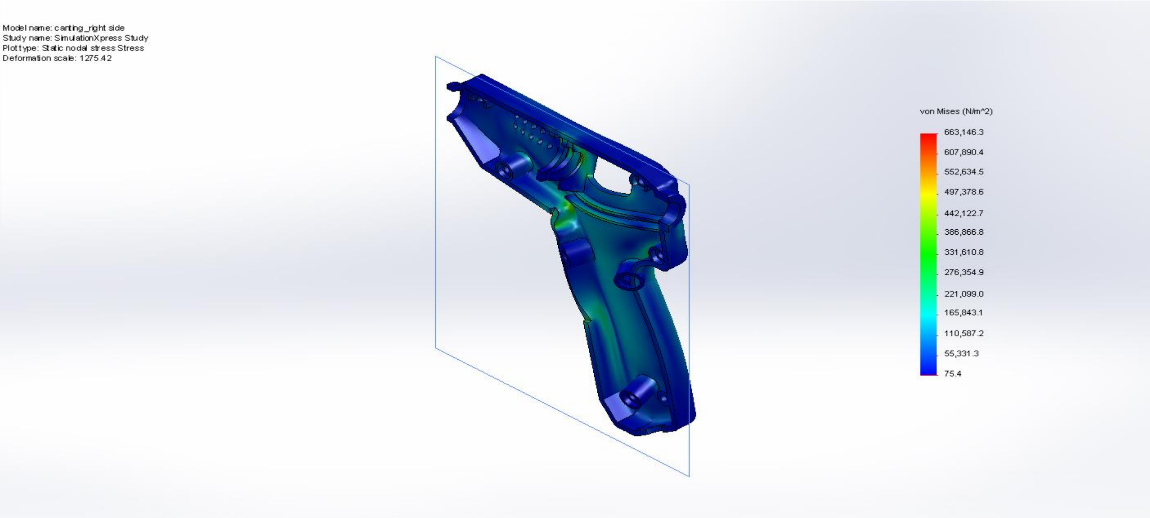
Mesh type	Solid Mesh
Mesher Used:	Standard mesh
Automatic Transition:	Off
Include Mesh Auto Loops:	On
Jacobian points	4 Points
Element Size	2.01361 mm
Tolerance	0.100681 mm
Mesh Quality	High

Mesh Information - Details

Total Nodes	41767
Total Elements	22109
Maximum Aspect Ratio	20.877
% of elements with Aspect Ratio < 3	96.1
% of elements with Aspect Ratio > 10	0.0633
% of distorted elements(Jacobian)	0
Time to complete mesh(hh;mm;ss):	00:00:12
Computer name:	AMRIE-PC

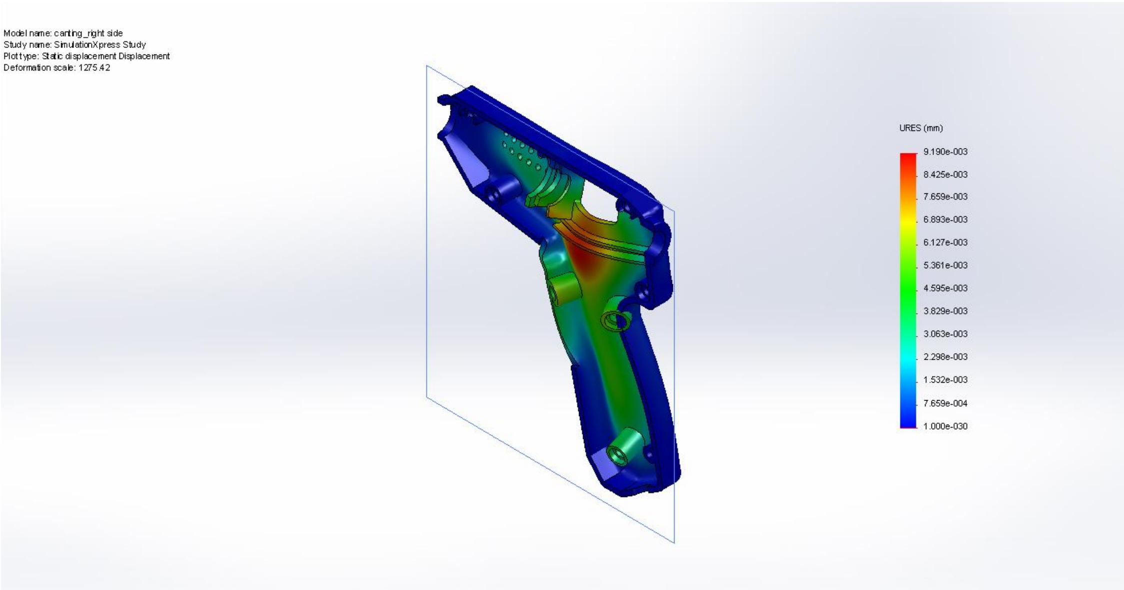
Study Results

Name	Type	Min	Max
Stress	VON: von Mises Stress	75.3661 N/m^2 Node: 8931	663146 N/m^2 Node: 31587



canting_right side-SimulationXpress Study-Stress-Stress

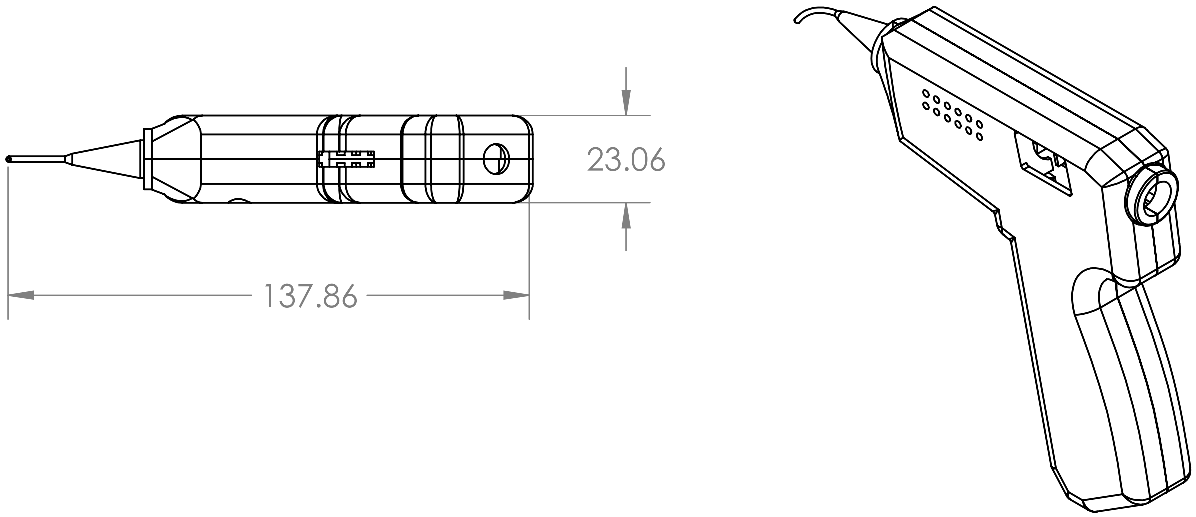
Name	Type	Min	Max
Displacement	URES: Resultant Displacement	0 mm Node: 15	0.0091904 mm Node: 18272

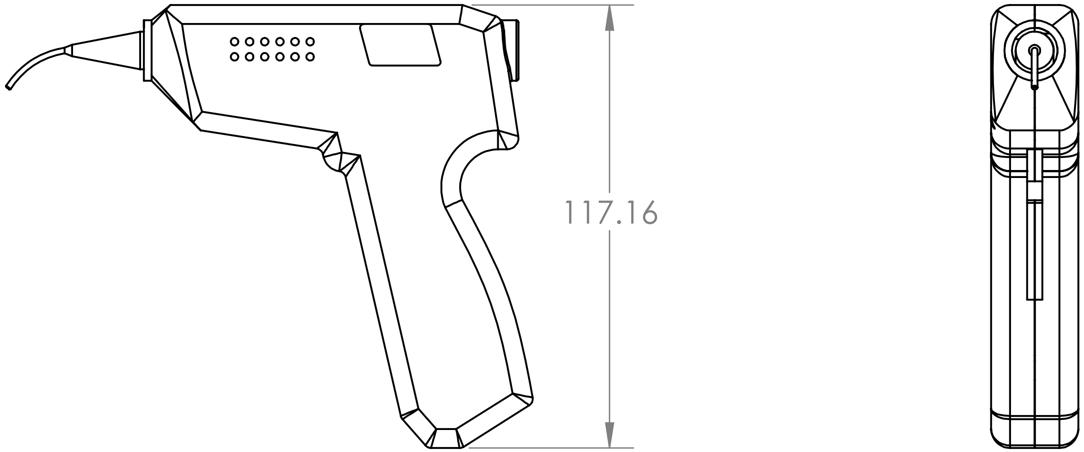


canting_right side-SimulationXpress Study-Displacement-Displacement

Name	Type
Deformation	Deformed Shape

canting_right side-SimulationXpress Study-Displacement-Deformation





DO NOT SCALE DRAWING

REVISION

TITLE:

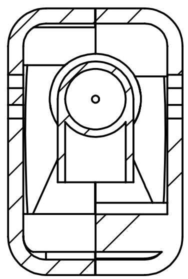
Canting tool

DWG NO. Product Assembly

A4

SCALE:1:2

SHEET 1 OF 1



SECTION B-B
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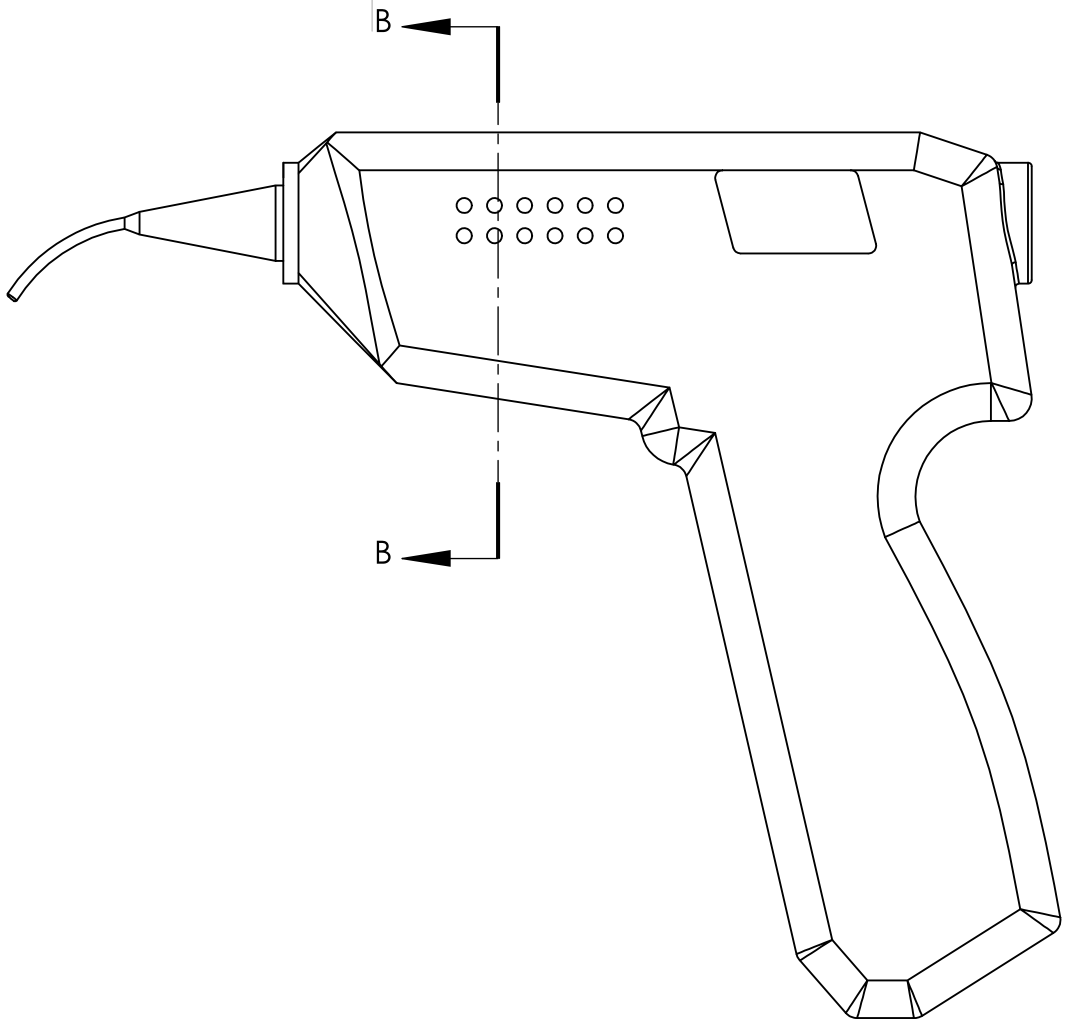
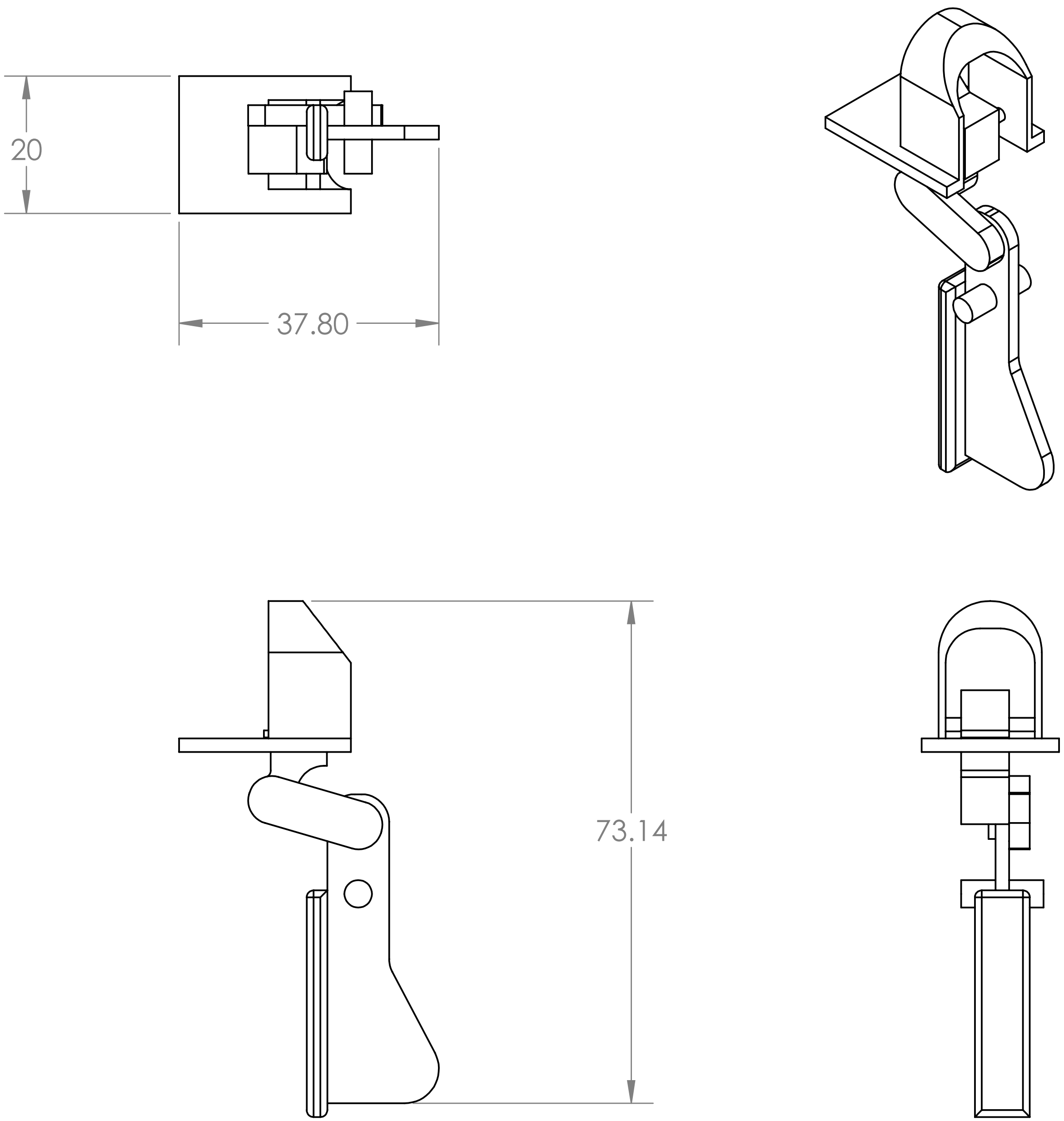


DO NOT SCALE DRAWING	REVISION

TITLE:

Canting tool

DWG NO.	Sectioning	A4
SCALE:1:2	SHEET 1 OF 1	



DO NOT SCALE DRAWING	REVISION

TITLE:

Trigger (mechanism)

DWG NO.	Trigger Assembly	A4
SCALE:1:1	SHEET 1 OF 1	

Gantt Chart for FYP1

	Tasks	weeks													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Final Year Project (FYP) briefing														
2	Project Title selection														
3	Discussion with supervisor about the selected project														
4	Gathering information for project														
5	Chapter one (Introduction)														
6	Chapter two (Literature review)														
7	Chapter three (Methodology)														
8	Proposal presentation														
9	Check writing with supervisor														
10	Finalise writing														
11	Submission of FYP1														

Gantt Chart for FYP2

Tasks		weeks													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Finalise Design for Semi auto canting tool														
2	Prototyping of canting tool														
3	Searching for design improvement possibility														
4	Preparing for material														
5	Simulation and analysis														
6	Fabrication process														
7	Chapter four (Result and analysis)														
8	Chapter five (Discussion)														
9	Check writing with supervisor														
10	Finalise writing														
11	Presentation and Submission of FYP2														