

DESIGN AND FABRICATE OF MULTIPURPOSE DESK FOR STUDENT

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A report submitted in partial fulfillment of the requirements  
for the award of the degree of  
Diploma of Mechanical Engineering

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### **SUPERVISOR DECLARATION**

“I declare that I have read this thesis and in my opinion, this thesis is enough to fulfill the purpose for the award for the Diploma of Mechanical Engineering from the aspects of scope and quality.”

Signature : .....

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Date : 10 NOVEMBER 2008

### DECLARATION

I declare that this report entitled “*Design and Fabrication of Multipurpose Desk for Students*” is the result of my own research except as cited in the references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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## **ABSTRACT**

Designing and fabrication a multipurpose desk for student is a product that fulfills the students needs. This project uses many materials such as zinc, hollow steel bar and others. Overall, this project involves many processes, starting from the design concept, fabrication and assembling procedures. Even though there are many types of multipurpose desk for student in the market, the completion of this new model provides a more practical usage.

## **ABSTRAK**

Mereka bentuk dan membuat meja pelbagai fungsi untuk pelajar merupakan salah satu produk untuk kepentingan pelajar. Projek ini menggunakan pelbagai jenis bahan seperti zink, besi berongga dan sebagainya. Keseluruhan projek ini melibatkan berbagai-bagai proses bermula dengan idea konsep rekabentuk, pemotongan bahan, mereka bentuk dan fabrikasi. Walaupun meja pelbagai fungsi seperti ini telah banyak di pasaran, namun kelainan dalam penyelesaian meja ini telah dilakukan bagi memastikan ianya lebih praktikal untuk digunakan.

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## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 Project Synopsis**

The purpose of the project is to design and fabricate a multipurpose desk to fulfill the requirement for engineering student. This table would be different from another table. In this study, the multipurpose table will be designed and fabricate and ensure these tables comply with customer needs. As the Diploma final year project allocates the duration of 1 semester, this project is need skills to handle several machines such as punch machine, bending machine, drilling and grinding machine.

The title of this project is “Multipurpose Desk for Students”. This project involves the fabrication of multipurpose desk with a specification regarding strength, material and cost. With the newly designed and fabricated table, tests are required to be conducted and to verify the design. This project will acquire the skill of design and fabrication.

## **1.2 Problem Statement**

The common problems occur and faces student who lives at hostel is:-

- i. There is no specific and systematic to store drawing tool and stationery.
- ii. Existing tables are not adjustable.
- iii. Most students put many book and drawing tool on their desk.
- iv. The table is big and heavy.

## **1.3 Project Objective**

The objective of this project is to provide and introduce the new concept of table which can give better or systematic storage to store engineering drawing stationery. It is also to provide a multipurpose and student friendly table. Finally, introduce the new concept of the table that meets people specification.

## **1.4 Project Scope of Work**

Scopes of the projects are limited to the below equipments and materials:-

- i. Design of product is assisted using solidwork software.
- ii. Fabrication process will use all necessary manufacturing process including punch machine, bending machine, cutting and joining process.
- iii. Material that will be used to fabricate this table are mild steel rectangular hollow bar, stainless steel sheet metal and mild steel sheet metal.

## 1.5 GANTT CHART

**Table 1.1:** Gantt chart

Project Activities	Weeks														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Literature Review	Plan														
	Actual														
Idea generation	Plan														
	Actual														
Finalized Concept	Plan														
	Actual														
Fabrication	Plan														
	Actual														
Result& Finding	Plan														
	Actual														
Discussion/ Conclusion	Plan														
	Actual														
Slide Preparation/ Presentation	Plan														
	Actual														
Report Writing	Plan														
	Actual														
Submit Report	Plan														
	Actual														

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 INTRODUCTION**

This chapter is about literature review of existing product in the market. It also describes the table such as type of table, dimension of table, advantages and disadvantages the table. This literature review is very important especially to study about the table especially about function and design. It is helpful to make idea generation.

#### **2.2 EXISTING PRODUCT**

In this part, it will show some type of tables. All these tables have own advantages and disadvantages.

##### **2.2.1 Student Desk**

We can found this desk usually at school. This desk is design for student in the classroom.

The advantages of this table are simple design. If we look this table, the material that use not to much and easy to fabricate it. Beside that, this table also can be size the height. Every leg of this table already install regulator. So student can adjust the height suitable with them.

We can move this table easily because this table is lightweight. This table is easy to use. Students can put or take their book easily because this table has space to put book or file and the space is already open.

The disadvantages of this table do not have a systematic storage. This table only has one space to put things. This table also not suitable for storage especially if we want to keep important things inside the table. It is because the space of this table is widely open and we cannot lock it because there is no drawer.

Beside that, this table not to comfortable to use. It is not comfortable because this table do not have the place to put our leg when we use this table.



**Figure 2.1:** Student Desk

### 2.2.2 Writing Table

A writing table has a series of drawers directly under the surface of the table, to contain writing implements, so that it may serve as a desk.

The advantage of this table is very comfortable especially when we write on it. It also has a large surface. So we can put more things such as books, papers and stationeries. Besides that, this table also has two drawers to keep several book or stationery.

The disadvantage of this table is big. A lot of space needed in our room to put this table. This table also difficult to move or not portable. This table is expensive because it needs high quality of wood to produce this table.



**Figure 2.2:** Writing Table

### 2.2.3 Standing Table

A standing desk is both an antique desk and a modern desk form conceived for writing or reading while standing up or while sitting on a high stool. The term stand-up or stand up desk is also used. While most modern desks are 30 inches high and most antique desks 29 inches high, there is no such average for standing desks.

The advantage of this table is users of are fairly immobile so it is relatively easy to adjust the height of a seat to compensate for variations in the individual height of the users. Beside that, users of a standing desk move around a bit more, so it is not practical to have them stand on a small pedestal or some other object. The advantage of this table is simple design and easy to fabricate.

The disadvantage is these tables do not have a systematic storage. So we only can put things on this table. This table is expensive because it needs high quality of material to produce this table.



**Figure 2.3:** Standing Table

#### 2.2.4 Drawing Table

Figure 2.4 shows the new type of drawing table.

The advantage of this table is we can adjust their height suitable with user. Besides that, the other advantage is lightweight. So we can move this table to other place easily. This table is simple design and easy to produce it because not need too much material to fabricate.

The disadvantage of this table does not have any storage if we want to store several books and other thing such as drawing stationery. Beside that, this table only to drawing work and it not suitable for writing.



**Figure 2.4:** Drawing Table

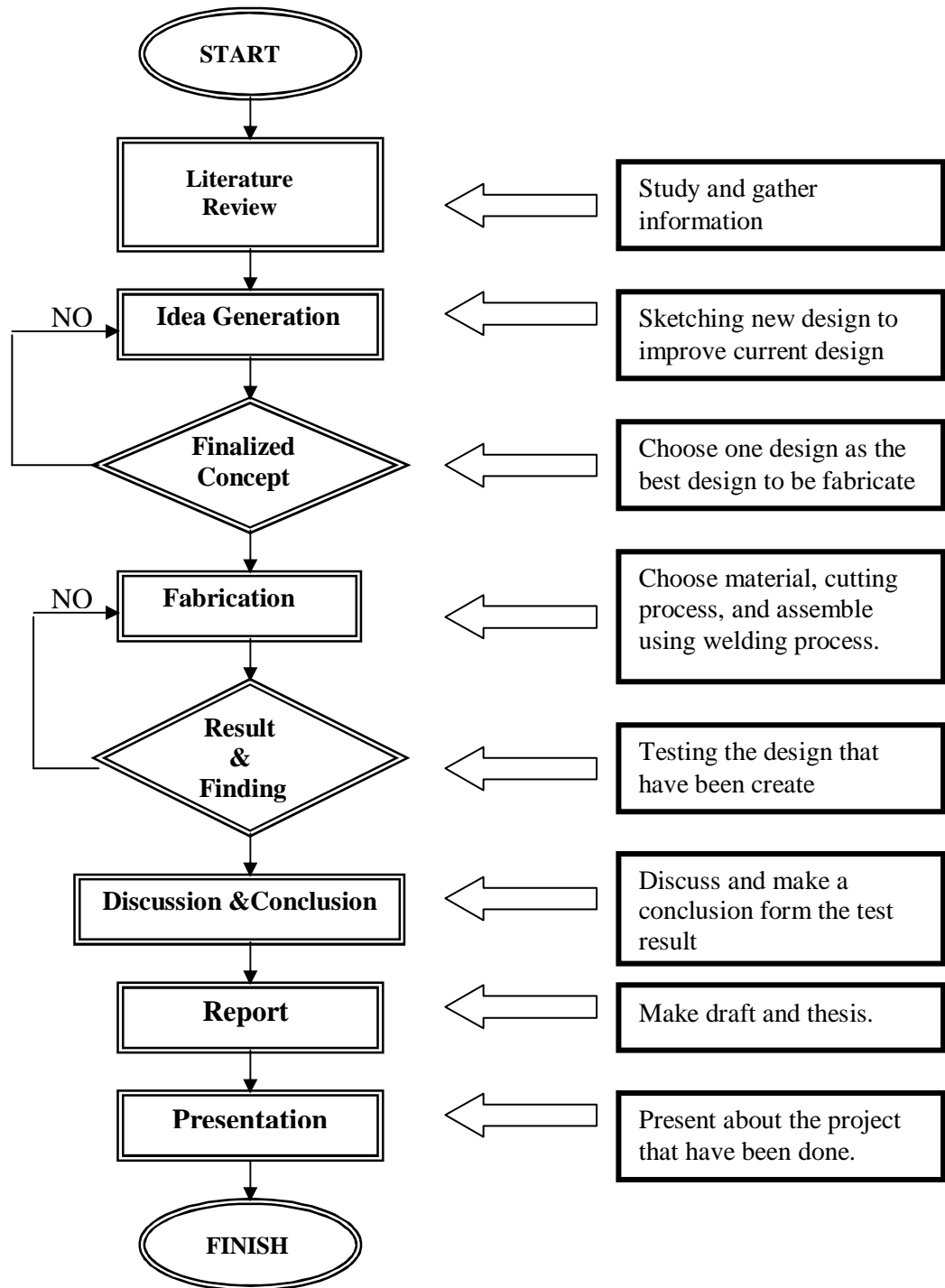


## **CHAPTER 3**

### **METHODOLOGY**

#### **3.1 PROJECT FLOW DIAGRAM**

In fabrication of the multi-function table, there is a planning of the overall progress to assure the project can be finish on schedule.



**Figure 3.1:** Project flow chart

From the flow chart above, this project started with the literature review and research about the title. Then, study and make a lot of investigation about multipurpose desk. This includes a study about concept of multipurpose desk, process to fabricate, and material. These tasks have been done through study on the internet, books and other sources.

The information gathered and the project is continued with the design process. It is important to make a suitable design for the project. After several design sketched, design consideration have been chosen.

After all the engineering drawing finished, the drawing has been used as a reference for the next process, which is fabrication stage. This process will consist fabrication to all parts that have been designed by follow the dimension using various type of manufacturing process. The manufacturing processes include in this process are welding, cutting, drilling, bending and others. During the fabrication process, if there is something wrong occur, such as not balance dimension or the chassis was broken so the process will be stop and go back to previous step, make a modification against.

Evaluation stage has been implemented after fabrication stage. The evaluation is by considering the strength, durability, safety and workability of the desk. During the evaluation, if problem occur such as malfunction, modification will be done.

Then, after all the processes mentioned above are done, all materials for report writing are gathered. The report writing process will be guided by the UMP final year project report writing. Preparation for final presentation is also being made by finished the slide show. The project ended after the presentation and submission of the report.

### **3.2 DESIGN**

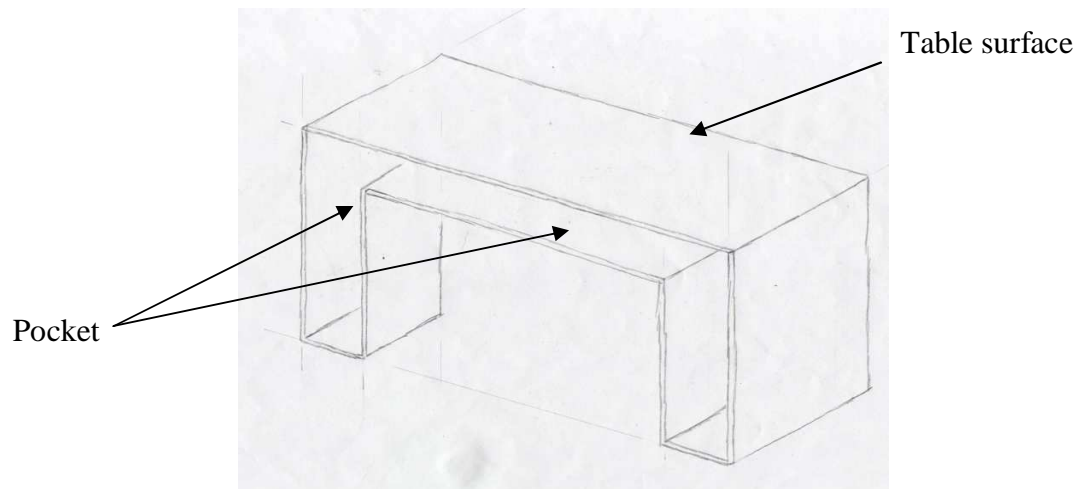
The Design of the multipurpose desk must be compliance to several aspects. The design consideration must be done carefully so the design can be fabricated and the table is functional. The aspect that must be considered in designing the multipurpose tables are:-

- i. Durability: The table must be durable when put with book and drawing stationeries.
- ii. Material : The material that will be used must be suitable to fabricate this table
- iii. Cost : It depends on material and manufacturing process should reduce the cost to the minimum.

### **3.3 IDEA GENERATION AND SKETCHES**

After finish literature review or study about table, the project is continued with the idea generation and sketches.

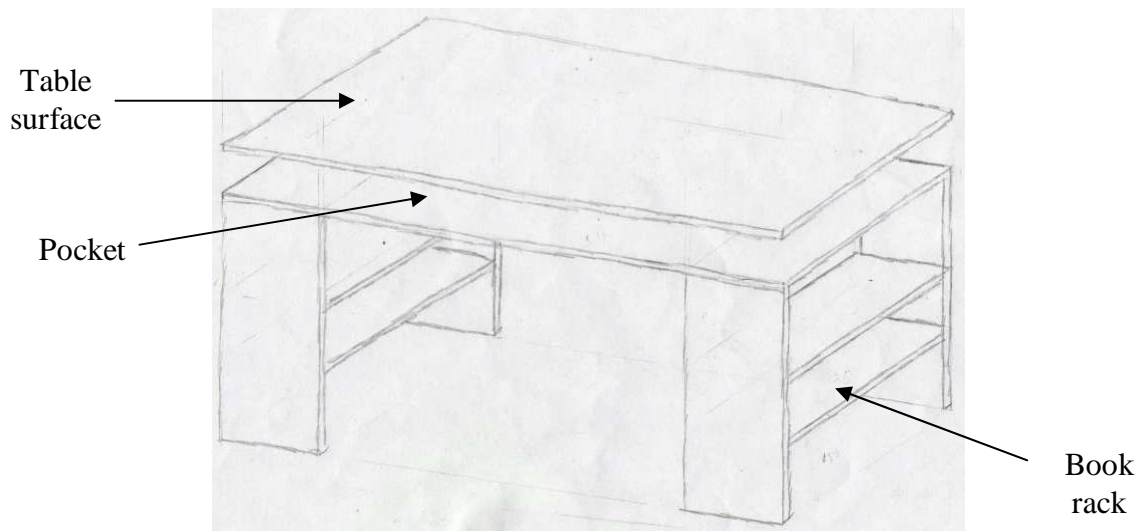
### 3.3.1 Design A



**Figure 3.2:** Design A

This is the design A. It is a simple design and also simple to fabricate. This table has three pockets. So we can put or store several books and drawing tools. This table use aluminum for the cover and pocket. The table surfaces made from sheet metal. The material for chassis is hollow steel. It is light and suitable for this design. The process that will use is welding for the chassis and rivet for the process aluminum joining.

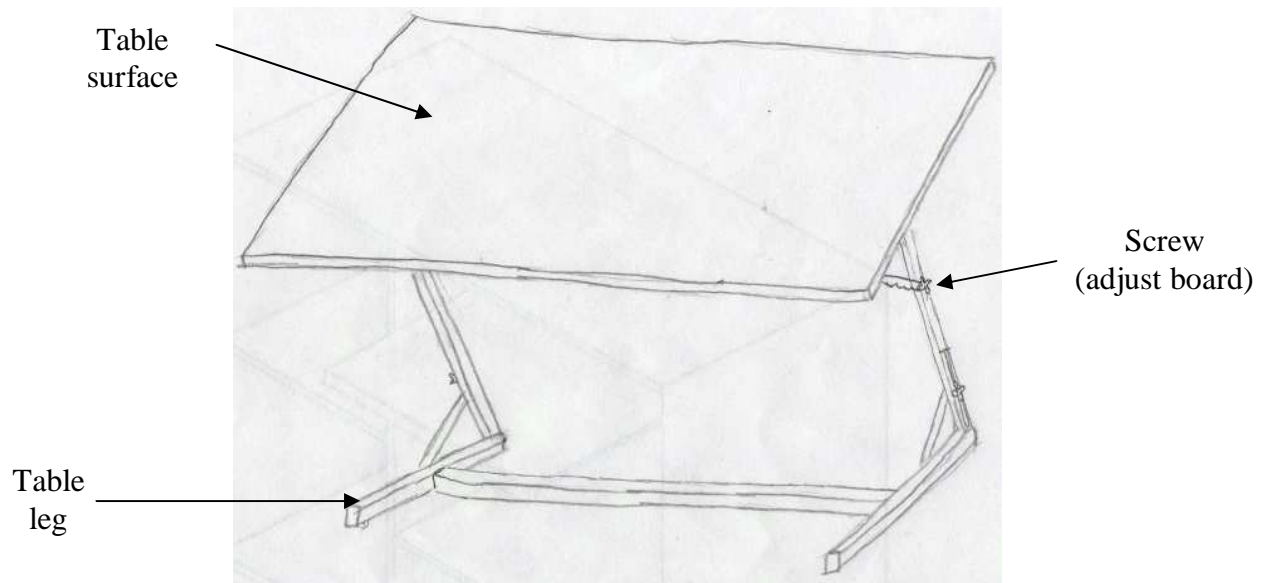
### 3.3.2 Design B



**Figure 3.3:** Design B

This is design B. It possesses two book racks at right and left this table. Aluminum is used for the cover and sheet metal is for the surface of the table and rack. It is easy to be produced and the toughness is good. This table also has pocket under the table surface, so we can put several drawing tools. The material for chassis is hollow iron. The process that will use is welding for the chassis, rivet for the process joining.

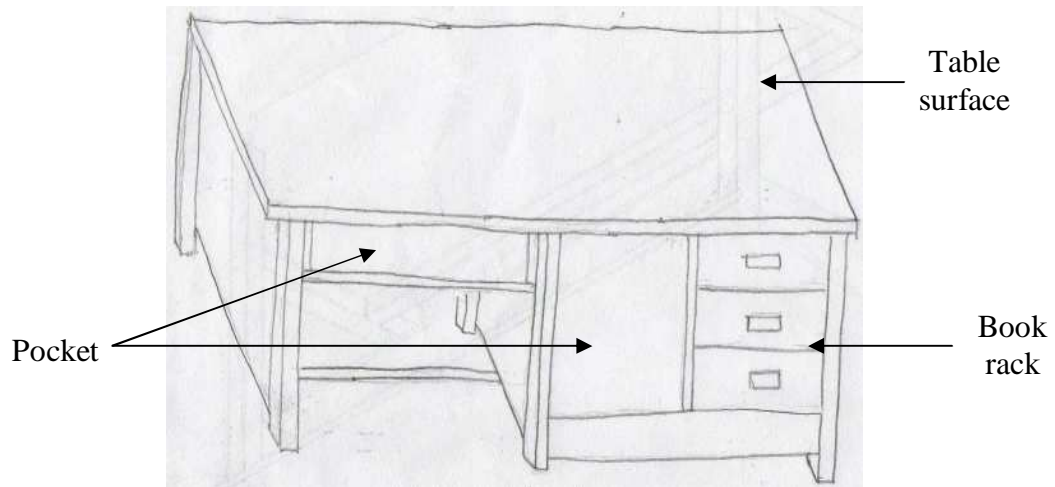
### 3.3.3 Design C



**Figure 3.4:** Design C

This table has a simple design and easy to produce. It design specially for drawing task but not suitable to write on this table. We can adjust the height of this table and the angle of table surface. It is light because it needs less many materials to fabricate. The material for chassis is hollow iron and for table surface is sheet metal. The process that will use is welding for the chassis and rivet for the process sheet metal to chassis. It is easier to produce, faster and cheaper than other table.

### 3.3.4 Design D

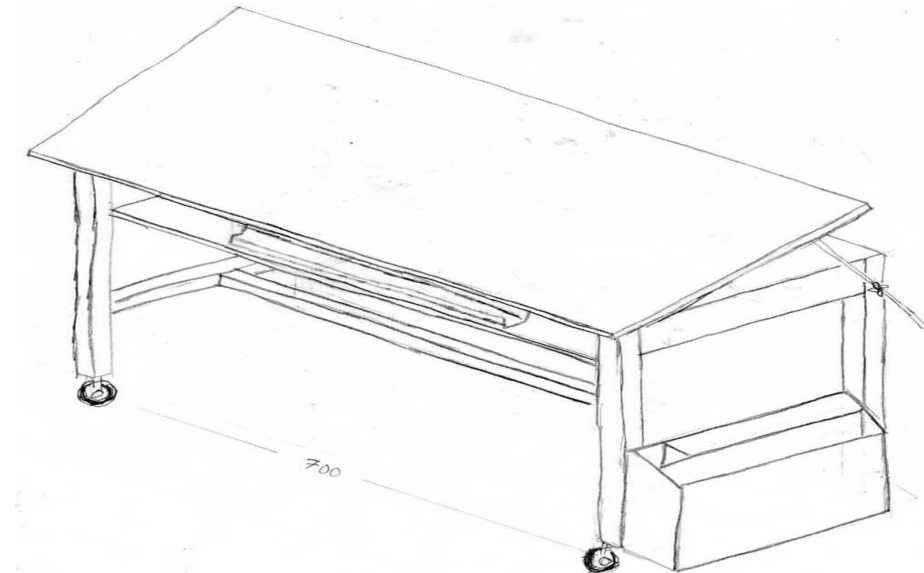


**Figure 3.5:** Design D

This is design D. It possesses one book rack at front of top table and has two pockets. So we can fill by several books and drawing tools. The material that will be used is aluminum for the pocket, drawer and book rack. The material for chassis is hollow iron. This table also uses plywood for table surface. The process that will use is welding for the chassis, and rivet for the joining rack on the table aluminum joining to chassis.



### 3.3.5 Finalized Concept



**Figure 3.6:** Finalized Concept

This is finalized concept. It possesses one side pocket at right side of table. So we can fill by drawing paper. This table also has adjustable board. So student can able to raise up the position of the drawing board depend on their comfort level while make a drawing works. This table is portable because it has wheel. We can put the stationery and book under the drawing board because it has space for keep things. Beside that, at the left side of this table has T-square storage. The material that will be used is aluminum for the side pocket. The material for chassis is hollow iron. This table also uses stainless steel for drawing board. The process that will use is welding for the chassis, and rivet for the joining rack on the table aluminum joining to chassis.

### 3.4 CONCEPT GENERATION AND EVALUATION

This is table to determine the best concept for fabricate multiple function table.

**Table 3.1:** Pugh selection method

Selection Criteria	Concepts			
	A	B	C	D
Customer Request	0	+	0	0
Ease to use	+	+	+	-
Ease to manufacture	0	0	+	-
Comfort	0	+	+	0
Safety	0	0	0	0
Book fill	0	+	-	+
Cost manufacture	0	0	0	-
Finishing	0	0	0	-
Durability	-	0	0	0
$\Sigma +$	1	4	3	1
$\Sigma 0$	7	5	5	4
$\Sigma -$	0	0	1	4
Net Score	1	4	2	-3
Ranking	3	1	2	4

Notes:

+ = Better than

- = Worse than

0 = Same as

### 3.4.1 Result

The Table 3.1 shows the method to evaluate concept that has been designed to determine the best concept multi-purpose table that most ideal to be produced. It can be evaluated through several selection criteria suitable for its functions. From this table, nine selection criteria have been chosen.

The first criteria are customer request. It is important to know what customer needs about this product. It is easier when the product enters the market. Next selection criteria are ease to use. It can evaluate a concept with identify method to fill a book to a rack or take a book from rack.

Beside that, ease to manufacture also has been considered as the selection criteria. It includes a process to fabricate a concept, a material to be used, and other else. The comfort, finishing and safety when using a concept also important.

After that, cost of manufacture also has been considered as the selection criteria. When a concept enters to market, cost is very important to interest customer to buy a concept. Lastly the selection criteria that have been chosen are durability. It can test with make full book into a rack.

According from the table, analysis of the concept selection shows that combination of Design B and Design C. Therefore combination of Design B and Design C is the best concept to be produce.

### **3.5 PRODUCT DESIGN SPECIFICATION**

The product design specification is like below.

#### **3.5.1 Chassis**

The material is 1 x 1 inches hollow mild steel bar

- i. It have four table leg
  - 4 pieces x 30 inches long
- ii. Cross-beam
  - 3 pieces x 36 inches long
  - 4 pieces x 34 inches long
- iii. Using metal inert gas (MIG) for joining to fabricate the chassis.

#### **3.5.2 Table Surface**

- i. The material we will use is steel
  - The wide is 34 inches
  - The length 36 inches

#### **3.5.3 Pocket**

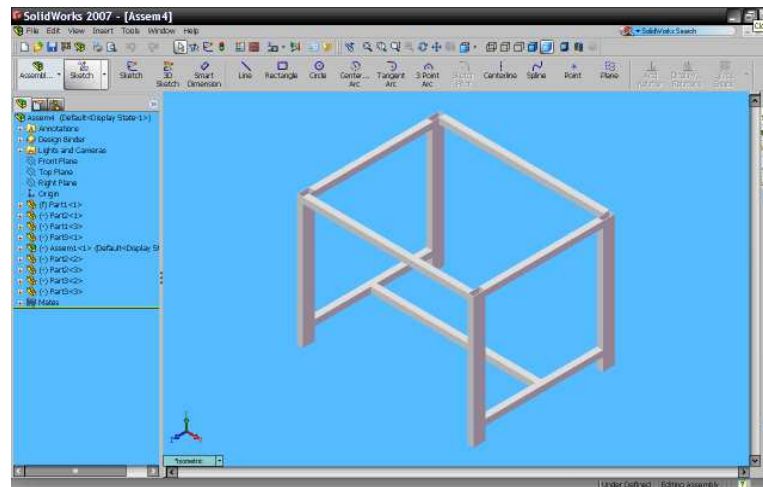
- i. It locate at right side the table
- ii. The material is zinc
- iii. Using welding to join with chassis

### 3.6 ENGINEERING DRAWING OF THE DESIGN

After a design has been selected, the next step is the designing process is dimensioning. The design is separated into part by part and the dimensioning is firstly sketched on paper.

After dimensioning, the engineering drawing of the design is drawn using solidworks application, at this stage solid modeling method is used. Part by part solid modeling created according to the dimension before, after all part created, the 3D model is assembled with each others base on design. All parts is converted into orthographic view to get its engineering drawing detail assemble process is done.

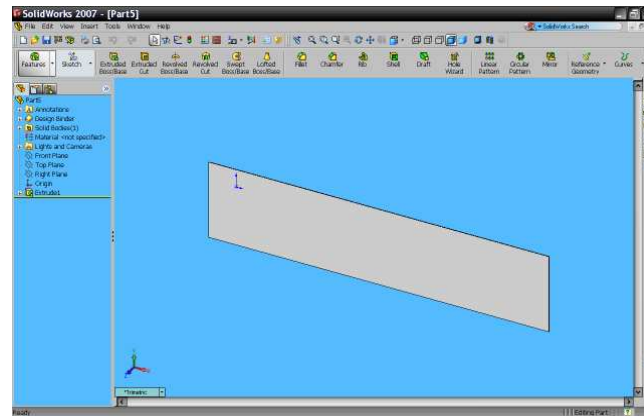
#### 3.6.1 Chassis



**Figure 3.7:** Chassis

The figure 3.7 shows the table chassis drawing using solidwork software. It is create to give more strength for the table.

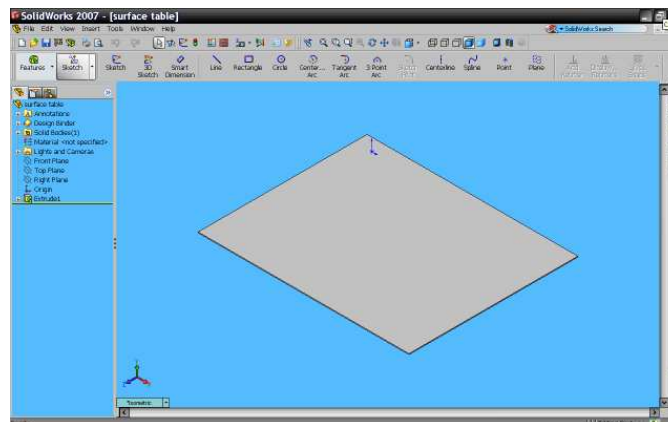
### 3.6.2 Part 1



**Figure 3.8: Part 1**

The figure 3.8 shows a part of a table drawing using solidwork software. This part is located at back and side of a chassis. It creates to avoidance a stationery fall down from drawer and table. It also shows table more tidy and interesting.

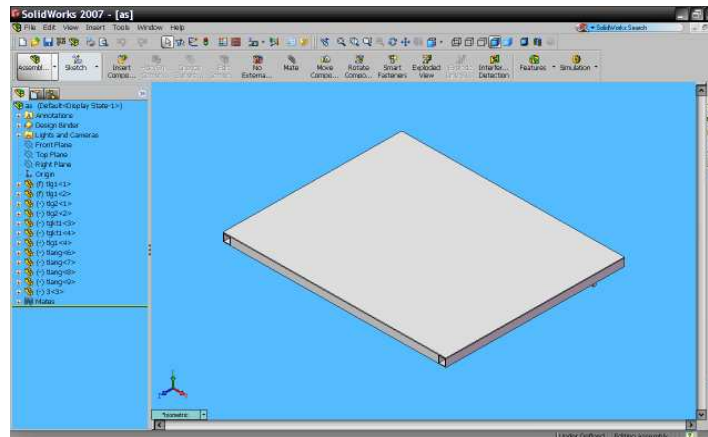
### 3.6.3 Part 2



**Figure 3.9: Part 2**

The figure 3.9 shows a part of a table drawing using solidwork software. This part located under a table. It is create to catch stationery fall down.

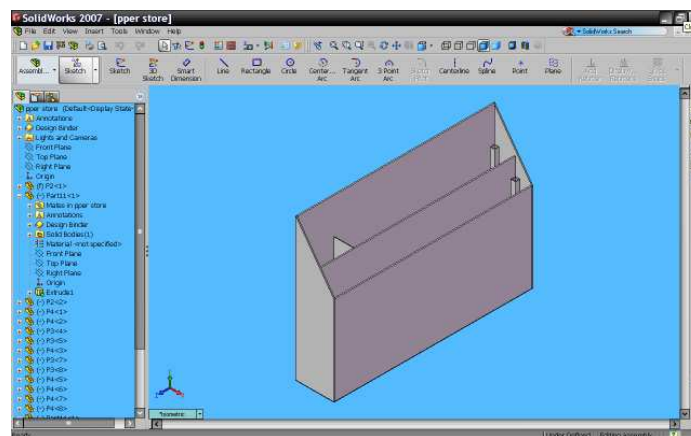
### 3.6.4 Drawing Board



**Figure 3.10: Drawing Board**

The figure 3.10 shows the drawing board drawing using solidwork software. It is located on the table.

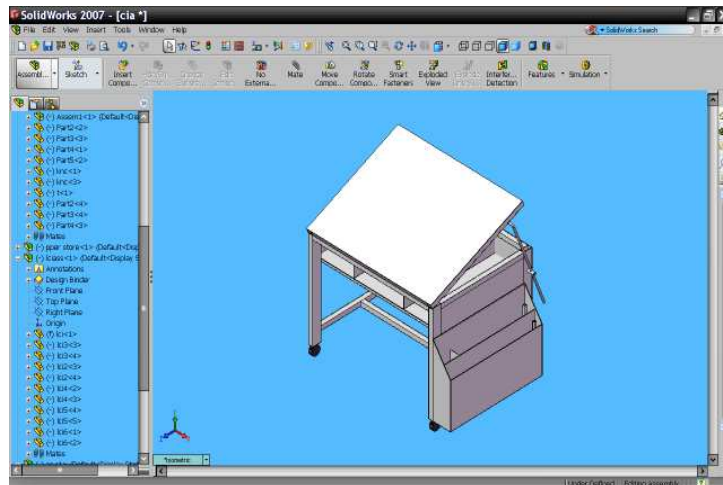
### 3.6.5 Side Pocket



**Figure 3.11: Side Pocket**

This part is side pocket. It is located side the table. User can store or put their drawing paper in this part.

### 3.6.6 Full Assembly Multipurpose Drawing Table



**Figure 3.12:** Multi-purpose Table

## 3.7 CUTTING MATERIAL

After finish design multi-purpose table via engineering drawing, next process is cutting material. The selection of material is depending on material that has been in UMP Mechanical Lab. The acquisition of material must be get agreement from supervisor and lecturer. The cutting process is like below.





**3.13:** Materials at UMP Mechanical Lab



**3.14:** Material Selection



**3.15:** Measurement and Marking



**3.16:** Cutting Material



**3.17:** Removing burr

### **3.8 FABRICATION PROCESS**

After cutting process is fabrication process will take place. This process is about using the material chosen and makes the product base on the design and by followed the design dimension. Many methods can be used to fabricate product for instant punching, shearing and welding. In the project fabrication process needed to make the table is suitable for the application. This was include part by part fabrication until assembly to others component. The fabrication process of multi-purpose table like below.

### 3.8.1 Shearing

The first step for fabrication process is shearing and shearing machine was used. This machine is use to cut a sheet metal. This is process to fabricate several parts such as adjustable board, side pocket, part 1 and part 2.



**Figure 3.18** Setup a machine



**Figure 3.19:** Shearing Process

### 3.8.2 Welding

This is process to fabricate a chassis of the table. MIG welding or metal inert gas has been used to joint this part. Safety when using this machine is important to avoidance from injury.



**Figure 3.20:** MIG welding machine at UMP mechanical lab



**Figure 3.21:** Welding process



### 3.8.3 Drilling

After finish welding process, the fabrication is continued with drilling process. The process is to make a hole before using a rivet to join several parts.



**Figure 3.22:** Drilling process

### 3.8.4 Rivet

After finish drilling process, the fabrication is continued with rivet process.



**Figure 3.23:** Rivet process

### 3.9 FINISHING

After finish joins several parts into chassis, the next step is finishing process. This process is divided into several stage such as removing burr, surface cleaning and painting. The table will look interesting when using this process.

#### 3.9.1 Removing Chip

This process is for removing burr after using a several process like welding, drilling, punching and other process. It is also for avoidance from injury when using this table because this burr is having sharp edge.



**Figure 3.24:** Process removing chip

### 3.9.2 Painting Process

After finish all process, the fabrication is continued with painting process. This process is to cover the material from rust and to have better appearance.



**Figure 3.25:** Painting a rack



## **CHAPTER 4**

### **RESULT AND DISCUSSION**

#### **4.1 INTRODUCTION**

This chapter will discuss about the project. It includes the completed product, types of defects, product specification and cause of problem of the project. The analysis also was helped to give improvement of the table. It also will show the product defect and defect troubleshooting. This analysis also to compare between of the planned product specification with product specification when completed fabricates.

#### **4.2 RESULT**

After finish fabrication process, all information about this product is collected and gathered. It is important to classify the product before it can use. The complete fabrication multi-purpose table like below.



**Figure 4.1:** Isometric view



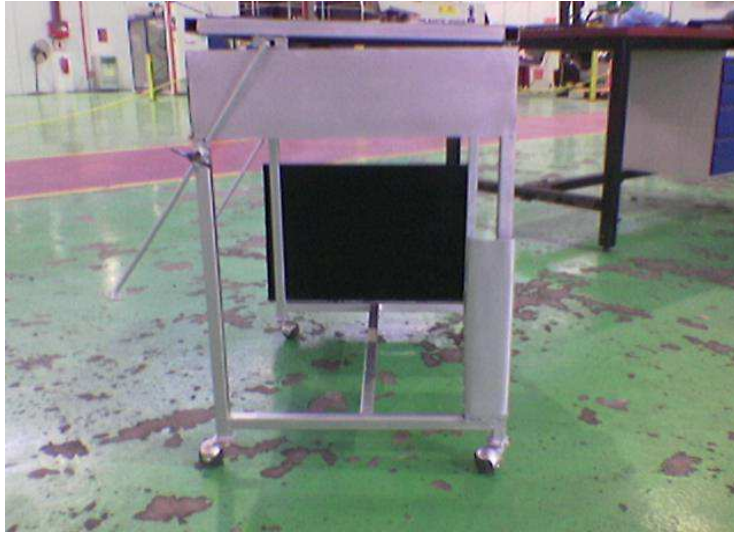
**Figure 4.2:** Front view



**Figure 4.3:** Rear view



**Figure 4.4:** Side view (right)



**Figure 4.5:** Side view (left)

#### 4.2.1 Product Specification

This is another example of analysis process. The product is classify to several category such as weight, colour, wide, height and other else. The product specification is like below.

**Table 4.1:** Table of product specification

Category	Specification
Weight	30 kg
Colour	Flat silver and black
Wide	38 inches
Height	32 inches
Maximum force can be load	1000 N

#### 4.3 DISCUSSION

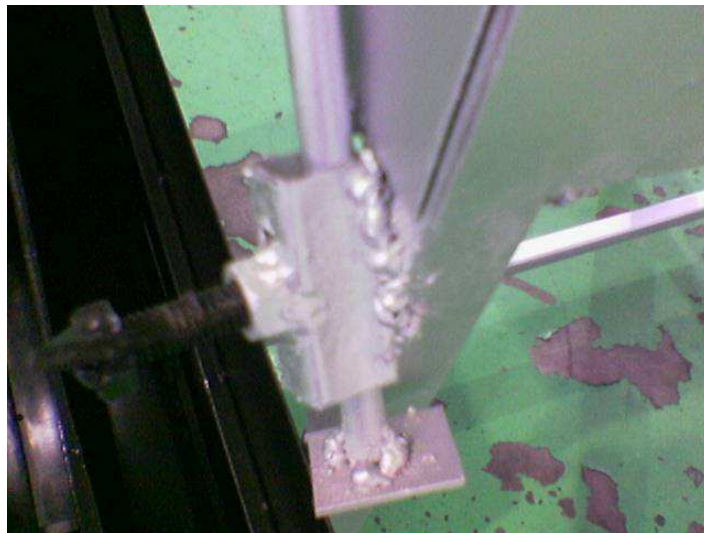
Discussion is divided into two parts. Firstly is discussion about type of defect on the final product .Second, is about the problem in progress start with literature review until fabricate and finish this product.

### 4.3.1 Types of Defect

After finish fabrication process, many types of defects are exist. It happens from fabrication process and the weakness using several machine and tool. At the same time, this event can give someone more experience and knowledge. Type of defects is like below.

#### i. Bead

Figure 4.6 is an example for a defect in chassis. The bead is not trim from welding process. The voltage when welding process is not suitable for this material. Insufficient experience to handle this machine also cause of the defected.



**Figure 4.6:** Bead at the chassis

## ii. Gap

Figure 4.7 is shown a defect in part .It is occurring after using arc welding. This defect happens cause by the chassis not has flat surface and careless in measuring process.



**Figure 4.7:** Gap between two materials

## iii. Not Parallel

This defect happen cause by less skill when process weld the legs of this table. When the legs is not place at the flat surface during weld the leg.



**Figure 4.8:** Leg not parallel

### **4.3.2 Problems in Project**

Many problems occur in progress to design and fabrication of this table such as gather raw data and literature review, design and fabrication. The problem in project is as below.

#### **i. Literature Review**

The problem during literature review is mainly about the difficulty to know about the title such scope, concept and how to fabricate it into reality. Raw material also the problem encountered during this step because the raw material at UMP mechanical lab not available for the first design the project .The whole design was change to suitable with material available at UMP mechanical lab and the problem like limited resources to get the relevant and suitable materials such as books and internet connection problem.

#### **ii. Problems in Design**

The problem also occurs at this step. The problem came during decision making to design that suitable with available machine in UMP mechanical lab .During this period many concept design have been find out when to choose one design that have all criteria needed by specification is can proceed and running machine. After a design is selected, another problem encountered is detail dimensioning, the dimension should suitable with scope of the project and after consider all part and material use the dimensional was suitable with project scope.



### **iii. Problems in Fabrication**

Problem during this stage is very critical that cause the actual progress not according to the project planning schedule. First, the problem is to find material that suitable for the product. The suggested material to produce drawing board and side pocket for this table is not available such as mild steel sheet metal. After considering all problems about the availability of the material, the design for the project was change with constraint to the available material.

The problem also occurs during fabrication process. It is hard to fabricate the material with the changed design and it is difficult to apply machining process such as using the shearing machine.

## **4.4 TESTING AND ANALYSIS**

After the fabrication is finished, the product is been analyzed and tested. At this stage, it will discuss and describe about the function of the important part of this table such as drawing board, side pocket, and T-store.

#### 4.4.1 Adjustable Board

Figure 4.9 shows the important part of this table, that is adjustable board. Student able to raise up the position of the drawing board depends on their comfort level while make a technical drawing.



**Figure 4.9:** Student doing a technical drawing

#### 4.4.2 T-square Storage

Figure 4.10 shows the T-storage. It place at left side of this table. It functions to store T-square while we do not use it.



**Figure 4.10:** T-square storage

#### 4.4.3 Side Pocket

Figure 4.11 shows the side pocket. The function of this side pocket is to store the drawing paper. This side pocket is dividing into several parts. It can make easy to store drawing paper because drawing paper has several size such as A1, A2, A3 and A4 size.



**Figure 4.11:** Side pocket

#### 4.4.4 Portable

This table is user-friendly. It is because this table has wheel, so it easy for student to move this table wherever he want or desired.



**Figure 4.12:** Table moveable

## **CHAPTER 5**

### **CONCLUSION AND RECOMMENDATION**

#### **5.1 INTRODUCTION**

For the final chapter it represent about conclusion and recommendation for the project. The important things for this chapter are about the problems encountered during the whole project carried out. The problem are included the process planning that had been done. These project problems also make the student to think more creative to solve the problem. This chapter will also discuss about the conclusion of the project, concluding all the process involved. Beside, this chapter also contains recommendation about the project. So for this recommendation it can make improvement about the project for future work.

#### **5.2 CONCLUSION**

As the conclusion, the objective of the project achieved. The table have a better space for better arrangement of book, paper and engineering drawing stationery. This also can help the consumer to have a conducive environment while comply their task. Beside that, this table is portable because it has wheel so it easy for student to move this table wherever he want or desired. This table also was improved their ergonomic factor for the human being doing task by using the table. It also was introduced new concept of the table that meets people specification.

### **5.3 RECOMMENDATION**

After complete this task, this table look more interesting and more ergonomic if give improvement or add several parts for another function. Surface table should be change from steel to plywood. It is because plywood will better than stainless steel in terms at conduciveness. In addition, plywood also lighter than stainless steel. Thus, the specification of the table is enhanced.

The material side pocket of table also can give improvement. At this part, the material is suitable is plywood and it also easy to fabricate.

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## APPENDIX A

## DETAIL DRAWING OF THE PART

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MALAYSIA  
PAHANG**

**SUPERVISOR:**  
EN. IDRIS BIN MAT SAHAT

**OBJECT AND  
REFINE SHARP  
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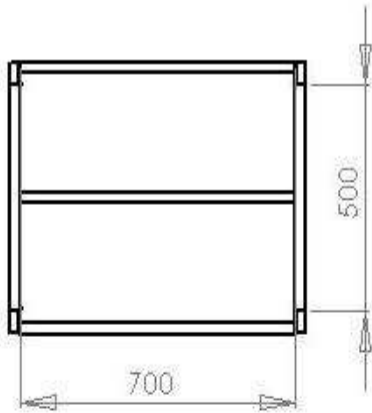
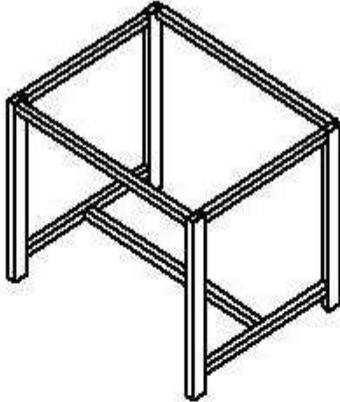
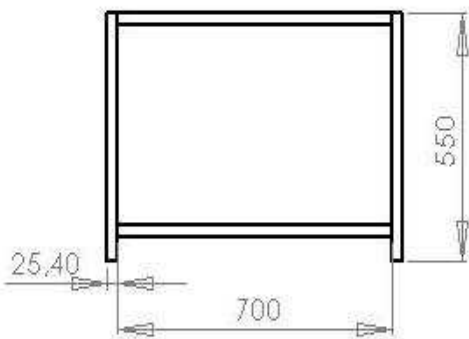
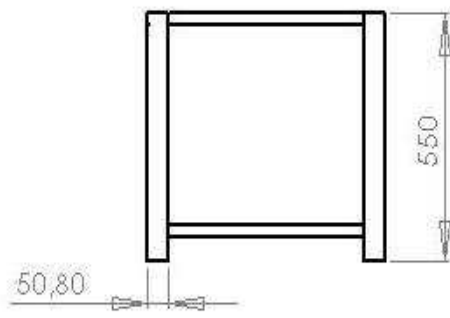
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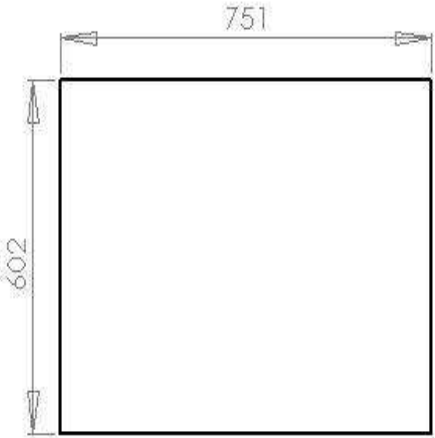
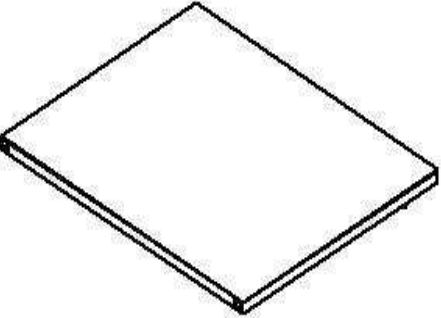
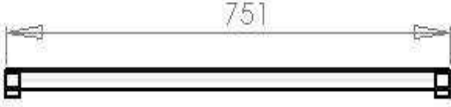
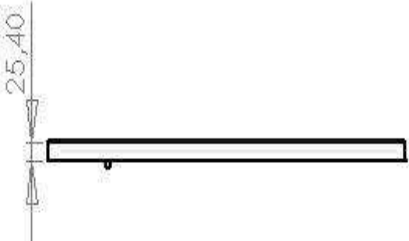
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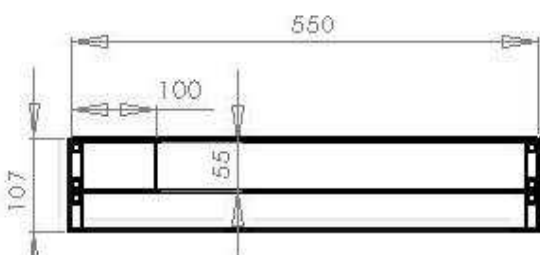
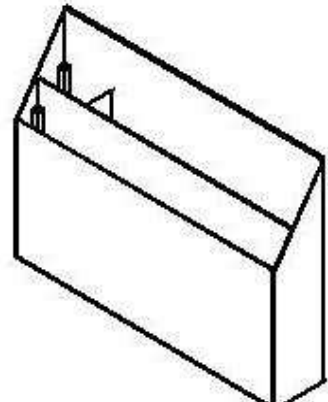
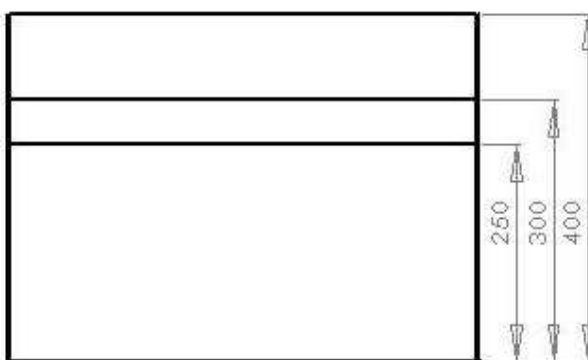
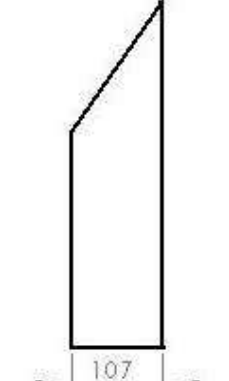
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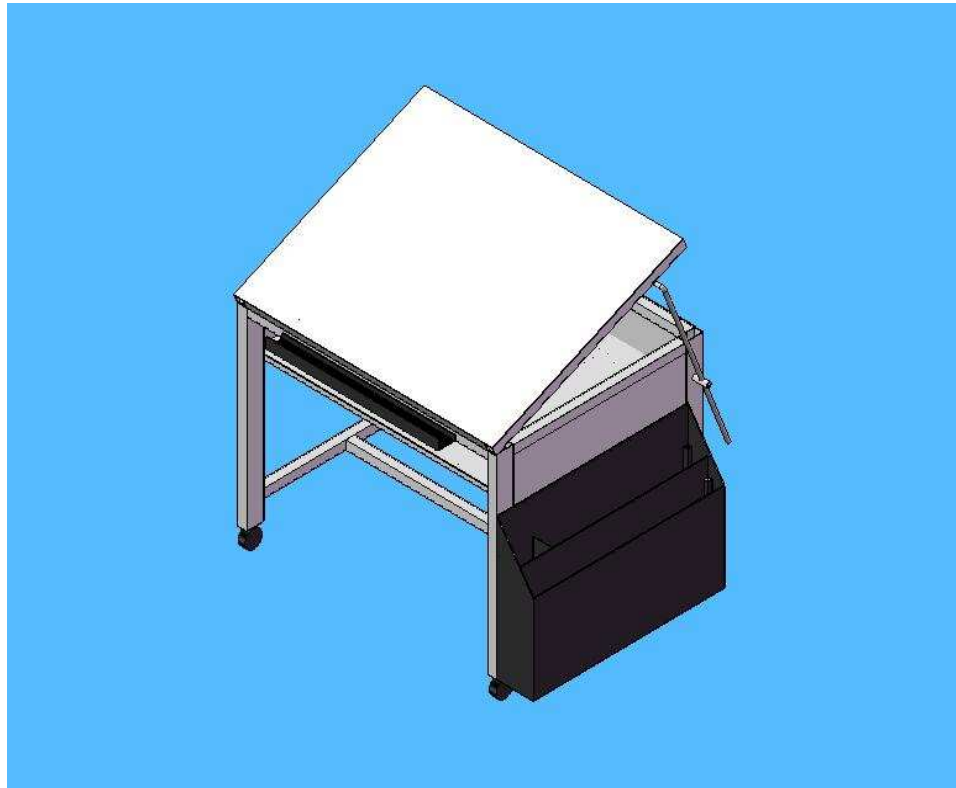
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**APPENDIX B****PART OF ASSEMBLY**

## APPENDIX C

### COMPLETE PRODUCT

