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**BORANG PENGESAHAN STATUS TESIS**

**JUDUL: DESIGN AND FABRICATION OF PORTABLE KITCHEN FOR OUTDOOR USE**

**SESI PENGAJIAN: 2008/2009**

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DESIGN AND FABRICATION OF PORTABLE KITCHEN FOR OUTDOOR USE

MUHAMMAD HAFIZ BIN ABDUL LATIP

A report submitted in partial fulfilment of the requirements  
For the award of the  
Diploma of Mechanical Engineering

Faculty of Mechanical Engineering  
UNIVERSITI MALAYSIA PAHANG

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### **STUDENT'S DECLARATION**

I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged. The thesis has not been accepted for any degree and is not concurrently submitted for award of other degree of Diploma of Mechanical Engineering.

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## **ABSTRACT**

The study of manufacturing was very important in order to carry out this project to ensure that the student understand on what are needs to do. This project is about designing and fabricating the Portable Kitchen to solve problems that most user encounter when doing outdoor cooking activities. First is portability and second is multipurpose. This project involves designing the kitchen by searching in the internet and on local hardware shop but unfortunately no design is appropriate. So, this product design is an original idea. After completing design process, it is made real product by many manufacturing method. This project also require to ensure the safety for the indeed of publishing. Methods and process involve in this project for instance joining using MIG welding, cutting using shearing method and a finishing processes. This project in mainly about generating a new concept of portable kitchen for outdoor use that can fulfil the need of outdoor cooking. After all process had been done, this kitchen may help us to understand the fabrication and designing process that involved in this project.

## ABSTRAK

Pembelajaran mengenai pembuatan adalah penting untuk menjalankan projek ini bagi memastikan pelajar memahami tentang perkara yang perlu dilakukan. Projek ini adalah mengenai merebentuk dan membuat Dapur Aktiviti Luar Mudah Alih bagi menyelesaikan masalah dimana kebanyakan pengguna hadapi semasa sedang menjalankan aktiviti memasak diluar rumah. Pertama ialah mudah alih dan kedua pelbagai guna. Projek ini melibatkan proses merekabentuk dapur dengan cara melayari diinternet atau mencari produk serupa di kedai perkakasan tempatan akan tetapi tiada idea dapat diperolehi. Jadi, rekabentuk produk ini adalah idea asal. Selepas siap proses merekabentuk, rekabentuk dijadikan produk sebenar dengan beberapa proses pembuatan. Produk ini juga melibatkan ciri-ciri keselamatan bagi pengguna untuk tujuan pemasaran. Kaedah dan proses yang terlibat dalam projek ini bagi penyambungan segera menggunakan proses kimpalan (MIG), memotong menggunakan kaedah terikan dan proses penyudah. Projek ini sebenarnya melibatkan proses menjana konsep baru dalam menghasilkan dapur mudah alih yang dapat memenuhi keperluan untuk memasak diluar rumah. Selepas semua proses telah terlaksana, dapur mudah alih ini akan membantu kita tentang pemahaman proses merekabentuk dan penghasilan yang terlibat dalam projek ini.

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## **INTRODUCTION**

### **CHAPTER 1**

#### **1.1 Project Title**

The title of this project is “Design and Fabricate Portable Outdoor Kitchen for Outdoor Activities”. Fabrication of the foldable table is concern to portability, strength and user friendly. New concept requires improving function and portability.

#### **1.2 Project Synopsis**

This project is Design and Fabricate Portable Kitchen for Outdoor Use. The project involves processes to design and fabricate Portable Outdoor Kitchen for Outdoor Use. The fabrication of this product concern mainly on the strength, durability, easy and more function of the portable kitchen. The kitchen is designed to solve difficulty to bring anywhere and function. In addition, modification is made to solve the problem. Also, acquire the skills of design, analysis and fabrication.

#### **1.3 Project Background**

At this moment, portable kitchen is rarely been seen that have the portability and function. Most of the market available product only serve one function and

always large in size. This project is serve 2 in 1 function and have the desired portability.

We know that kids' today even adults' loves outdoor activities and the demand for more innovation of cooking stoves is needed. This product is designed to be portable as to make the product can be carried alone as most other product require a bag. Different manufacturer had produced different kind of shape and function but the problem still exist.

Portable kitchen is a cook ware that can be carried from one place to another with ease. This project carry method is as same as a bag. It is very useful for outdoor activities and also picnic. However to have more function means to reduce appearances.

## **1.4 Project Objectives**

Project objective divide by two. It is general objective and specific objective for the title of the project.

### **1.4.1 General Objective**

Diploma final years project objective is to practice the knowledge and skills of the student that have been gathered before in solving problem using academic research to born an engineer that have enough skill, This project also important to train and increase the student capability to get knowledge, research, data gathering, analysis making and then solve a problem by researching of scientific research.

The project also will educate the student in communication like in presentation and educate them to define their research in presentation. The project also will generate students that have capability to make a good research report in

thesis form or technical writing. This project also can produce and train student to capable of doing work with minimal supervisory and more independent in searching, detailing and expanding the experience and knowledge.

Nevertheless this project is also important to generate and increase interest in research work field.

#### **1.4.2 Specific Project Objective**

The objective for this project is:

- (i) To produce the product that can be utilized as kitchen for outdoor activities.
- (ii) To fabricate and introduce the new concepts and ideas for future prospect of portable kitchen.
- (iii) To produce portable kitchen that can be used anywhere.

#### **1.5 Problem Statement**

Nowadays people are facing problem while the need to bring kitchen from one place to another and need more space when store with other thing. Thus, with the development of this portable kitchen, it hope that it can contribute to give ideas how to solve problem about space to store and bring one place to another and have more function.

#### **1.6 Project Scope**

The project scope of this project is to:

- (i) Design a portable, lightweight and user friendly kitchen.



- (ii) Must be made of non-toxic material.
- (iii) Can cook food like rice and grill fish and meats.
- (iv) The manufacturing process must save time and cost

### **1.7 Project Gantt chart**

A Gantt chart is a chart that depicts progress in relation to time, often used in planning and tracking a project. For the figure of the project Gantt chart see appendix C.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 Introduction**

A kitchen is ware that used to cook and portable is term used to describe things that can be carried or moved with ease. We already know that many outdoor kitchens are designed whether it is too large or too small and have only one function. So some innovations have been seen that can make an outdoor kitchen portable like adding some wheels and using other more lightweight materials. Portable kitchen is a cooking stove a cooking stove that can be carried from one place to another with ease. A portable kitchen is essential in camping or outdoor BBQ because of its characteristics and advantages. Many products in the market that have our self-specification, shape and type manufacture by different manufacturing company. Research review about foldable table is to gather data to make a new concept of portable kitchen.

#### **2.2 Technical Review**

Technical review of product shows a detail of product such as description, specification and sometimes product overview. Here is the technical review of available portable kitchen available in market.



**Figure 2.1:** Portable Kitchen (PK99470)

**Product Description:**

The Portable Kitchen® is the finest cast aluminium barbecue grill available on the market today. The classic design of our unique barbecue grill will enhance the beauty of your patio or deck. The durable construction of this grill will ensure many years of enjoyment grilling, smoking or roasting your favourite recipe. The hinged grid allows easy refuelling with charcoal or wood chips during low heat smoking and roasting. The versatility of this grill allows you to use it as a smoker, high-heat searing, or slow roasting, you'll have unbeatable cooking control. While The PK Grill is an excellent addition to any backyard, the oven can be easily be detached for tailgating and camping.



**Figure 2.2:** Bongos Portable Kitchen

Product Description:

The Portable Kitchen® is the finest cast aluminium barbecue grill available on the market today. The classic design of our unique barbecue grill will enhance the beauty of your patio or deck. The durable construction of this grill will ensure many years of enjoyment grilling, smoking or roasting your favourite recipe. The hinged grid allows easy refuelling with charcoal or wood chips during low heat smoking and roasting. The versatility of this grill allows you to use it as a smoker, high-heat searing, or slow roasting, you'll have unbeatable cooking control. While The PK Grill is an excellent addition to any backyard, the oven can be easily be detached for tailgating and camping.



**Figure 2.3:** Portable Kitchen

#### Product Description:

This ingenious, somewhat portable kitchen unit was designed by *Aurelien Banerjee & Olivier Picard* and is also known as a mobile *cuisinette*. It's manufactured out of the same kind of stainless steel found in professional kitchens and reportedly can be transported in a station wagon.

### **2.3 Basic Parts**

The basic parts of a Grill are divided into three parts:

- (i) Cooking Grid: Used to place meat and raw materials.
- (ii) Charcoal container: Used to place charcoal and burning materials.
- (iii) Body parts: Stores Charcoal container and Cooking grid.

## CHAPTER 3

### METHODOLOGY

#### 3.1 Project Flow Chart

For the diagram as shown figure 3.1, the project starts with literature review and research about the title. This consist a review of the concept of portable kitchen, portable kitchen features and type of portable kitchen that are used for camping, outdoor cooking and other outdoor activities. These tasks have been done through research on the internet, books and other sources.

After collected all the relevant information, the project get through to design process. In this step, from the knowledge gather from the review is use to make a sketch that is suitable for the project. After three sketched, design consideration have been made and one design have been chosen. The selected design sketched is then transfer to solid modelling and drawing using solid work application. The material and the measurement needed for the foldable listed down and calculated to give an ergonomic shape of the foldable table.

After the needed material is list, acquisition step take places. There are only a few materials that need to be bought such as Gloss spray, hinge and other finishing product. Some material is well prepared by the laboratory such as sheet metal, square hollow metal can be acquired.

After all parts needed have been gathered, the project proceeds to the next process and that is fabrication process. The finished drawing and sketching is used as

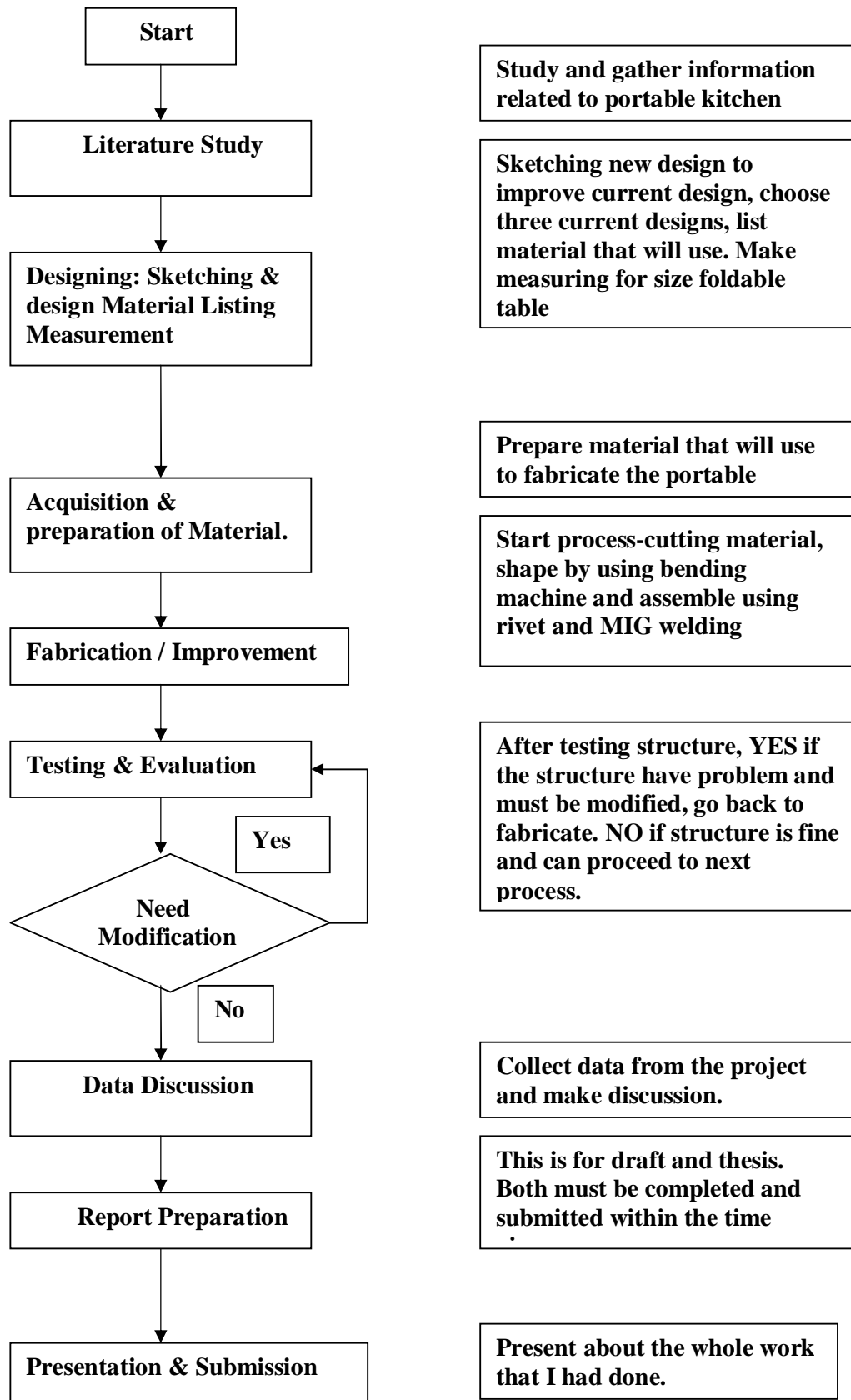
reference by following the measurement and the type of material needed. The fabrication process that involved is cutting, welding, grinding and other. After every process is finished, the parts are check to make sure that the output of the process is according to the product requirement.

If all the parts had been processed, the parts are joined together to produce full-scale foldable table. Here come the testing and evaluation process. The foldable table will be test to see if it fulfils the requirement such as portability, stability, strength and functionality. During the testing, if problem occur such as malfunction or unstable, the portable kitchen will step back to previous process to fixed back the problem. The portable kitchen is expected to have an error that may cause the part to be redesigned again. The foldable table is finished by doing some finishing process such as spraying the portable kitchen.

After all parts had been joined together, comes the last phase of the process that is data discussion. In data discussion, the draft report and all related articles are gathered and hand over to the supervisor for error checking. The finish product will be compare with the report to make sure that there is no mistake on both report and project.

After the product and report had been approve by the supervisor, the report is rearrange and print out to submit at the supervisor, the project coordinator and faculty of Mechanical Engineering. In this stage, the final presentation was also being prepared and waited to be presented.

**Figure 3.1: Project flow chart**





### 3.2 Design

The design of the Portable Kitchen for Outdoor use must be compliance to several aspects. The design consideration must be done carefully so the design can be fabricated and the parts are all functioning. The aspects that must be considered in designing the Portable Kitchen are:

- i) Ergonomic Factors: Portable kitchen must be user friendly as easy to use and portable.
- ii) Strength: It is second of important design criteria in designing Portable kitchen. This is because portable kitchen is mostly bought to a forest with harsh condition and that is why strength is needed.
- iii) Material: Availability of material is one of aspects that have been considered. The material available can be used depend on their purpose.
- iv) Cost: The cost of whole system must be not exceeding from budget given and also reasonable.
- v) Environment: The portable kitchen is suitable to be use in all places such as picnic place, camping except in a house because it may lead to lost of property.

### 3.3 Drawing

The drawings are divided into two categories, which are:

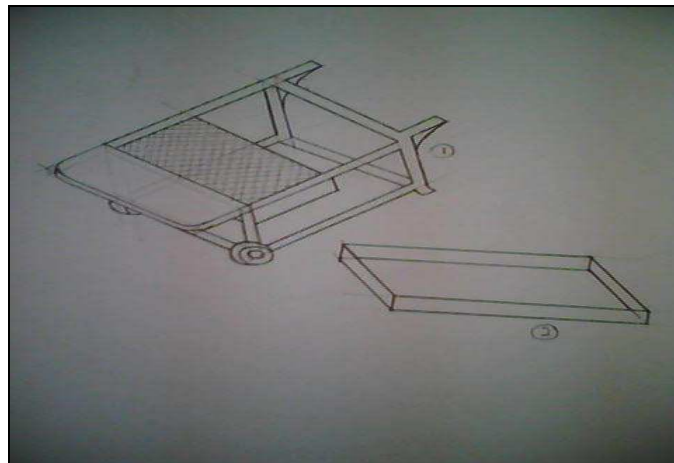
- i) Sketching: All the ideas for Portable Kitchen fabrication are sketched on the paper first to ensure that ideas selection can be made after the selected design chose.
- ii) Solid Works Application: The design or concept sketched is transfer to solid modelling and drawing using Solid Work application.

### 3.3.1 Sketching and Drawing Selection

From the existing ideas, only five sketching that had been chosen to be considered as the final ideas, which are:

### 3.3.2 Concept A

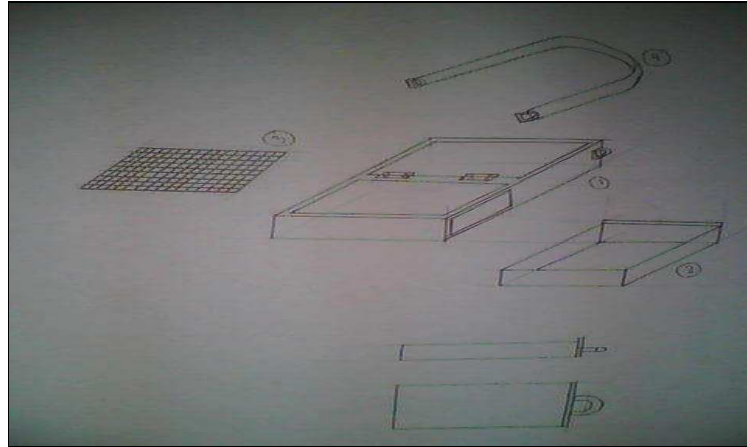
This concept is the datum concept to generate other concept and make comparison with other concept. This concept is a market product concept that is designed to be used as near house portable kitchen. It is not suitable to be used in the forest because of its size and design.



**Figure 3.2:** Concept A (Datum)

### 3.3.3 Concept B

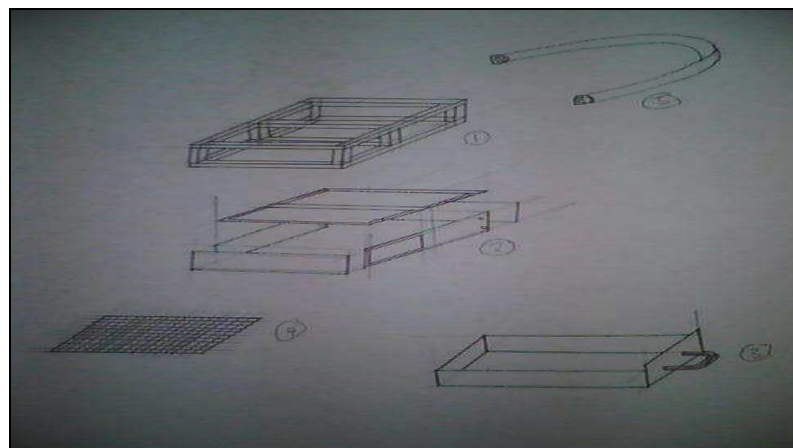
This concept is generated with a discussion with my supervisor. This concept uses a drawer-like style to store charcoal and cooking tools. It has the portability but not the strength. The carry method of this concept is like carrying a bag. It is also difficult to produce.



**Figure 3.3:** Concept B

### 3.3.4 Concept C

This concept is generated from concept B. It is an improved design of concept B because it has higher strength because the inside part is designed with high strength material. It is also easier to produce because it utilizes the MIG welding method. This concept carry method is same as concept B.



**Figure 3.4:** Concept C

### 3.4 Concept Generation and evaluation

Two concepts for the portable kitchen were developed. These are evaluated against the datum of the standard portable kitchen.

		Concept A	Concept B	Concept C
1	Lightweight	4	2	4
2	Portability	4	3	4
3	High strength	3	4	5
4	Cost efficiency	3	2	4
5	Easy to handle	4	4	4
6	Quantity of material	4	3	3
7	Easy to manufacture	2	2	4
8	Maintenance	3	4	4
9	Heat transfer efficiency	4	3	4
10	Functionality	3	3	4
		34	30	40

* Legend	
Satisfactory	1 to 3
Intermediate	4
Excellence	5

**Table 3.1:** Metrics

		Concept variants		
	Selection criteria	Concept 1	Concept 3	Concept 2
1	Lightweight	(+)	(+)	0
2	Portability	(+)	(+)	0
3	High strength	(-)	(+)	0
4	Cost efficiency	0	0	0
5	Easy to handle	(+)	(+)	0
6	Quantity of material	(+)	0	0
7	Easy to manufacture	(-)	(+)	0
8	Maintenance	(-)	(+)	0
9	Heat transfer efficiency	(+)	(+)	0
10	Functionality	0	(+)	0
Pluses (+)		5	8	
Minuses(-)		3	0	
Sames		2	2	
Net		3	8	
Rank		2	1	
Continues		No	Yes	

**Table 3.2:** Pugh analysis

Notes:

+ = Better than

0 = Same as

- = Worse than

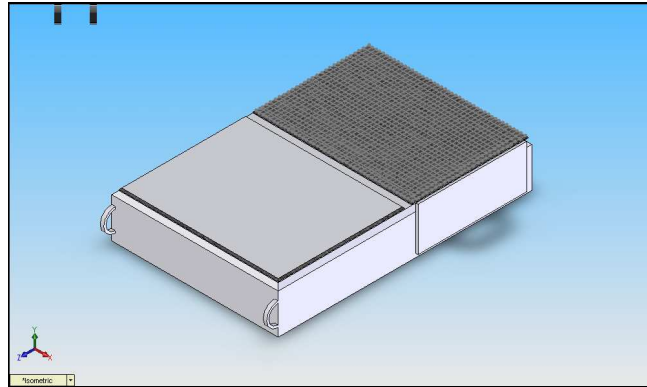
From the concept of selection table, the advantages and disadvantages of the design can be outlined. Criteria or characteristic for the product to be fabricated are the important thing to consider, before fabrication process. Ten criteria are been chosen to be considered. According to the table, study of the concept selection shows that Final concept scores the highest positive signs. As we can see on the figure in Final Concept, the portable kitchen is more easy to use and easy to bring anywhere.

This is also more durable because it using the material where formed from square hollow steel. The inside part of the portable kitchen is made from square hollow steel. The drawer-like charcoal container is made from sheet aluminium because of its heat resistant. Its outer is part is made from sheet metal for strength. Because of that, the Final Concept is the best selection to fabricate the Mini Foldable Table.

### **3.5 Computer Aided Design Drawing**

After a design has been selected, the next step in designing process dimensioning. The design is separated into part by part and the dimensioning process is firstly sketched on paper. The dimensioning is base on relevant dimensions and also referring the existence portable kitchen so that the design is fit into other part.

After dimensioning, the drawing of the design is drawn using Solid Works application; at this stage solid modelling method is used. Part by part solid modelling creates according to the dimension done before, after all the part created, The 3D model assemble with each other base on the design.



**Figure 3.7:** Overall view of the design

### 3.6 Design Specification

Based to the drawing and sketching selection, after generate and evaluated the best concept selection. The Final concept is the best design that can be fabricated. Table 3.7 is the detail product design specification of the Final Concept:

Parts	Material	Type	Size(mm)	Quantity
1	Mild steel	Square hollow	430 x 12.7 x 12.7	4
2	Mild steel	Square hollow	290 x 12.7 x 12.7	6
3	Zinc	Sheet Metal	290 x 130 x 3	2
4	Zinc	Sheet Metal	215 x 130 x 3	2
5	Zinc	Sheet Metal	290 x 215 x 3	2
6	Zinc	Sheet Metal	290 x 430 x 3	1
7	Zinc	Sheet Metal	430 x 130 x 3	1

8	Metal	Hinge	25 x 20 x 2	4
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**Table 3.3:** Design Specification

### 3.7 Fabrication Process

After designing phase, fabrication process takes place. These processes are about using material selection and make the product base on the design and by followed the design dimension. Many methods can be used to fabricate a product, like welding, cutting, drilling and many more method. Fabrication process is a process to make only one product rather than manufacturing process was used at the whole system production. This way include part fabrication until assembly to others component.

#### 3.7.1 Process Involve

In order to make the design come reality, fabrication process needs to be done first. The fabrication process starts from dimensioning the raw material until it is finish as a desire product. The processes that involve are:

i) Getting material

Figure 3.7 introduce the material have in UMP mechanical laboratory. This rack has more type of steel like L-shape sheet, square hollow steel, cylindrical hollow and non-hollow aluminium and steel and etc.





**Figure 3.8:** Material

ii) Measuring and Marking

After getting the material, the next step is measurement and marking material like in Figure 3.8. The equipment used in this process is measuring tape and marker pen. The scale is from solid work software and this scale is the true.



**Figure 3.9:** Measurement and marking the material

iii) Cutting material

Figure 3.10 introduce the process of cutting the material using floor cutter disc after measurement and marking process.



**Figure 3.10:** Cutting the material

iv) Shearing material

Shearing is a metal fabricating process used to cut straight lines on flat metal stock. During the shearing process, an upper blade and a lower blade are forced past each other with the space between them determined by a required offset. Normally, one of the blades remains stationary.



**Figure 3.11:** Process of Shearing sheet metal

v) Bending Process

After shearing process the sheet metal will undergo process of bending using Bending Machine to get true shape for the project.



**Figure 3.12:** Process of bending sheet metal

v) Joining Process

Figure 3.11 introduce about joining method using MIG welding. This process is used to joining the part using steel. The joining parts are base, their frame and also the cover of the frame.



**Figure 3.13:** MIG welding process

vii) Grinding Process

After cutting, shearing and welding process the sharp edge and the burr is removed using hand grinder show is Figure 3.10 to remove chip after cutting, shearing and welding process to remove beads before and after joining process. This step is crucial to remove dangerous sharp edge.



**Figure 3.15:** Grind using hand grinder

### **3.7.2 Process Procedure**

**Step 1:** Measuring the material into the require dimension based on design specification. 12.5 mm x 12.5 mm square hollow steel was the first material that measure. Second, sheet metal is required after order than it is measured and marked. All the measuring and marking process is done by using steel ruler, measuring tape, and steel marker.

**Step 2:** Cut the material into its desired length based on measuring and marking process by using floor cutter disc for hollow steel. Before proceeding with this process, safety measurement had been carried out by wearing Personal Protective Equipment (PPE) such as goggle, glove and ear plug. These safety measurements are so important in order to prevent the projectile spatter from the cutting process.

**Step 3:** All the material that had been cut is grinded to give smooth surface on the edge to make sure that joining process can be done precisely. Then all material was arranged into joining position.

**Step 4:** To cut sheet metal, the proper machine to be use is the Shearing Machine. Before cutting the material, the material is measured and the desired length to be cut is selected by using the control panel. Then the material is inserted into the machine and aligned properly to prevent defect. Cut the material.

**Step 5:** After finish cutting sheet metal using shearing machine, parts that will make into the coal storage must go through bending process to get desired shape.

**Step 6:** The joining process was carried out by using the Gas Metal arc welding or formerly known as MIG (Metal inert Gas). First, the welding machine is set up to make sure that the output of the process will satisfy. Face shield, apron, goggle and other PPE equipment is required.

**Step 7:** All parts were weld together according on the method joining drawing. During this process, a minor movement of the material will give bad effect to the

framework. It is because hollow steel will expand and twist a little due to the temperature change.

**Step 8:** After finish welding, the entire welded place were then grinded to make sure that the entire joint surface was smooth from any spatters or sharp edge. During the process the careless of wearing an ear plug will cause high risky damage to ears. Hand glove and goggle are also need to give attention.

**Step 9:** After all the process had been done, portable kitchen will be sprayed black in the inside and white on the outside. This is considered as the finishing process.

### **3.8 Summary**

This chapter had been discussed generally about project methodology, how to manage flow work and process involved. Throughout this project have learned how to design start with sketching, design concept, concept selection and drawing until fabricate and assemble the portable kitchen structure with step by step. This project can be developed the skill to manage the machine such as shear machine, vertical saw and welding.

## CHAPTER 4

### RESULTS AND DISCUSSION

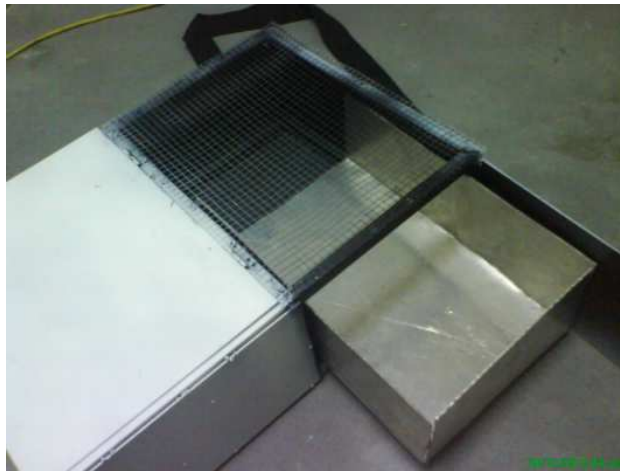
#### 4.1 Final Product

The portable kitchen was finish and get result after undergoes step by step start with literature review, design and sketching, technical drawing and solid modelling using Solid Work and Auto CAD application, fabrication process with cutting, punching, shearing, joining and assembly.

##### 4.1.1 Result after finishing



**Figure 4.1:** Portable kitchen finished



**Figure 4.2:** Charcoal opened



**Figure 4.3:** Rice cooker opened.

## 4.2 Product Specification

For the product specification, there are a lot of factor that consider. The product is classify to several categories such as weight, colour, wide, height and other else.



The product specification is like below. Below is the result for product specification which is.

Categories	Result
Weight	3.5 kg
Colour	Black inside white outside
Height	130mm
Wide	290mm
Length	430mm
Maximum item can be grilled	3 pieces of chicken part
Maximum weight of rice can be cooked	According to standard camping rice cooker
Convenience	Portability and multifunction

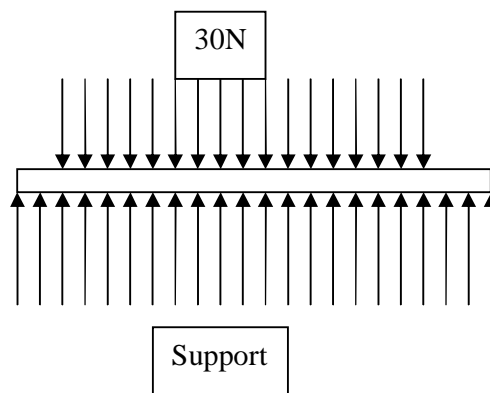
**Table 4.1:** Product specification

### 4.3 Discussion

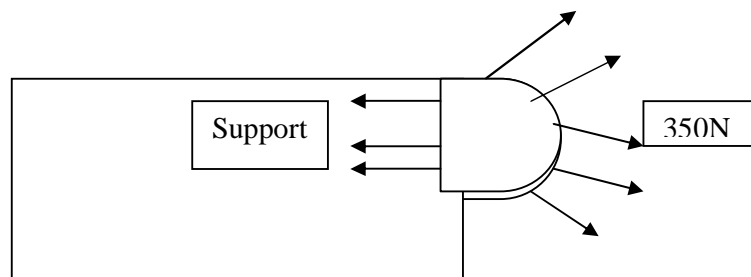
Discussion is divided by two parts. Firstly is discussion about types of defect on the final product. Second, is about the problem in the progress start with literature review until fabricate and finish the product.

### 4.3.1 Strength Analysis

Strength is the power to resist strain or strain. For the portable kitchen, strength is an important factor because most part of the portable kitchen will be exposed to stress or strain when carrying or cooking. The parts that are being analyzed are the grill part and hanging part. For detailed analysis, see appendix



**Figure 4.4:** A strength analysis on grill part



**Figure 4.5:** A strength analysis on hanger part

### 4.3.2 Types of Defect

There are so many things that happen in fabrication process such as defect. This defect happen because of lack of skills to operate machine such as when handling MIG welding machine. This defect can see after fabrication process is finished. At this time, this problem make we have new experience and how to avoid this problem happen again. There are some defects happen on the product below:

#### 4.3.2.1 Incorrect position

This defect happen because of lack skill and assistance to make sure the door is in correct position. The door should be hold by an assistant and weld properly.



**Figure 4.6:** Incorrect position of door

#### 4.3.2.2 Cannot close properly

Figure 4.6 shows a defect in the door that cannot be closed properly. This is because of the hinge is accidentally welded at the moving part thus making the door difficult to close.



**Figure 4.7:** Door cannot be closed properly

#### 4.3.2.3 Miscalculation of length

This happens because of miscalculation when taking measurement on the material. The material is also hard to bend thus making it a lot harder to make according to the specification.



**Figure 4.8:** Length miscalculation

### **4.3.3 Problem in progress**

Many problems occur in progress to design and fabrication of this kitchen such as gather raw data and literature review, design and fabrication.

#### **4.3.3.1 Literature Review Problems**

The Problem during literature review is mainly about the difficulty to know about the title such as 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 availability in UMP Mechanical Lab and the problem is like limited resources to get the relevant and suitable materials such as books and internet connection problem.

#### **4.3.3.2 Design Problems**

The problems also occur 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 but when choose one design that have all criteria needed by specification is can proceed and running machine such as shearing machine. After a design is selected, another problem encountered is details 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.

#### **4.3.3.3 Fabrication Problems**

Problem during this stage is very critical that make the actual progress not follow project planning schedule. First, the problem is to find material that suitable

for the title of the project. The suggestion material to produce portable kitchen is not available such as aluminium sheet metal was finish. After consider all problems about material available design for the project was change follow material available such as zinc sheet metal.

The problem also comes during fabrication process, mainly is hard to fabricate the material with the design was change in order to be easy in machining process such as about used shearing machine. The major problem is difficult to find tool and machine to use to fabricate. Firstly, the outer part of the portable kitchen is going to be aluminium sheet metal but unfortunately the material cannot be weld together with the inside part. This is because of material property differences. The MIG welding is also a problem; when I came to the lab to use MIG, the machine cannot be use and have wait several days for the spare part to arrive.

## **CHAPTER 5**

### **CONCLUSION AND RECOMMENDATION**

#### **5.1 Introduction**

This chapter is about problems the project encounter before, during and after project. This chapter also will discuss about the conclusion of the project. Problem that will be discussed is the entire problem encountered in every task in the project.

#### **5.2 Conclusion**

The conclusion, the project to fabricate the portable kitchen has fulfilled the objectives successfully. This project was done around thirteen week included the report, almost all the step such as literature review, design, fabrication process. To complete this project was follow with the planning and Gantt chart.

#### **5.2 Recommendation**

Several recommendations to express for myself and the faculty for future final year project are:

- a) The planning schedule and Gantt chart of the project must be done before the project started.

- b) More time given to the project, it include statement the final year student should more focus on the final year project, this could make the result the project finish on time and have better result.
- c) The involvement of the student must be observed more efficient.

### **5.3 Future Work**

Future planning for the portable kitchen is to add more function and reduce the weight of the portable kitchen. The additional function should concern more about the safety and multiuse of the portable kitchen. This project can be used by student to gain knowledge and understanding of mechanical response in process to make product and could helpful in the study of process machining such as shearing machine, bending and welding.

To be efficient, the upgrade should involve, using lighter material (example square hollow aluminium-light and good strength). If the upgrade can be done, the portable kitchen would have better portability, performance, stable and better looking. In the future the portable kitchen must be ergonomic, lightweight, more function or useful and goods from the previous portable kitchen.

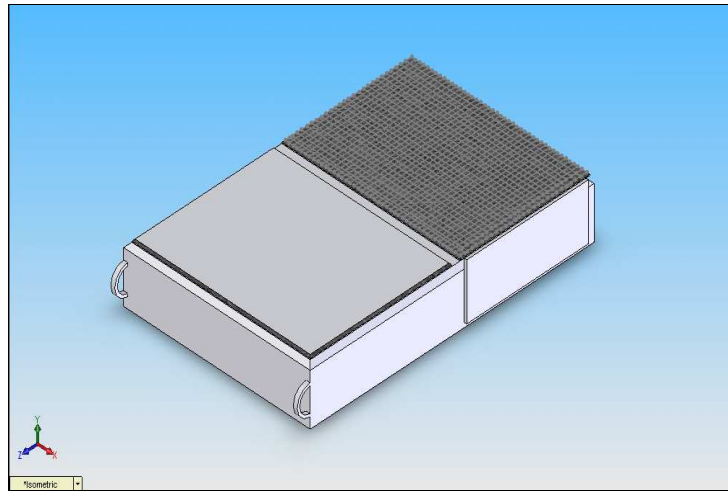
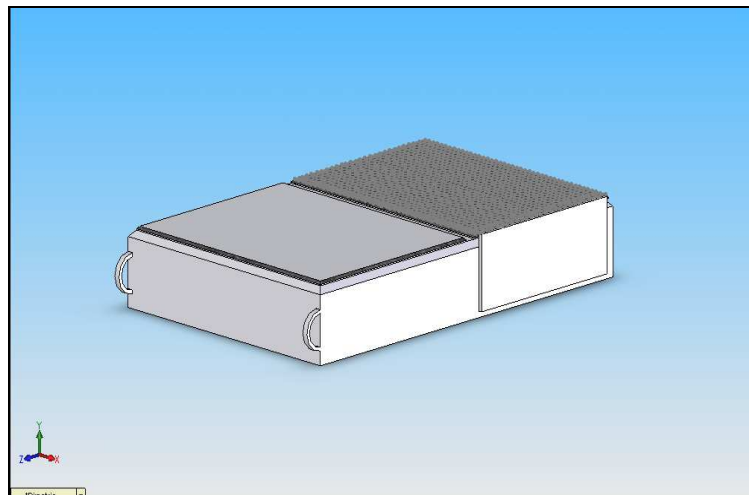


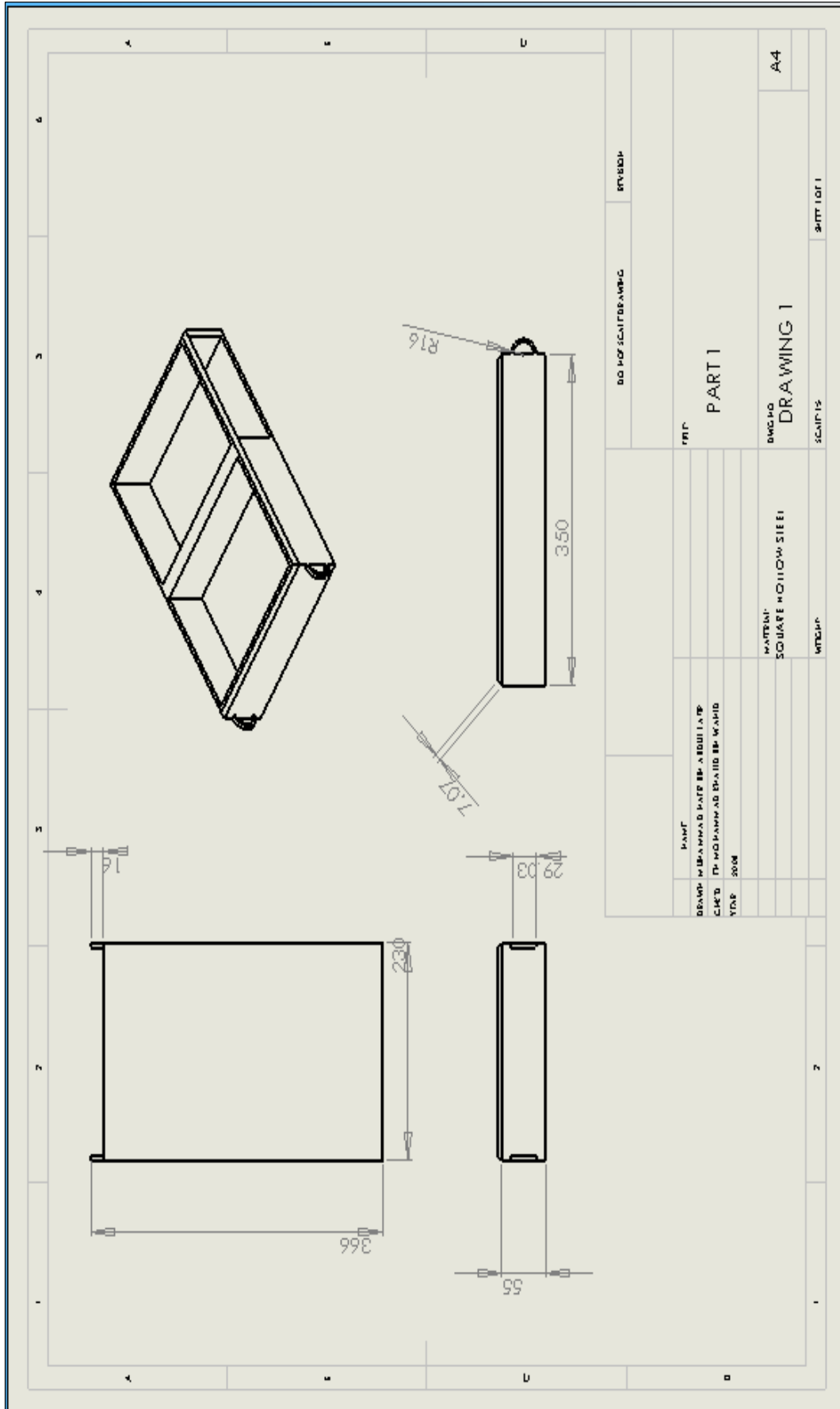
## REFERENCES

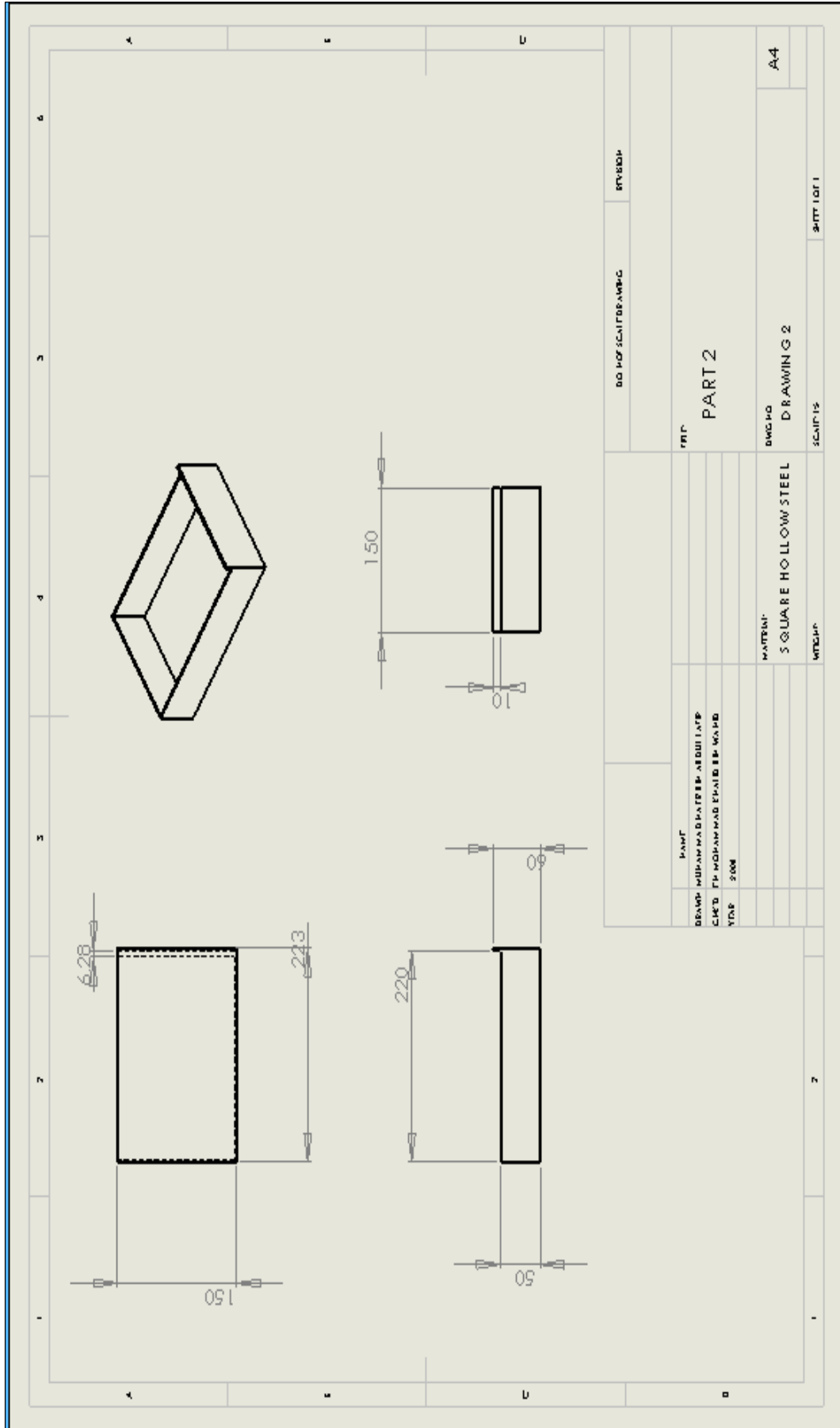
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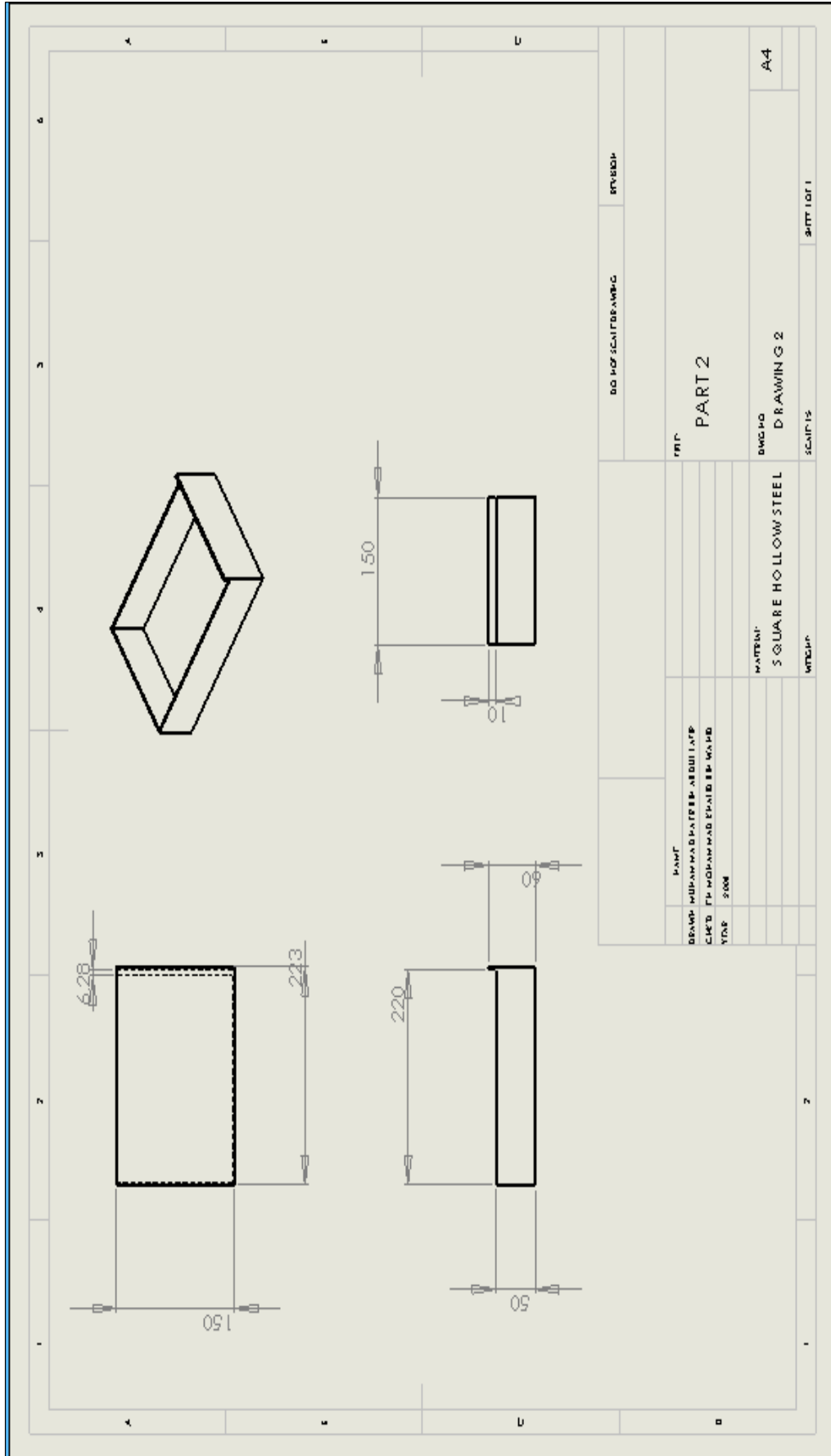
**APPENDIX A**

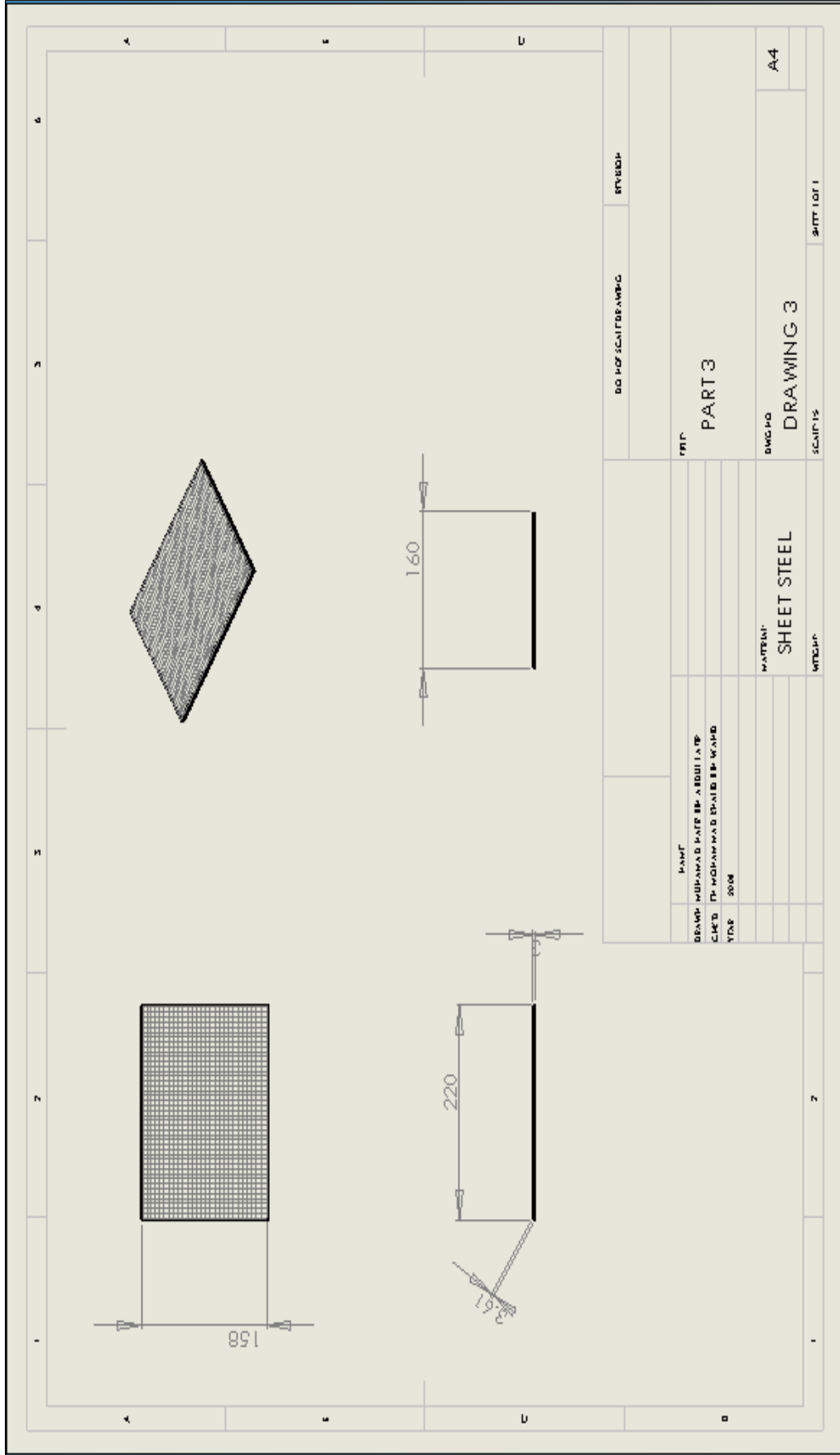
Solid Work Drawing 3D and 2D

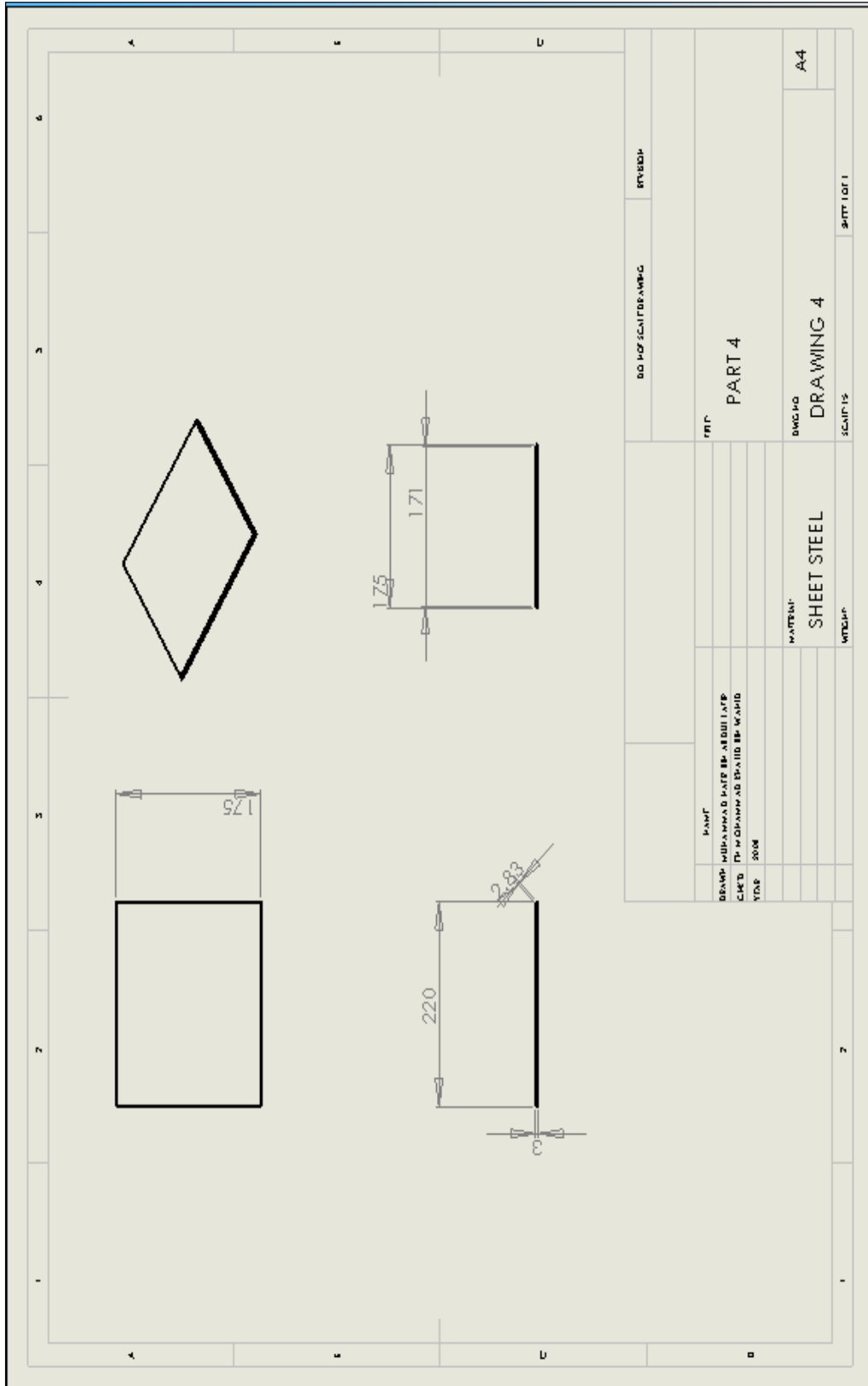
**Figure A1: Isometric view****Figure A2: Dimetric View**











## APPENDIX B

Figure and list of machine



**Figure B1:** Pneumatic Shearing Machine

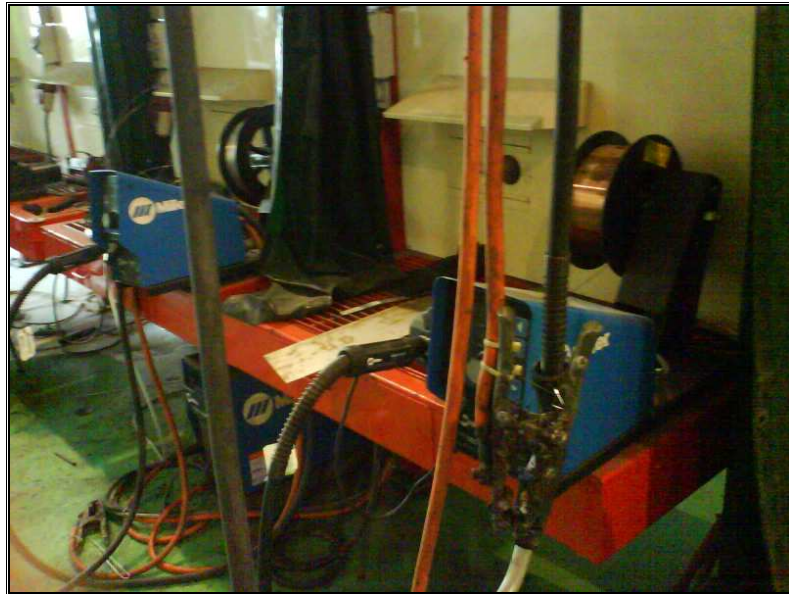




**Figure B2:** NC Bending Machine (TrumaBend V85S)



**Figure B3:** Vertical Saw Machine



**Figure B4:** MIG Welding Apparatus



**Figure B5:** Floor Disc Cutter



**Figure B6:** Portable Hand-Grinder



**Figure B7:** Measuring tape

APPENDIX C

List of Important Figure

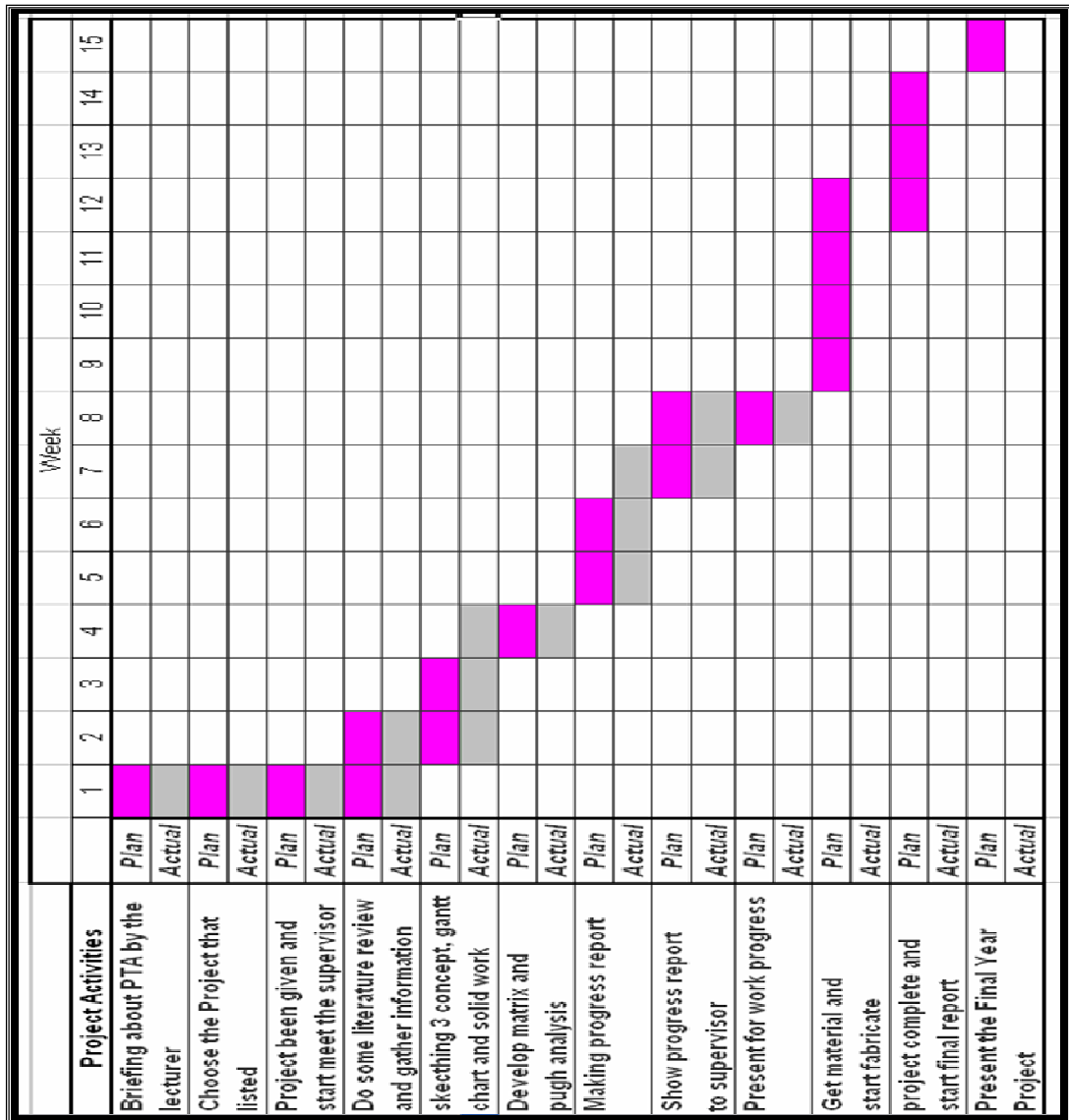
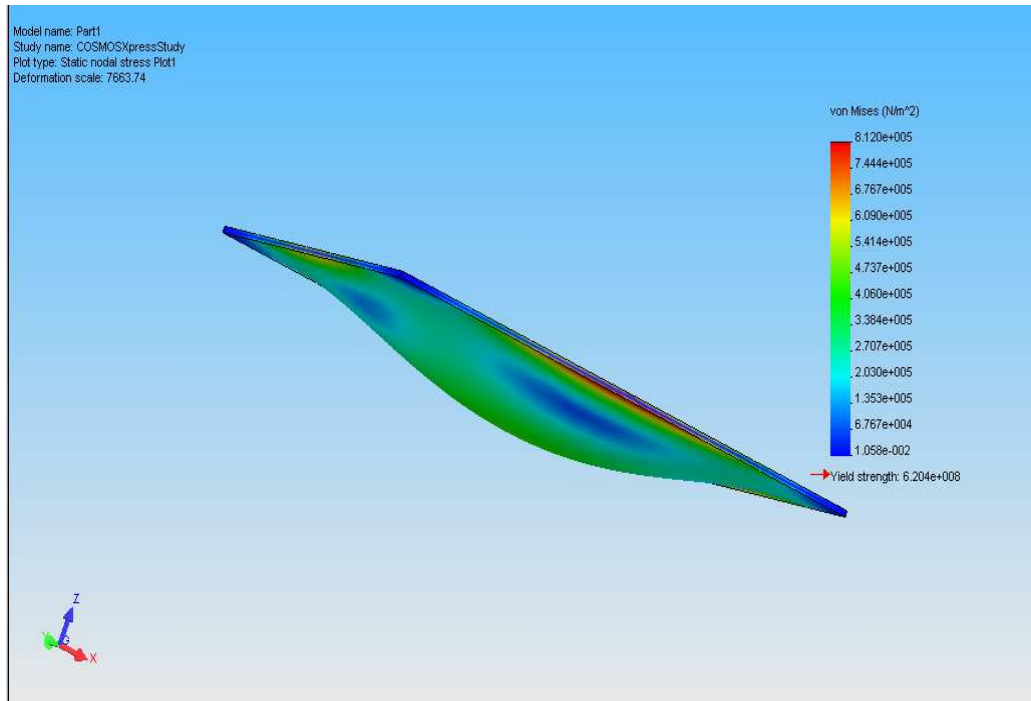
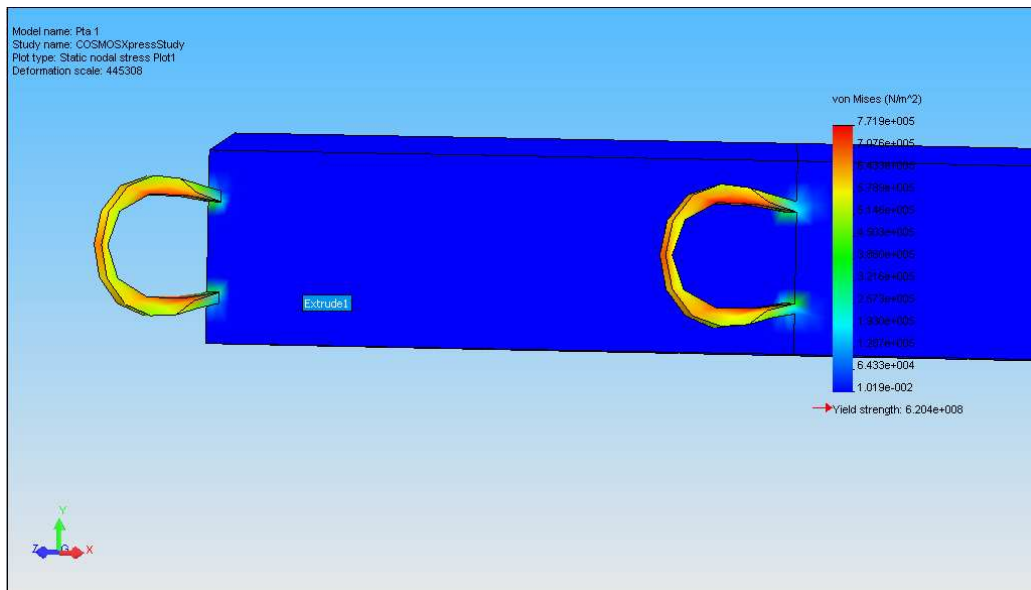


Figure C1: Project Gantt chart



**Figure C2:** Strength analysis on grilling part



**Figure C3:** Strength analysis on hanging



