

# UNIVERSITI MALAYSIA PAHANG

## BORANG PENGESAHAN STATUS TESIS ♦

**JUDUL: DESIGN AND FABRICATE THE PORTABLE AND ADJUSTABLE DINING CHAIR FOR CHILD**

**SESI PENGAJIAN: 2008/2009**

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DESIGN AND FABRICATE THE PORTABLE AND ADJUSTABLE DINING CHAIR  
FOR CHILD

NABILAH BINTI HARMAIN

A report submitted in fulfillment of the  
requirement for the award of the Diploma  
of Mechanical Engineering

Faculty of Mechanical Engineering  
University Malaysia Pahang

NOVEMBER 2008

### **SUPERVISOR'S DECLARATION**

I hereby declare that I have checked this project report and in my opinion this project is satisfactory in terms of scope and quality for the award of Diploma in Mechanical Engineering.

Signature .....

Name of Supervisor: Hazami Bin Che Hussain

Position : .....

Date : .....

### **STUDENT'S DECLARATION**

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

Signature .....

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Date : .....

## **DEDICATION**

This report is dedicated to Allah Subhanahu wa Ta`aalaa whose guidance, help and grace was instrumental in making this humble work a reality. This dedication goes to my beloved family which is my father Mr. Harmain Bin Hj Ahmad and my mother Madam Norsiah Binti Idris, other siblings and also friends, without whom and his/her lifetime efforts, my pursuit of higher education would not have been possible and I would not have had the chance to study for a mechanical course.

Also special thanks to my supervisor, Mr Hazami bin Che Hussain and mechanical staff, without whose wise suggestion, helpful guidance and direct assistance, it could have neither got off the ground nor ever been completed.

## **ACKNOWLEDGEMENT**

I would like to express my gratitude and appreciation to all those who gave me the possibility to complete this report. Special thanks is due to my supervisor Mr. Hazami bin Che Hussain whose help, stimulating suggestions and encouragement helped me in all time of fabrication process and in writing this report. I also sincerely thanks for the time spent proofreading and correcting my many mistakes.

I would also like to acknowledge with much appreciation the crucial role of the staff in Mechanical Laboratory, who gave me a permission to use the lab equipment and also the machine and to design the drawing and giving a permission to use all the necessary tools in the laboratory.

Many thanks go to the all lecturer and supervisors who have given their full effort in guiding the team in achieving the goal as well as their encouragement to maintain our progress in track. My profound thanks go to all classmates, especially to my friends for spending their time in helping and giving support whenever I need it in fabricating my project.

## **ABSTRACT**

In this project, this dining chair for child is designed to make parents easier to handle their child during in daily activities. The objectives for my project are to make the chair is suitable in any areas either at home or outside. Besides that, this project is designed to save of space when use or after use it. We can easier to carry and also storage the dining chair anywhere we want to go such as travelling and so on. This involves the process of designing the dining chair for child by considering the shape, the ergonomic factor and also the safety factors. Several methods and processes involved are conceptual design, material selection, cutting, drilling, welding and finishing. After all the processes had been done, this dining chair may help us to understand the fabrication and designing process that involved in this project.

## **ABSTRAK**

Dalam projek ini, kerusi kanak-kanak ini direka untuk memudahkan ibu bapa dalam urusan penjagaan anak-anak dalam aktiviti seharian. Objektif dalam penghasilan projek ini adalah untuk menghasilkan kerusi makan yang sesuai yang sesuai digunakan di mana sahaja tempat samaada di rumah atau di luar rumah. Produk ini juga di reka untuk mengurangkan penggunaan tempat ketika menggunakan atau selepas menggunakannya. Ini juga dapat memudahkan penyimpanan kerusi makan ini ketika hendak dibawa bersiar-siar di luar kawasan rumah. Proses ini melibatkan proses mereka bentuk kerusi kanak-kanak dengan mengambil kira bentuk, factor-faktor ergonomik dan juga factor keselamatan. Selepas rekaan itu siap, ia telah dihasilkan kepada produk yang sebenar di mana rekaan tadi digunakan sebagai rujukan. Beberapa cara dan proses yang terlibat adalah rekaan konsep, pemilihan bahan, proses pemotongan, proses menebuk lubang, proses mengimpal dan kemasan.



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## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 PROJECT INTRODUCTION**

This project presents design and fabricate of an adjustable and portable dining chair for child that considers safety, space and ergonomics factor. This dining chair would be different from existing dining chair in market nowadays. The Diploma final year project allocates the duration of one semester, this large man-hour project requires significant efforts of the student to participate. Basically the entire Portable and Adjustable Dining Chair project could be divided into three stages which are concept review and fabrication, designing and make finishing.

The Portable and Adjustable Dining Chair for Child is equipped by using all items and methods for instance rod hollow steel, aluminium sheet plate, steel rod and also skills in manufacturing processes MIG welding to join the parts, drilling, shearing and bending. The advantages of the proposed dining chair to be developed can be seen that it portable which can be easily storage, travelling and saves on spaces.

The process of fabrication is initiated from conceptual design stage by considering the advantages as well simplicity. In order to make safety and ergonomic factor will be taken. Practical fabrication and design involves the measurement, cutting the materials into required size and shape, assembly and making finishing.



## **1.2 PROBLEM STATEMENT**

Most of the current dining chair in market nowadays just designs to make it look modern and beautiful but the functions not suitable for child used. Besides that the current product need a spaces when to used or storage, and also it difficult to transferable to another place like to go travelling.

It is important to further improve the current design of dining chair for child, so that is more efficient to use.

## **1.3 SCOPES OF THE PROJECT**

### **a) Safety**

- i. Can attaches securely and safely to most of dining chair and ensure a good fit to either round, curved or square backed chairs, and it is secured in place with a strap.
- ii. Mounting the chair is quick and easy to do, simply place the dining chair atop the chair, hook the arms onto the back.
- iii. Also will includes with the plastic lining at the bottom of arms chair that will make sure the chair cannot slide down form the high chair.

### **b) Ergonomics**

- i. Easy to use and easy when handling based on the design and material being used to produced the product.
- ii. The product is light in weight that made from hollow steel and sheet plate.
- iii. Has a comfortable cushion and portability tray that parents can use it or not for their child.

- iv. Can be use for children aged from about seven months to around three years of age.
- v. It is portability when the chair folds flat for transport or storage.

c) Aesthetics need

- i. Small size – That make it easy to use and storage for go travelling or after use it.
- ii. Light in weight – That make it easy to carry and hold from one place to another.

d) Material considered

- i. Rectangular hollow steel
- ii. Rod hollow steel
- iii. Aluminium sheet plate

## **1.4 PROJECT OBJECTIVES**

There are two main objectives to achieve in this research which are:

- i. Design and fabricate the adjustable and portable dining chair for child that suitable for any chair either round, curve or square back chair and also suitable for any areas.
- ii. Design and fabricate the dining chair that can be folded flat for easy for storage and traveling.

## **1.5 PROJECT PLANING**

This project started with made a research and literature review. It is from internet, magazines, public areas and my supervisor that related to my project title. All of this literature review takes about three week. I also do my schedule management for my project. This is done by using Microsoft Excel Worksheet using Gantt chart system.

The next week I have been submit my project title acceptance form and continue detail research in adjustable and portable dining chair that it takes a week to be done.

After all of literature review done, I must find out what are the advantages and problem or weakness about the current product in the market nowadays. After that I will sketch my ideas for making a new features design. I have sketched the three ideas before I decide the best ideas that I choose for PTA project. The sketching of the seat takes about two weeks to be done. The sketching done using manual sketched hand at A4 size paper.

After decide the best ideas that have been choose the sketching concept idea transfer into Auto CAD and SolidWork with actual dimension.

The next task is preparation of progress presentation or mid presentation, both of these tasks takes one week to be done. These mid presentations have been done at week seven. On this week I have to prepare the slide presentation and speech for the presentation.

The fabrication process is started on week eight. For the first fabrication is must fabricate the arms chair that have a hook for attaches at the backed chair between 30-40 cm height. After that I have make the '**H**' support and sit place that will be joint with the arms. For the finishing I will spray my product to make it look more smooth and beautiful. Fabrication stage is taking a much time to complete. This task scheduled takes several weeks to finish.

Lastly, the final report has been written and prepared for presentation. This will take about one week to prepared and accomplish. A report is guided by UMP thesis format and also guidance from supervisor. Due to any problems that student face, the management has agreed to extend the time of submission of the report and presentation. All task scheduled takes around fourteen weeks to complete.

NO	ACTIVITIES		MONTH / WEEK															
			JULY				AUGUST				SEPTEMBER				OCTOBER			
			1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1	Meet the supervisor	Planning																
		Actual																
2	Reserch and gathering data	Planning																
		Actual																
	a) define product at market	Planning																
		Actual																
	b) specification	Planning																
		Actual																
3	Make & decide the best ideas	Planning																
		Actual																
4	Sketching product	Planning																
		Actual																
5	Make the first draf report	Planning																
		Actual																
6	First presentation	Planning																
		Actual																
7	a) sketching with AutoCAD and solidwork	Planning																
		Actual																
	b) testing analysis	Planning																
		Actual																
8	Make the product	Planning																
		Actual																
	a) welding	Planning																
		Actual																
	b) bending	Planning																
		Actual																
	c) cutting	Planning																
		Actual																
	d) shearing	Planning																
		Actual																
9	Report	Planning																
		Actual																
10	Final presentation	Planning																
		Actual																

**Table: 1.1** Gantt chart project

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 INTRODUCTION**

Initially, the dining chair for child is designed as one product that height chair, look modern design and beautiful, and therefore difficult to move from one place to another.

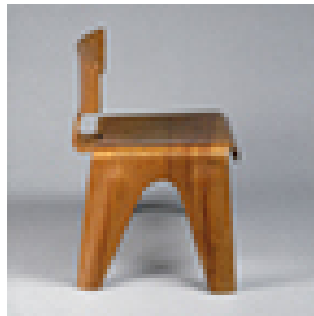
Additionally, a design project for a new product or some feature of a product can be initiated by the desire to redesign it. Redesign is fostered by market demand for a new model or the desire to include a new technology in an existing product. Redesign can also be initiated to fix a problem with an existing product, reduce product cost, simplify manufacturing, and respond to a required change of materials or for many reasons. Often the desire to change the product design is the need of the product to be less expensive, to have new features or to last longer.

## 2.2 HISTORY OF DINING CHAIR FOR CHILD

This molded plywood chair is part of a suite of furniture the Eameses designed in 1946 specifically for children. This project reflects an increasing interest in the postwar period in creating modern furniture, toys, and other objects for the use and benefit of young children. While recalling their other popular plywood chairs of this period, the LCW (Lounge Chair Wood) and DCW (Dining Chair Wood), this chair is simpler in design and construction. It is comprised of a single piece of molded plywood, draped into a sturdy, durable form, built to withstand the rigors of playtime while providing comfort and support to young, growing bodies. The heart-shaped cutout in the center of the chair back is a reminder of the Eames' strong appreciation of folk art and culture, in this case, Charles' interest in Swedish folk art. Gift of Daniel Wolf, 1986. Molded plywood; H. 14 1/2 in. (36.8 cm), W. 14 1/2 in. (36.8 cm), D. 10 1/4 in. (26 cm).<sup>(1)</sup>



(a)



(b)

**Figure 2.1:** Child's chair

## 2.3 TYPES OF DINING CHAIR

Several Dining Chair for Child with various function have been found.

- 2.3.1 **High Chair Baby** - These high-rising youth chairs fit nicely at any table, giving your child the boost they need to reach their food. His or her feet are not supported to allow freedom of movement. Have a long legs that suitable used for height of dining table. This product is made from wood that easy to fabricate and more safely to use by children. (Figure 2.2)



**Figure 2.2:** High Chair Baby

- 2.3.2 **Custom Stain Chair** - With an oversized eating tray, you can fit a four course meal on it; or just allow extra space that mess that will surly result from an everyday meal. Made from wood that have smooth surface and provide the safety of child used. The children sit in this dining chair in an ergonomically correct position with a straight back and have a place to put their arms. His or her feet are not supported to allow freedom of movement. (Figure 2.3)



**Figure 2.3:** Custom Stain Chair

- 2.3.3 **BackGo Chair** – This product is lightweight and includes with padded back support that can be secured to chairs, floor, wheelchairs, and strollers. It also simple to use in a home, school or when traveling. But it have limitation for kids movement if use the strap and not suitable for kids that seven months to one year of age. It made from mild hollow steel that has strength that can load heavy weight. Have a 30 cm height and 30 cm wide of BackGo chair. (Figure 2.4)



**Figure 2.4:** BackGo Chair

- 2.3.4 **Yeppi's Baby Chair** – Comfortable cushion and modern design. This product also has been design with a safety that it has wheels lock to keep chair in place. However, this product just suitable for baby that are one year and above and also suitable for home use only. It made from plastic that give it more light than steel that commonly used for design the product.(Figure 2.5)



**Figure 2.5:** Yeppi's Baby Chair



2.3.5 **High Chair** – Suitable used for all ages of child and have a comfortable seat that make from plastic. Not easy to damage because it make from steel. Have long legs that suitable use for whole dining table where ever like home or outside. However, the size of the design will need a space to use and storage. (Figure 2.6)



**Figure 2.6:** Baby Chair

## 2.4 JOINING METHOD

From our study, several joining process must be done to assembly, the process is:

### 2.4.1 WELDING PROCESS

MIG (Metal Inert Gas) or as it even is called GMAW (Gas Metal Arc Welding) uses an aluminum alloy wire as a combined electrode and filler material. The filler metal is added continuously and welding without filler-material is therefore not possible. Since all welding parameters are controlled by the welding machine, the process is also called semi-automatic welding.

The MIG-process uses a direct current power source, with the electrode positive (DC, EP). By using a positive electrode, the oxide layer is efficiently removed from the aluminum surface, which is essential for avoiding lack of fusion and oxide inclusions. The metal is transferred from the filler wire to the weld bead by magnetic forces as

small droplets, spray transfer. This gives a deep penetration capability of the process and makes it possible to weld in all positions. It is important for the quality of the weld that the spray transfer is obtained.

There are two different MIG-welding processes, conventional MIG and pulsed MIG:

- a) Conventional MIG uses a constant voltage DC power source. Since the spray transfer is limited to a certain range of arc current, the conventional MIG process has a lower limit of arc current (or heat input). This also limits the application of conventional MIG to weld material thicknesses above 4 mm. Below 6 mm it is recommended that backing is used to control the weld bead.
- b) Pulsed MIG uses a DC power source with superimposed periodic pulses of high current. During the low current level the arc is maintained without metal transfer. During the high current pulses the metal is transferred in the spray mode. In this way pulsed MIG is possible to operate with lower average current and heat input compared to conventional MIG. This makes it possible to weld thinner sections and weld much easily in difficult welding positions.

Gas Metal Arc Welding (GMAW) is frequently referred to as MIG welding. MIG welding is a commonly used high deposition rate welding process. Wire is continuously fed from a spool. MIG welding is therefore referred to as a semiautomatic welding process.

## **2.4.2 MECHANICAL FASTENING**

Two or more components may joined or fastened in such a way that they can be taken apart sometime during the products service life or life cycle. Numerous product (including mechanical pencils, watches, computers, appliances, engines, and bicycle) have components that are fastened mechanically. Mechanical fastening may be preferred over other methods for the following reasons, ease of assembly, maintenance, parts replacement, or repair, ease in creating design that require moveable joints, such

as hinges, sliding mechanism, and adjustable components and fixtures and lastly lower overall costs in manufacturing the product.

The most common method of mechanical fastening is by use of bolts and nuts. These operations are known also as mechanical assembly. Mechanical fastening generally requires that the components have holes through which the fasteners are inserted. These joints may be subjected to both shear and tensile stresses and should be designed to resist these forces.

### 2.4.3 DRILLING PROCESS

A drill is a tool with a rotating drill bit used for drilling holes in various materials. Drills are commonly used in woodworking, metalworking, construction and DIY.

The drill bit is gripped by a chuck at one end of the drill, and is pressed against the target material and rotated. The tip of the drill bit does the work of cutting into the target material, either slicing off thin shavings (twist drills or auger bits), grinding off small particles (oil drilling), or crushing and removing pieces of the workpiece.



**Figure 2.7:** Press Drilling Machines

A drill press Figure 2.7 (also known as pedestal drill, pillar drill, or bench drill) is a fixed style of drill that may be mounted on a stand or bolted to the floor or workbench.

A drill press consists of a base, column (or pillar), table, spindle (or quill), and drill head, usually driven by an induction motor. The head has a set of handles (usually 3) radiating from a central hub that, when turned, move the spindle and chuck vertically, parallel to the axis of the column. The table can be adjusted vertically and is generally moved by a rack and pinion; however, some older models rely on the operator to lift and reclamp the table in position. The table may also be offset from the spindle's axis and in some cases rotated to a position perpendicular to the column. The size of a drill press is typically measured in terms of *swing*. Swing is defined as twice the *throat distance*, which is the distance from the center of the spindle to the closest edge of the pillar. For example, a 16-inch (410 mm) drill press will have an 8-inch (200 mm) throat distance.

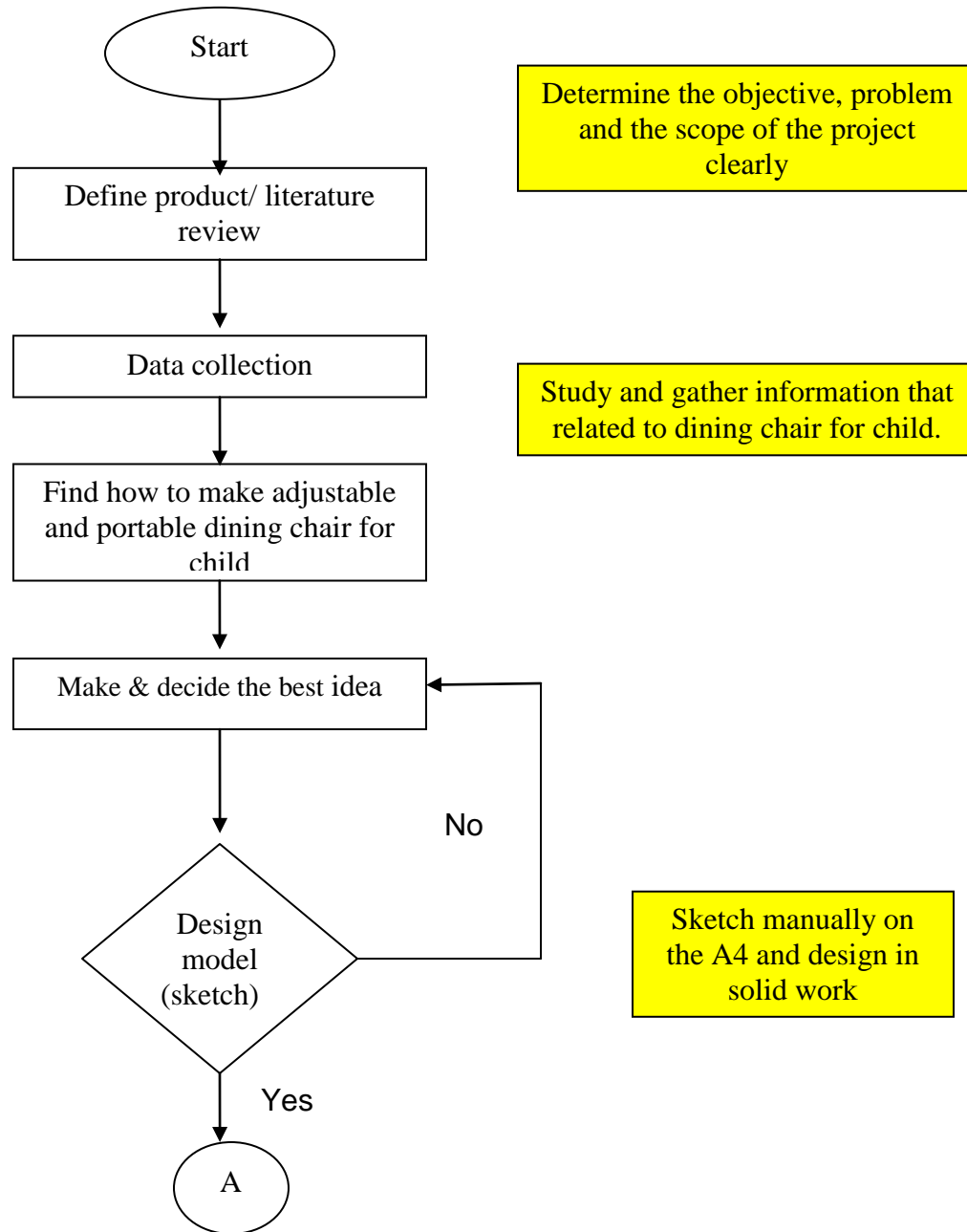
## CHAPTER 3

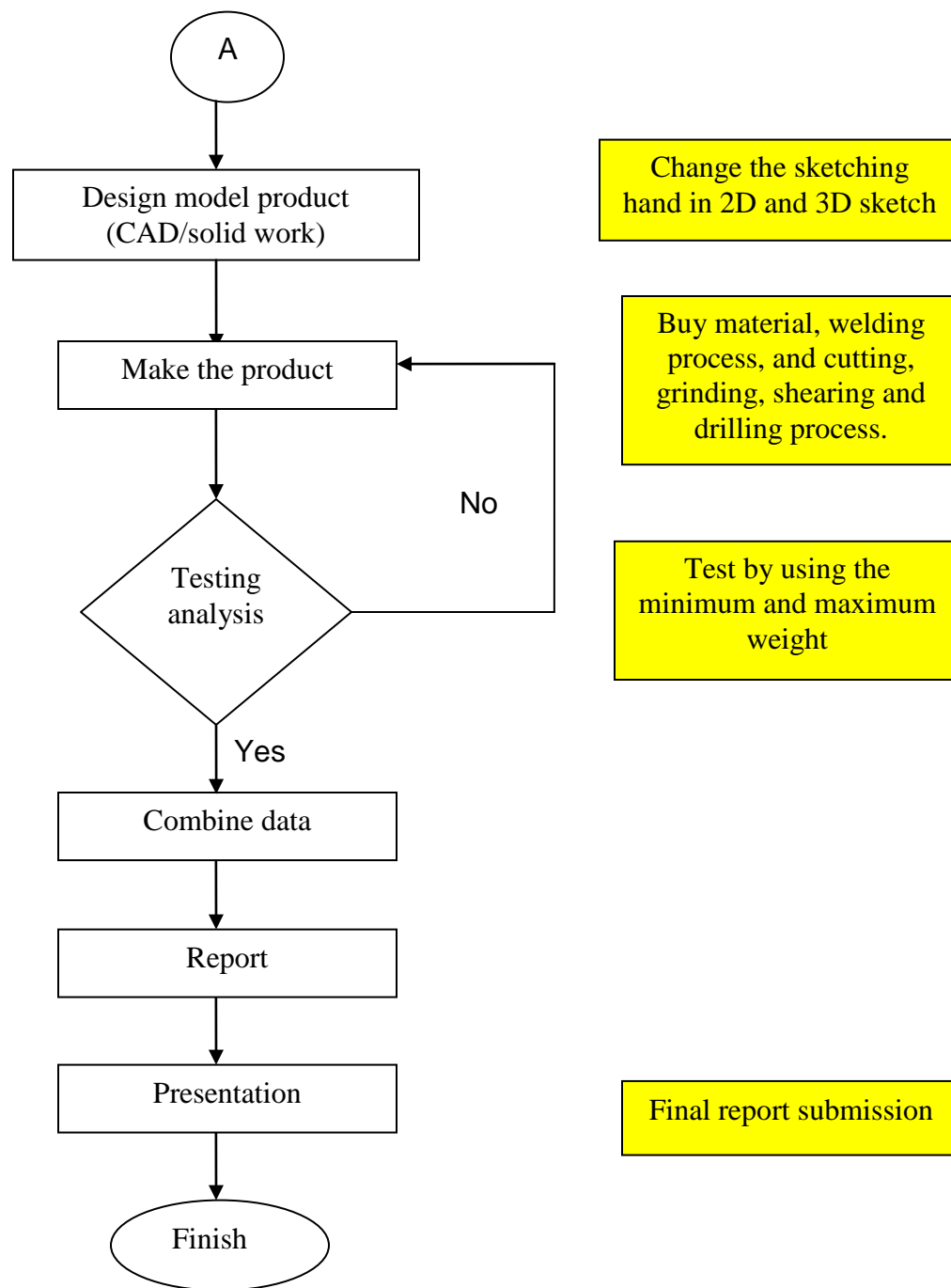
### METHODOLOGY AND PROCESS

#### 3.1 INTRODUCTION

Project methodology is a body of practices, procedures and rules used by those who work in a discipline or engage in an inquiry and a set of working methods. Project methodology for development of a truss frame model for removable seat is shown by flowchart in the **Figure 3.1**.

### 3.2 PROJECT FLOW CHART





**Figure 3.1:** Flow chart of the project

From the flow chart in **Figure 3.1**, this project started with the literature review or defines the product and research about the title. The main important of the project is determination is the objective. Then, study and make a lot of research about dining chair for child. These tasks have been done through research on the internet, magazines, from public areas and others sources.

Then the information has been collect and gather, after that, the project will be continuing with the design process. In this stage, the knowledge and lessons that have studied will be applied in sketching. The manual sketching is on the A4 it is to make a suitable design for the project. I have sketched three ideas for my product design. After several design sketched, design consideration have been made and one of the design have been chosen. The selected sketch will be transfer to engineering drawing by using Solid works program.

After all the drawing finished, the drawing was used as a reference for the next process, which it is fabrication stage. This process is consists fabricate all the parts that have design before by following all the dimension using various type of manufacturing process. The manufacturing process included in this process is welding by using MIG, cutting, grinding, drilling and others. For the arms, support and the back seat I used the mild hollow steel to make a high strength and light in weight.

Testing stage has been implementing after fabrication stage. The testing is to gathered information about strength of the chair. During the testing, if problem occur such as the seat bend, the process step back to previous process, which is fabrication. If the seat can be loaded by forces, the project will be declaring success.

Then, all the process mentioned above is done; all the material for report writing is gathered. The report writing process will be guided by the UMP final year project report writing. This process also, preparation for presentation slides for the final presentation for this project. The project ended after the submission of the report and the slide presentation has been present.



### **3.3 DESIGN**

The design of the Portable and Adjustable Dining Chair for Child 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 dining chair are including:

- i. Strength: Must have certain strength to ensure that it can load heavy weight.
- ii. Ergonomics factors: The dining chair must be easy to handle.
- iii. Safety: Giving the safety for child when using it.
- iv. Material: Availability of material is one of aspects that have been considered.

### **3.4 DRAWING**

The drawing process will be divided into two categories, which are including:

- i. Sketching : All the ideas for making the dining chair will be sketch on the paper first to ensure that idea selection and be made after this.
- ii. SolidWork software : The sketching idea in hand manual sketch will be change in 3D using SolidWork.

### **3.5 DESIGN SPECIFICATION**

The design of the Portable and Adjustable Dining Chair must be considered that it can endure several specifications, which are including:

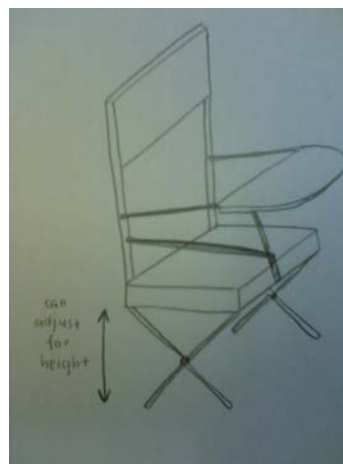
- i. The dining chair has the sit place that can be folded flat and the portable tray that will it make easy for storage.
- ii. Have the suitable hook that can fit any back chairs.

- iii. Overall materials are one inch hollow steel for make the '**H**' support, aluminium sheet plate for sit place and tray, 2 cm rod hollow steel for arms and stand, and 1 cm hollow steel for back sit.
- iv. The dining chair is suitable to keep the weight of child with the maximum weight of 18 kilogram and save to use.

### 3.6 SKETCHING DRAWING SELECTION

From the existing ideas, three sketching ideas had been considered and compared as shown in below:

#### 3.6.1 CONCEPT 1



**Figure 3.2:** Sketching 1

From the figure 3.2, this sketching has legs that can be adjusted for height. It also includes with portable tray and has a safety strap for protect the child at chair. Made from rod hollow steel and aluminium sheet plate that it will light weight. This design also has a small size that can easy for carry from one place to another. However, the legs for this design are difficult to make and not suitable to use at the high chair.

### 3.6.2 CONCEPT 2



**Figure 3.3:** Sketching 2

From the figure 3.3 shows that this sketching idea is a simple design. It has a portable tray that parents can use it or not for their child. This design also will made from aluminium sheet plate and rod hollow steel that to make it light weight. Besides that, this chair will design that it can use for two situations that can stand at floor and chair. It also has includes with a safety strap for baby protection.

### 3.6.3 CONCEPT 3



**Figure 3.4:** Sketching 3

From the **figure 3.4** show that the design has a simple design but has strength to load the heavy weight. It also can for two situations that is can stand on the floor and

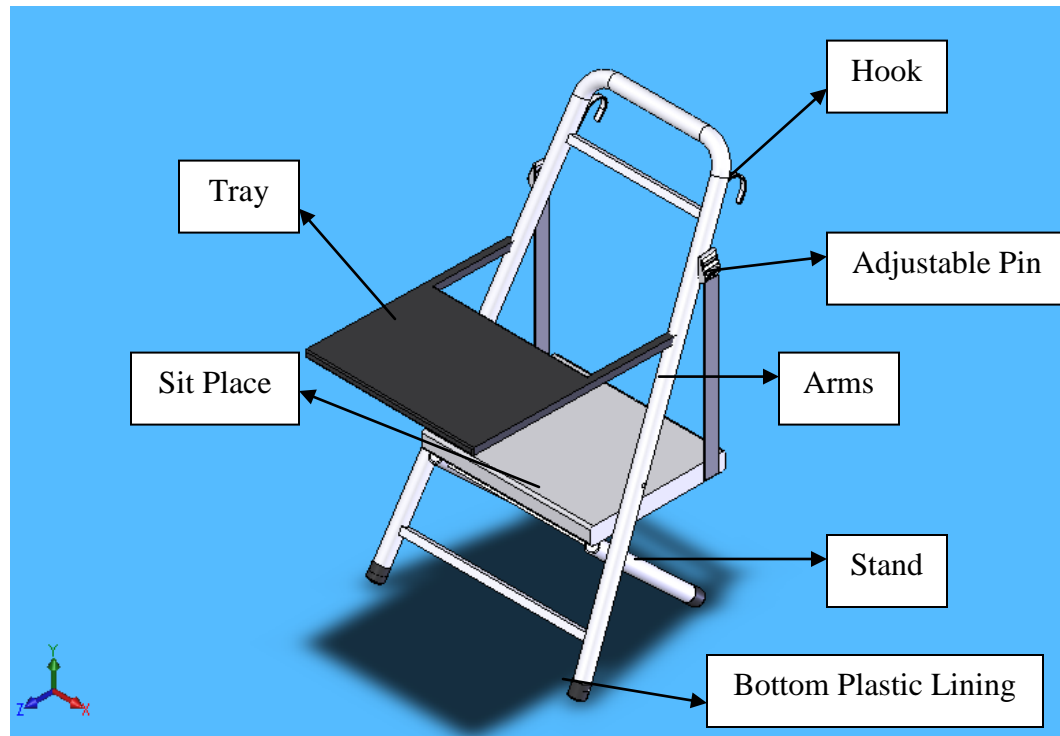
high chair. This chair is made from hollow mild steel bar and aluminium sheet plate that can make it light weight. The child sits in this dining chair in an ergonomically correct position with a straight back and comfortable cushion. His or her feet are not supported to allow freedom of movement.

### **3.7 CRITERIA FOR SELECTION**

- i. Saves on space.
- ii. Small size.
- iii. Light in weight.
- iv. Allows child to sit up at the table.
- v. Attaches quickly and easily to most dining chairs with round or square backs 30-40cm high.
- vi. Folds flat for easy storage and travel.
- vii. Ideal for home use, restaurants, cafes, visiting friends and relatives.
- viii. Easy to clean.
- ix. Portability tray
- x. Comfortable cushion
- xi. Can use at chair or floor

### **3.8 FINALIZED DESIGN**

The third sketching idea has been chosen after comparing with another designs and extracting good features. Figure 3.5 shows that the final idea of the dining chairs for child. Rod hollow steel and rectangular hollow steel was chooser as a body for this dining chair because it is properties that are lighter than solid steel but have high strength. As a sit plate, the aluminium sheet plate was choosing and the rectangular hollow steel was choosing to be the support. The tray also has use the same material that is aluminium sheet plate and rectangular hollow steel.



**Figure 3.5:** Dining chair

This design is to allow children to sit up to the table which allows the child to be part of any gathering. This means that the child can enjoy and share their gathering with their family or friend at the same table.

Beside that, portable and adjustable dining chair is ergonomic because the product is easy to use, to handling, travelling and storage. The compact design makes this dining chair very practical in use even though it looks quite small and the sit place can be fold flat that gives parents easy to storage it after use or storage in car for travelling. That situation can saves on space especially in car and home.

This chair is made from hollow mild steel bar and aluminium sheet plate that can make it light weight. The child sits in this dining chair in an ergonomically correct position with a straight back and comfortable cushion. His or her feet are not supported to allow freedom of movement. And also my product will design to give the child to sit up at the table at the correct height.

Lastly, it easily fit a wide range of chairs. The arms is adjust that can use for high and low backed chairs between 30-40 cm from the base of the chair. My product arms adjust independently that it will fit on to round back and square back chairs. It also will include with portability tray and cushion that parents can use it or not. This dining chair also safely with strap for the child safety and plastic lining at bottom dining chair that make sure it do not slide down from the chair.

### **3.9 PART OF PRODUCT**

Basically there are parts in a dining chair that design:

- i. Arms
- ii. Sit place
- iii. Tray
- iv. Stand

### **3.10 MATERIALS**

The materials that have use are for the parts of dining chair:

- i. Arms
  - 1 of rod hollow steel with measurement of 145 cm length by using (Ø 2 cm)
  - 1 of rectangular hollow steel with measurement of 25 cm length by using (1x 1 cm wide)
  - 1 of rectangular hollow steel with measurement of 35 cm length by using (1x 1 cm wide)
- ii. Stand
  - 2 of rectangular hollow steel with measurement of 20 cm length by using (1x 1 cm wide)
  - 2 of rod hollow steel with measurement of 30 cm length by using (Ø 2 cm)

iii. Sit plate

- 35 x 25 cm of aluminium sheet plate
- of rectangular hollow steel with measurement of 20 cm of length by using (1 x 1 inch wide)
- 1 of rectangular hollow steel with measurement of 25 cm of length by using (1 x 1 inch wide)

iv. Tray

- 18 x 23 cm of aluminium sheet plate
- 2 of rectangular hollow steel with measurement of 35 cm length by using (1x 1 cm wide)
- 2 of rectangular hollow steel with measurement of 21 cm length by using (1x 1 cm wide)

### **3.11 FABRICATION PROCESS**

Fabrication process is a stage after designing process. These processes are about using the material selection and make the product base on the design and by followed the design dimension. Most of a product produce was made by steel. In fabrication stage, a lot of method can be applied to produce the products such as welding, fastening, cutting, and drilling and more method. Fabrication process is needed to make the sit place, arms chair, hook and stand that made from hollow steel. Manufacturing process is difference from fabrication process in term of production quantity. Manufacturing in term of the process that will be focused on a large scale of production rather then fabrication process, it is a stage to make only one product. Fabrication finish until the last component was assembled. Several processes have been used to fabricate the dining chair. The fabrication process starts from dimensioning the raw material until it is finish as a desired product. The processes that involved are including:

### 3.11.1 MEASURING AND MARKING PROCESS

The figure 3.6 show the fabrication processes was started with measuring the material into the required dimension needed. The measuring process firstly done to the hollow pipe, the pipe is mark into the dimensions according to its length needed. The types of material identification needed to make sure all part can be assembling with the correct way. Secondly the material were used to be measuring is the aluminium sheet plate. All the measuring and marking process is done by using steel ruler, measuring tape, and steel marker.



**Figure 3.6:** Measuring process

### 3.11.2 CUTTING PROCESS

Then, after measuring and marking process, the marked material goes to next process is cutting that show in figure 3.7 and figure 3.8. Firstly the hollow pipe is cut into its desired length. This process is done using floor disc cutter. After the hollow pipe, the sheet plate also being cut by using the vertical bend saw. Before proceeding with this process, safety measurement had been carried out by wearing Personal Protective Equipment (PPE) such as goggle and hand glove. These safety measurements are so important in order to prevent the projectile spatter from the process.





**Figure 3.7:** Cutting process



**Figure 3.8:** Sheet plate cutting process

### 3.11.3 BENDING PROCESS

The figure 3.9 show, sheet plate that had been cut to the required size is bending to the suitable size with the '*H*' support sit. The vice and the hammer will used for this process.



**Figure 3.9:** Bending process

#### **3.11.4 DRILLING PROCESS**

Then the all material that had been cut will drill at the several locations to make the holes for bolts and nut and also for making joining with the other part. Drilling machines was used during this process for joint the parts. After the material that had been cut to required size, the material will be shear to 90 degree of angle to make for hold place.



**Figure 3.10:** Drilling process

#### **3.11.5 WELDING PROCESS**

Then, the material that had been drilled, grinded and cut will be ready to be joining with using the welding. The joining process was carried out by using the Gas

Metal Arc welding or formerly known as (MIG) Metal Inert Gas that shows in figure 3.11. Before started the process, the out put of the processes had been setup to make sure it will satisfy and suitable with the material used. Before proceeding with this process, safety measurement had been carried out by wearing Personal Protective Equipment (PPE) such as face shield, hand gloves and so on.



**Figure 3.11:** Welding process

#### **3.11.6 GRINDING PROCESS**

All the material that had been weld was grinded to give smooth surface from the sharp edge and weld spark that will make dangerous when handling the material. The hand grinder was used for this process. The figure 3.12 shows the grinding process.



**Figure 3.12:** Grinding process

### 3.11.7 SPRAYING PROCESS

After all the process had been done, figure 3.13 shows the last process is spraying the product to make it look more smooth and beautiful. Before that the whole product must be brush by using the sand paper to ensure it from dirt and rust. The whole product will spray with the white colour. After the spray had dry, the baby cushion is put at the chair to give it more comfortable for sitting.



**Figure 3.13:** Spraying process

## CHAPTER 4

### RESULT AND DISCUSSION

#### 4.1 FINISH PRODUCT

The figures below show that product that has finished fabricating:



**Figure 4.1:** Stand on the chair



**Figure 4.2:** Stand on the floor



**Figure 4.3:** Side view



**Figure 4.4:** Front view

No	Characteristic	Dimension
1.	Height	35 cm
2.	Width	24 cm ( top) 30 cm ( bottom )
3.	Weight	1.6 kilogram
4.	Colour	White and black

**Table 4.1:** Product specification

## 4.2 TESTING PRODUCT

The figure below show the testing process that have done to my dining chair. A child that has 15.3 kilogram and 2 year 6 month of aged has been test to the product. For the result, the dining chair can load a weight of that child.



**Figure 4.5:** Stand on the chair





**Figure 4.6:** Stand on the chair without a tray and cushion



**Figure 4.7:** Stand on the floor



### **4.3 DISCUSSION**

For the result for the testing product, this dining chair can proof that it can load weight of child. However, the dining chair has a problem when the arm's dining chair is too short for attaching the hook onto the back chair. So for the future fabrication, I need to improve up the hook of dining chair which is it can be adjust so it can be used with the different type of height of dining chair and also it can give more comfortable to child when they sit on the product . Another problem encountered during to give stabilities for dining chair to stand on the floor and the material for the tray is not suitable because it so heavy because it made from sheet plate and rectangular hollow steel.

## **CHAPTER 5**

### **CONCLUSION & RECOMMENDATION**

#### **5.1 INTRODUCTION**

This chapter is about problems the project encounter before, during and after the project. This chapter also will discuss about the conclusion of the project. Problem that will be discussed here is the entire problem encountered in every task in the project. The problem encountered during literature review is mainly about the difficulty to get the material to be used in this project. The problem is like, limited resources to get the relevant material such as books and internet connection problem. The problem also comes from the material itself such as many non relevant literature reviews about the project title.

#### **5.2 PROJECT PROBLEMS**

##### **5.2.1 Designing and sketching**

Many problems come at this stage. The problems came during decision making to select the best criteria that need for the project. During this period many design have been sketched but to pick one design that have all the criteria needed by the specification is hard. After a design is selected, another problem encountered is dimensioning the design. After several searching and discussion with the supervisor the problem is solved.

Another problem encountered during design process is material selection for the system, these happen because, the project budget is disclose. The material selection also hard to done because no specific information about available material at the market. Another problem during material selection is the status of person in charge on buying the material and how to buy the material.

#### 5.2.2 Fabrication process

I have problem in welding process because the skill in welding is not quite good during the fabrication. Secondly, I have change the material from rectangular hollow bar to the rod hollow steel because that material cannot be shear to making my arm's chair.

#### 5.2.3 Lab machine and equipments

Less amount of machines in lab such as MIG welding and vertical bend saw. And the some lab equipment is malfunction.

### 5.3 CONCLUSION

In general, the project achieves objectives however some objectives are ignored due to the time frame. Overall perception of the project carried out was good. The project was completed on schedule despite being started late because of some confusion.

### 5.4 RECOMMENDATION

- i. Make the hook that can adjust for height of chair.
- ii. Make the tray that easy to clean and light of weight such as made from wood, acrylic or plastic.
- iii. Provide more MIG welding machine and lab equipment in lab.

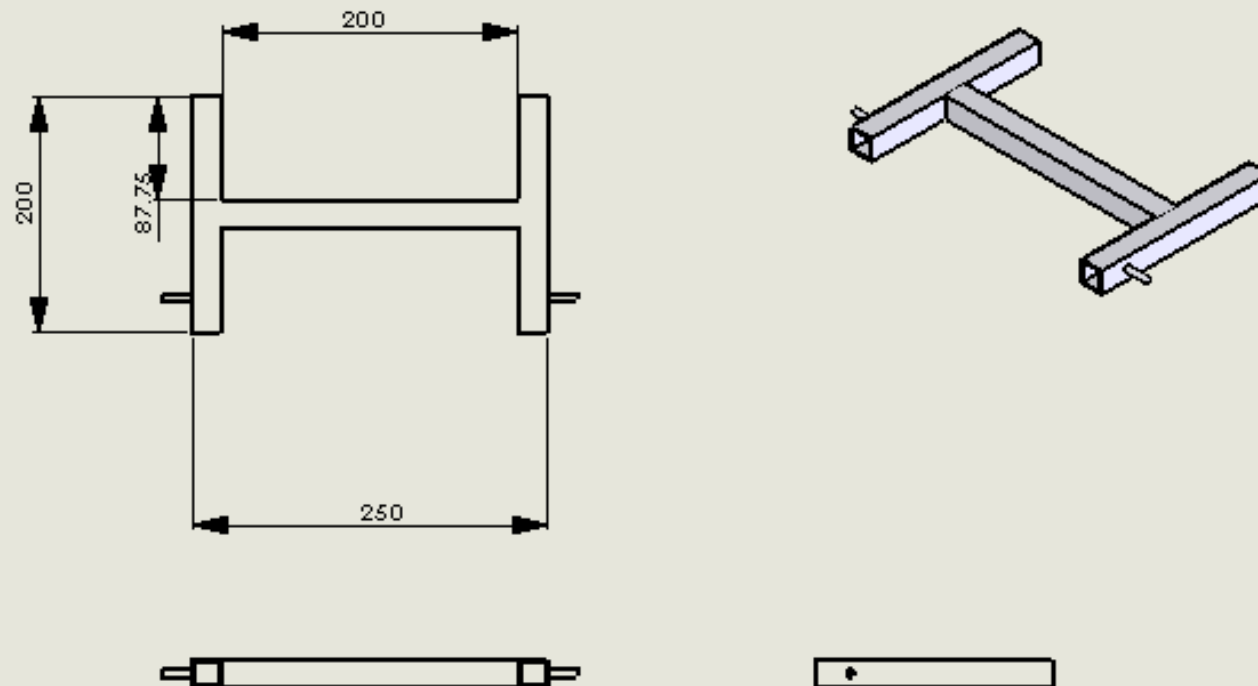
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**APPENDIX A:**  
Parts of Dining Chair







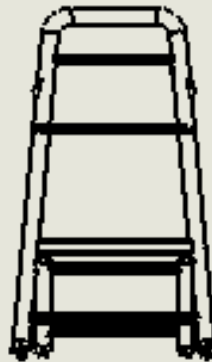
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