DESIGN AND FABRICATION OF ADJUSTABLE FOR SECONDARY STUDENT

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DESIGN AND FABRICATION OF ADJUSTABLE TABLE FOR SECONDARY STUDENT

MOHD AZMEER BIN ALIAS

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

Faculty of Mechanical Engineering
University Malaysia Pahang

NOVEMBER 2009

SUPERVISOR DECLARATION

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

Signature : …….....

Name of Supervisor : WAN ANUAR BIN WAN HASSAN

Date : …….....

AUTHOR DECLARATION

I declare that this report entitled "*Design and fabricate of adjustable table for secondary 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.

Signature : .....

Name of candidate : MOHD AZMEER BIN ALIAS

Date : .....

DEDICATION

To my beloved mother and father

En Alias Bin Hj Ismail

Pn Asmah Binti Kasim

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. Wan Anuar Bin Wan Hassan whose help, stimulating suggestions and encouragement helped me in all time of fabrication process and in writing this report.

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 automotive 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 classmate, especially to my friends for spending their time in helping and giving support whenever I need it in fabricating my project..

ABSTRACT

This report presents about the table that always been used especially in lab. This table is an item of furniture comprising an open, flat surface supported by a base or legs that used to hold articles such as food or papers at a convenient or comfortable height when sitting, and is therefore often used in conjunction with chair. In designing such a product or thing for human use, the 'human factor' is the important element that must put in consideration. One of the things that regularly used by secondary students when use table. Research had shown that human product that can be adjustable following to the situation, is a product that consider more about the ergonomics terms. The idea of the fabricating of this table is based on student's creativity. Materials are proposed for the fabrication of the table is a carbon steel material. In this report, we'll also be having more to the fabrication of this table. The development during the project is to fulfill the learning objective that to produce the adjustable table according to the human factor terms which is secondary students. The variety of applications from the project can be use to produce a product based on human factor.

ABSTRAK

Laporan ini membentangkan tentang meja yang sering kali digunakan terutamanya di dalam makmal. Meja merupakan suatu perkakas yang mempunyai permukaan rata dan disokong oleh kaki dan digunakan untuk memegang sebarang peralatan. Dalam merekabentuk sesebuah produk atau barangan untuk kegunaan manusia, ‘faktor manusia’ merupakan elemen penting yang harus dititikberatkan. Salah satu barangan yang lazim digunakan oleh pelajar-pelajar sekolah menengah untuk membuat sesuatu perkara adalah meja. Kajian telah menunjukkan bahawa produk manusia yang boleh disesuaikan mengikut keadaan adalah merupakan produk yang mengambil kira faktor manusia atau ergonomik. Idea pembentukan meja ini berdasarkan kreativiti pelajar sendiri. Bahan yang dicadangkan untuk pembentukkan meja ini merupakan material jenis besi berkarbon. Dalam laporan ini juga akan lebih memfokuskan kepada pembentukkan meja. Pembangunan yang dijalankan semasa kajian ini adalah untuk memenuhi objektif pengajian untuk menghasilkan rekabentuk meja yang boleh diubahsuai ketinggiannya berdasarkan terma-terma faktor manusia terutamanya pelajar-pelajar sekolah menengah. Kepelbagaian aplikasi daripada kajian ini boleh digunakan untuk menghasilkan produk berdasarkan faktor manusia.

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CHAPTER 1

INTRODUCTION

1.1 Overview

This project presents design and fabrication of a lab adjustable table for secondary students that considers the height of table and ergonomics factor. This adjustable table would be different from existing table in market nowadays. The Diploma final year project allocates the duration of 1 semester, this large man-hour project requires significant efforts of the student to participate. Basically the entire Design and Fabrication of Lab Adjustable Table for Secondary Student could be divided into 3 stages which are concept review and fabrication, designing and make finishing.

The Lab Adjustable Table for Secondary Student is equipped by using all items and methods for instance square hollow carbon steel, square hollow steel, rubber, and also skills in manufacturing processes like Submerged Arc Welding (SMAW) welding to join the parts. The advantages of the proposed adjustable table to be developed can be seen that it portable which can be easily handling, travelling and very useful for our secondary students.

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 lab table in market nowadays just designs to make it look modern and beautiful but the functions not suitable for secondary student used. Besides that the current product has many heights and needs spaces when to use or store, and also it difficult to transfer to another place like to go travelling.

It is important o further improve the current design of lab table for secondary student, so that it is more efficient to use.

1.3 Importance of The Project

The project leads the student to understand how to use the knowledge and skill gathered before solve the problem. This project also promote the student is capability of research, data gathering, analysis and then solving problem scientifically.

The project also educates the student in communication like in presentation and educates them to defend their research in the presentation. The project also will generate student that have capability to make 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 knowledge and experiences.

1.4 Project Objectives

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

a) Design the lab adjustable table for secondary student that suitable for any height.

b) Fabricate the lab adjustable table for secondary student that suitable for any height.

1.5 Scopes of the Project

The Scope of this Project are :

i. To study the process of engineering design in making a product
ii. Improvement of the designed table; especially for students' need and its function
iii. Fabricate the lab adjustable table with small scaling
iv. Come up with the idea of human factor in the design

1.6 Project Planning

This project started with 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 five 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 lab adjustable table that it takes a week to be done.

After all 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 sketch my ideas for making a new features design. I have sketched 5 ideas before Then, I decide the best ideas that I choose for PTA project. The sketching of the table takes about three weeks to be done. The sketching done using Auto CAD software.

After decide the best ideas that have been choose, I have changed the manual sketching hand in Auto CAD 3D and Solid Work that have the full 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 eight. 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 upper and the lower part of this table. After that I have combine this two part by supporting the upper part and the bottom part using hydraulics system component which is located at the center of the upper part and the bottom part. The hydraulic components that use for this project is hydraulics car jack. For the finishing I spray my product to make it look more smooth and beautiful. Before spray the product, the broken metal that effects by the welding process will grind by grinder to get the good surface and not dangerous for user. 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.

1.7 Report Outline

ACTIVITIES		WEEKS													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Briefing by the supervisor & select the title	Plan														
	Actual														
Draft the problems statements, objective, scope & project background	Plan														
	Actual														
Make research about the literature review	Plan														
	Actual														
Draft the flow chart	Plan														
	Actual														
Draft the sketching & design	Plan														
	Actual														
Draft the selection of concept generation	Plan														
	Actual														
Draft the proposal	Plan														
	Actual														
Present the proposal	Plan														
	Actual														
Fabricate & finshing process	Plan														
	Actual														
Prepare the final presentation	Plan														
	Actual														
Final Year Project Presentation & submit the report	Plan														
	Actual														

Figure 1.1 Gantt chart

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Initially, the lab adjustable table is designed as one product that the height not fixed, and very useful and suitable for our secondary students.

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.

The purpose of this chapter is to explain about the design process required for making a product .Chapter Two also discusses about the ergonomic concept especially in working posture, which can be understand through ergonomic studies and the previous researches. In addition, there is also information about human-body study related to engineering design or human factor design consideration. This chapter also will covered the material, processing to produce the product, and the important part is the human height.

2.2 Human Height

Human height is a measurement of the length of a human's body, from the bottom of the feet to the top of the head, when standing erect. It is still not demonstrated on what time during the day humans should get measured because the spine shrinks during the day and that makes people about one inch taller in the morning than in the evening. Most readily sources tell that the best time to measure is in the forenoon because one is stretched in the morning for a short time. About 3 or 4 hours after being awake, the human is already at his lowest height. The eventual height of an adult human is dependent on both hereditary and environmental factors. The particular human genome that an individual inherits is a large part of the first variable nature and a combination of health and other environmental factors present before adulthood (when growth stops) are a major part of the second determinant "nurture". Hereditary factors include both genes and chromosomes, and are inborn. Environmental factors are events that occur before adult height is reached, such as diet, exercise, disease and living conditions.

When populations share genetic background and environmental factors, average height is frequently characteristic within the group. Exceptional height variation (around 20% deviation from average) within such a population is usually due to gigantism or dwarfism which are medical conditions due to specific genes or to endocrine abnormalities. In regions of extreme poverty or prolonged warfare, environmental factors like malnutrition during childhood or adolescence may account for marked reductions in adult stature even without the presence of any of these medical conditions. This is one reason that immigrant populations from regions of extreme poverty to regions of plenty may show an increase in stature, despite sharing the same gene pool.

The average height for each sex within a population is significantly different, with adult males being (on average) taller than adult females. Women ordinarily reach their greatest height at a younger age than men, as puberty generally occurs several years earlier in young women than in young men. Vertical growth stops when the long bones stop lengthening, which occurs with the closure of epiphyseal plates. These plates are bone growth centers that disappear ("close") under the hormonal

surges brought about by the completion of puberty. Adult height for one sex in a particular ethnic group follows more or less a normal distribution.

2.3 History of Table

Some very early tables were made and used by the Egyptians, and were little more than metal or stone platforms used to keep objects off the floor. They were not used for seating people. Food was usually put on large plates deposed on a pedestal for eating. The Egyptians made use of various small tables and elevated playing boards. The Chinese also created very early tables in order to pursue the arts of writing and painting.

The Greeks and Romans made more frequent use of tables, notably for eating, although Greek tables were pushed under a bed after use. The Greeks invented a piece of furniture very similar to the guéridon. Tables were made of marble or wood and metal (typically bronze or silver alloys). Later, the larger rectangular tables were made of separate platforms and pillars. The Romans also introduced a large, semicircular table to Italy, the mensa lunata.

Furniture during the Middle Ages is not as well-known as that of earlier or later periods, and most sources show the types used by the nobility. In the Eastern Roman Empire, tables were made of metal or wood, usually with four feet and frequently linked by x-shaped stretchers. Tables for eating were large and often round or semicircular. A combination of a small round table and a lectern seemed very popular as a writing table[2]. In western Europe, the invasions and internecine wars caused most of the knowledge inherited from the classical era to be lost. As a result of the necessary movability, most tables were simple trestle tables, although small round tables made from joinery reappeared during the 15th century and onward. In the Gothic era, the chest became widespread and was often used as a table.

Refectory tables first appeared at least as early as the 16th century, as an advancement of the trestle table; these tables were typically quite long and capable of supporting a sizeable banquet in the great hall or other reception room of a castle.

2.4 Type of Table

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

2.4.1 Tripod Tables

Tripod tables were very popular during the 18th and 19th centuries as candle stands, tea tables, or small dining tables. Their typically round tops often had a tilting mechanism. The folding top enabled them to be stored out of the way (e.g., in room corners) when not in use. A further development in this direction was the "birdcage" table, the top of which could both revolve and tilt.

Figure 2.1: Tripod Tables

Source: http://www.chestofbooks.com (11 October 2009)

2.4.2 Pembroke Tables

Pembroke tables were first introduced during the 18th century and were popular throughout the 19th century. Their main characteristic was a rectangular or oval top with folding or drop leaves on each side. Most examples have one or more drawers and four legs sometimes connected by stretchers. Their design meant they could easily be stored or moved about and conveniently opened for serving tea, dining, writing, or other occasional uses.

Figure 2.2: Pembroke Tables

Source: http://www.oneofakindantiques.com (11 October 2009)

2.4.3 Sofa Tables

Sofa tables are similar to Pembroke tables and usually have longer and narrower tops. They were specifically designed for placement directly in front of sofas for serving tea, writing, dining, or other convenient uses.

Figure 2.3: Sofa Tables

Source: http://www.amishwoodworkes.com (11 October 2009)

2.4.4 Work Tables

Work tables were small tables designed to hold sewing materials and implements, providing a convenient work place for women who sewed. They appeared during the 18th century and were popular throughout the 19th century. Most examples have rectangular tops, sometimes with folding leaves, and usually one or more drawers fitted with partitions. Early examples typically have four legs, often standing on casters, while later examples sometimes have turned columns or other forms of support.

Figure 2.4: Works Tables

Source: http://myworldinthreedimension.blogspot.com (11 October 2009)

2.4.5 Drum Tables

Drum tables are round tables introduced for writing, with drawers around the platform.

Figure 3.5: Drum Tables

Source: http://www.thefurniture.com (11 October 2009)

2.4.6 End Tables

End tables are small tables typically placed beside couches or armchairs. Often lamps will be placed on an end table.

Figure 2.6: End Tables

Source: http://www.byamish.com (11 October 2009)

2.4.7 Billiard Table

A Billiards table is bounded tables on which billiards-type games are played. All provide a flat surface, usually composed of slate and covered with cloth, elevated above the ground.

Figure 2.7: Billiards Tables

Source: http://www.trendir.com (11 October 2009)

2.4.8 Table Tennis

Table tennis tables are usually masonite or a similar timber, layered with a smooth low-friction coating. It is divided into two halves by a low net, which separates opposing players.

Figure 2.8: Tables Tennis

Source: http://www.gibs.at (11 October 2009)

2.5 Joining Method

Joining involves in assembly stage. Commonly used method to join metal part is Shielded Metal Arc Welding (SMAW).

2.5.1 Shielded Metal Arc Welding (SMAW)

Shielded metal arc welding (SMAW), also known as manual metal arc (MMA) welding or informally as stick welding, is a manual arc welding process that uses a consumable electrode coated in flux to lay the weld. An electric current, in the form of either alternating current or direct current from a welding power supply, is used to form an electric arc between the electrode and the metals to be joined. As the weld is laid, the flux coating of the electrode disintegrates, giving off vapors that serve as a shielding gas and providing a layer of slag, both of which protect the weld area from atmospheric contamination.

Because of the versatility of the process and the simplicity of its equipment and operation, shielded metal arc welding is one of the world's most popular welding processes. It dominates other welding processes in the maintenance and repair industry, and though flux-cored arc welding is growing in popularity, SMAW continues to be used extensively in the construction of steel structures and in industrial fabrication. The process is used primarily to weld iron and steels (including stainless steel) but aluminum, nickel and copper alloys can also be welded with this method.

Figure 2.9: Shielded Metal Arc Welding Machine

To strike the electric arc, the electrode is brought into contact with the workpiece in a short sweeping motion and then pulled away slightly, with a movement like lighting a match. This initiates the arc and thus the melting of the workpiece and the consumable electrode, and causes droplets of the electrode to be passed from the electrode to the weld pool. As the electrode melts, the flux covering disintegrates, giving off vapors that protect the weld area from oxygen and other atmospheric gases. In addition, the flux provides molten slag which covers the filler metal as it travels from the electrode to the weld pool. Once part of the weld pool, the slag floats to the surface and protects the weld from contamination as it solidifies. Once hardened, it must be chipped away to reveal the finished weld. As welding progresses and the electrode melts, the welder must periodically stop welding to remove the remaining electrode stub and insert a new electrode into the electrode holder. This activity, combined with chipping away the slag, reduce the amount of time that the welder can spend laying the weld, making SMAW one of the least efficient welding processes. In general, the operator factor, or the percentage of operator's time spent laying weld, is approximately 25%.

The actual welding technique utilized depends on the electrode, the composition of the workpiece, and the position of the joint being welded. The choice of electrode and welding position also determine the welding speed. Flat welds require the least operator skill, and can be done with electrodes that melt quickly but solidify slowly. This permits higher welding speeds. Sloped, vertical or upside-down welding requires more operator skill, and often necessitates the use of an electrode that solidifies quickly to prevent the molten metal from flowing out of the weld pool.

However, this generally means that the electrode melts less quickly, thus increasing the time required to lay the weld.

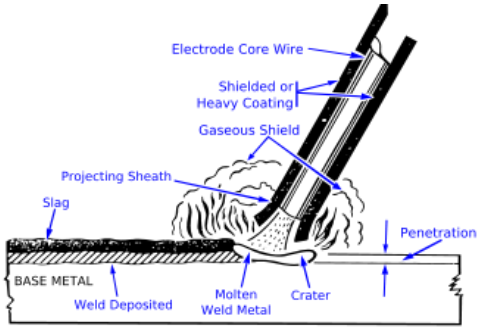

Figure 2.10: Shielded Metal Arc Welding Diagram

Source: http://www.weldacop.com (11 October 2009)

2.5.2 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.

2.6 Drilling Machines

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 2.11: Press Drilling Machines

A drill press Figure 2.10 (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.

A drill press has a number of advantages over a hand-held drill:

- less effort is required to apply the drill to the workpiece. The movement of the chuck and spindle is by a lever working on a rack and pinion, which gives the operator considerable mechanical advantage.
- the table allows a vise or clamp to position and lock the work in place making the operation much more secure.
- the angle of the spindle is fixed in relation to the table, allowing holes to be drilled accurately and repetitively.

Speed change is achieved by manually moving a belt across a stepped pulley arrangement. Some drill presses add a third stepped pulley to increase the speed range. Modern drill presses can, however, use a variable-speed motor in conjunction with the stepped-pulley system; a few older drill presses, on the other hand, have a sort of traction-based continuously variable transmission for wide ranges of chuck speeds instead, which can be changed while the machine is running.

Drill presses are often used for miscellaneous workshop tasks such as sanding, honing or polishing, by mounting sanding drums, honing wheels and various other rotating accessories in the chuck. This can be dangerous on many presses, where the chuck arbor is held in the spindle purely by the friction of a Morse taper instead of being held securely by a drawbar.

2.7 Material

2.7.1 Introduction

Carbon steel, also called plain carbon steel, is steel where the main alloying constituent is carbon. The AISI defines carbon steel as: "Steel is considered to be carbon steel when no minimum content is specified or required for chromium, cobalt, columbium [niobium], molybdenum, nickel, titanium, tungsten, vanadium or zirconium, or any other element to be added to obtain a desired alloying effect; when the specified minimum for copper does not exceed 0.40 per cent; or when the maximum content specified for any of the following elements does not exceed the percentages noted: manganese 1.65, silicon 0.60, copper 0.60."

The term "carbon steel" may also be used in reference to steel which is not stainless steel; in this use carbon steel may include alloy steels.

Steel with a low carbon content has properties similar to iron. As the carbon content rises, the metal becomes harder and stronger but less ductile and more difficult to weld. In general, higher carbon content lowers the melting point and its temperature resistance. Carbon content influences the yield strength of steel because carbon atoms fit into the interstitial crystal lattice sites of the body-centered cubic (BCC) arrangement of the iron atoms. The interstitial carbon reduces the mobility of dislocations, which in turn has a hardening effect on the iron. To get dislocations to move, a high enough stress level must be applied in order for the dislocations to "break away". This is because the interstitial carbon atoms cause some of the iron BCC lattice cells to distort.85% of all steel used in the U.S. is carbon steel.

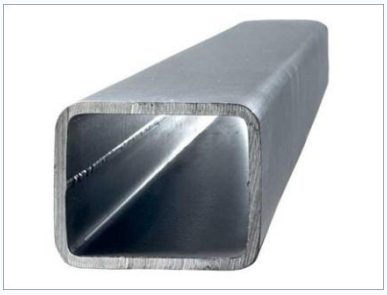

Figure 2.12: Square Hollow Carbon Steel

Source: http://www.tradeindia.com (11 October 2009)

2.6.2 Types of Carbon Steel

(a) Mild and low carbon steel

Mild steel is the most common form of steel as its price is relatively low while it provides material properties that are acceptable for many applications. Low carbon steel contains approximately 0.05–0.15% carbon[1] and mild steel contains 0.16–0.29%[1] carbon, therefore it is neither brittle nor ductile. Mild steel has a relatively low tensile strength, but it is cheap and malleable; surface hardness can be increased through carburizing.

It is often used when large amounts of steel is needed, for example as structural steel. The density of mild steel is approximately 7.85 g/cm^3 (0.284 lb/in^3) and the Young's modulus is 210,000 MPa (30,000,000 psi).

Low carbon steels suffer from yield-point runout where the materials has two yield points. The first yield point (or upper yield point) is higher than the second and the yield drops dramatically after the upper yield point. If a low carbon steel is only stressed to some point between the upper and lower yield point then the surface may develop Lüder bands.

(b) Higher carbon steels

Carbon steels which can successfully undergo heat-treatment have a carbon content in the range of 0.30–1.70% by weight. Trace impurities of various other elements can have a significant effect on the quality of the resulting steel. Trace amounts of sulfur in particular make the steel red-short. Low alloy carbon steel, such as A36 grade, contains about 0.05% sulfur and melts around 1426–1538 °C (2600–2800 °F).[6] Manganese is often added to improve the hardenability of low carbon steels. These additions turn the material into a low alloy steel by some definitions, but AISI's definition of carbon steel allows up to 1.65% manganese by weight.

(c) Medium carbon steel

Approximately 0.30–0.59% carbon content. Balances ductility and strength and has good wear resistance; used for large parts, forging and automotive components.

(d) High carbon steel

Approximately 0.6–0.99% carbon content. Very strong, used for springs and high-strength wires.

(e) Ultra-high carbon steel

Approximately 1.0–2.0% carbon content. Steels that can be tempered to great hardness. Used for special purposes like (non-industrial-purpose) knives, axles or punches. Most steels with more than 1.2% carbon content are made using powder metallurgy. Note that steel with a carbon content above 2.0% is considered cast iron.

Steel can be heat treated which allows parts to be fabricated in an easily-formable soft state. If enough carbon is present, the alloy can be hardened to increase strength, wear, and impact resistance. Steels are often wrought by cold working methods, which is the shaping of metal through deformation at a low equilibrium or metastable temperature.

CHAPTER 3

METHODOLOGY

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 lab adjustable table is shown by flowchart in the Figure 3.1.

Methodology is one of the most important elements to be considered in developing a research. Research methodology indicates procedures that are planned for the research. It is to ensure that the development of the research is smooth and get the expected result. It is also to avoid the research to alter course from the objectives that have been stated or in other words the project follow the guideline based on the objectives.

A good methodology can described the structure of the research where by it can be the guideline in managing the project. In other words the methodology can be described as the framework of the research where it contains the elements of work based on the objectives and scopes of the research.

3.2 Process Outline

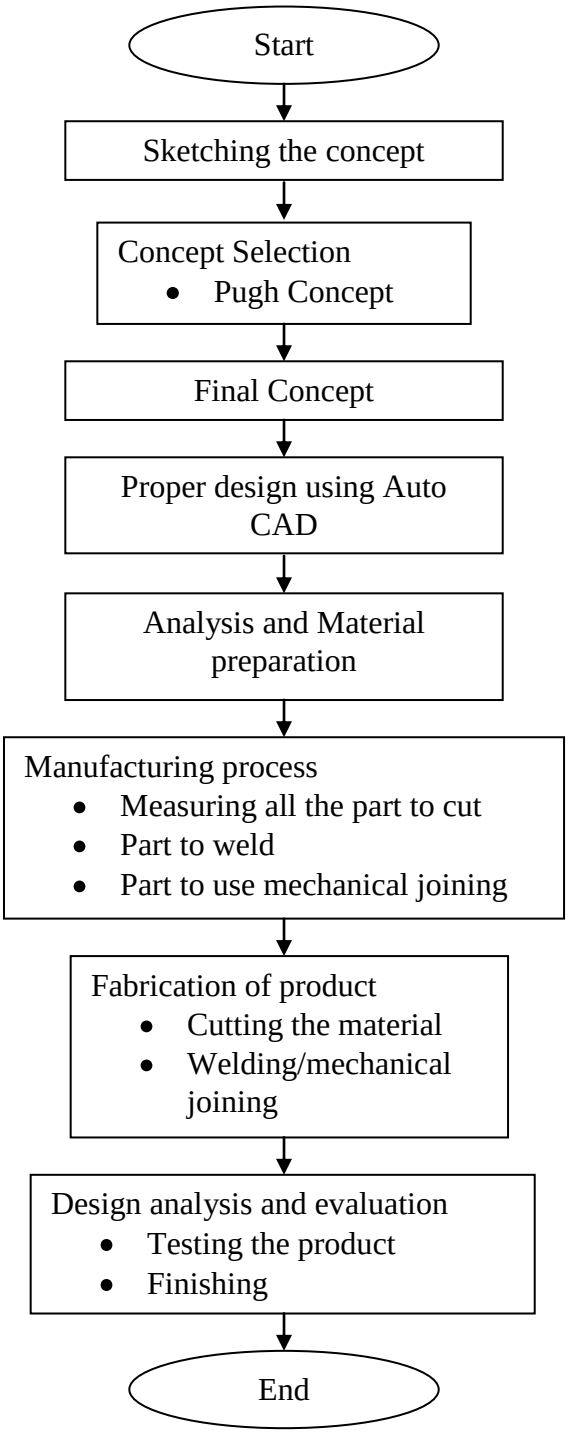

Figure 3.1: Flowchart of the project methodology

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 lab adjustable table for secondary student. 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 3 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 Auto CAD 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 SMAW, cutting, grinding, drilling and others. For the arms, support and the back seat I used the carbon hollow steel to make a high strength and light in weight.

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 Fabrication Process

3.3.1 Introduction

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 upper part and the bottom part 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.

3.3.2 Process Involve

Several processes have been used to fabricate the lab adjustable table. The fabrication process starts from dimensioning the raw material until it is finish as a desired product. The processes that involved are including:

a) Measuring : Measuring the material into dimension needed.
b) Marking : All measured materials need to be marked to give precise dimension.
c) Cutting : Cutting the material into part according to dimension needed.
d) Joining : Materials joined by the method of welding
e) Drilling : Marked holes are then drilled to make holes for joining it with another part.
f) Finishing : Any rough surface cause by welding spark were grind to give smooth and safe surface.
g) Spraying : Using white spray colour to the whole product.

Steps-By-Step Process

The fabrication processes was started with measuring the material into the required dimension needed. The measuring process firstly done to the hollow carbon steel 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 rectangular hollow steel. Thirdly the material were used to be measuring is the rubber. All the measuring and marking process is done by using steel ruler, measuring tape, and steel marker.

Then, after measuring and marking process, the marked material goes to next process, cutting. Firstly the square hollow carbon steel is cut into its desired length. This process is done using vertical bend saw. After the square hollow carbon steel, the rectangular hollow steel 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.

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.

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 Shielded Metal Arc Welding(SMAW) or formerly known as Manual Metal Arc Welding (MMA). 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.

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.

After all the process had been done, 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 black colour.

Figure 5.1: Measuring process

Figure 5.2: Cutting process

Figure 5.3: Grinding process

Figure 5.4: Welding process

Figure 5.5: Drilling process

Figure 5.6: Spraying process

3.3.3 The Whole Product Review

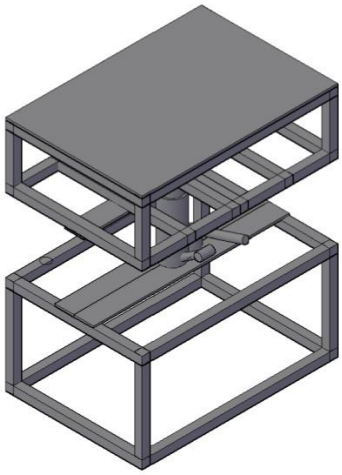

Figure 5.7: First view

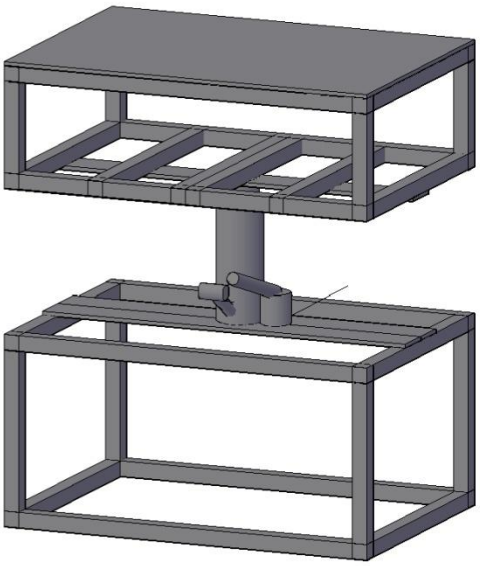

Figure 5.8: Second view

CHAPTER 4

RESULT AND DISCUSSION

4.1 Introduction

This chapter explains detailed process involved in the fabrication. This will include the design and sketching that had been chosen to be the final for fabricating.

4.2 Design

The design of the Lab Adjustable Table for Portable and Adjustable Dining Chair for Secondary Student 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:

a) Strength: Must have certain strength to ensure that it can load heavy weight.
b) Ergonomics factors: The adjustable table must be easy to handle.
c) Material: Availability of material is one of aspects that have been considered.

4.3 Drawing

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

a) Sketching : All the ideas for making the adjustable table will be sketch on the Auto CAD 2D to ensure that idea selection and be made after this.
b) Auto CAD software : The sketching idea in hand manual sketch will be change in 3D using Auto CAD.

4.4 Design Specifications

The design of the Lab Adjustable Table for Secondary Student must be considered that it can endure several specifications, which are including:

a) The adjustable table can will fixed the height into the minimum height that will make easy for storage.
b) Have the suitable surface which is rubber that will easy to student make some lab task.
c) Overall materials are 1 inch hollow carbon steel for make the upper part.

4.5 Sketching Drawing Selection

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

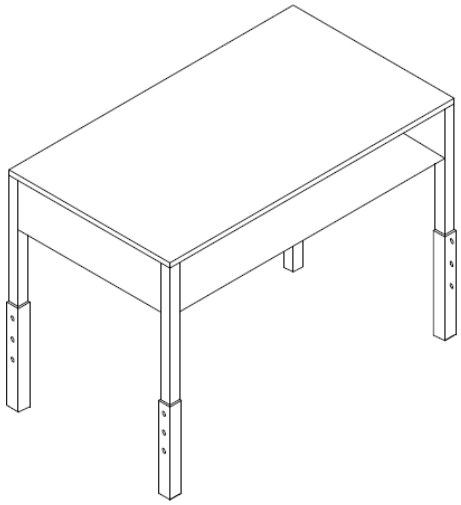

Figure 4.1: Sketching 1

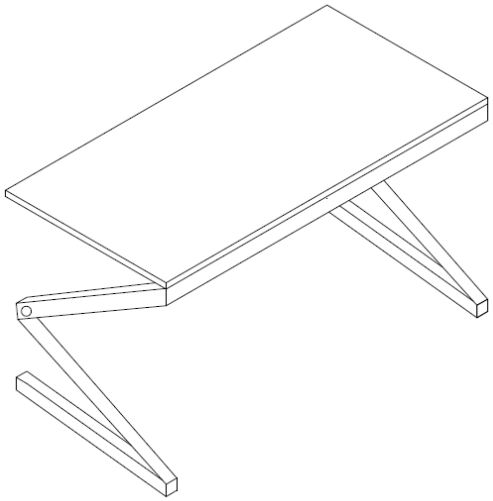

Figure 4.2: Sketching 2

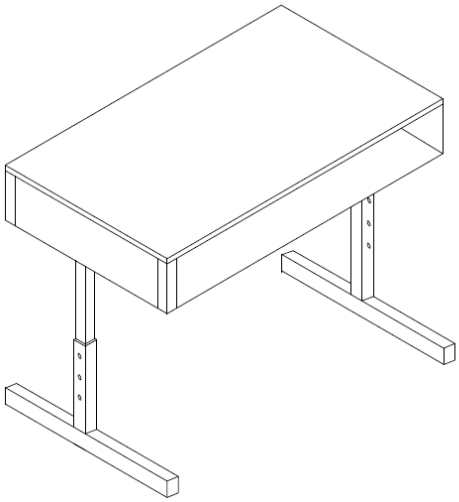

Figure 4.3: Sketching 3

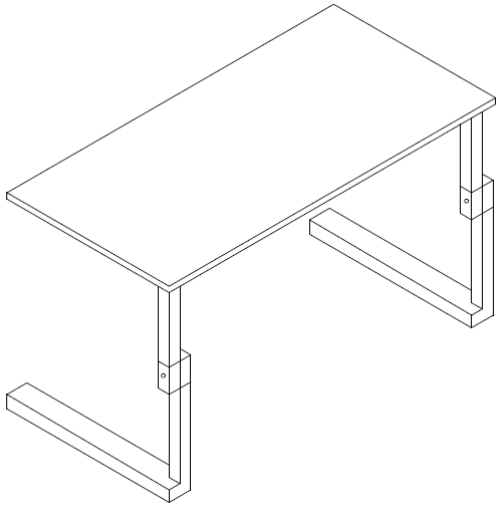

Figure 4.4: Sketching 4

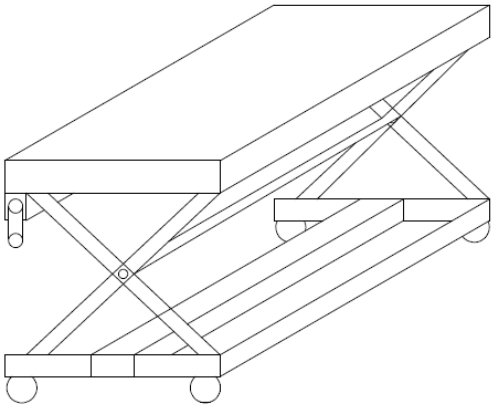

Figure 4.5: Sketching 5

4.5.1 Finalized Design

The finalized design has been chosen as the ideas after comparing with another designs and extracting good features using the Pugh Concept.

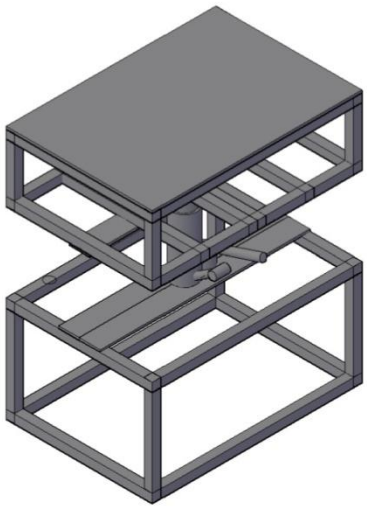

Figure 4.6: Final Design

This design is to allow student to adjust the height followed that height that they want and will make the student comfortable when use it. This means that the different height of student can do some lab task or works at the same table.

Beside that, lab adjustable table is ergonomic because the product is easy to use, to handling, travelling and storage. This lab adjustable table is made from hollow carbon steel bar and hollow steel that can make it strength .

Lastly, the students can storage this lab table by adjust the height into the minimum height which can make the size of the table small and easy to storage. For the upper part, there have a space to keep the equipment like the drawer but it not have the door or some plate blocks which make the students more easy to keep or take some equipment from there. It also have the handle to adjust the height, if want to minimum the height, just push the release handle into counter clockwise. The maintenance of the hydraulics system is very easy because it have a space to refill the hydraulics oils.

CHAPTER 5

CONCLUSION & RECOMMENDATTION

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.

5.2.1 Project problems

a) 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.

b) Fabrication process

Students need to given more time to finish fabricating their product because the joining finishing was not so good but yet can still reliable.

c) Material preparation

The material in lab is not available for making my project and to order the material at market take a long period time to arrive. As an alternative I have decided to use recycle material that found around the lab to start the fabrication process while waiting the material needed is arriving.

d) Lab machine and equipments

The amount of machines in lab is not enough to use for the whole student PTA and PSM to do the project in the same time. And the some lab equipment is malfunction. Then the amount of protective equipments is less to use.

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. If more time and good budget is given the project will be complete successfully.

5.4 Recommendation

a) The weight of the Lab Adjustable Table more light by using the different types of material
b) Using the big size of the hydraulics system.

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APPENDIX A

Table of Pugh Concept

	Concept Variants					
Selection Criteria	Concept 1	Concept 2	Concept 3	Concept 4	Concept 5	Datumm
Easy to handling	(-)	(+)	(-)	(+)	(+)	0
Easy to use	0	(+)	0	(+)	(+)	0
Easy to move	(-)	(-)	(-)	(-)	(+)	0
Capability	(+)	(-)	0	0	(+)	0
Strength	(+)	0	0	(-)	(+)	0
Shapes	0	0	(-)	(-)	0	0
Function	(+)	(-)	0	(+)	(+)	0
Pluses	3	2	0	3	5	0
Sames	2	2	4	1	1	0
Minuses	2	3	3	4	0	0
Net	1	-1	-3	-1	5	0
Rank	2	3	5	4	1	0
Continues	NO	NO	NO	NO	YES	