DESIGN AND FABRICATION OF ADJUSTABLE WORK POSITIONER

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BORANG PENGESAHAN STATUS TESIS ◆

JUDUL: **DESIGN AND FABRICATE OF ADJUSTABLE WORK POSITIONER**

SESI PENGAJIAN: 2009/2010

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DESIGN AND FABRICATION OF ADJUSTABLE WORK POSITIONER

MOHAMAD NAFIS BIN JAMALUDDIN

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

Faculty of Mechanical Engineering
UNIVERSITI MALAYSIA PAHANG

NOVEMBER 2009

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 : Wan Anuar Bin Wan Hassan
Date :

AUTHOR 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 diploma and is not concurrently submitted for award of other diploma.

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Name of candidate : MOHAMAD NAFIS BIN JAMALUDDIN

Date : 22 NOVEMBER 2009

DEDICATION

To my beloved mother and father

En. Jamaluddin Bin Mohd Noor

Pn. Shuhaimi Binti Abdul Hamid

ACKNOWLEDGEMENTS

First and foremost, I present my gratitude to Allah the Almighty for His blessings on me that enable me to finish this project.

I am grateful and would like to express my earnest gratitude and appreciation to my supervisor Mr. Wan Anuar Bin Wan Hassan for his patient, germinal ideas, priceless guidance, nonstop encouragement and constant support that encourage me to finish this project. I am grateful for his consistent support from the first day I applied to graduate program to these concluding moments. I am truly thankful for his progressive vision about my training in science, his tolerance of my naive mistakes, and his dedication to my future career.

My sincere thanks go to all my classmates and members of the staff of the Mechanical Engineering Department, UMP, who assisted me in many ways and made my stay at UMP pleasant and unforgettable. I also want to acknowledge my appreciation to anybody for spending their time and energy to help me endure my hard times in finishing this project.

I acknowledge my sincere indebtedness and gratitude to my parents for their love, dream and sacrifices throughout my life. I cannot find the appropriate words that could properly describe my appreciation for their devotion, support and faith in my ability to reach my goals.

ABSTRACT

The objective of this project is to design and fabricate an adjustable work positioner. Adjustable work positioner is important equipment because it reduces the work area of a person and provides a practical and suitable place to put their tools while working. However, the current adjustable work positioners do not have enough safety characteristic that can covert the user from danger which there is sharp edges on the product. They also have a low level of stability which increases the risk of falling when using the adjustable work positioner. That is the main reason why we need a concept of the adjustable work positioner. The main features of this adjustable work positioner are the platform that can be set to the most convenient height and tilted to a specific angle that the user desires. The idea was appear because of the lack of adjustability in the existing products. The idea of the fabrication of this adjustable work positioner is based on student's creativity. The selection of suitable materials in the fabricating of this adjustable work positioner is a loaded material which has suitable weight; long life-span and can detain large force. Materials are proposed for the fabrication of the adjustable work positioner is mild steel material. There are several processes involved during the design and fabrication of this adjustable work positioner which are consisted in this report.

ABSTRAK

Objektif projek ini adalah untuk mereka dan membentuk sebuah tempat kerja mudah alih. Tempat kerja mudah alih merupakan suatu peralatan penting di mana ia mengecilkan penggunaan kawasan kerja and menyediakan tempat yang praktikal dan sesuai untuk meletakkan peralatan semasa bekerja. Namun begitu, tempat kerja mudah alih yang sedia ada di pasaran tidak mempunyai ciri-ciri keselamatan yang mencukupi yang dapat melindungi pengguna dari bahaya di mana ia mempunyai bucu-bucu yang tajam. Ia juga mempunyai tahap kesetabilan yang rendah yang mana meningkatkan risiko peralatan untuk jatuh semasa menggunakan tempat kerja mudah alih. Maka dengan alasan tersebutlah kita memerlukan concept baru bagi sesebuah tempat kerja mudah alih. Ciri-ciri utama tempat kerja mudah alih ini ialah platfomnya boleh diubah ke suatu ketinggian yang paling sesuai dan sudutnya dapat diubah-ubah mengikut kemahuan pengguna. Idea ini tercetus akibat daripada kurangnya pengubahsuaian yang terdapat pada produk semasa. Idea membentuk tempat kerja mudah alih ini adalah berdasarkan kreativiti pelajar sendiri. Pemilihan material yang sesuai untuk pembentukan pula berdasarkan berat material yang sesuai, tahan lama dan kebolehan untuk menahan beban. Material yang dicadangkan untuk pembentukan tempat kerja mudah alih ini ialah mild steel. Beberapa proses juga diperlukan semasa mereka dan membentuk tempat kerja mudah alih sebagaimana yang terkandung di dalam laporan ini.

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P	Pressure
A	Area
σ_y	Yield stress
σ_{cal}	Calculated stress
τ_{cal}	Calculated stress
τ_y	Yield stress

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CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter explained about the project objectives, project background, project scope and problem statement of the project. Beside that, this chapter also covers the project flow of this project.

1.2 Background of The Project

The purpose of this project is to design and fabricate an adjustable work positioner which provides a place for the user to put their things such as pliers, hammers, screwdrivers, bolts and nuts and many more. Furthermore, adjustable work positioner places containers at a comfortable position for picking operations. So the user does not need to bend down to pick the tools on the floor or having difficulties to get their equipments while working at a higher place.

This final year project allocates the duration of one semester to be finished. The fabrication of the adjustable work positioner inquires me to have skills in handling several machines such as welding machines, bending machines, cutting machines, drilling machines, riveting, grinding machines and many more to make the product.

1.3 Objective

The objective of this project is to design and fabricate an adjustable work positioner.

1.4 Scope

This project will be limited within the following scopes, which are:

(i) Maximum load that this adjustable work positioner can withstand is 30kg.

(ii) The tilt angle of the platform of the adjustable work range from 0°, 10°, 20° and 30°.

(iii) The adjustable height range from 0.5m to 1m.

1.5 Problem Statement

(i) Current adjustable work positioner do not has proper safety because it has sharp edges at the corners of its platform.

(ii) Current adjustable work positioner is expensive because it uses pneumatics shaft to adjust its height.

(iii) Stability is important for an adjustable work positioner to a give steady and firm place to put things. But, current adjustable work positioner is not so stable.

1.6 Conclusion

From this chapter, we can conclude that the all scopes use is very important to create the product. Besides, we also have known the main objective of this project so that we will know the direction of this project.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The purpose of this chapter is to provide a review of past research efforts related to adjustable work positioner. This chapter will explain about the research of the project that has been chosen and explained about adjustable work positioner features and specifications. A review of other relevant research studies is also provided. Substantial literature has been studied on history, types of material needed, techniques and machines use in fabrication and many other things that are related to this project.

2.2 Introduction Of Product

The adjustable work positioner is commonly use in working area such as laboratories and workshops. It places container at a convenient position for picking operation. By putting the tools on the adjustable work positioner, the work area of the user is reduces as the adjustable work positioner avoids the user from commuting from the place he put the tools to the place he is working.

2.3 Product Review

If we go to a car workshop for example, we will see the mechanics put their tools such as spanner, pliers, screwdrivers and tool boxes on the floor which is clearly not a practical way to put those things while working. This is because they might step on those tool and break the tools. It becomes even worst if it injures the mechanics. In addition, the mechanic needs to bend down to take the tools which he put on the floor. Another example of problem is if we put the tools on a table, we cannot bring the tool to a height we want because the table height is fixed.

So, the adjustable work positioner is made to solve this problem. An adjustable work positioner has a pneumatics telescoping shaft attach to a platform of the top which can be tilted to a desired angle while the other end of the shaft is attach to 4 leg stand with a wheeler at each end to give mobility to the adjustable work positioner. The pneumatics telescoping shaft is a user friendly part of the adjustable work positioner because in uses a lever to control its height. Although pneumatics shaft makes it easy to change the height, but it is very expensive to buy. The wheels attached to the legs provide mobility to the adjustable work positioner so that we can drag it to anywhere we want. With the production of the adjustable work positioner, the user can reduce their working area because they don't have to go back and forth to take the tool they want to use. With adjustable work positioner, they just need to drag it to the place they want to work. Overall, adjustable work positioner places containers at a comfortable position for picking operations.

2.4 Work Area

Work area is defined as the place where people do their work. Working in a large coverage of area must be really tiring to a person because he needs to move a lot to do their jobs. Besides that, going from a place just to take a tool to the work places is in fact not a practical way as the worker might needs to go back to take other tools or just to put the tools back to the place they take it.

Nowadays, as people are trying to reduce the work area, there are a lot of products which are suitable to place tools on them and bring them to the work place. By doing this, they do not have to commute from the place he put the tools to the place he is working and this reduces the coverage of working area of the worker.

2.5 Ergonomics Of Working

Ergonomics is the science of fitting workplace conditions and job demands to the capabilities of the employees. Ergonomics principles are use to improve the fit between the workers and the workspaces. A practical approach to ergonomics considers the match between the person, the equipment they use, the work processes and the work environment. A person capabilities, physical attributes and work habits must be recognised to improve the ergonomics factor in the workplace.

By applying ergonomics principle to the workplace, risk factors are minimized, productivity is increased and overall workplace quality is improved. The workstation must be adjusted to promote a neutral position while a person works. When adjusting a workstation, keep in mind that all of the equipment interacts. Making one adjustment may alter another. Arrange your tools and materials for the work to flow efficiently through your work station. Your arrangement might not be quite the same as another person would choose because your methods of working are slightly different. Place frequently used items near at hand.

To arrange the work area ergonomically, you need to consider the base of support and place the equipment and materials where appropriate to the workplace. By placing the tools and equipment near, we actually reduces the work pace from walking to too many places just to do a job. If ergonomics principles are fully applied in the workplace, we actually are working in a smarter way, not a harder and tiring way of working.

2.6 Materials Specification

2.6.1 Mild and Low Carbon Steel

Mild Steel is better than other material because of the price is not expensive and it beneficial for producing castings, forgings, stamping, rolling, welding, machining and heat treatment works.

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 and mild steel contains 0.16–0.29% 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.

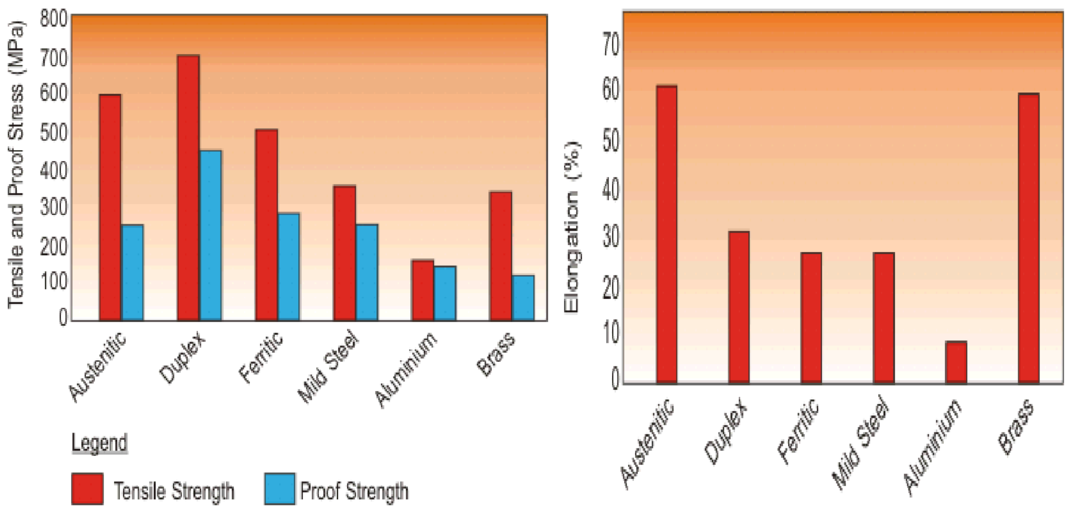


Figure 2.1: Mild Steel Material Properties

Source: The A to Z of Materials 2004

It is often used when large amounts of steel are 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 run out where the materials have 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 low carbon steel is only stressed to some point between the upper and lower yield point then the surface may develop bands.

2.6.2 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.

2.6.3 High Carbon Steel

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

2.6.4 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 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 stable temperature.

2.7 Machining Equipment

2.7.1 Drilling

A drill or drill motor is a tool fitted with a rotating cutting implement used for drilling holes in various materials. The drill bit is gripped by a chuck at one end of the drill and rotated while pressed against the target material. 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. Specially designed drills are also used in medicine, space missions and other applications.

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

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.

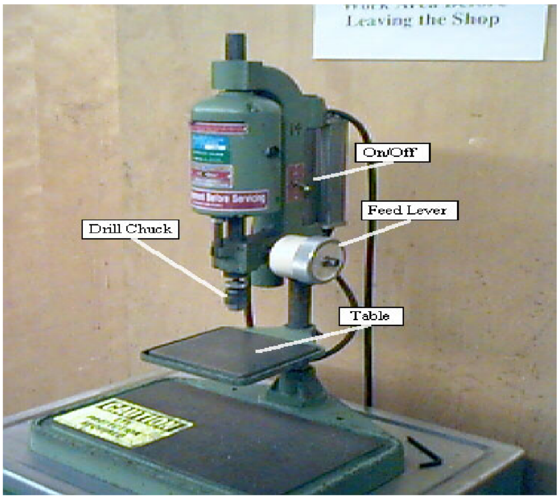


Figure 2.2: Press Drilling Machines

Sources: Wikipedia (2006)

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 arbour is held in the spindle purely by the friction of a Morse taper instead of being held securely by a drawbar.

2.7.2 Welding Machines

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

2.7.2.1 Metal Inert Gas (MIG) Welding

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.

Figure 2.3: Metal Inert Gas (MIG) Welding

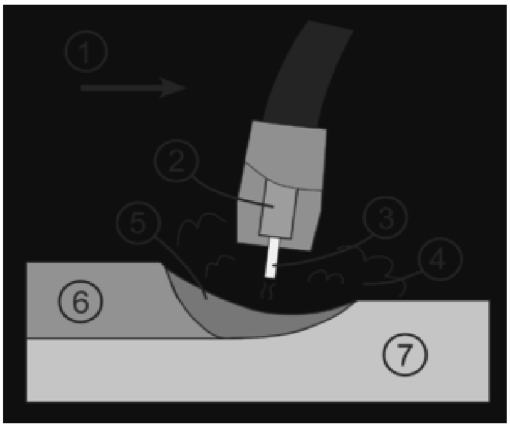
Sources: Wikipedia 2003

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.



MIG weld area. **(1)** Direction of travel, **(2)** Contact tube, **(3)** Electrode, **(4)** Shielding gas, **(5)** Molten weld metal, **(6)** Solidified weld metal, **(7)** Workpiece

Figure 2.4: Schematic of Metal Inert Gas (MIG) Welding

Sources: Wikipedia 2003

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.

2.7.2.2 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 2.5: 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 vapours 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.

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.

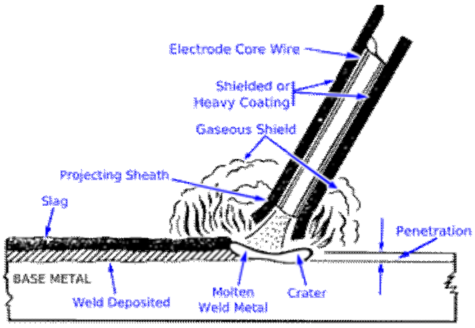


Figure 2.6: Shielded Metal Arc Welding Diagram

Source: Weldacop 2009

2.7.3 Rivet

A rivet is a permanent mechanical fastener. Before it is installed it consists of a smooth cylindrical shaft with a head on one end. The end opposite the head is called the buck-tail. On installation the rivet is placed in a punched or pre-drilled hole. Then the tail is "upset" (i.e. deformed) so that it expands to about 1.5 times the original shaft diameter and holds the rivet in place. To distinguish between the two ends of the rivet, the original head is called the factory head and the deformed end is called the shop head or buck-tail.

Figure 2.7: Blind Rivet (POP Rivet)

Source: Wikipedia 2004

Blind rivets are tubular and are supplied with a mandrel through the center. The rivet assembly is inserted into a hole drilled through the parts to be joined and a specially designed tool is used to draw the mandrel into the rivet. This expands the blind end of the rivet and then the mandrel snaps off. (A POP rivet is a brand name for blind rivets sold by Emhart Technologies.) These types of blind rivets have non-locking mandrels and are avoided for critical structural joints because the mandrels may fall out, due to vibration or other reasons, leaving a hollow rivet that will have a significantly lower load carrying capability than solid rivets. Furthermore, because of the mandrel they are more prone to failure from corrosion and vibration. Unlike solid rivets, blind rivets can be inserted and fully installed in a joint from only one side of a part or structure, "blind" to the opposite side.

2.7.4 Grinding Machines

Grinding is a finishing process used to improve surface finish, abrade hard materials, and tighten the tolerance on flat and cylindrical surfaces by removing a small amount of material. Information in this section is organized according to the subcategory links in the menu bar to the left.

In grinding, an abrasive material rubs against the metal part and removes tiny pieces of material. The abrasive material is typically on the surface of a wheel or belt and abrades material in a way similar to sanding. On a microscopic scale, the chip formation in grinding is the same as that found in other machining processes. The abrasive action of grinding generates excessive heat so that flooding of the cutting area with fluid is necessary.

Figure 2.8: Grinder

Sources: Tradevv, Grinder 2005

CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter consists about the conceptual design, concept selection, and selection of the final design. It also explained about the method of fabricate such as the cutting of the material, drilling, welding, riveting and grinding. I also will explain about the design that had been chosen to be as the final idea to be produced or fabricate. All the fabrication process in this project is going to be explained in details.

Methodology is one of the most important elements to be considered in this project. Research methodology indicates procedures that are planned for the project. It is to ensure that the development of the project is smooth and get the expected result. It is also to avoid the project 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 project where by it can be the guideline in managing the project. In other words the methodology can be described as the framework of the project where it contains the elements of work based on the objectives and scopes of the project.

3.2 Flow Chart Of Methodology

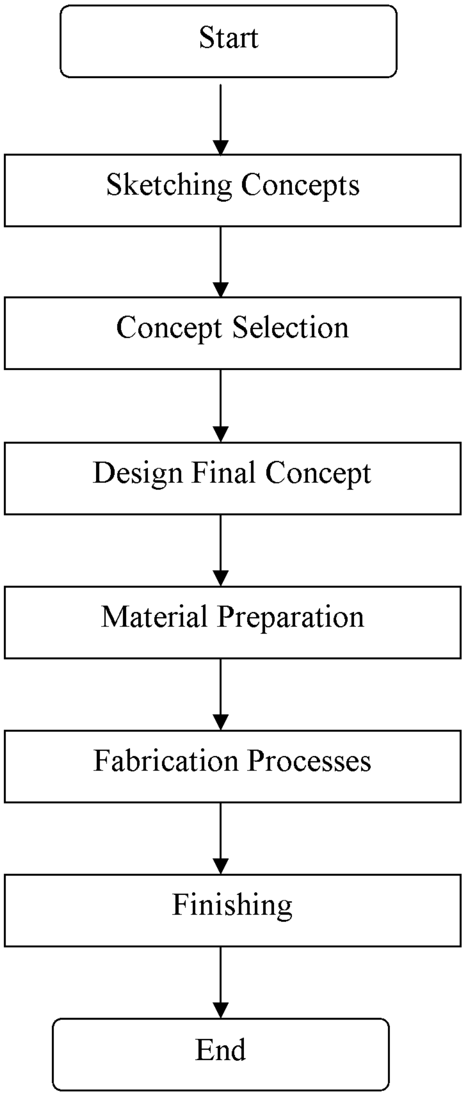


Figure 3.1: Flow chart of Methodology

3.3 Concept Generation

After brainstorming to generate a few designs of adjustable work positioner, I have come out with four design of adjustable work positioner. All the concepts must go through concept selection to determine which one is the best design to be fabricated among all the four design of the adjustable work positioner.

3.4 Sketching Concept

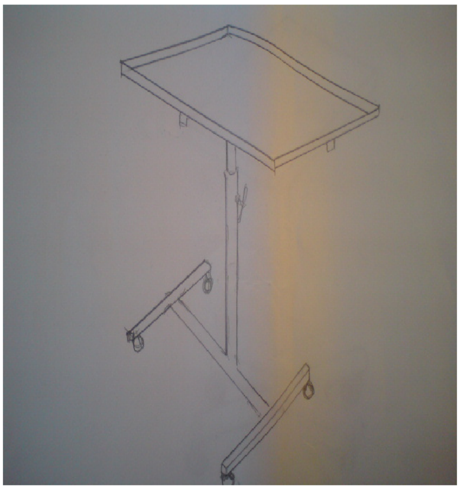


Figure 3.2: Concept A

Concept A design has a few advantages which are easy to adjust its height, and easy to be move anywhere we want. Beside the advantages, it also has few disadvantages that are this design is not so stable and the angle of its platform cannot be adjusted.

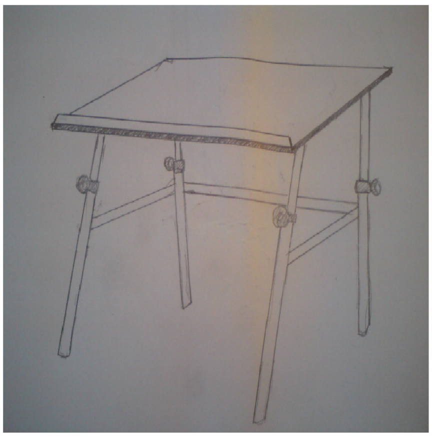


Figure 3.3: Concept B

For concept B, its advantages are it has stability and the platform can be tilted to an angle we want. But, it is hard to adjust its height due to its four legs and it in not portable.

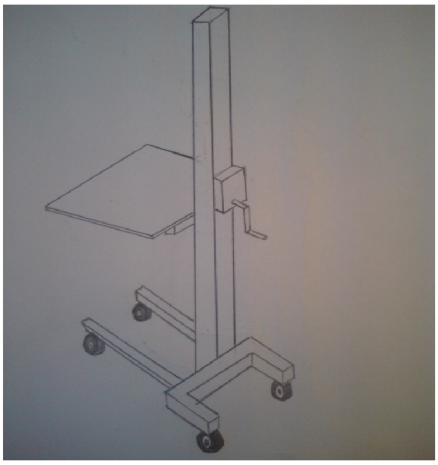


Figure 3.4: Concept C

Concept C design has a few advantages which are adjustable height, easy to move around and it is stable. But the angle of its platform cannot be adjusted.

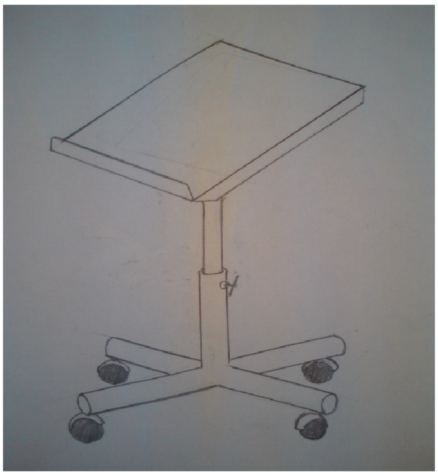


Figure 3.5: Concept D

Concept D design is quite similar to concept A but it has few improvements so that it is stable, easy to tilt the angle of its platform, adjustable height and moveable to anywhere we want.

3.5 Concept Selection

In order to determine which design is the best to be fabricated, all of the concept must undergo concept selection (Pugh Method). The result of the selection is as shown in the table below.

Table 3.1: Concept Selection Table

Selection Criteria	Concepts Variants			
	A	**B(Datum)**	**C**	**D**
Easy to move	+	0	+	+
Easy to handle	+	0	0	+
Angle Changeability	-	0	-	+
Height Adjustability	+	0	+	+
Easy to use	0	0	0	+
Easy to fabricate	0	0	-	0
Stability	0	0	0	0
Low cost	-	0	-	+
Durability	0	0	0	0
Safety	+	0	0	+
Plusses	4	0	2	7
Same	4	0	5	3
Minuses	2	3	3	0
Net	2	0	-1	7
Rank	**2**	**3**	**4**	**1**
Continue	√	√	X	√

Note :
+ = Better than
- = Worse than
0 = Same as

From the table, we can see that the Concept D get the highest net score followed by Concept A, Concept B and then Concept C scores the lowest net score. Due to that, Concept D is chose as the concept to be fabricated in this project.

3.6 Final Concept

After go through the concept selection, the final concept that is going to be fabricated which is Concept D which will be drawn by using AutoCAD.

Figure 3.6: Final Concept (Concept D)

This design allow the user adjust its height easily because it uses the concept of telescopic shaft. The adjustable height of the adjustable work positioner allow the user to do work at a low places and the higher places. It also gives comfort where the user can adjust to the height that is convenient to their body.

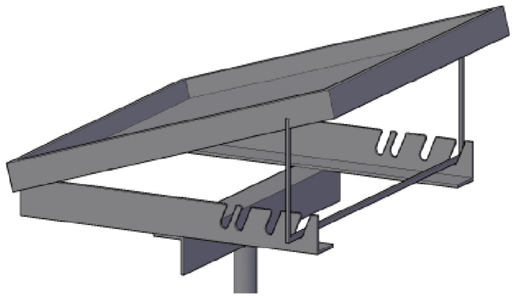


Figure 3.7: Tilt platform

Beside that, adjustable work positioner provided a platform with tilt angle that allow the user to adjust the angle of its platform to angle that the user feels comfort to work with.

Lastly, the user can bring the adjustable work positioner as there are four wheel attach to its base. This will help the user to reduce their working pace because they do not to commute from the place he put the tools to the place he is working and this reduces the coverage of working area of the worker. The user just put the tools such as pliers, hammer, screwdriver, spanner or even the tool box on the platform and drag the adjustable work positioner to the place where he want to work.

3.7 Material Preparation

After we get the final design, we need to prepare all of the material that we need to fabricate the adjustable work positioner. Below are all the parts that are needed.

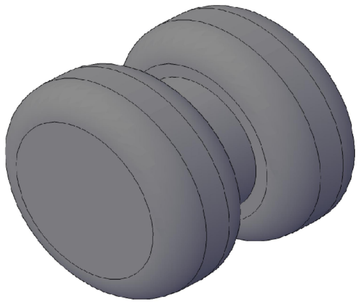


Figure 3.8: Wheel

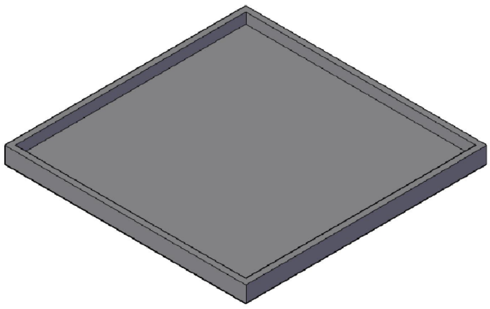


Figure 3.9: Platform

Figure 3.10: Steel Rod (Hollow)

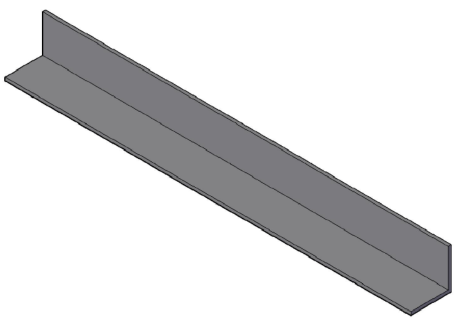


Figure 3.11: L Bar

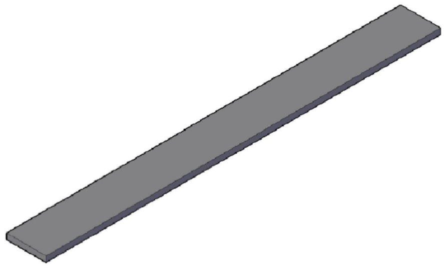


Figure 3.12: Square Bar

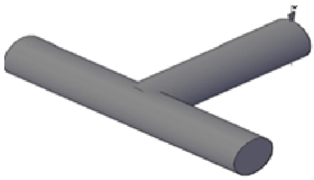


Figure 3.13: Bolt (Stopper)

The table of Bill of Material below shows the dimension and the quantity of all the parts that are going to be used to fabricate the adjustable work positioner.

Table 3.2: Bill of Material

No.	Parts	Dimension (mm)	Quantity
1.	Wheel	50 mm Dia.	4
2.	Platform (Sheet Metal)	450 x 450 x 1	1
3.	Rod A (Mild Steel)	Outer Dia.- 33 Inner Dia.- 28 Length – 500	1
4.	Rod B (Mild Steel)	Outer Dia.- 26 Inner Dia.- 21 Length – 500	1
5.	L Bar	400 x 40 X 3	3
6.	Bar A	500 x 50 x 7	2
7.	Hollow Square Bar	400 x 18 x 18	4
8.	Rod C	440 x 5 x 5	1
9.	Bolt (Stopper)	5 mm Dia. Length - 30	1

3.8 Fabrication Process

After the designing phase, here comes the fabrication process. This process is about using the material selection and makes the product base on the design and by following the design dimension stated in the Bill of Material (BOM). Many methods will be used to fabricate the product such as measuring and marking, cutting, drilling, joining and finishing. Fabrication process is difference from manufacturing process in term of production quantity. Fabrication process is a process to make only one product rather than manufacturing process that focus to large scale production. As there are a lot of processes of fabrication, there also need a lot of machines and tools to perform the processes.

3.8.1 Measuring and Marking

Before we cut the material to the dimension we want, we need to measure and mark the material first. This is to ensure the precision of the material's length which is quite important in the fabrication process. It is also to avoid the waste of the material because we undersize while cutting it.

To perform this process, we will need a measuring tape, scriber and a vernier height gauge.

Figure 3.14: Measuring Process

(a) Using scriber

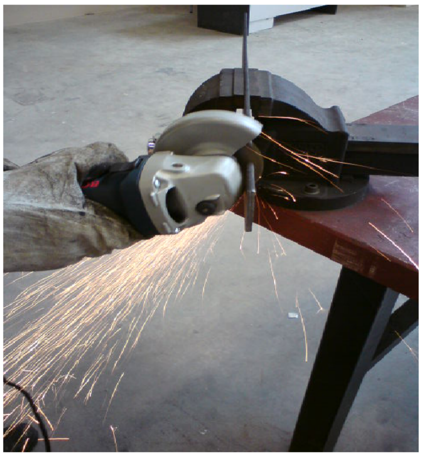
(b) Using vernier height gauge

Figure 3.15: Marking Process

3.8.2 Cutting

In this process, hand saw and grinder will be use to cut the materials according to the measuring that have been marked.

(a) Using handsaw



(b) Using hand grinder

Figure 3.16: Cutting Process

3.8.3 Drilling

Then the all material that had been cut will drill at the several locations to make the holes for rivet, bolts and nut. There are two types of drilling machines was used during this process which is hand drill and press drill.

Figure 3.17: Using press drill

Figure 3.18: Using hand drill

3.8.4 Bending

To fabricate the platform, the sheet metal need to be bend on each corner to make sure there are no sharp edges on the platform. It is also to avoid the tool from falling to the floor.

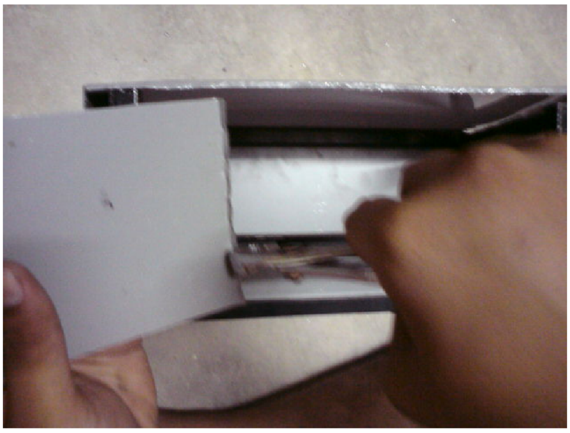


Figure 3.19: Bending process

As the bending machine is not fully setup, the bending process is done alternatively where I only use pliers and vise to bend the sheet metal. Although the bend is not as good as the result of bending machine, it is enough to fulfill the requirements that are to eliminate the sharp edges and the bend can avoid tools from falling to the floor.

3.8.5 Joining

As the parts are cut, the joining process will take place to join all the parts. There are two process uses to join the parts which are welding and riveting.

The machines use for welding process is Metal Inert Gas (MIG) welding and Shielded Metal Arc Welding (SMAW).

Figure 3.20 Using SMAW

Figure 3.21: Using MIG

There are also parts that are join by rivet like the platform as the platform is made of thin sheet metal it is not suitable to weld to join it with other parts.

Figure 3.22: Using rivet

3.8.6 Finishing

Then again, we use hand grinder to make smooth surface at the welding points and to eliminate sharp edges. After all of the sharp edges is removed, the adjustable work positioner is ready for the last process which is painting.

Figure 3.23: Painting the product

3.9 Final Product

After all of the fabrication process, the adjustable work positioner is finished and ready to be use. The final product in several views is shown below.

Figure 3.24: Final Product

Figure 3.25: Tilted Platform

Figure 3.26: Adjustable Height

Figure 3.27: Tools on the platform

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

The final fabrication of the adjustable work positioner is done in limited times due to several problems occur to the project. There are also a few problems that I have to face to finish the fabrication process. This chapter will discuss mainly about the problems encountered during the whole project was been carried out. It also covers the analysis of the adjustable work positiner.

4.2 Structure Analysis

An analysis on the structure has been done in order to determine whether the product can withstand the load given. Due to the scope of the project, the load is limited to 30kg which is equal to 294.3N. I assume the 30kg load as 300N to make it easier.

The analysis is done base on the material used which is ASTM-A36 which is mild steel. As the load is only coming from the platform, the analysis take place only at three major parts which are:

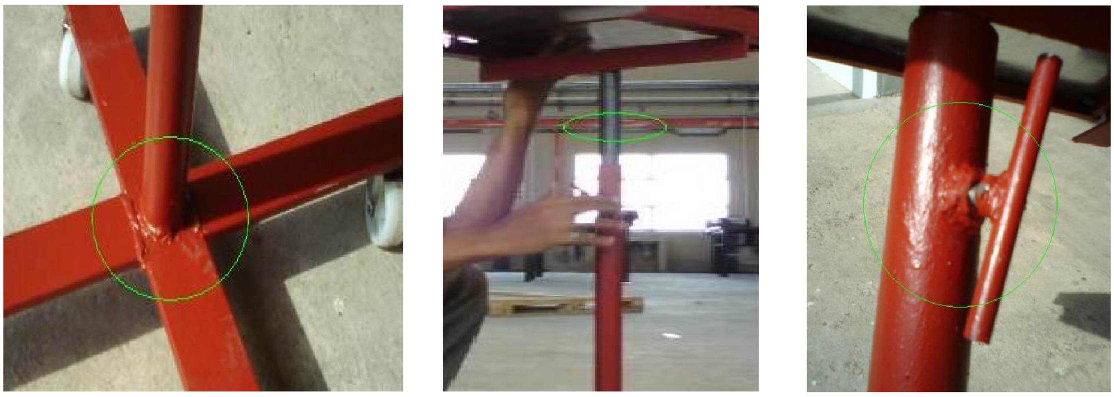


Figure 4.1: Points of Analysis

4.2.1 Bar A (Base)

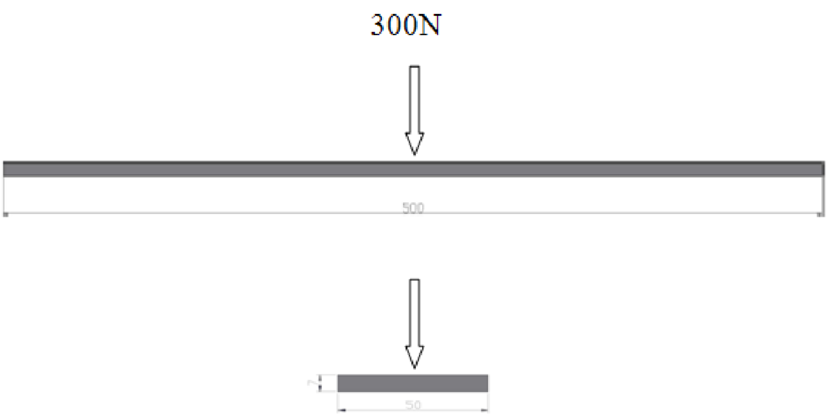


Figure 4.2: Analysis on Bar A

$$\tau_{cal} = \frac{P}{A} \tag{4.1}$$

$$\tau_{cal} < \tau_y$$

$$\tau_y = 145MPa$$

$$\tau_{cal} = \frac{P}{A} = \frac{300}{(5 \times 10^{-3})(7 \times 10^{-4})}$$

$$\tau_{cal} = 85.714MPa$$

4.2.2 Rod B

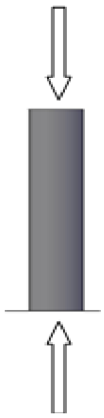


Figure 4.3: Analysis on Rod B

$$\sigma_{cal} = \frac{P}{A} \tag{4.2}$$

$$\sigma_{cal} < \sigma_y$$

$$\sigma_y = 145MPa$$

$$\sigma_{cal} = \frac{P}{A} = \frac{300}{(\pi j^2)_{out} - (\pi j^2)_{in}}$$

$$\sigma_{cal} = \frac{P}{A} = \frac{300}{(\pi(0.013)^2)_{out} - (\pi(0.0105)^2)_{in}}$$

$$\sigma_{cal} = 1.625MPa$$

4.2.3 Bolt (Stopper)

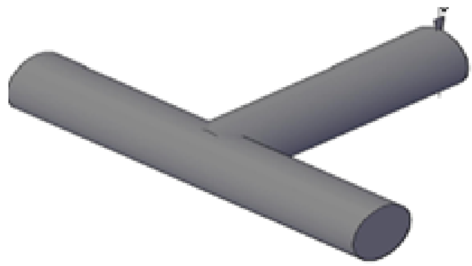


Figure 4.4: Analysis on Bolt

$$\tau_{cal} < \tau_y$$

$$\tau_y = 145MPa$$

$$\tau_{cal} = \frac{P}{A} = \frac{300}{(\pi j^2)}$$

$$\tau_{cal} = \frac{P}{A} = \frac{300}{\pi(2.5 \times 10^{-3})^2}$$

$$\tau_{cal} = 15.28MPa$$

From the analysis, we can see that none of the calculated strength (τcal) exceeds the maximum yield strength (τy). So, it is clearly that theoretically the structure of the adjustable work positioner has no problem to stand the load of 30kg.

4.3 Problem Faced During Fabrication Process

4.3.1 Lack of Equipment

As all of us know that the Faculty of Mechanical just moved from Gambang Campus to Pekan Campus, so there are few machines are cannot be use yet. There are problems to use machines such as disc cutter machine and bending machine. In order to overcome this problem, I have other type of equipment to perform the same task such as some of the parts is cut by using hand saw and the platform of the adjustable work positioner is bend manually by using only pliers and vise. The processes cost me a lot of cost and time.

Furthermore, there are several equipment that I need to take instead of from the mechanical lab such as I need to borrow rivet, hand grinder and hand drill from my friends because at the mechanical lab, there are only a few hand drill and hand grinder available but we need to queue to use it because there are a lot of student waiting to use them at the same time.

4.3.2 Lake of Time

Although I start the fabrication quite early, I still need to rush the process in order to make sure the product is finished before the due date. This because of the time I wasted for the bus travel from Gambang Campus to Pekan Campus. A lot of things that I plan to do for the project are ruin because I need to stick with the bus schedule. It makes me postpone the things to another time.

4.3.3 Not Enough Material

There are several materials that I have to get it from the hardware store because I cannot get it inside such as in order to get a circular hollow rod that is nicely fit into another circular hollow rod, I have to buy them on a hardware store located at Indera Mahkota. To get to there hardware store is not a problem at all but as my trip back from Pekan is evening, the hardware store usually already close when I arrive at the Gambang Campus around 5p.m in the evening.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Introduction

This final chapter represents about conclusion and recommendation for the project. This chapter will discuss mainly about the conclusion of the project, concluding all the process that involved. Besides that this chapter also contains recommendation about the project. This recommendation can make improvement about the project in the future.

5.2 Conclusion

The objectives of the project which are to design and fabricate an adjustable work positioner are successfully done and achieved. Although there are a lot of obstacles, I am really thankful that I can finish this project within the time given. I am also really satisfied where I have learned a lot of knowledge and skill in so many things throughout this project. I hope these valuable experiences I get will be useful to me in the future.

This project also generates my capabilities as a responsibility person. This is because I had to take care and take a look for my project. Finally, I can conclude that final year project is very important because we can learn a lot of things that are important for us to use them while we are working in the future.

5.3 Recommendation

5.3.1 The Tilt Angle

The adjustable work positioner that I have made can only tilt from 0° to 30°. To make the adjustable work positioner a lot mare convenient to use, the angle of the platform can be increase to give the user more comfort while they are working.

5.3.2 Use Hydraulics Shaft

By replacing the telescopic shaft to a hydraulics shaft, we can make the user easier to change the height of the adjustable work positioner. Hydraulics shafts can stop under heavier load the bolt stopper can hold.

5.3.3 Other Material

Maybe in the future, we can change the material to make a stronger adjustable work positioner. Not only the material is stronger, it is also lighter than the adjustable work positioner so that it can easily be move around the workplaces.

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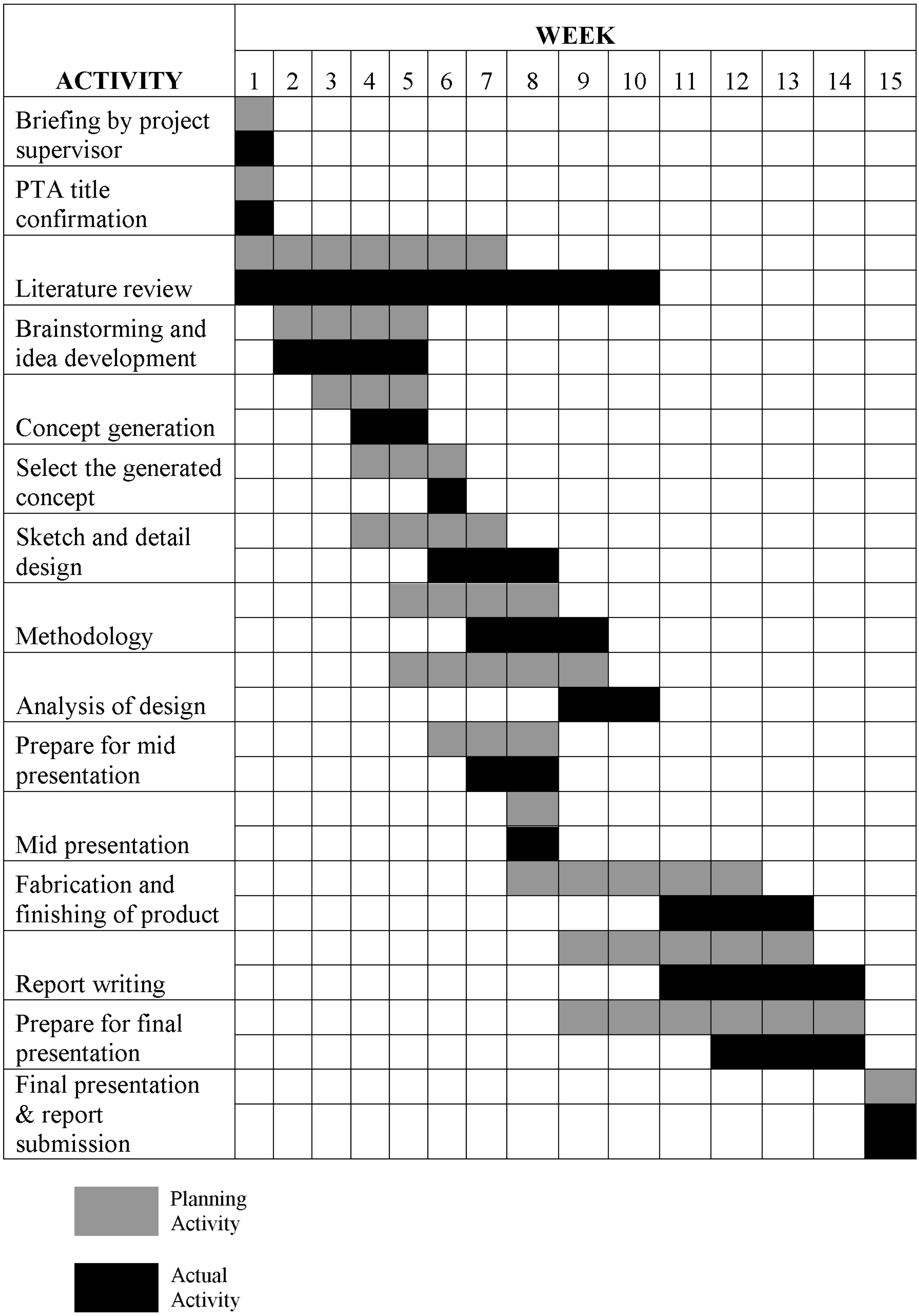
APPENDIX A

Gantt chart of the project



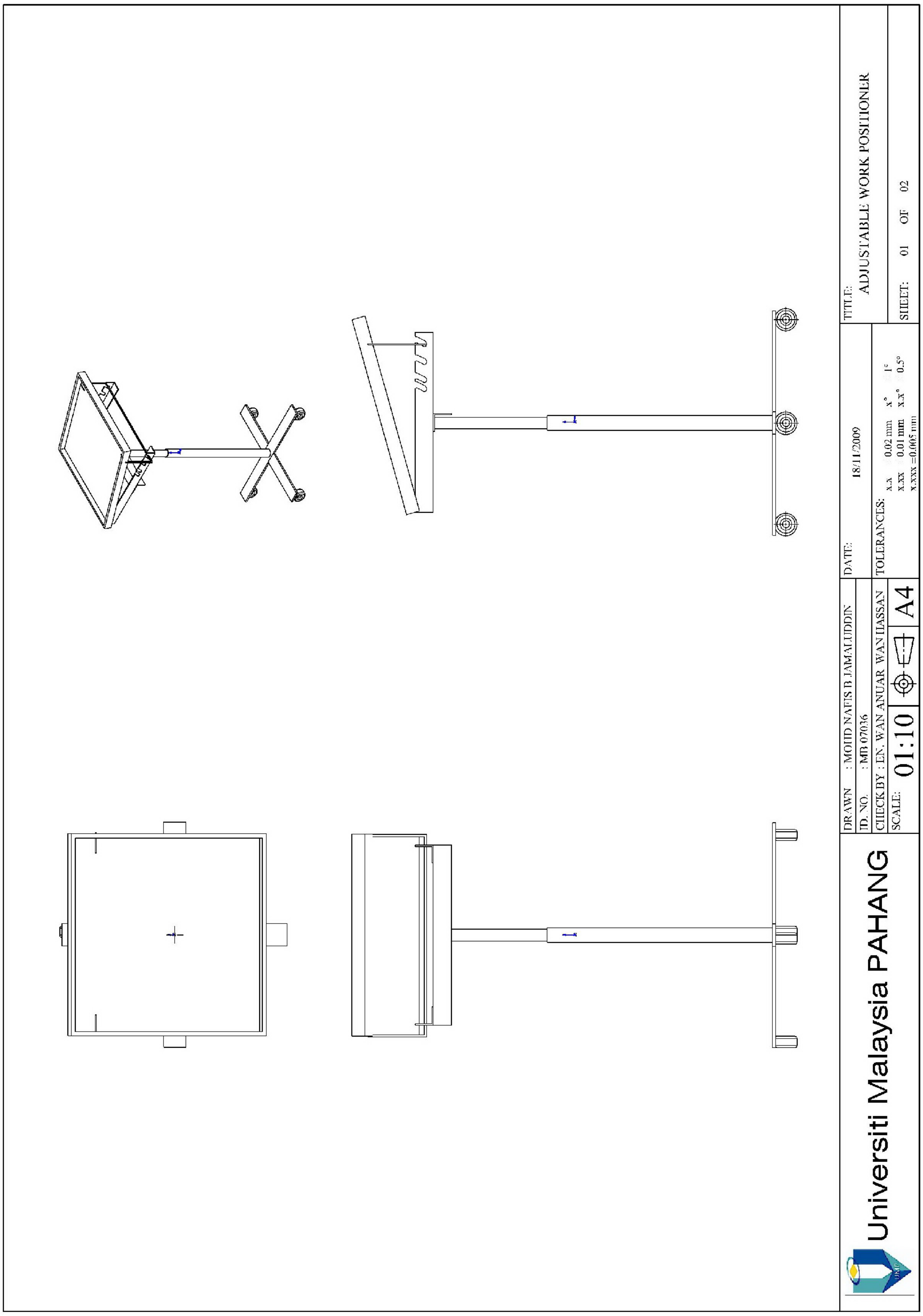
APPENDIX B

Table of the typical yield strength

Material	Yield strength (MPa)	Ultimate strength (MPa)	Density (g/cm^3)
Structural steel ASTM A36 steel	250	400	7.8
Steel, API 5L X65 (Fikret Mert Veral)	448	531	7.8
Steel, high strength alloy ASTM A514	690	760	7.8
Steel, pre-stressing strands	1650	1860	7.8
Steel Wire			7.8
Steel (AISI 1060 0.6% carbon) Piano wire	2200-2482		7.8
Stainless steel AISI 302 - Cold-rolled	520	860	
Cast iron 4.5% C, ASTM A-48	276	200	
Titanium alloy (6% Al, 4% V)	830	900	4.51
Aluminium alloy 2014-T6	400	455	2.7
Copper 99.9% Cu	70	220	8.92
Cupronickel 10% Ni, 1.6% Fe, 1% Mn, balance Cu	130	350	8.94

APPENDIX C

Drawing A



APPENDIX D

Drawing B