DESIGN AND FABRICATION OF THREE SHELVES BOOK TRUCKS

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BORANG PENGESAHAN STATUS TESIS

JUDUL **DESIGN AND FABRICATION OF THREE SHELVES BOOK TRUCKS**

SESI PENGAJIAN: **2009/2010**

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DESIGN AND FABRICATION OF THREE SHELVES BOOK TRUCKS

MUHAMAD MUHAIMIN BIN RONI

Report submitted in partial fulfillment of the requirements
for the award of Diploma in Mechanical Engineering

Faculty of Mechanical Engineering
UNIVERSITI MALAYSIA PAHANG

NOVEMBER 2009

SUPERVISOR DECLARATION

I hereby declare that I had read this project report and in my opinion this project report is sufficient in terms of scope and quality for the purpose of the granting of Diploma of Mechanical Engineering.

Signature : ……

Name of Supervisor : Wan Anuar Bin Wan Hassan

Date : …….

AUTHOR'S DECLARATION

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

Signature	:	
Name	:	MUHAMAD MUHAIMIN BIN RONI
ID Number	:	MB07078
Date	:	20 NOVEMBER 2009

DEDICATION

To my beloved mother and father

En. Roni Bin Awang Kechi'a

Pn. Kalsom Binti Mamat

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 me 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 main objective of this project is to design and fabricate of three shelves book trucks which can make people easy in doing their daily job. Purpose of this shelves produced is to make a transportation of books, reference materials, medical charts and others materials more easy from a place to another. With application of wheel, holder and barrier at the main part, this shelves book trucks can accept at minimum two hundred (200) to three hundred (300) of books and others. Assume of the materials have been done by consider the maximum size is three to four centimetre (cm). Currently, the product that exist in the market not meet customer need, that's why this product produced to make customer not hesitate to use it. Three shelves book trucks produced by selection the suitable materials, techniques and process which is can make the product have long-life span and can detain the load given. The ideas to produced this product is based on student's creativity. Besides, the design that have been selected base on stability, affordable to accept load and also ability to bring anywhere because of the size and the function. There are several process that used during fabricate this product and it's entertain in this report.

ABSTRAK

Objektif utama projek ini ialah untuk melakar dan membentuk rak buku tiga tingkat dimana ianya dapat menolong manusia melakukan kerja harian mereka. Tujuan rak buku ini dihasilkan ialah untuk memudahkan kerja-kerja pemindahan buku, bahan rujukan, carta perubatan dan lain-lain dokumen berkaitan dari satu tempat ke tempat lain. Dengan aplikasi roda, pemegang dan penghadang di bahagian utama, rak buku ini dapat menerima sekurang-kurangya dua ratus (200) hingga ke tiga ratus (300) buah buku dan lain-lain bahan berkaitan. Dianggarkan bahan yang ingin diletakkan diatas rak ini mempunyai saiz maksimum sebanyak tiga hingga ke empat sentimeter (cm). Dengan keadaan sekarang, rak buku yang berada dipasaran tidak memenuhi minat pelanggan, oleh kerana itulah produk ini dihasilkan supaya pelanggan tidak ragu-ragu untuk menggunakannya. Rak buku tiga tingkat ini dihasilkan dengan pemilihan bahan, teknik dan proses yang sesuai dimana ianya tahan lama dan boleh menerima beban. Idea untuk menghasilkan produk ini berdasarkan kepada kretiviti pelajar sendiri. Selain itu, lakaran yang dipilh adalah berdasarkan kepada kestabilan, kemampuan untuk menerima beban dan kebolehan untuk dibawa kemana sahaja kerana saiz dan fungsinya. Beberapa proses digunakan untuk menghasilkan produk ini dan ianya dipaparkan didalam laporan ini.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter focuses about the project title and the task that have to completed for the final year project specially for the last year's student whose taking Diploma In mechanical Engineering. For this project, the title that have choose is Design and Fabricate of three (3) Shelves Book Truck. Shelves book truck is commonly used to put the book, reference material and others that can put there. This three shelves book truck designed and fabricated so that it can work properly to the human and followed the customer needs.

1.2 Objective

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

The project also will educate the student in communication like in a presentation and educate them to defend their research in the presentation. The project also will generate students that have capability to make a good research report in thesis form or technical writing. This project also can produce and train student to capable of doing work with minimal supervisory and more independent in searching, detailing and expanding the experiences and knowledge.

1.3 Specify Project Objective

i. To fabricate a three (3) shelves book trucks
ii. To design a new concept of three (3) shelves truck which is easy to transport book, reference materials, medical charts and others.

1.4 Scope

i. This shelves book truck has three (3) shelve and wheels that make easy transport job.
ii. Minimum reference book and files can put is about 200 to 300 pieces.
iii. Shelves book trucks have many steel structure that make it more stable.

1.5 Problem Statement

i. Safety factor
ii. Materials factor

iii. Movement factor

iv. Time factor

Safety factor is considered on the safety of the product when finish fabricated. It focuses on the sharp edge, stables and enough to received load.

Materials factor is focuses on the material that use where the cost, ability to received load and also the durability.

Movement factor more focuses on the wheel that use which is it can move the shelves book truck smoothly without no need more force from the person.

Time factor is about the time that student have. Normally, the time interrupted when they are problem in finding the materials at the hardware shop. Besides, it also about the cost that student have to pay first.

1.6 Project Background

Based on the objective and scope above, this project is all about the concept, skill, ability and afford to achieve and grab the main purpose in designed and fabricate. This is so important because its applied all the main thing from every sight such as how to make a new designed so that customer not hesitate to use. Besides, this three shelves book trucks makes the student more expert in gain the skill and develop the creativity on how to begin the new concept, design, the analysis of the structure and others. Three shelves book trucks make people easy in doing job such as transport the book, reference materials, files and medical charts. With the steel structure, this shelves book trucks can receive at minimum two hundred (200) to three hundred (300) of books. Making the people who use this shelves book trucks more easy, it comes with wheels and holder on the top. Hopefully, this shelves book trucks will help the people in doing their daily job.

1.7 Project Stages

This project started with briefing by supervisor about the final year project for the students who's taking the diploma in their learning process for the faculty of mechanical engineering. This final year project specially for the student in University Malaysia Pahang is to produce the best and the world class student. After that, I have make confirmation about the project title.

After all that, i made a research and literature review via internet, books, supervisor, and others relevant academic material to the project title, this literature review takes about a several week. The reviews not stop there. It continues along of this final project.

After identify the literature review and knowledge, I continue with making the research about the project and I started to sketch. Sketching consist of three design which comes from my own ideas and inspiration. Before that, I have identified the scope so that it can help me to make the product. This scope very important because it will gathered the data collection about the product.

Next, after identify the scope and do the sketching, I make research again to find and identified the raw materials which is suitable to fabricate my product. This is so important because it will decide the objective of this project can be achieve or not. So the main objective for my final project is to design and fabricate the three shelves book trucks which can help people in doing their daily job about transportation the reading materials.

After choose the best materials and the design suitable with current condition, I start to research about the cost and the size at the hardware shop. The materials that use to fabricate this shelves book trucks is steel, zinc plate and the rubber or plastic wheel.

After all the thing finish, I am busy doing my first presentation about my project. This need me to present to the panel and tell them about the project and

also the current progress. After that, I start doing mf fabricate at week nine. This fabrication take three week to finish completely. All the part need to join and for this join, I used the welding, drill and rivet process. Before that, steel that used have been cut by using vertical bend saw and measured by measurement tape.

Finally, at week eleven, the fabricated process finish and now the testing process will be run. I have put many references book and also files on the shelves book trucks to see that whereas it can accept load or not. During this process, shelves book trucks also checked on their safety and health which related to the OSH.

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

After the product and the report had been approved by the supervisor, the report is rearrange and print out to submit at the supervisor, the project coordinator and also to the faculty of Mechanical Engineering. In this stage, everything about final project have finished and achieve the objective.

1.8 Gantt Chart

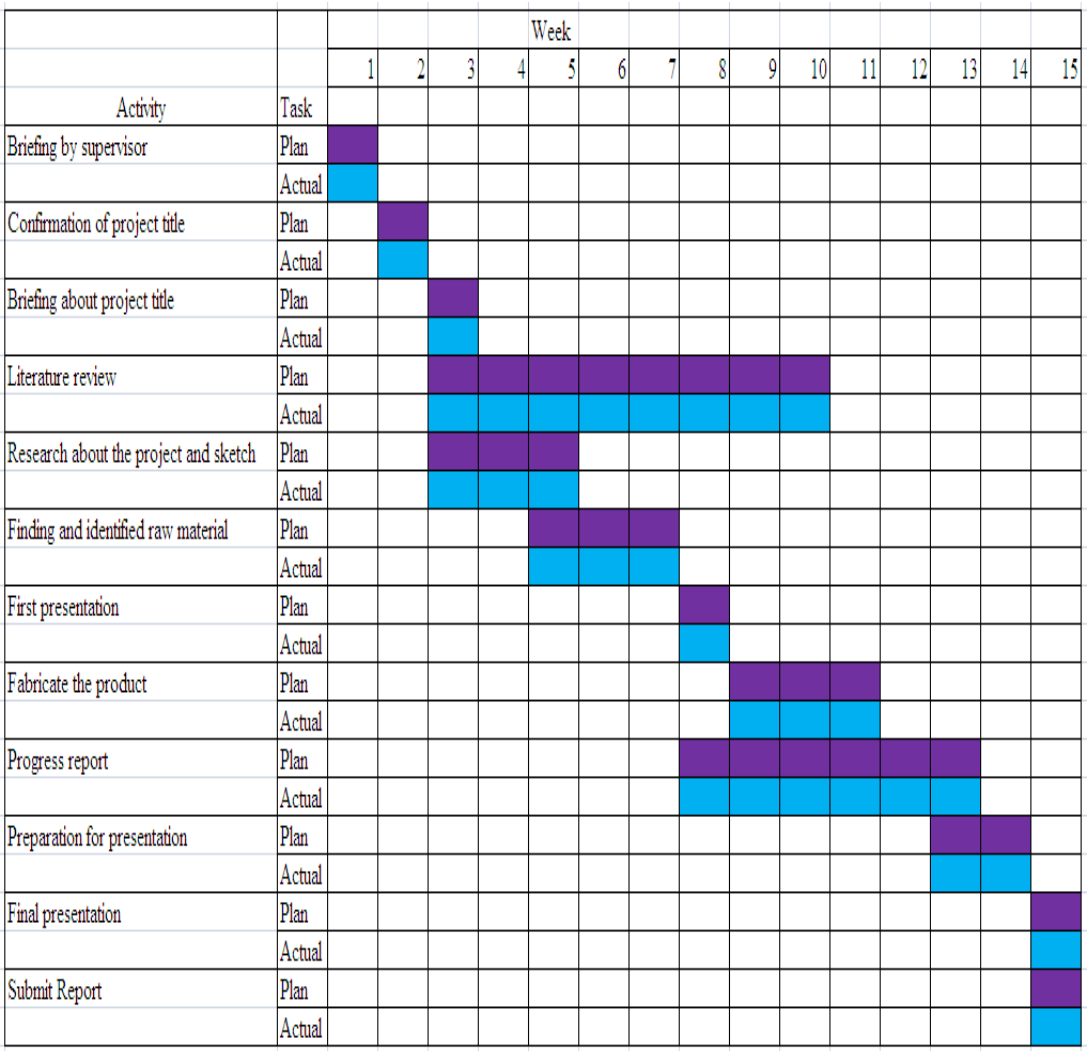

Figure 1.0: Gantt chart for project planning

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

For this chapter, student needs to search on book, articles, publications, and internet materials that related base on the final project. Literature review tells about the whole of the project which is consist of materials used, technique and machines used, and whatever that related to this fabricate product.

This project was given 'Design and fabricate of three (3) shelves book trucks'. This project involve to design and fabricate that entirely different from current design that seen in the market. Basically, this project have 4 stages:

i. Article review, researching and gathering information.
ii. Design , sketching by hand , and draw using computer software
iii. Produce the selected product, using machining process
iv. Writing the project report.

2.2 Type of Shelves Book Trucks

Figure 2.1: Two door book trucks

http://www.thefurniture.com [Date on 7 September]

This two door book trucks comes with no wheel that make people difficult to transfer the book or reference materials to another site.

Figure 2.2: 3 Range book trucks

http://www.thefurniture.com [Date on 7 September]

Next, for this 3 range book trucks, there are no safety aspect for the book or files. This is because the degree of the book and files stand nearest to 90◦ (degree). Besides, it also have no wheel that can help people to transfer reference materials.

Figure 2.3: Permanent shelves book trucks

http://www.thefurniture.com [Date on 7 September]

This permanent shelves book trucks currently cannot remove anywhere because it tight to the wall. With the size that comes from floor to ceiling,its currently make people difficult to take book. Furthermore, this permanent shelves book trucks comes with no wheel and no barrier at the front side so that the book will not drop down.

2.3 Types of Materials

2.3.1 Plastic

Plastic is the general common term for a wide range of synthetic or semi synthetic organic amorphous solid materials suitable for the manufacture of industrial products. Plastics are typically polymers of high molecular weight, and may contain other substances to improve performance and/or reduce costs.

The word derives from the Greek (*plastics*), "fit for molding", from *πλαστός* (*plasters*) "molded". It refers to their malleability or plasticity during manufacture that allows them to be cast, pressed, or extruded into an enormous variety of shapes — such as films, fibers, plates, tubes, bottles, boxes, and much more.

The common word "plastic" should not be confused with the technical adjective "plastic", which is applied to any material which undergoes a permanent change of shape (a "plastic deformation") when strained beyond a certain point. Aluminum, for instance, is "plastic" in this sense, but not "a plastic" in the common sense; while some plastics, in their finished forms, will break before deforming and therefore are not "plastic" in the technical sense.

There are two types of plastics, thermoplastic and thermoses. Thermoplastics, if exposed to heat, will melt in two to seven minutes. Thermoses will keep their shape until they are a charred, smoking mess. Some examples of thermoplastics are grocery bags, piano keys and some automobile parts. Examples of thermoses are kid's dinner sets and circuit boards.

2.3.2 Steel

Steel is an alloy consisting mostly of iron, with a carbon content between 0.2% and 2.1% by weight, depending on the grade. Carbon is the most cost-effective alloying material for iron, but various other alloying elements are used such as manganese, chromium, vanadium, and tungsten. Carbon and other elements act as a hardening agent, preventing dislocations in the iron atom crystal lattice from sliding past one another. Varying the amount of alloying elements and form of their presence in the steel (solute elements, precipitated phase) controls qualities such as the hardness, ductility, and tensile strength of the resulting steel. Steel with increased carbon content can be made harder and stronger than iron, but is also less ductile.
Alloys with a higher carbon content are known as cast iron because of their lower melting point and castability. Steel is also distinguished from wrought iron, which can contain a small amount of carbon, but it is included in the form of slag inclusions. Two distinguishing factors are steel's increased rust-resistance and better weldability.

Though steel had been produced by various inefficient methods long before the Renaissance, its use became more common after more efficient production

methods were devised in the 17th century. With the invention of the Bessemer process in the mid-19th century, steel became a relatively inexpensive mass-produced material. Further refinements in the process, such as basic oxygen steelmaking, further lowered the cost of production while increasing the quality of the metal. Today, steel is one of the most common materials in the world and is a major component in buildings, infrastructure, tools, ships, automobiles, machines, and appliances. Modern steel is generally identified by various grades of steel defined by various standards organizations.

2.3.2.1 Uses

Figure 2.4: A roll of steel wool

Iron and steel are used widely in the construction of roads, railways, infrastructure, and buildings. Most large modern structures, such as stadiums and skyscrapers, bridges, and airports, are supported by a steel skeleton. Even those with a concrete structure will employ steel for reinforcing. In addition to widespread use in major appliances and cars (Despite growth in usage of aluminium, it is still the main material for car bodies.), steel is used in a variety of other construction-related applications, such as bolts, nails, and screws. Other common applications include shipbuilding, pipeline transport, mining, offshore construction, aerospace, white goods (e.g. washing machines), heavy equipment (e.g. bulldozers), office furniture, steel wool, tools, and armour in the form of personal vests or vehicle armour (better known as rolled homogeneous armour in this role

http://en.wikipedia.org/wiki/Steel [Date on 10 September 2009]

2.3.3 Zinc

Zinc (pronounced /ˈ zɪŋk/ *zingk*, from German: *Zink*), also known as spelter, is a metallic chemical element; it has the symbol Zn and atomic number 30. It is the first element in group 12 of the periodic table. Zinc is, in some respects, chemically similar to magnesium, because its ion is of similar size and its only common oxidation state is +2. Zinc is the 24th most abundant element in the Earth's crust and has five stable isotopes. The most exploited zinc ore is sphalerite, a zinc sulfide. The largest exploitable deposits are found in Australia, Canada, and the United States. Zinc production includes froth flotation of the ore, roasting, and final extraction using electricity (electrowinning).

Brass, which is an alloy of copper and zinc, has been used since at least the 10th century BC. Impure zinc metal was not produced in large scale until the 13th century in India, while the metal was unknown to Europe until the end of the 16th century. Alchemists burned zinc in air to form what they called "philosopher's wool" or "white snow". The element was probably named by the alchemist Paracelsus after the German word *Zinke*. German chemist Andreas Sigismund Marggraf is normally given credit for discovering pure metallic zinc in 1746. Work by Luigi Galvani and Alessandro Volta uncovered the electrochemical properties of zinc by 1800. Corrosion-resistant zinc plating of steel (hot-dip galvanizing) is the major application for zinc. Other applications are in batteries and alloys, such as brass. A variety of zinc compounds are commonly used, such as zinc carbonate and zinc gluconate (as dietary supplements), zinc chloride (in deodorants), zinc pyrithione (anti-dandruff shampoos), zinc sulfide (in luminescent paints), and zinc methyl or zinc diethyl in the organic laboratory.

Zinc is an essential mineral of "exceptional biologic and public health importance".Zinc deficiency affects about two billion people in the developing world and is associated with many diseases. In children it causes growth retardation, delayed sexual maturation, infection susceptibility, and diarrhea, contributing to the death of about 800,000 children worldwide per year. Enzymes with a zinc atom in the reactive center are widespread in biochemistry, such as alcohol dehydrogenase in

humans. Consumption of excess zinc can cause ataxia, lethargy and copper deficiency.

2.3.3.1 Ancient Use

Figure 2.5: Arch from zinc

Source: http://en.wikipedia.org/wiki/Zinc [Date on 9 September 2009]

Various isolated examples of the use of impure zinc in ancient times have been discovered. A possibly prehistoric statuette containing 87.5% zinc was found in a Dacian archaeological site in Transylvania (modern Romania). Ornaments made of alloys that contain 80–90% zinc with lead, iron, antimony, and other metals making up the remainder, have been found that are 2500 years old. The Berne zinc tablet is a votive plaque dating to Roman Gaul made of an alloy that is mostly zinc. Also, some ancient writings appear to mention zinc. The Greek historian Strabo, in a passage taken from an earlier writer of the 4th century BC, mentions "drops of false silver", which when mixed with copper make brass. This may refer to small quantities of zinc produced as a by-product of smelting sulfide ores. The Charaka Samhita, thought to have been written in 500 BC or before, mentions a metal which, when oxidized, produces *pushpanjan*, thought to be zinc oxide.

Zinc ores were used to make the zinc–copper alloy brass many centuries prior to the discovery of zinc as a separate element. Palestinian brass from the 14th to 10th

centuries BC contains 23% zinc. The Book of Genesis, written between the 10th and 5th centuries BC, mentions Tubalcain as an "instructor in every artificer in brass and iron" (Genesis 4:22). Knowledge of how to produce brass spread to Ancient Greece by the 7th century BC but few varieties were made.

2.4 Techniques/Machined Used

2.4.1 Band Saw

Figure 2.6: Band saw

http://en.wikipedia.org/wiki/Band [Date on 10 September 2009]

A band saw uses a blade consisting of a continuous band of metal with teeth along one edge. Workpieces are fed into the cutting edge on vertical machines. The saw may be powered by wind, water, steam, electrical motor or animal power. The band rides on two wheels rotating in the same plane. Band sawing produces uniform cutting action as a result of an evenly distributed tooth load. Band saws can be used for woodworking, metalworking, or for cutting a variety of other materials, and are particularly useful for cutting irregular or curved shapes, but can also be used to produce straight cuts. The radius of a curve that can be cut on a particular saw is determined by the width of the band and its lateral flexibility.

2.4.2 Welding

Welding is a fabrication or sculptural process that joins materials, usually metals or thermoplastics, by causing coalescence. This is often done by melting the workpieces and adding a filler material to form a pool of molten material (the *weld pool*) that cools to become a strong joint, with pressure sometimes used in conjunction with heat, or by itself, to produce the weld. This is in contrast with soldering and brazing, which involve melting a lower-melting-point material between the workpieces to form a bond between them, without melting the workpieces.

2.4.2.1 Operation

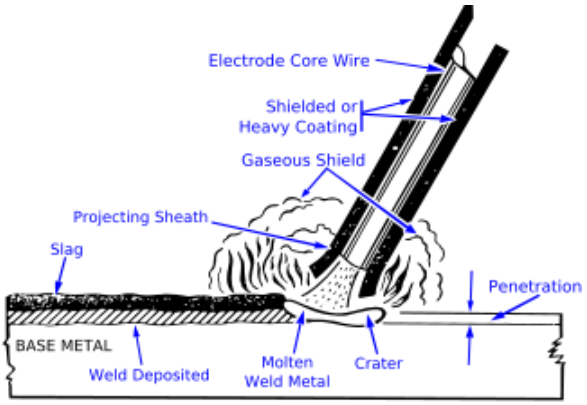

Figure 2.7: Weld area

http://en.wikipedia.org/wiki/Shielded_metal_arc welding

[Date on 10 September 2009]

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.

4.3 Grinding

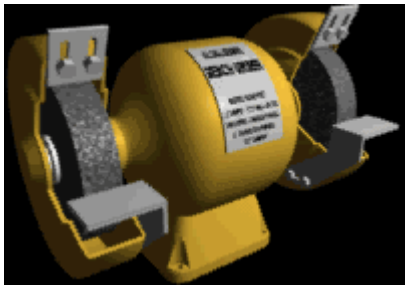

Figure 2.8: Grinding machine

http://en.wikipedia.org/wiki/Grinding [Date on 10 September 2009]

The grinding machine consists of a power driven grinding wheel spinning at the required speed (which is determined by the wheel's diameter and manufacturer's rating, usually by a formula) and a bed with a fixture to guide and hold the work-piece. The grinding head can be controlled to travel across a fixed work piece or the workpiece can be moved whilst the grind head stays in a fixed position. Very fine control of the grinding head or tables position is possible using a vernier calibrated hand wheel, or using the features of NC or CNC controls.

Grinding machines remove material from the workpiece by abrasion, which can generate substantial amounts of heat; they therefore incorporate a coolant to cool the workpiece so that it does not overheat and go outside its tolerance. The coolant also benefits the machinist as the heat generated may cause burns in some cases. In very high-precision grinding machines (most cylindrical and surface grinders) the final grinding stages are usually set up so that they remove about 200nm (less than 1/100000 in) per pass - this generates so little heat that even with no coolant, the temperature rise is negligible.

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. In this chapter, I will explain about the process that involved during the fabrication process. I also will explain about the design and analysis that had been chosen to be as the final idea to be producing or fabricate. All the fabrication process in this project is going to be explained in details.

3.2 Project Methodology

i. Identify the problem statement and find the solution
ii. design
iii. Finalize concept and evaluation.
iv. Material selection.
v. Fabrication process.
vi. Testing and improvement process.
vii. Finishing.

3.3 Project Flow Chart

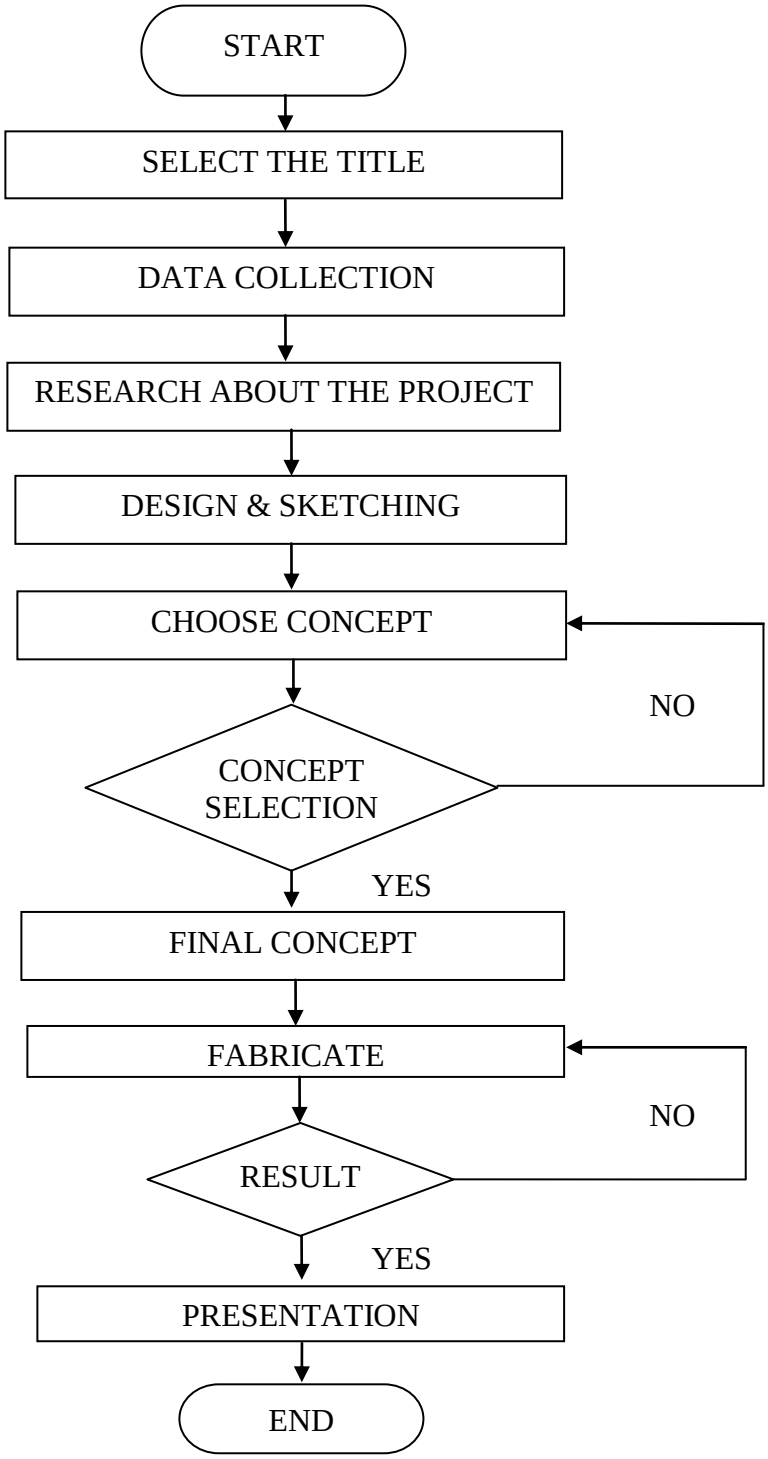

Figure 3.0: Project flowchart

In fabrication of the multipurpose rack structure, there is a planning of the overall progress to assure the project can be finish on a schedule.

From the flow chart in figure 30 above , this project started with the literature review and research about the title. The main important of the project is determination the objective. Then ,study and make a lot of investigation about the multipurpose rack structure and machining process involved. This is including a review of types of materials, strength of material, way to produce and machining process. These tasks have been done through research on the internet, books and others sources.

Then the information has been collected and gathered. After that, the project is continued with the design process. In this stage , the knowledge and lessons that have been studied will be applied. It is important to make a suitable design for the project. After several design sketched, design consideration have been made and one of the design have be chosen. The design have been chosen by the Pugh's selection method. The selected sketch is the transferred to solid modeling and engineering drawing by using AutoCAD software.

After the design was completed, the attention now is to prepare the material. The information about the material was gathered from internet to get the material to produce a product. Ability to hold and carry a large amount of load was the first priority in choosing a material and the material must not too heavy so that wills easier the user to carry it.

Now the fabricate stage. This process consists fabricate all the parts that have design before by following all the dimension using various type or manufacturing process. During the fabrication process, if there is something wrong occur , such as not balance dimension so the process will be stop and go back to previous step, make a modification against.

After all the fabrication 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 included the presentation slide making for the final presentation of the project.

The project ended after the submission of the report and slide presentation has be present.

3.4 Design

The Design of the three shelves book trucks must be compliance to several aspects. The design consideration must be done carefully so the design can be fabricated and the parts are all following the drawing.

3.4.1 Design 1

Figure 3.1: Concept 1

i. Distance shelve to shelve too closed

ii. No holder to hold and move

iii. Can’t put reference material by standing position

3.4.2 Design 2

Figure 3.2: Concept 2

i.Difficult to human to see the title of reference material

ii.No barrier at side that can make the references material fall down.

3.4.3 Design 3

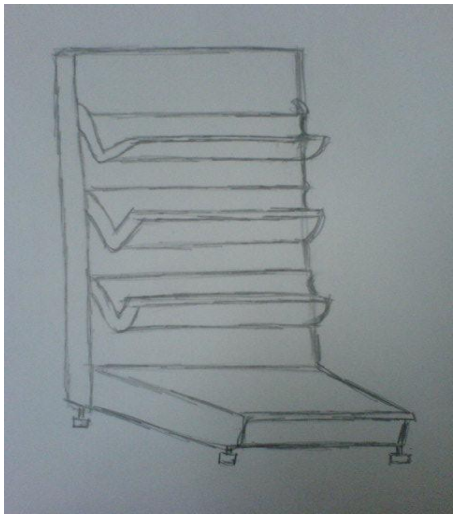

Figure 3.3: Concept 3

i.No wheel at the bottom.

ii.Can put the reference material at only a side.

iii.Can’t put too many reference materials.

3.5 Concept Screening

	Concept Varians			
Selection Criteria	1	2	3	Datum
Total mass	-	+	+	+
Material of product	=	=	=	=
Product size	-	+	=	+
Hardness	=	=	=	=
Manufacturing cost	+	-	+	+
Colour	=	=	=	=
Modern design	=	=	-	+
Environmentally friendly	=	=	=	=
Pluses (3)	1	2	3	4
Same (1)	5	5	5	4
Minus (0)	2	1	1	0
Net	8	11	14	16
Rank	4	3	2	1
Continue	NO	NO	NO	YES

Figure 3.4: Pugh concept

3.6 Final Concept

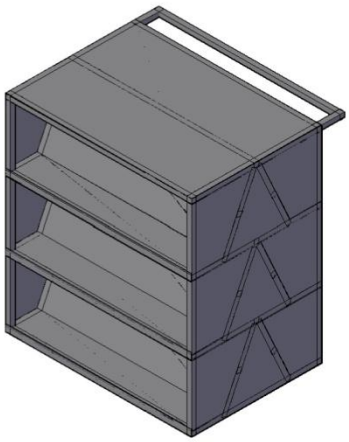

Figure 3.5: Final concept

3.7 Fabrication

3.7.1 Introduction

There are five main phases that have been recognized to be the guideline throughout the Research:

i. Phase 1 – Measuring the material

ii. Phase 2 – Cutting the material

iii. Phase 3 – Welding/Joining process

iv. Phase 4 – Drill and rivet process

v. Phase 5 – Finishing process

3.8 Bil of Material

NO	PART	DIMENSION(cm)	QUANTITY
1	Wheel	5 Dia. / 2.5 R	4
2	Plate (Zinc Plate)	56X80	1
		56X90	2
		35X80	6
3	Hollow Steel	90X2X2	4
		80X2X2	12
		56X2X2	8
		80X3X3	6
		10X2X2	2

Figure 3.6: Bil of material

3.9 Phase 1 – Measuring the Material

3.9.1 Measuring Tape

Figure 3.7: Measuring tape

Figure 3.8: Measuring process

A tape measure or measuring tape is a flexible form of ruler. It consists of a ribbon of cloth, plastic, fiber glass, or metal strip with linear-measurement markings. It is a common measuring tool. Its flexibility allows for a measure of great length to be easily carried in pocket or toolkit and permits one to measure around curves or corners. Today it is ubiquitous, even appearing in miniature form as a keychain fob, or novelty item.

3.9.2 Steel Rule

A ruler, or rule, is an instrument used in geometry, technical drawing and engineering/building to measure distances and/or to rule straight lines. Strictly speaking, the *ruler* is essentially a straightedge used to rule lines and the calibrated instrument used for determining measurement is called a "measure". However, common usage implies that a ruler is a straightedge that is calibrated for making measurements.

3.10 Phase 2 – Cutting the Material

3.10.1 Band Saw

Figure 3.9: Band saw machine

A band saw uses a blade consisting of a continuous band of metal with teeth along one edge. Workpieces are fed into the cutting edge on vertical machines. The saw may be by wind, water, steam, electrical motor or animal power. The band rides on two wheels rotating in the same plane. Band sawing produces uniform cutting action as a result of an evenly distributed tooth load. Band saws can be used for woodworking, metalworking, or for cutting a variety of other materials, and are particularly useful for cutting irregular or curved shapes, but can also be used to

produce straight cuts. The radius of a curve that can be cut on a particular saw is determined by the width of the band and its lateral flexibility.

3.11 Phase 3 – Welding/Joining Process

3.11.1 Welding

Figure 3.10: Welding or joining part

Welding is a fabrication or sculptural process that joins materials, usually metals or thermoplastics, by causing coalescence. This is often done by melting the workpieces and adding a filler material to form a pool of molten material (the *weld pool*) that cools to become a strong joint, with pressure sometimes used in conjunction with heat, or by itself, to produce the weld. This is in contrast with soldering and brazing, which involve melting a lower-melting-point material between the workpieces to form a bond between them, without melting the workpieces.

http://en.wikipedia.org/wiki/welding [15 November 2009]

3.12 Phase 4 – Drill and Rivet Process

3.12.1 Drilling Machine

Figure 3.11: Drill the workpieces

Drilling is the cutting process of using a drill bit in a drill to cut or enlarge holes in solid materials, such as wood or metal. Different tools and methods are used for drilling depending on the type of material, the size of the hole, the number of holes, and the time to complete the operation.

Drilling is a cutting process in which a hole is originated or enlarged by means of a multipoint, fluted, end cutting tool. As the drill is rotated and advanced into the workpiece, material is removed in the form of chips that move along the fluted shank of the drill. One study showed that drilling accounts for nearly 90% of all chips produced.

Manufacturing Engineering and Technology, Kalpakjian, Schmid, 2006

Orbital Drilling Goes Mainstream for the Dreamliner, Aerospace Engineering & Manufacturing, SAE International Publications, March 2009, p. 32 [11 September 2009]

3.12.2 Rivet Process

Figure 3.13: Three aluminum blind rivets: 1/8", 3/32", and 1/16"

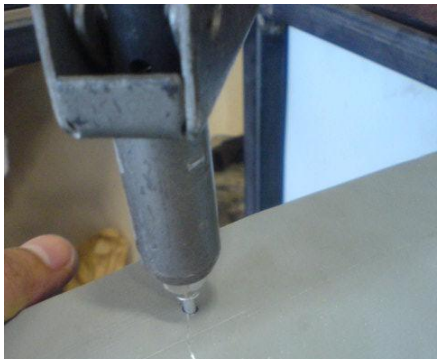

Figure 3.12: Rivet the zinc

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.

Because there is effectively a head on each end of an installed rivet it can support tension loads (loads parallel to the axis of the shaft); however, it is much more capable of supporting shear loads (loads perpendicular to the axis of the shaft). Bolts and screws are better suited for tension applications.

Fastenings used in traditional wooden boat building like copper nails and clinch bolts work on the principle of the rivet but they were in use long before the term rivet was invented and, where they are remembered, are usually classified among the nails and bolts respectively.

http://en.wikipedia.org/wiki/Rivet (15 November 2009)

3.13 Phase 5 – Finishing Process

3.13.1 Aerosol Spray

Aerosol spray is a type of dispensing system which creates an aerosol mist of liquid particles. This is used with a can or bottle that contains a liquid under pressure. When the container's valve is opened, the liquid is forced out of a small hole and emerges as an aerosol or mist. As gas expands to drive out the payload, some propellant evaporates inside the can to maintain an even pressure. Outside the can, the droplets of propellant evaporate rapidly, leaving the payload suspended as very fine particles or droplets. Typical liquids dispensed in this way are insecticides, deodorants and paints. An atomizer is a similar device that is pressurised by a hand-operated pump rather than by stored gas.

http://en.wikipedia.org/wiki/Aerosol_spray [15 November 2009]

CHAPTER 4

RESULT AND DISCUSSION

4.1 Introduction

The final fabrication of the ‘THREE SHELVES BOOK TRUCKS’ is done from only limited times due to several problems occur to the project. In this chapter will discuss mainly about the result of the project, analysis about the project and all problems encountered during the whole project was been carried out.

4.2 Result

After past through the final fabrication which is spray the product, this is the result that I can show.

Figure 4.0: Front view with holder

Figure 4.1: side view with wheel

Figure 4.2: Rear view with barrier

4.3 Problem During Fabrication Process

4.3.1 Laboratory location

The Mechanical Metal Foaming Laboratory in Kuala Pahang, Pekan is located from UMP Gambang. The students need to make their own transport to go there. Furthermore, the journey to Kuala Pahang needs to take around two hours. In that two hours, the students can do their final year project if the metal foaming laboratory is still in Gambang.

4.3.2 Material

The students need to use their money to buy the material at the outside shop like hardware due to the material that provide in the store is not enough. For my project, I have to buy the zinc plate, rivet blind with size 1/8", 3/32", and 1/16",and also wheel to move the three shelves book trucks.

4.4 Project Problem

4.4.1 Design and sketching

Due to the design and sketch from the students, so there are some problem in assume the actual dimension and size of every part such as length of hollow steel, wide of zinc plate and others.

4.4.2 Literature review

In literature review, there are no concept that widely use by the current manufacturer and make the student get some trouble in finding the literature review. Furthermore, by make research from the internet also can't find the literature review for the three shelves book trucks. So, to solve the problem, I have discuss with my supervisor and also my friends to try to get the nearest literature review with the book trucks, trolley or others that looks same as.

4.4.3 Material

Some materials needs student to buy at the hardware shop. So, this may take several time to student to find the suitable materials that will be used to fabricate the project. Hopefully, after this, University should provide the enough materials that suitable for student declaration in doing their final project.

4.4.4 Fabrication Process

For the final year project, student should given more time to fabricate their product. This is due to the machine that not enough in the lab such as metal inert gas MIG weld, cutting or bend saw and others.

4.4.5 Budget

It is not so effective to use student's money to get the materials. University should provide budget at first stage so that student's expenses are not interfere.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Introduction

For this chapter, student should find the conclusion and recommendation for the fabricated product. Besides, student also should find the future recommendation about this product. This mainly to make improvement about this product and also overall about the beginning until the end of the process to produce the product.

5.2 Conclusion

As a conclusion, I think this final year project make me more discipline in doing and fabricating the product. For me, time is gold and I use them every second meaningfully so that the time not wasted. Besides, with time also, the product that produce is complete and fulfill the objective and also the scope of this project. A lot of thanks for my supervisor, Mr Wan Anuar Bin Wan Hassan for his teach and guide me in finish this project and also conclude the report completely. Not forgotten also to all my diploma's friend for their companion.

5.3 Recommendation

5.3.1 Student's Budget

For the recommendation to improve the final year project is about the budget which include the student's budget. For me, department or management of University should give the budget to the student first before they start to fabricate. This would cause student's finance will rise up to high demand in order to buy material which could not get in lab. With this method, student can finished their project early due to the enough money and not make them waiting much longer in order of financial problem.

5.3.2 Machine Operation

Next, University's department should finish or setup the machine that have in the lab early before the student start their fabrication process. This is due to the student need to waiting much longer and need them to wait the turn for use every machine. This is a wasted time and the product cannot finish early.

5.4 Future Work

The final year project is a most important subject that must be learns in the final semester. It is because this project can make the student practice their skill of machining process since semester one. Its include using welding machine, drilling machine, CAD software, Solidwork software and others else. So for my three shelves book truck project, I think a lot of things can be improved in the future. The improvement could be in the characteristics like a body frame that it I need to made it small than this product. Beside that I also need to change the type of material used so that it is more suitable with references size and others. In the future also I should use all material should be lightweight and hardy. Besides

that, the financial is very important to develop this three shelves book trucks and could be produce or sell to the market in the future.

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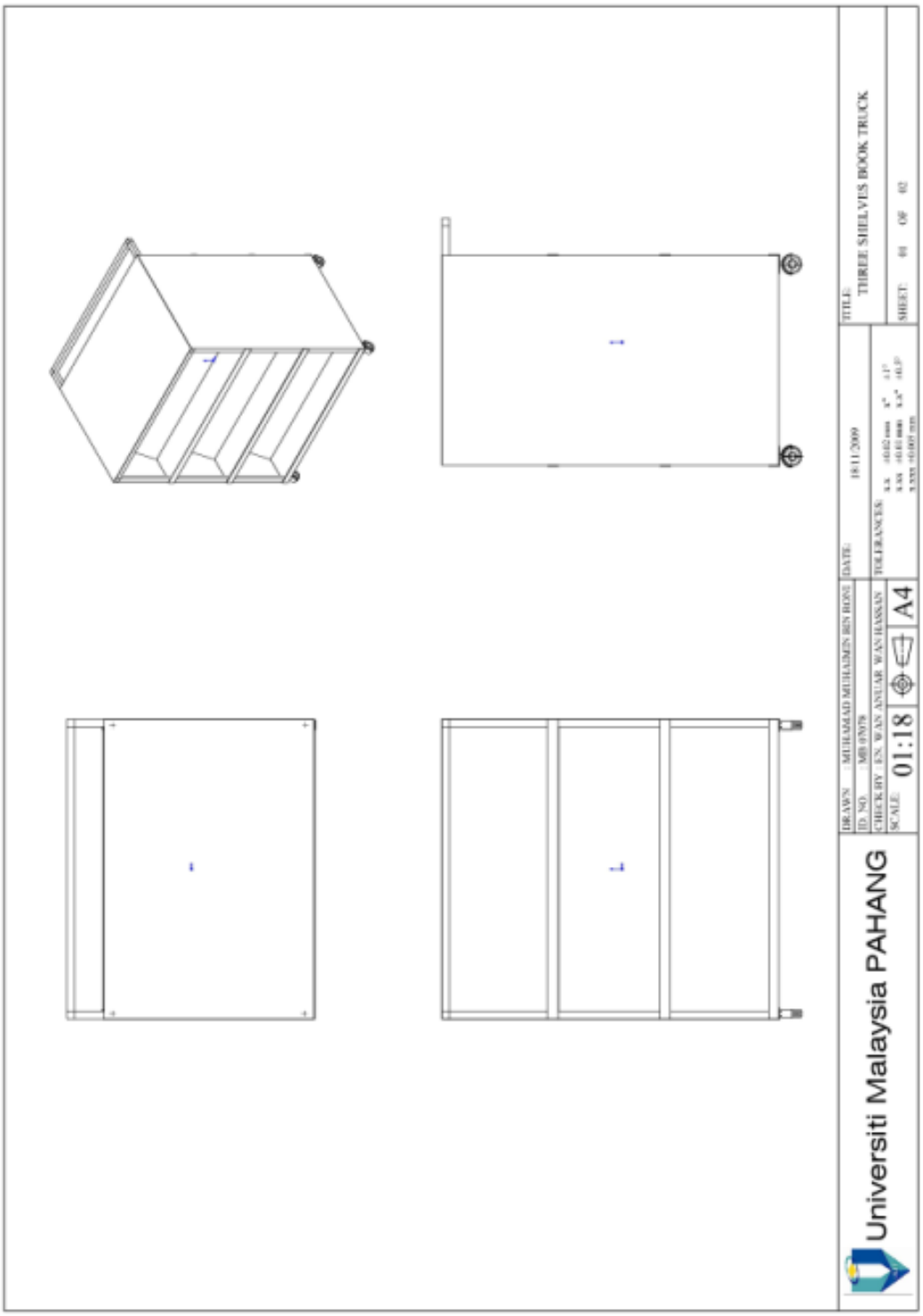
http://en.wikipedia.org/wiki/Aerosol_spray [15 November 2009]

Appendix A

Isometric View



Appendix B

Structure View