DESIGN AND FABRICATE TWO SHELVES FILE CART

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BORANG PENGESAHAN STATUS TESIS

JUDUL **TWO SHELVES FILE CART**

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DESIGN AND FABRICATE TWO SHELVES FILE CART

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

Faculty of Mechanical Engineering
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NOVEMBER 2009

SUPERVISOR DECLARATION

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

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Name of Supervisor : WAN ANUAR B WAN HASSAN

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I declare that this thesis entitled "*Two Shelves File Cart*" is the result of my own research except as cited in references. The thesis has not been accepted for any diploma and is not concurrently submitted in candidature of any other diploma.

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DEDICATION

To my beloved father and mother

En. Md Ibrahim Bin Md Meera

Pn. Asmah Beevi Binti Samsudeen

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First of all I am grateful to ALLAH S.W.T for blessing me in finishing my final year project (PTA) with success in achieving my objectives to complete this project.

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ABSTRACT

The file cart is a major usage to store documents and file by in order. File cart is merrily use at office or library order to make people easy to take files or documents. This file cart is taken from the concept of trolley like in the supermarket then change to the concept of file storage which makes more uses in future. With this invention, people who are short do not need to climb up the shelves to pick the documents which merrily use in daily work, which are stack up on file rack. And students at library which needs to refer to the reference book could also use this file cart. This is because students would like to have more than one reference book to refer to. So the file would come in handy. File rack is typically used for academic and industrial applications where significant volumes of physical archive material, filing or books are to be stored. Medical records at hospital storage and governmental record storage applications also make heavy use of these systems. Smaller commercial applications in file or media intensive offices such as the legal profession are common.

ABSTRAK

Penggunaan rak fail ini luas dalam menyusun dokumen atau fail mengikut susunan. Penggunaan rak fail bertroli ini kebanyakannya digunakkan di pejabat dan perpustakaan bagi menyenangkan proses pengambilan fail. Rak fail ini berkonsepkan seperti penggunaan troli di pasaraya kemudian diubahkan konsepnya menjadi rak fail yang memudahkan penggunaan di masa hadapan. Dengan ini, orang yang rendah dapat mengambil fail yang digunakan kerap kali tanpa perlu memanjat rak fail yang tinggi. Dan kepada pelajar pula, rak fail begini amat berguna dimana mereka perlu menggunakan buku rujukan. Selalunya buku rujukan yang dirujuk oleh pelajar pelajar adalah lebih daripada satu. Maka secara langsung, troli file ini dapat membantu dalam pengambilan buku-buku rujukan di perpustakaan. Penggunaan rak file di bahagian akedemik dan industri adalah untuk menyimpan jilid-jilid, aritfak bacaan yang penting. Sistem ini dperhebatkan lagi penggunaannya dibahagian menyimpan dokumen dibahagian kerajaan dan di tempat menyimpan rekod perubatan pesakit di hospital. Penggunaan komersil lebih kecil dalam fail atau pejabat-pejabat intensif media seperti profesion guaman adalah biasa

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CHAPTER 1

INTRODUCTION

1.1 Introduction

In this chapter, we will discuss about the problem statement, objective of the project, scope of the project, and finally project background.

1.2 Problem Statement

Nowadays, many type of file cart had been invented according to human needs from time to time. Recent documents which been used or read but indeed to use again for reference could use a file cart. For example in library students could not carry a lot of books in a time. Instant, it is tiring when a student walks back and front taking books that related to their studies. So with this file cart invented student could take more books than they ever take.

1.3 Objective

The objective of this project is to design and fabricate two (2) shelves file cart which are accessible, quite mobile, maneuverable, balance, sturdy and strong enough to withstand the load.

1.4 Scope

(a) The file cart can move in any directional way.

(b) The maximum load which the file cart could stand is 30kg

(c) The type of filing which are accessible for storage are A4 and A3.

(d) Area which uses the file cart is offices and libraries.

1.5 Project Background

This project is mainly about fabricating a file cart which is accessible where the file is easily put and take. Also file could be taken out from both side neither from the front and back nor from right and left. Another qualification is quite mobile. The file cart must not squeal when being push or pull. This also shown that the file cart had an addition quality which is the file have wheels. Next, maneuverable where we also could see as the file could be push or pull in any direction. Then, the file cart also being qualified which are balanced, sturdy and strong enough to withstand the load. Form this project background; we could have an overall view about the file that needs to be designed.

1.6 Conclusion

By this chapter, we had a view on the file cart which are accessible, quite mobile, maneuverable, balance, sturdy and strong enough to withstand the load.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

On chapter 2 literature reviews will discuss about the various type of filing which we use in our daily lives. From this literature review, we could understand the various filing method which were invented before and their needs.

A literature review is a body of text that aims to review the critical points of current knowledge on a particular topic. Literature review are secondary sources, and as such, do not report any new or original experimental work. Most often associated with science oriented literature, such as thesis, the literature review usually precedes a research proposal, methodology and result section. Its ultimate goal is to bring the reader up to date with current literature on a topic and forms the basis for another goal, such as future research that may needed in the area.

2.2 History

There are many types of filing documents or paper in order such as horizontal filing, vertical filing, lateral filing, shelf filing and etc. A file cart (or file cabinet in North American English) is a piece of office furniture usually used to store paper documents in file folders. In most simple sense, it is an enclosure for drawers in which items are stored. The two most common forms of filing cabinets are lateral and vertical filing.

A vertical file cabinet has drawers that extent from the short side (typically 15 inches) of the cabinet. A lateral file cabinet has drawers that extent from the long side (various lengths) of the cabinet. These are also called side filers in Great Britain. There are also lateral files and shelf files. In United States, file cabinets are usually built to accommodate 8.5 × 11 paper, and in other countries, filing cabinets are often designed to hold other sizes of paper, such as A4 paper.

Source: http://en.wikipedia.org/wiki/File_cabinet

2.3 Types of Filing

2.3.1 Horizontal Filing

Figure 1: Two tall metal file cabinets for work

Source: http://en.wikipedia.org/wki/File_cabinets

Henry Brown, an American inventor, patented a "receptacle for storing and preserving papers" on November 2, 1886. This was a fire and accident safe container made of forged metal, which could be sealed with a lock. It was special in that it kept the paper separated.

2.3.2 Vertical Filing

Figure 2 A wooden Filing Cabinet with drawer opner

Source: http://en.wikipedia.org/wki/File_cabinets

The vertical filing cabinet (vertical file cabinet in the United States) more or less as in use today was invented by Edwin G. Seibels in 1898. He invented a vertical filing system in 1898 that revolutionized record-keeping. Previously businesses kept papers in envelopes in turn stored in arrays of pigeonholes often lining a wall. Finding and opening envelopes and unfolding papers were troublesome and inefficient. Seibels reasoned that folding was not necessary papers could be kept in large envelopes standing on end vertically in a drawer.

2.3.3 Lateral Filing

Figure 3: Lateral type of filing

Source: http://en.wikipedia.org/wki/File_cabinets

Lateral files are typically 20 inches deep and manufactured in 30, 36, and 42 inch widths and 2, 3, 4, and 5 drawer versions. The 30 inch wide, 2 drawer versions is popular for use inside cubicle workstations as it is engineered to fit under or alongside the cubicle work surfaces. Logic for the use of 3, 4, and 5 drawer files is similar to that of vertical files. Unlike vertical files, most lateral files allow for side-to-side or front-to-back filing.

2.3.4 Shelf Filing

Figure 4: Shelf type of filing

Source: http://en.wikipedia.org/wki/File_cabinets

A shelf file is a cabinet designed to accommodate folders with tabs on the side rather than on the top. The cabinet has no drawers, only shelves. Some shelf files come with doors that recede into the cabinet. These cabinets are typically 12" or 18" deep, for letter or legal size folders respectively. Like lateral files, they are made in 30", 36", and 42" widths but are usually only installed in 5-high and 6-high applications.

2.4 Material Selection

Steel is an alloy consisting mostly of iron, with 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 more brittle.

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.

Plastic is the general common term for a wide range of synthetic or semisynthetic 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.

Wood is an organic material; in the strict sense it is produced as secondary xylem in the stems of trees (and other woody plants). In a living tree it transfers water and nutrients to the leaves and other growing tissues, and has a support function, enabling woody plants to reach large sizes or to stand up for themselves. However, wood may also refer to other plant materials with comparable properties, and to material engineered from wood, or wood chips or fiber.

So there are 3 types of material to choose for fabrication of the product. Each material has its advantages and disadvantages. For this project, I choose steel as the material to fabricate this product.

2.5 Link Metric of Needs

BIL	NEEDS / METRIC	Total mass	Material of product	Product size	Hardness	Manufacturing cost	Modern design	Enviromentally friendly
1	Easy to use	X		X				
2	Cost		X			X		
3	Difficult to broke		X		X			
4	Interesthing design						X	
5	Anti-rust							X
6	Can recycle							X
7	Without sharp edges						X	
8	Simple shape						X	
9	Long resistance		X					

Table 1: Link of metric

2.6 Conclusion

From this chapter, we could see the types of filing, and material selection which needs us to make a selection on what material which is been choose in order to fabricate the file cart. Also the link metric of needs been finalized in order the material is final to fabricate the product.

CHAPTER 3

METHODOLOGY

3.1 Introduction

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.

This chapter will discuss about the concept selection, flow char, product design specification, process, bill of material, concept screening..

3.2 Concept Selection

Concept selections were done by sketching a few concepts which is originally ideas to fabricate the product. After concepts were drawn out, next is to select the best concept with the best features to make the product.

Invented by Stuart Pugh the decision-matrix method, also Pugh method, is a quantitative technique used to rank the multi-dimensional options of an option set. It is frequently used in engineering for making design decisions but can also be used to rank investments options, vendor options, product options or any other set of multidimensional entities. A basic decision matrix consists of establishing a set of weighted criteria upon which the potential options can be decomposed, scored, and summed to gain a total score which can then be ranked.

The advantage of this approach to decision making is that subjective opinions about one alternative versus another can be made more objective. Another advantage of this method is that sensitivity studies can be performed. An example of this might be to see how much your opinion would have to change in order for a lower ranked alternative to out rank a competing alternative. Morphological analysis is another form of a decision matrix employing a multi-dimensional configuration space linked by way of logical relationships.

Source : http://en.wikipedia.org/wiki/Pugh_Concept_Selection
From Wikipedia, the free encyclopedia (Redirected from Pugh Concept Selection)

3.2.1 Concept Sketching

3.2.1.1 Concept A

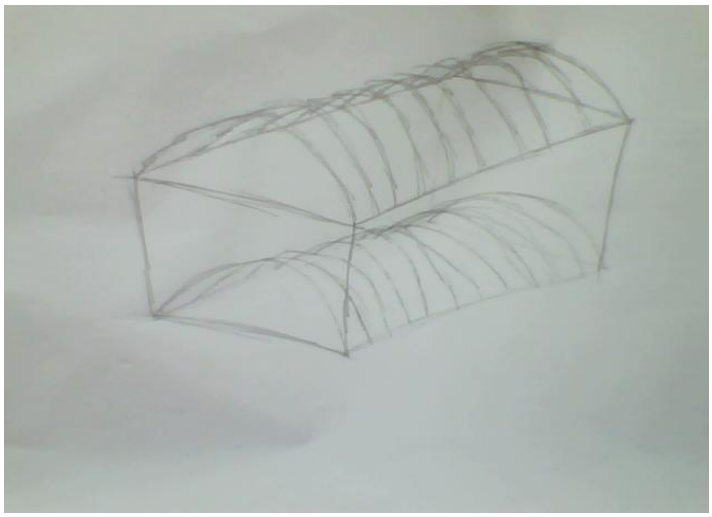


Figure 5: Concept A

The first concept I have drawn is like figure 4 has a bend steel which to separate the files but there are a few of limitation which is file cart only could put a limited quantity of file. And another limitation is can't move where not attached wheel in order to quite mobile and maneuverable

3.2.1.2 Concept B

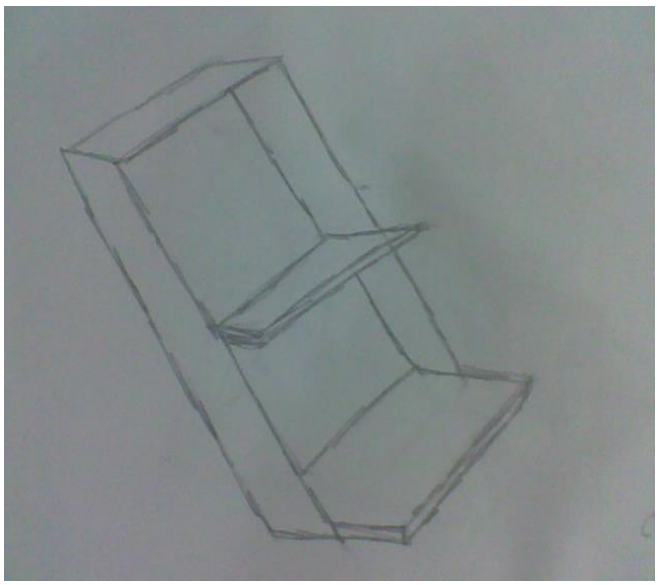


Figure 6: Concept B

The second concept is concept B. This concept had fulfill the requirement of two shelves, but had also its own weakness. Same as concept A the file cart can't move anywhere which it is static. Next is accessible, where the file could not easy accessible because only could put a one side of the file cart. And not balanced as because more than 90^0.

3.2.1.3 Concept C

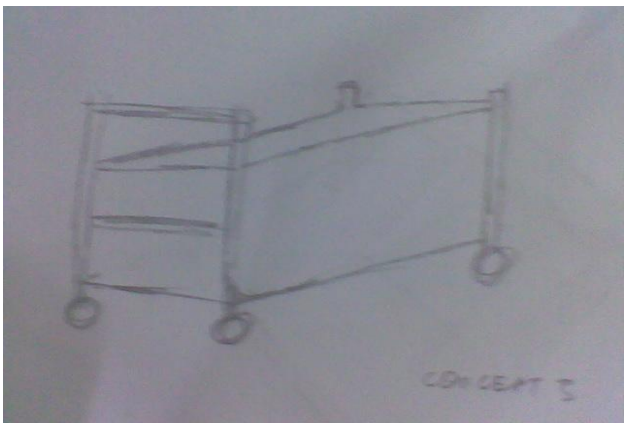


Figure 7: Concept C

This is concept C which is a file where could move and its structure more like to a tank where all side is covered. The disadvantages of this file cart are people would have bend down to take file. This will cause back ache if people gets over to take file again and again. By the way this file cart is only one level. So this does not meet the requirement which is two shelves.

3.2.1.4 Datum

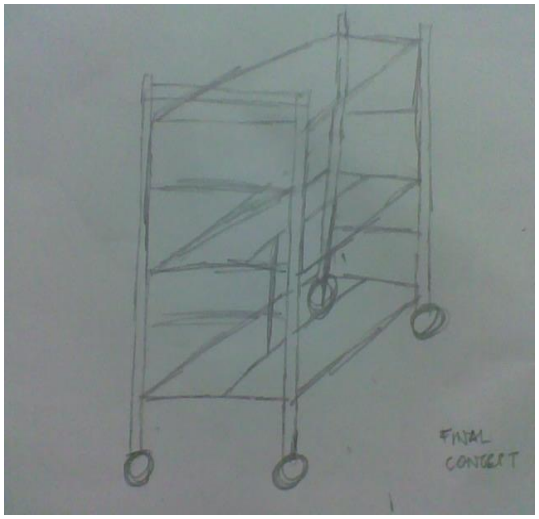
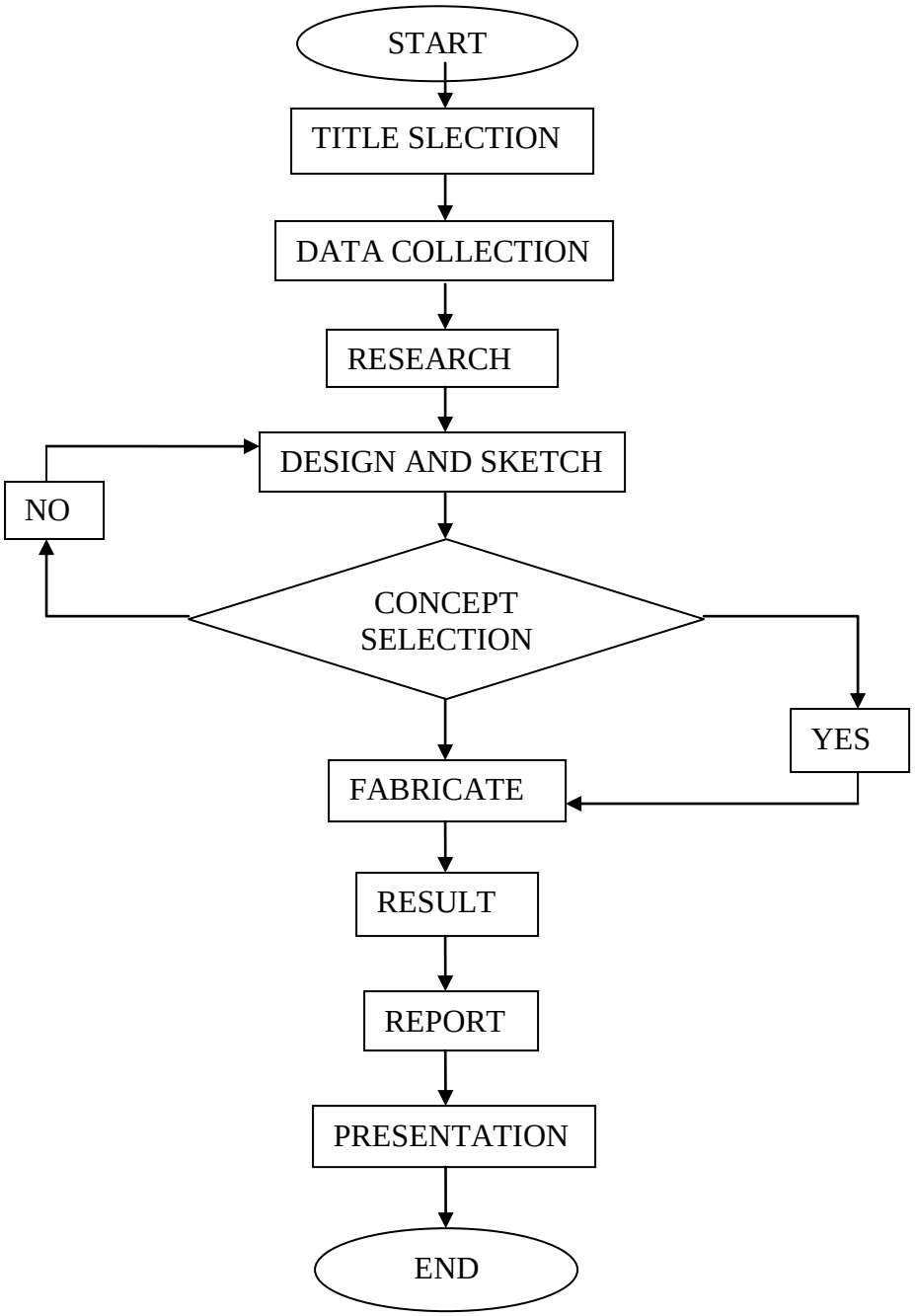


Figure 8: Datum

This is the concept that I have choose to be my product which is the Datum. This Datum is accessible, quite mobile, maneuverable, and balanced.

3.3 Flow Chart



3.4 Product Design Specification

(a) Product title

File Cart

(b) Purpose

To store paper documents

(c) New or special features

- Easy to use
- Simple design
- Anti rust

(d) Competition.

Will compete against standard file cart

(e) Relationship to existing products line

- This is a start-up venture. No other products currently exist

(f) Functional performance

- Long life
- Anti rust
- Can be recycle
- Save the cost

(g) Physical requirements

- File cart is measured by 80cm×60cm×80cm
- Weight is 8 kg
- Square shape
- A simple design

(h) Service environment.

- The file cart cases should be stable from -20 to 100℃, 20 to 100 percent relative humidity

(i) Human factors

- File cart must be simple
- No sharp corners or edges to cause cut or snag clothing
- Easy to use

(j) Legal requirements

- No toxic materials to be associated with manufacture.
- Acts on surrounding nature 1974 (changed 1985).

3.5 Process

3.5.1 Fabrication Process Flow

The fabrication process consists of 5 phases :

(a) Phase 1 - Preparing the material
(b) Phase 2 - Measuring process
(c) Phase 3 - Cutting process
(d) Phase 4 - Joining process
(e) Phase 5 - Finishing process

3.6 Fabrication Process

Next is the fabrication process. This fabrication process explain about how the file cart build by using the technique and skills gather which had been thought through diploma studies.

3.6.1 Preparing The Material

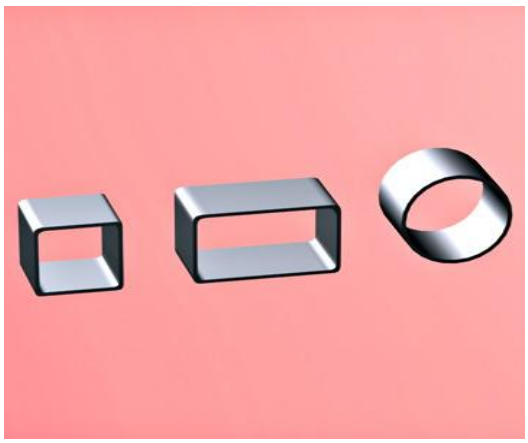


Figure 9: Hollow steel

Source: http://img.alibaba.com/photo/50456737/Hollow_Steel_Sections__Round_Steel_Tubes_for_Vehicles.jpg

The first process to make the product is by preparing the right type of material. The material that been chosen is steel which 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 more brittle.

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. The type of steel that be chosen to fabricate this product is square hollow and round hollow steel.

3.6.2 Measuring Process

Figure 10: Measuring tape

Source: http://www.allproducts.com/manufacture11/tmt/gn7525.jpg

A ruler or rule is a tool used in, for example, geometry, technical drawing, engineering, and carpentry, to measure distances or to draw straight lines. Strictly speaking, the ruler is the instrument used to rule straight lines and the calibrated instrument used for determining length is called a measure, however common usage calls both instruments rulers and the special name straightedge is used for an unmarked rule. The use of the word measure, in the sense of a measuring instrument, only survives in the phrase tape measure, an instrument that can be used to measure but cannot be used to draw straight lines.

Measurement of the workpiece is measure by using measuring tape. Workpiece were mark by using pencil. The measurements for establishing the product are :

(a) Length: 60cm×6
(b) Wide: 80cm×4
(c) Height: 80cm×4
(d) Partion: 35cm×2

3.6.3 Cutting Process

Figure 11: Vertical bend saw

Source: http://www.demmlermachinery.com/images/Vertical%20Bandsaw.JPG

In cutting process, we use the automatic bend saw because it easy to cut the steel and also can save time. 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. Advantages using automatic saws are automatic band saws feature preset feed rate, return, fall, part feeding, and part clamping. These are used in production environments where having a machine operator per saw is not practical. The material were cut according to the measurement which have been measured. As for tolerance for cutting the material, 0.5cm plus on every measurement were add in order to get a precise reading.

3.6.4 Joining Process

Figure 12: Shielded metal arc 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.

Shielded metal arc welding (SMAW), which is also known as manual metal arc welding (MMA) or stick welding. Electric current is used to strike an arc between the base material and consumable electrode rod, which is made of steel and is covered with a flux that protects the weld area from oxidation and contamination by producing CO_2 gas during the welding process. The electrode core itself acts as filler material, making a separate filler unnecessary. The process is versatile and can be performed with relatively inexpensive equipment, making it well suited to shop jobs and field work. Furthermore, the process is generally limited to welding ferrous materials, though special electrodes have made possible the welding of cast iron, nickel, aluminum, copper, and other metals. Inexperienced operators may find it difficult to make good out-of-position welds with this process.

Figure 13: Gas metal arc welding

Gas metal arc welding (GMAW), also known as metal inert gas or MIG welding, is a semi-automatic or automatic process that uses a continuous wire feed as an electrode and an inert or semi-inert gas mixture to protect the weld from contamination. As with SMAW, reasonable operator proficiency can be achieved with modest training. Since the electrode is continuous, welding speeds are greater for GMAW than for SMAW. Also, the smaller arc size compared to the shielded metal arc welding process makes it easier to make out-of-position welds (e.g., overhead joints, as would be welded underneath a structure).

The equipment required to perform the GMAW process is more complex and expensive than that required for SMAW, and requires a more complex setup procedure. Therefore, GMAW is less portable and versatile, and due to the use of a separate shielding gas, is not particularly suitable for outdoor work. However, owing to the higher average rate at which welds can be completed, GMAW is well suited to production welding. The process can be applied to a wide variety of metals, both ferrous and non-ferrous. Source : http://en.wikipedia.org/wiki/Welding

In this process, I used 2 types of welding skill which as mention above that is Shield Metal Arc Welding (SMAW) and Gas Metal Arc Welding (GMAW) or more known as Metal Inert Gas (MIG).

Figure 14: SMAW

Figure 15: SMAW

First weld the main frame which is the body of the file cart. Finish welding, next weld the partion separately from the main frame. After finish welding, weld the partion into the main frame. Next weld the base of the frame with wheels in 4 position. Finally weld the holder bar to the main frame

3.6.5 Finishing Process

Figure 16: Painting (Spraying)

Figure 17: Angle Grinder

Source: http://www1.istockphoto.com/file.jpg

Source : http://en.wikipedia.org/wiki/Angle_grinder

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.

Source : http://en.wikipedia.org/wiki/Aerosol_spray

An angle grinder, also known as a side grinder, is a handheld power tool used for cutting, grinding and polishing. Angle grinders can be powered by an electric motor, petrol engine or compressed air. The motor drives a geared head at a right-angle on which is mounted an abrasive disc that can be renewed when worn. Angle grinders typically have an adjustable guard and a side-handle for two-handed operation.

Source : http://en.wikipedia.org/wiki/Angle_grinder

For the finishing process, firstly we could use angle grinder to grind off the over-weld parts or to smooth the surface of the weld surface in order to look neat. After finish grinding, we could paint the fail cart to summarize our product.

3.7 Bill Of Material

Table 2: Bill of material

Bil	Item	Quantity	Thick/Diameter (cm)	Width (cm)	Length (cm)	Lumber
A	Outer frame	4	2.5	2.5	80	Hollow square steel
B	Outer frame	6	2.0		80	Hollow round steel
C	Body part	6	2.0		60	Hollow round steel
D	Partion	2	2.0	10	35	Hollow round steel

3.8 Concept Selection

3.8.1 Concept Screening

Table 3: Concept screening

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

3.9 Conclusion

In this chapter, we have drawn sketches by taking with the qualifications of the objective. Finally, we have selected the best design which is the datum as our final product. Then fabrication process takes place.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

In this chapter, we will discuss about the result occurs which after we have the fabrication process done. Also we will discuss about the analysis which had been done in order to measure the capability of the file cart.

4.2 Analysis

4.2.1 Stress Analysis

Stress analysis is an engineering discipline that determines the stress in materials and structures subjected to static or dynamic forces or loads (see statics and dynamics) (alternately, in linear elastic systems, strain can be used in place of stress).

The aim of the analysis is usually to determine whether the element or collection of elements, usually referred to as a structure, can safely withstand the specified forces.

Source: http://en.wikipedia.org/wiki/Stress_analysis

4.2.2 Strength of Material

In materials science, the strength of a material is its ability to withstand an applied stress without failure.

$$\sigma = \frac{F}{A},$$

Where F is the force [N] acting on an area A [m^2]. The area can be the unreformed area or the deformed area, depending on whether engineering stress or true stress is used.

Source: http://en.wikipedia.org/wiki/Strength_of_materials

4.2.3 Newton's Law

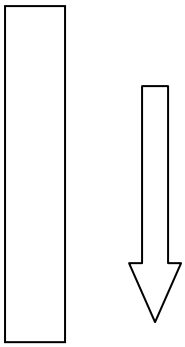
Newton's second law states that the force applied to a body produces a proportional acceleration; the relationship between the two is

$$\mathbf{F} = m\mathbf{a},$$

Where **F** is the force applied, *m* is the mass of the body, and **a** is the body's acceleration. If the body is subject to multiple forces at the same time, then the acceleration is proportional to the vector sum.

Source: http://en.wikipedia.org/wiki/Newton%27s_laws_of_motion

Below is the calculation which I had done for maximum weight could stand by the file cart:



$\sigma = F / A$

$F = ma$

$F = ma$

$= (30kg) \times 9.812$

$= 294.36$ N/ms^{-2}

$\sigma = F / A$

$\sigma =$ stress

$F =$ force

$A =$ area

$A = 0.025\ m \times 0.025\ m$

$= 6.25 \times 10^{-4}$ m^2

$\sigma = F / A$

$= 294.36 / 6.25 \times 10^{-4}$

$= 470976$ N/m^2

4.3 Result

Finally this is the outcome which I had achieved after doing fabrication process.

Figure 18: File cart

4.4 Conclusion

As for conclusion in this chapter, I had find out the stress line and calculate the stress which the file cart could stand with the load.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

The main objectives of this study are to design and fabricate two (2) shelves file cart which are accessible, quite mobile, maneuverable, balance, sturdy and strong enough to withstand the load.

As conclusion, I have achieved both design and fabricate the file cart with the qualities of accessible, quite mobile, maneuverable, balance, sturdy and strong enough to withstand the load. According to the design I have fabricate the final product.

5.2 Recommendation

5.2.1 Student's Budget

Firstly, I would like recommend to University authority whereby they should hand over to the students the funds first in order for the students to buy materials or other equipments related to their project. By this improper situation, students will have to use their own money which are known among the students the loan been taking for a semester is doesn't enough.

5.2.2 Location Of The Main Campus

The location of lab at the main campus which are far from the students residents where the main campus is located in Pekan and the students are staying at Gambang. The need for travel is very crucial because students must travel for more than an hour to reach there. This also will make the students tired in order of travelling. By the way, there are limitations of transportation in which students going to the lab. In case the students had miss the bus so they have to wait for another bus which in that consumes time.

5.2.3 Time Frame

The time frame completing this project is very short. This could be avoided if the management had completing the setup of machines at the lab. In this case, students would have to wait in order to use particular machine.

5.2.4 Limitation of Material

As generally known the main campus at Pekan is not 100% finish its construction. Not all the material which had been brought up to the main campus lab. This cause students to find the suitable material in which to fabricate their product is very hard.

5.2.5 Suitable Place to Keep Students Project

The University authorities should give students a suitable place to keep their material from stolen not by just keeping in the lab. There are other students from other course which happens to not finish their project would take the material which been prepare by other students. This incident had happen to myself where my

material which be ready had been stolen by someone. So in order to prevent this happen to other students in the future, I hope this could be prevented earlier as the University authorities give a suitable place for students to keep their project.

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APPENDIX A

Gantt Chart