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JUDUL: DESIGN AND FABRICATE WALKING AIDED TOOL FOR PARALYZED PEOPLE

SESI PENGAJIAN: 2006/2009

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DESIGN AND FABRICATE WALKING AIDED TOOL FOR PARALYZED PEOPLE

ABDUL RASHID BIN MUHAMMAD

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

Faculty of Mechanical Engineering
UNIVERSITI MALAYSIA PAHANG

NOVEMBER 2008

SUPERVISOR'S DECLARATION

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

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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.

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ABSTRACT

Designing and fabricating a walking aided tool is a product to fulfill customer needs especially for those who are half paralyzed people for rehabilitation process or move in their daily activities better. Overall, this project involves with many processes, starting from designing the concept of the product, fabrication process which involves with some mechanical process such as machining, welding, drilling and other process.

There are several aspects which are considered on this project such as high strength, ergonomic and other. Material used on this project consist of hollow steel tube, hollow steel pipe and steel bar in order to support certain weight capacity. This product also built with specific height in order to meet the ergonomic aspect to make the user comfortable and the product users friendly. Even though there are a lot of existing products on the market, the completion of this model provides a more practical usage.

ABSTRAK

Produk ini direka cipta untuk memenuhi kehendak pelanggan terutamanya golongan separuh lumpuh dalam membantu mereka ketika menjalani latihan untuk berjalan seperti biasa dan juga memudahkan urusan seharian mereka. Secara keseluruhannya, projek ini meliputi pelbagai proses bermula dari mereka bentuk, fabrikasi yang dimana terdiri daripada beberapa proses seperti memotong, mengimpal dan lain-lain proses.

Terdapat beberapa aspek yang ditekankan dalam projek ini iaitu tahan lasak, ergonomik dan juga lain-lain aspek. Bahan yang digunakan di dalam projek ini terdiri daripada besi berongga, paip besi berongga dan sebagainya untuk memastikan produk ini dapat menahan berat-berat tertentu. Selain itu, produk ini dicipta mengikut tinggi yang tepat supaya memenuhi ciri-ciri ergonomik seperti memberi keselesaan dan lebih mesra pengguna. Walaupun terdapat pelbagai jenis alat bantuan berjalan berada dipasaran, namun ciri dan kelebihan alat bantuan berjalan ini lebih praktikal digunakan.

TABLE OF CONTENTS

CHAPTER 3 METHODOLOGY

CHAPTER 4 RESULTS AND DISCUSSION

CHAPTER 5 CONCLUSION AND RECOMMENDATION

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS

ε	Strain
E	Young's Modulus
σ	Stress
F	Force
A	Area

CHAPTER 1

INTRODUCTION

1.1 OBJECTIVES

The purpose of this project is to expose the student about the process involve in produce a product through research and development. Other than that, this project also develops and improves engineering skills and knowledge that will helps and prepares the student facing the real situation on the industries. Some other objectives of this project are:

- To design and fabricate a walking aided tool in order to produce a product that can helps half paralyzed people in rehabilitation process and assist them to move in their daily activities better.
- Introduce new concept of walking aided tool to the half paralyzed people so that it can helps them effectively and fulfill their need to have a walking aided tool that is suitable for them.
- Develop the concept based on specific method such as Pugh Concept Selection Method, static analysis and other method.

1.2 SCOPES

The scopes of this project consists a few steps and need properly plan so that this project can achieve all the objectives. There are many processes involve in order to produce the product. The scopes of work in this project:

- Literature review which needs to find information about the walking aided tool from any possible resources such as internet, books and others.
- Drawing and design the final product using AutoCAD and SolidWorks.
- Fabricate the product from selected material using machining, welding, and other processes.
- Simulate and test the product in order to get the result.

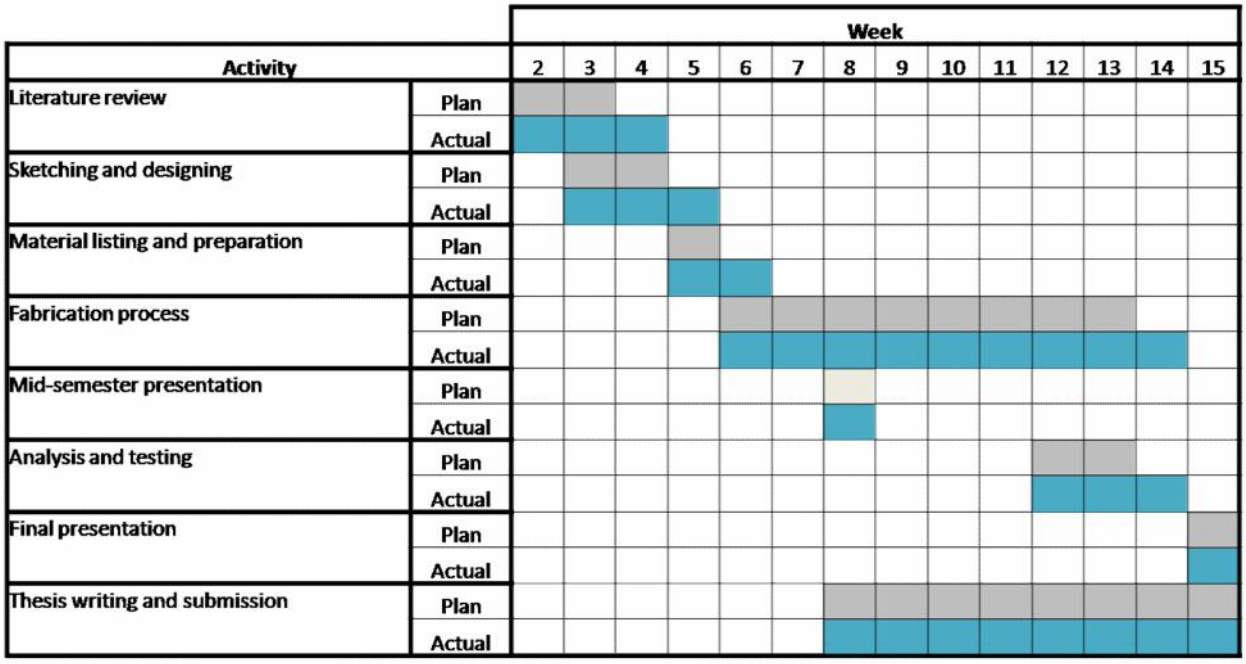
1.3 PROBLEM STATEMENT

Walking aids are ideal for people who temporarily injured or immobilized and often used during the rehabilitation process and physiotherapy. There are various types of walking aids available such as walkers, canes and crutches. The type of walking aid usually depends on user physical limits and stamina, but there is no suitable walking aid for the half paralyzed person because of:

- Some walking aids can not support heavy load from their body which can make them fall to the ground.
- They need to use more energy and can be use only in short time because lack of stamina.

1.4 GANTT CHART

Table 1.1: Gantt chart



Based on the Gantt chart from table 1.1, this project started with literature review on 2nd week until 3rd week. On this time, all information about the walking aid needs to find out from internet, books and other resources. Then, from here we will get an example and concept of the product.

On 3rd week until 4th week, we need to sketch the concept that we get from the literature review and then decide which concept is the best concept in order to fulfill the customer needs. After that, the concept will design using AutoCAD and SolidWorks based on suitable dimensions.

The project continues with material listing and preparation process. It took two weeks in order to decide suitable material that can be used in this project. We need to find a suitable material that can give enough strength to support load from human body and light so that it will be easier to move.

After received all material, the fabrication process took place from 6th week until 13th week. On this fabrication process, it will start by cutting the material to desire dimension according to the drawing. Then, it will follow by welding the material into a part. After it is done, we need to analyze the result we get from simulation and testing to make sure the product is suitable for the user.

There are two parts of presentation which is on 8th week and 15th week. On 8th week, it is mid-semester presentation where the student needs to present their progress on the project. On 15th week, student need to present and explain about the work done for the project and do the simulation in front of panels.

Report writing took about six week to complete starting from 8th week until 15th week. On this report, it should include the entire project starting from literature review until the result and discussion. The final report must be submitted on 15th week.

1.5 FLOW CHART

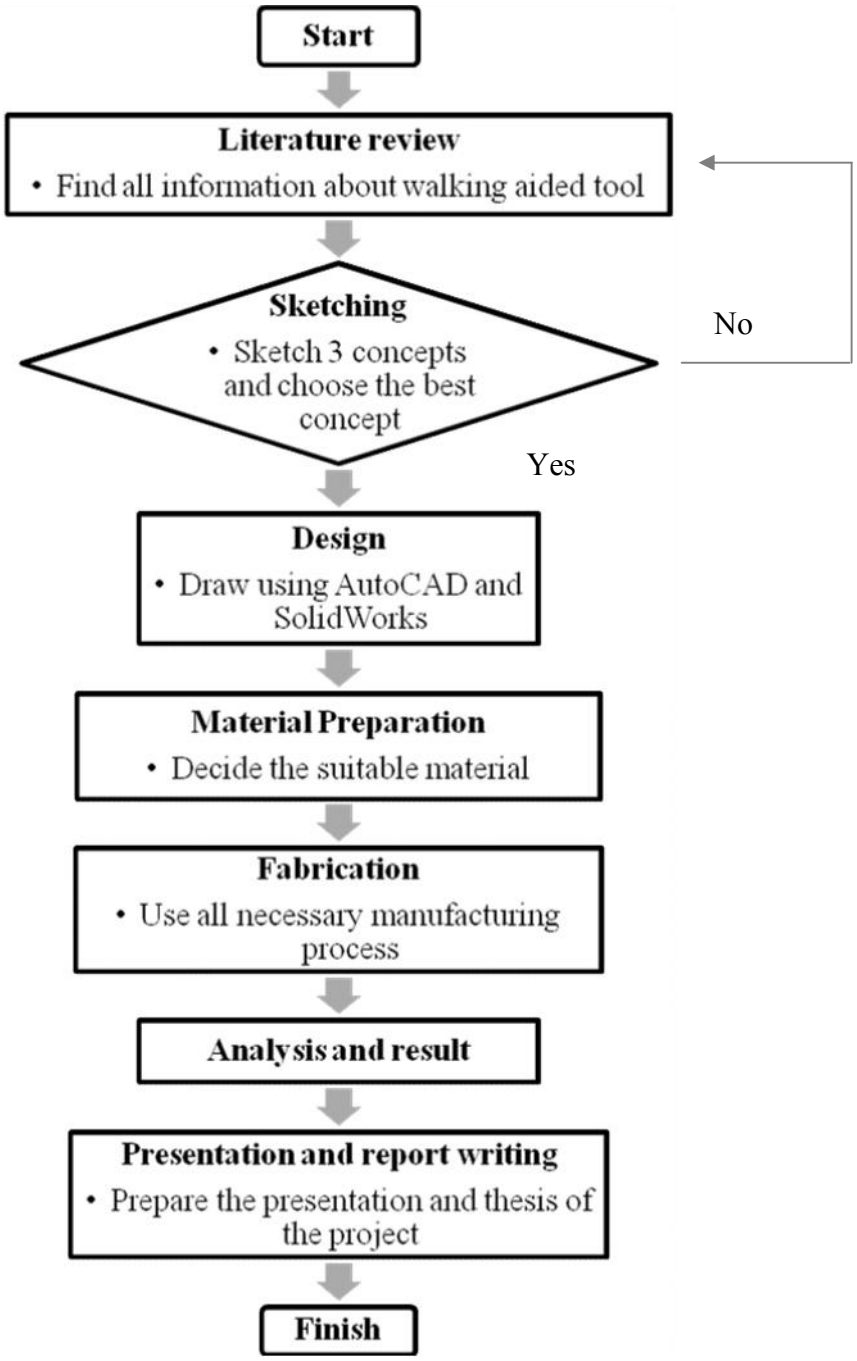


Figure 1.1: Flow chart

Figure 1.1 shows a flow diagram of the project. It started with literature review where all the information about the product is collected. The sources are from

relevant article in the internet, books and others resources. From the literature review we can find what user needs on their walking aid and try to improve it.

After getting some information, we can get an idea on what concept that can be put on our design and try to improve it and make it useful for user. Sketch at least three concepts and then decide which concept is most suitable for the user. If the concepts are not suitable for the user, we need to find more information about the product and try improving the existing design of the product.

After decide which concept is best for the user we need to draw into engineering drawing using software application such as AutoCAD and Solidworks. The drawing should consist of 2D and 3D drawing so that we can design how the product should be.

The other process follow is material preparation. Purpose of this process to determined which material is suitable for the product. The material should give enough strength and light so that it can be more users friendly. After that, we need to list the component and purchase it if necessary.

After that, we proceed to a fabrication work. The process consist of few manufacturing processes depend on the drawing. Some of the process is cutting process using the disk cutter, welding the material into a part, assembly all the part of the product and then finalized it.

Then, we need to do a simulation and test the product. After that, we need to analysis the result of the product whether it can be use or not. The product should support load from human body and user friendly so it can be better product for the user.

Finally, after getting the result we need to prepare for the presentation and report writing. Both should have entire process of the project including introduction, literature review, methodology and other things. The report should be submitted on the last week of the semester.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Many people use wheelchairs, but a lot of people are still able to walk with the help of a walking aid. A walking aid is ideal for the times you want to get out of your wheelchair for a little exercise and freedom. They are also useful if you're visiting somewhere that isn't wheelchair accessible.

There are various types of walking aids available that allow you to do this. There are assorted walking aids to help you while you are on your feet - such as walkers, canes and crutches. You can choose single point canes, quad point canes, crutches, forearm crutches, walkers, rolling walkers, and rollators. These walking aids are all relatively lightweight and portable.

The type of walking aid you choose usually depends on your physical limits and stamina. You might be able to use a walker, but not a cane or vice versa. You will also have to learn how to safely use your walking aid. You have to learn all of the safety issues involved with your walking aid or you may end up injuring yourself. Make sure you are properly trained with your walking aid. It is probably a good idea to consult your doctor before deciding on which walking aid is the best for you.

Walking aids are also ideal for people who are temporarily injured or immobilized and are often used during the rehabilitation process and physiotherapy. Most walking aids are adjustable to suit your height, but you need to make sure that

your aid or aids are the proper size for you. They are also usually built to handle a certain weight capacity so make sure the walking aids you are using are built to handle your body size and weight in order to make you comfortable with it. You will have a lot to choose from as walking aids come in various materials, sizes, shapes, designs, styles and colors.

Figure 2.1: Types of walking aids

2.2 TYPES OF WALKING AIDS

2.2.1 Walker

Walkers are specialty medical equipment used by senior citizens for additional stability when walking. A basic medical walker has four legs built on a frame with three sides that surround the person for stability. In the process of using a walker, the person must lift the walker off the ground as they take a step forward and walk into the frame.

There are also two-wheeled walkers that have glide caps on the rear legs and caster wheels on the two front legs. This is ideal for a person without the physical

strength to lift the walker because the two wheels in front and the glides in the rear enable easier movement while still creating stability.

The most important part of the proper use of a walker is to assure the correct height positioning: the height of the walker grips should line up properly with the wrists. If this is not done correctly, the person will be in an uncomfortable position because the handles are too low. If they are too high, it will create difficulties for them in transferring their weight.

Figure 2.2: Basic medical walker

Figure 2.3: Two-wheeled walker

2.2.2 Rolling Walker

Rolling walkers are a very common and helpful type of walking aid used by many people with weak legs or those who do not always require a wheelchair. Rolling walkers are also often used by the elderly. The rolling walker is designed to provide support so the person using it can maintain their balance and relieve their legs from some of their weight. Rolling walkers are also ideal for people who are recuperating from leg or back injuries and are still a little unsteady on their feet.

A rolling walker is basically a frame that is about waist high and has wheels on its legs. Rollers with smaller wheels are built for indoor use; while those with larger wheels are ideal for outdoor travel. A walker is usually slightly wider than the person using it and it is about a foot deep.

A person walks with the rolling walker in front of them with the frame of the walker surrounding their front and sides. Some walkers also have padded seats built into them. A rolling walker will enable you to keep your balance along with improving your posture at the same time. The walker will give you adequate support to help you from tiring quickly. If you do get tired while using your walker you can rest by sitting on the seat. You can also carry items with you while using a rolling walker by getting one with a front basket attached. Other accessories for rolling walkers include drink holders and plastic trays.

Make sure your rolling walker is the right size for you. You should not have to reach or bend too far to use one. Your wrists should line up with the top of the walker's handles. You should also make sure the seat is the right height for you. If your knees are bent 90 degrees or more when sitting down, the seat is too low and you may have difficulty when you try to stand up.

Rolling walkers are designed to hold a specific amount of weight so make sure your walker can handle your body weight. Heavier walkers are more stable and lighter models are easier to pack, store and transport. Rollers come in various sizes,

styles, designs, shapes and materials. They can be found in rigid models and foldable models.

Figure 2.4: Rolling walker

2.2.3 Rollators

Although some people may not consider them to be walkers, rollators are basically adjustable walkers with wheels attached to the bottom of the legs. The advantage of the wheels is that you don't have to lift the walker to go forward or backward. You just have to roll the walker along the ground to get from point A to point B. This makes it much easier to get around as the wheels are designed to turn, pivot and maneuver in a way that walkers can not.

Rollators with smaller wheels are aimed at indoor use; while rollators with bigger wheels are ideal for outdoor use. Like walkers, rollators are frames that are about waist high and are designed to give you support and stability while walking, along with comfort and convenience. You hold onto the frame with your hands and push it along in front of you as you walk. The rollator frame helps to support your body weight. They also help you to keep your balance and posture, and they take some of the pressure off of your legs.

Most rollators also have foldable, padded seats and back rests built into them. This way if you do get tired while walking, you can fold the seat down and rest on it. Make sure your seat is at the right height for you body size, or you may have difficulty when trying to stand up.

Rollators are generally made of sturdy, anti-rust aluminum and weigh between 10 and 30 pounds. Some rollators are rigid, but there are many foldable models available. Foldable rollators are generally lighter, making them easy to pack, store and carry.

Rollators come in various materials, sizes, shapes, designs, styles and colors. It is important that your rollator is the proper size for you. You should not have to bend or reach to use it and your wrists should line up with the rollator's handles. Make sure that the rollator is able to handle your body weight. Most models will have a maximum weight capacity. You can also get accessories for your rollator such as removable storage baskets, trays and drink holders. However, some models of rollators will come with a basket already attached to them.

Figure 2.5: Rollator

2.2.4 Single-point Canes

A cane, also known as a walking stick, is a very popular type of walking aid. Some people use canes as a fashion accessory, but a cane is designed to be a hand held aid that is used to support your body and to help relieve some of the pressure off your legs.

A single-point cane is the simplest and probably one of the oldest types of supportive devices or walking aids. Single-point canes are effective for helping people with minor instability and balance difficulties. They are often used by people with mobility impairments, the elderly and by people undergoing therapy or rehabilitation. Single-point canes often help to prevent people from falling during walks and are often used by seniors for this purpose.

This is important to make sure the cane is the proper size for your body. A cane that is either too high or too short can do more damage to your body. The approximate height of your cane can be determined by measuring the distance from your wrist to the floor when you are standing with your arms at your sides.

Canes are generally lightweight and have rubber tips attached to the bottom of them for extra stability. You can also fit your cane with grips that cover the handle and cushion your hand. Most cane shafts are made of wood, aluminum or Lucite and can be cut with a wood saw or hack saw. If you are not sure what size to order, it's a good idea to get a cane that's a little longer. This way you can always cut it down to size.

Many canes are built to carry a certain weight capacity so make sure your cane can handle your body weight. Single point canes come in a variety of sizes, colors, styles and designs. Some canes are adjustable and some are foldable.

Figure 2.6: Single-point cane

2.2.5 Quad-point Canes

A quad-point cane is a cane that has a base at the bottom of it with four short legs that touch the ground. These four legs are covered by tips or suction cups that are usually made of rubber. The tips are designed to give your cane a better grip on the ground and floor. A quad-point cane serves the same purpose as a single-point cane, but the four legs give it added stability, support and sturdiness.

Quad-point canes are often used by people with slight mobility impairments, people who are undergoing rehabilitation or therapy, and by elderly people. The low bases of these types of canes offer you a lower center of gravity for better balance. Most quad-point canes are also reversible for right or left handed use. Most canes are made of anti corrosive, anodized aluminum and non chip chrome and you can get grips for their handles to protect and cushion your hands. Quad-point canes are relatively lightweight and only weigh a couple of pounds. They are made to support your body and take the pressure off your legs to help you balance while walking, but they usually can't bear a person's entire body weight.

Some quad-point canes are a fixed height, but many of them are adjustable. However, it's still important that your cane is the right size for your body. The approximate height of your quad-point cane can generally be determined by measuring the distance from your wrist to the floor while standing with your arms to your sides. If you are unsure what height cane is right for you, do not hesitate to contact your doctor or physical therapist for their help. You should also get their help if you are not certain which type of cane you should be using, either a single-point cane or a quad-point cane.

Most canes are built to hold a specific capacity of weight, so make sure that your cane is designed to carry your body weight. Quad-point canes are available in assorted materials, colors, sizes, designs, shapes and styles.

Figure 2.7: Quad-point cane

2.2.6 Crutches

Standard crutches are usually used as temporary walking aids by people who are recovering from an injury, surgery or are in rehabilitation or therapy. They are often used by people who have a leg injury to help them get around on their feet.

Crutches are basically stick- like walking aids that help you to support your weight, by keeping pressure off of your injured leg. You use crutches by placing the tops under your armpits and by holding onto the handles; which are located about half way down the crutches. You then transfer your body weight through your arms onto the handles of the crutches.

Figure 2.8: Crutches

Your arms should be straight when using crutches. This enables you to take the weight off of your injured leg and use the crutches as a substitute leg. Make sure that you do not just lean on the crutches under your armpit. You have to use your arms to support yourself.

Figure 2.9: Proper use of crutches

Crutches are generally made of wood or aluminum and are lightweight, but very sturdy and steady if used properly. The ends of the crutches need to be covered by rubber tips to stop you from sliding on the floor or ground. Most crutches are also adjustable so you can set the height to fit your body size.

Crutches can very tiring to use and hard to maneuver so do not use them unless it is necessary. Crutches are only suitable for people who can still use one leg, or at least put some weight on one leg. Most crutches are made to handle specific weight capacity so it is important that your crutches can support your body weight.

2.2.7 Forearm Crutches

Forearm crutches are walking aids that are generally designed for long term use. They have been around for many years and are recognized as one of the most supportive and functional types of walking aid. They are often used by people who are mobility impaired, but can still use their legs.

Forearm crutches are designed to give you support and balance while walking. Forearm crutches look like canes with handles placed about a quarter of the way down them. At the top of the crutches are contoured arm cuffs in which you

place your arms. The cuffs will surround your arms just below the elbows to help reduce any strain on your arms. This allows you to your use your hands without dropping the crutches. Make sure that the arm cuffs are flexible and comfortable, and they don't pinch your arms. Cuffs that adjust in length just above the handgrip are usually the most comfortable. Some people cover their cuffs with material such as sheepskin for added comfort. Be sure that the handles of the crutches give you a good grip and are also comfortable.

The bottoms of forearm crutches are covered by replaceable rubber tips to help stop you from slipping and sliding on the floor or ground. Forearm crutches are relatively lightweight with some models weighing only a pound or two each. Most forearm crutches are designed to support a specific amount of weight so make sure your crutches are strong enough to hold your body weight.

Forearm crutches come in various sizes and it's important that your crutches are the proper size for your body height. Forearm crutches are also available in assorted materials, styles and colors. However, most crutches are made of high strength, anti-corrosive aluminum or carbon fiber.

Figure 2.10: Forearm crutches

2.2.8 Standing Frames

Having the ability to stand erect is something most of us take for granted. Standing frames for disabled individuals are used when it's impossible for them to achieve this on their own. Adult standing frames can accommodate a person up to six feet, five inches in height and 400 pounds in weight with adjustable features.

A standing frame is 100 percent weight-bearing and allows someone to be stable in a vertical position. They can change their position while using the standing frame which allows them to stretch their muscles. Standing frames have several features such as:

- Design support for the chest, knees, hips and the feet are in a secured, stable position.
- A standing frame is constructed of steel and is comfortably padded at the point of support.
- They are portable for easy transport to different locations.
- They require a minimum amount of storage space.

The traditional standing frame uses a hand-operated hydraulic lift to raise the person from their wheelchair to a fully upright position. It has all of the features to make the individual as comfortable as possible while in use. The support pads that brace the back, hips, chest and head enable anyone to be vertically stable, regardless of their injury. A standing frame is equipped with a power lift and power drive, so that an individual can be mobile (and stable) at home or work.

Figure 2.11: Standing frame

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

On this chapter, it will explain about the method and process in order to realize this project. Its start from design the concepts of the product, concepts generation and evaluation, design of the product, material preparation and lastly about fabrication process use in this project.

3.2 CONCEPTS

There are some aspects to consider in designing the concept. One of the aspects is the strength. This aspect is an important thing to consider because the walking aid should have enough strength to handle a certain weight capacity. Usually user depends on the product in order to stand or to walk forward. The other aspect is ergonomic which is the concept should be user friendly, lightweight and other characteristics. The walking aid should be user friendly as it can be use without proper training and use less stamina to use it. The other thing to be considered is the manufacturing process in order to realize this project. The process should be available to do in the FKM lab and that is important to reduce the manufacturing time. In this project, there are three concepts have been made based on the actual concept on the market but there are some improvement made on the concepts. Then, decide which concept is the best concept from all three concepts. After that, the best concept is design with either AutoCAD or SolidWorks software. The drawings consist of Orthographic and Isometric view so that all the details about the product can be include such as dimensions and so on.

3.2.1 Concept A

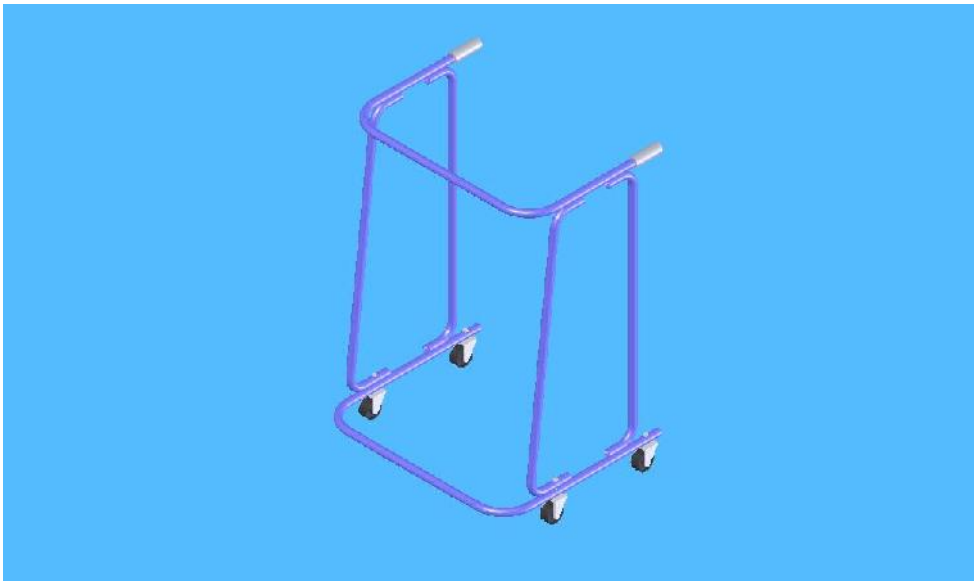


Figure 3.1: Concept A

The advantages of the above concept are this design could handle heavy weight capacity and have enough strength to support load from human body. This concept is about human waist in height so that makes the user feel comfortable when use it. One of the disadvantages of this product is the product's chassis built from many part. So it takes a lot of time to join all the part together. Other than that, some parts need to be bending by roller bending machine to shape it according to the design which is the machine not available on the lab.

3.2.2 Concept B

Figure 3.2: Concept B

The advantages of this design is the chassis are made from long hollow steel rod and then it would be bending by roller bending machine in order to reduces manufacturing time. Beside that, height of this concept is equal to human waist and wrist so that it can makes the user feel more comfortable when use it. The disadvantages of this concept are the process to manufacture is not available in the lab and can only support a light weight capacity from human body because of the structure.

3.2.3 Concept C

Figure 3.3: Concept C

The advantages of above concept above is this is the simplest design among the three concepts and easy to manufacture because consist of few processes only. Other than that, it has quality like the other concepts such as can support certain weight capacity transfer from human body and comfortable to be use because its height is only about human waist and wrist. All that factors are important because to make it user friendly and it can effectively helps half paralyzed person on their daily activities.

3.3 CONCEPT GENERATION AND EVALUATION

From all the three concepts, the best one should be decide as it will be the design of this project. Pugh Concept Selection Method was chosen to evaluate all the concepts where the actual product on the market is datum or reference based on selected criteria.

Tables 3.1: Pugh Concept Selection Method

Selection of Criteria	Concepts			
	Concept A	Concept B	Concept C	Tri-Wheel Walker
Ease to handling	(-)	(-)	0	0
Ease to manufacture	0	0	(+)	0
Lightweight	(-)	0	(+)	0
High strength	(+)	(-)	0	0
Adjustable height	(-)	(-)	(-)	0
Built with roller	0	0	0	0
Foldable	(-)	(-)	(-)	0
Pluses	1	0	2	
Sames	2	3	3	
Minus	4	4	2	
Net	-3	-4	0	
Rank	2	3	1	

From above table, all three concepts compared with Tri-Wheel Walker which is available on the market. Plus means that there is improvement compared to the datum and minus means the concepts did not have criteria like the datum. From this method Concept C is the best concept based on all the selected criteria and has been selected to be a final product.

3.4 DESIGN

After decide the best concept the concept is design using SolidWork software. The advantages of SolidWorks are we can create a 3 Dimensional drawing (3D) and using COSMOSXpress to analysis the strength of the product. Then, from 3D drawing, we need to create a 2D drawing which is Orthographic and Isometric view.

3.4.1 Orthographic View

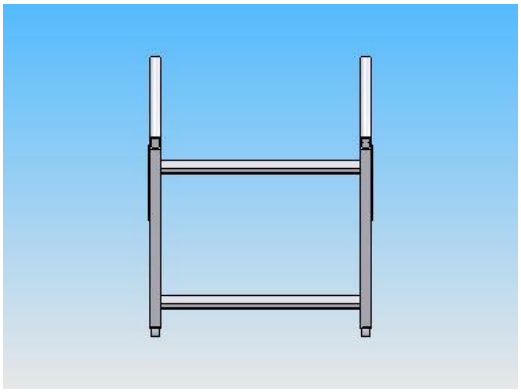


Figure 3.4: Top view

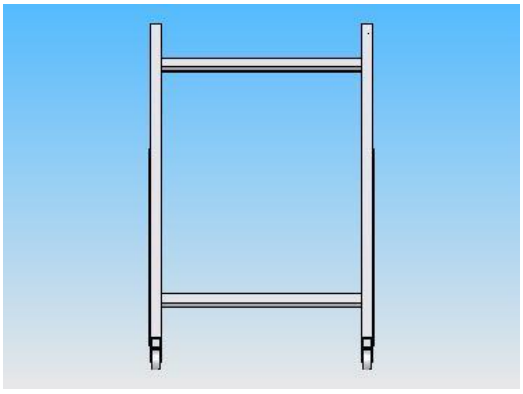


Figure 3.5: Front view

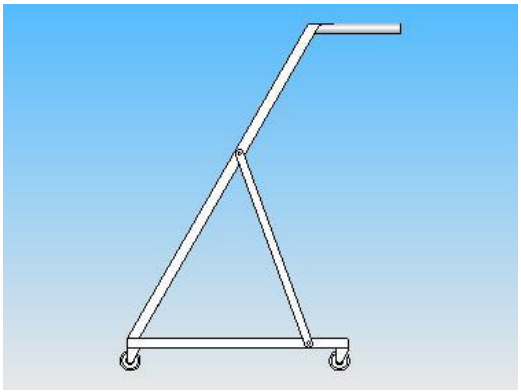


Figure 3.6: Side view

3.4.2 Isometric View

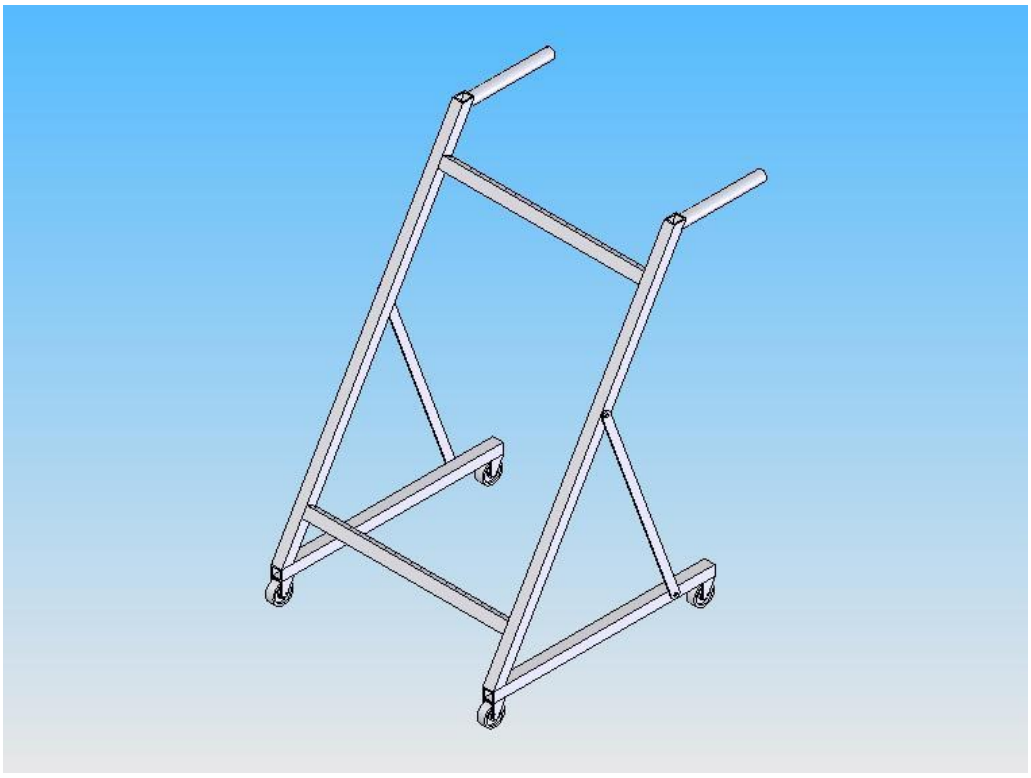


Figure 3.7: Isometric view

3.5 MATERIAL PREPARATION

Material preparation is started after designing process is done where on the drawing include the entire dimension so that it is easy to prepare a require material for the fabrication process. Most of the material is getting from the FKM lab such as 1 inch x 1 inch square steel tube, 1 inch hollow steel pipe and plate bar. There is just one component provide by supervisor which is the roller. In this project, 1 inch x 1 inch square steel tube is used because it has the strength to support load and lightweight because it is hollow. Then, for the handle hollow steel pipe is used because it comfortable for hand to grip. Beside that, steel bar is used as supports for the chassis in order to give more strength to the product to handle a weight capacity.

Figure 3.8: Some of the material used in this project

Table 3.2: Bill of Material

Part Name	Quantity	Size (mm)	Material
Chassis: 1) Handle	1	25.4 (diameter) x 500	Hollow Steel Pipe
2) Body	1	25.4 x 25.4 x 4500	Hollow Steel Tube
3) Support	2	520 x 20 x 3	Steel Bar
Wheel / Roller	4	-	Plastic
Basket	1	-	Steel
Spray Paint	1	-	-

3.6 FABRICATION PROCESS

3.6.1 Cutting Process

The material which had been selected was measured and marked according to the dimensions on the drawing. The equipment used on this process is measuring tape, steel ruler, scriber and L-square. L-square is used to make sure all the material

is in corrected dimensions. Then, all the material is cut using floor disc cutter machine and shearing machine into desired length.

Figure 3.9: Floor disc cutter machine

3.6.2 Welding Process

All the material that had been cut is grinded to make sure that all parts can join together smoothly. After all parts had been arranged, then the parts joined using Metal Inert Gas Welding (MIG) to make chassis or body of the product. Beside that, roller also joined to the chassis using MIG welding process.

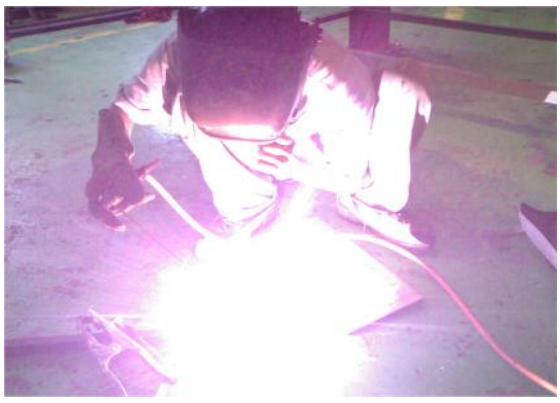


Figure 3.10: Welding process

Figure 3.11: After welding process

3.6.3 Drilling Process

After welding all the parts to make the chassis, then drilling process used to join the steel bar to the both side of the chassis and to put basket to the chassis. Several locations on the body and steel bar had been drilled based on the dimension on the drawing. After that, the support bar and basket joined to the chassis using rivet process.

Figure 3.12: Drilling process

3.6.4 Finishing Process

Firstly, the product that had been made is grinded to remove all the sharp edge and spatters on all the welding places. Then, the product wiped with turpentine to remove dust and dirty. Lastly, the product sprayed with black color using aerosol spray to make it more pleasing in appearance.

Figure 3.13: Finishing the project by spraying black color to the final product

CHAPTER 4

RESULTS AND DISCUSSION

4.1 INTRODUCTION

The results and analysis of walking aided tool is done using the fundamental of engineering analysis according on physic laws and fundamental of engineering analysis. The analysis will use theoretical and computer software. Problem that also will be discuss in this chapter are the prominent problem encounter in every stage of the project.

4.2 RESULTS

After completing the fabrication process, the product must be gone through the analysis process. At this stage, all data about the product is gathered. It is important to classify the product before it enters market.

4.2.1 Product Specification

In this project, the product will be classified in several categories which are length, height, width, weight and color.

Table 4.1: Product Specification

Categories	Results
Length	675 mm
Height	855 mm
Width	525.4 mm
Weight	9 kg
Color	Black

4.2.2 Defects

After the fabrication process is finish, some defects have been detected. This is because lack of skills and using wrong technique when using machine and tools. One of the defects is bead which is from welding process which is normally occurred when lack of skills when using the welding machine. From this problem, student is able to know their weakness and try to overcome it.

Figure 4.1: Bead on the product after welding process

4.3 PROJECT PROBLEMS

4.3.1 Literature review

It is because of limited information about the product. An example of this problem is about specification of the product which is most manufacturer did not mention in details about the product.

4.3.2 Design

Normally most of the existing product found in the internet is about American size in dimension which is not suitable for Malaysian. So on this project, the dimension is measure based on student size.

4.3.3 Fabrication process

Problem about this process is there is no enough machine, tool or equipment for the student where they need to share and wait for their turn to use the machine or equipment.

4.3.4 Material Preparation

Some of the material is not available on the FKM lab so need to purchase from the supplier. It takes about several weeks to get the material. Other than that, there are some difficulties to find some components from the hardware.

4.4 ANALYSIS

After the fabrication process is completed, the product should be test and do some analysis in order to determine the strength of the product. The application used on this project is COSMOSXpress which is available with SolidWorks. On COSMOSXpress we can do stress analysis and get the result in details.

4.4.1 STRESS ANALYSIS

Stress analysis is used to determine the stress in materials and structures subjected to static or dynamic forces or loads. The aim of the analysis is usually to determine whether the structure can safely withstand the specified forces. This is achieved when the determine stress for the applied forces is less than the ultimate tensile and so on. The load that has been applied is 130.8 N as the maximum load. The load is just assumption of weight capacity from human body to the product.

4.4.1.1 Stress

Stress is a measure of the average amount of force exerted per unit area. It is a measure of the intensity of the total internal forces acting within a body across imaginary internal surfaces, as a reaction to external applied forces and body forces. It was introduced into the theory of elasticity by Cauchy around 1822. Stress is a concept that is based on the concept of continuum. In general, stress is expressed as

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

Where:

- σ is the average stress, also called **engineering** or **nominal stress**, and
- F is the force acting over the area A.

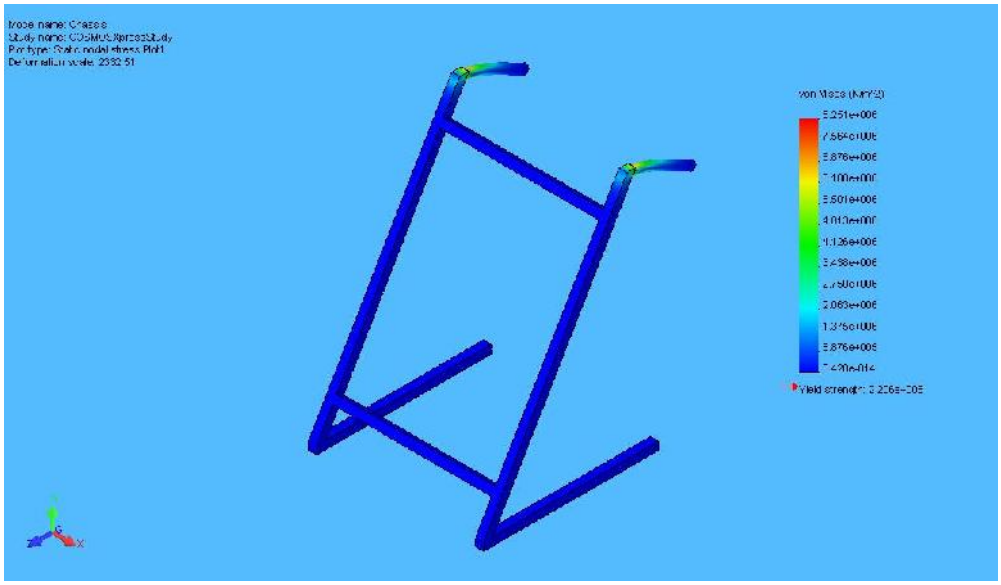


Figure 4.2: Result of stress analysis

4.4.1.2 Displacement

Displacement is the vector that specifies the position of a point or a particle in reference to a previous position, or to the origin of the chosen coordinate system. When the reference point is the origin, this is better referred to as a position.

A displacement vector is a simplified representation of motion. Namely, it indicates both the length and direction of a hypothetical motion along a straight line from the reference point to the actual position. A motion along a curved line cannot be represented by a single displacement vector, and may be described as a sequence of very small displacements. On the other hand, a distance is typically defined as a scalar quantity and can be used to indicate both the length of a displacement (minimum distance) and the length of a curved path (traveled distance), but not the direction of the motion.

When the reference point is a previous position, the displacement vector is the difference between the final and initial position. This difference, divided by the time needed to perform the motion, defines the average velocity of the point or particle.

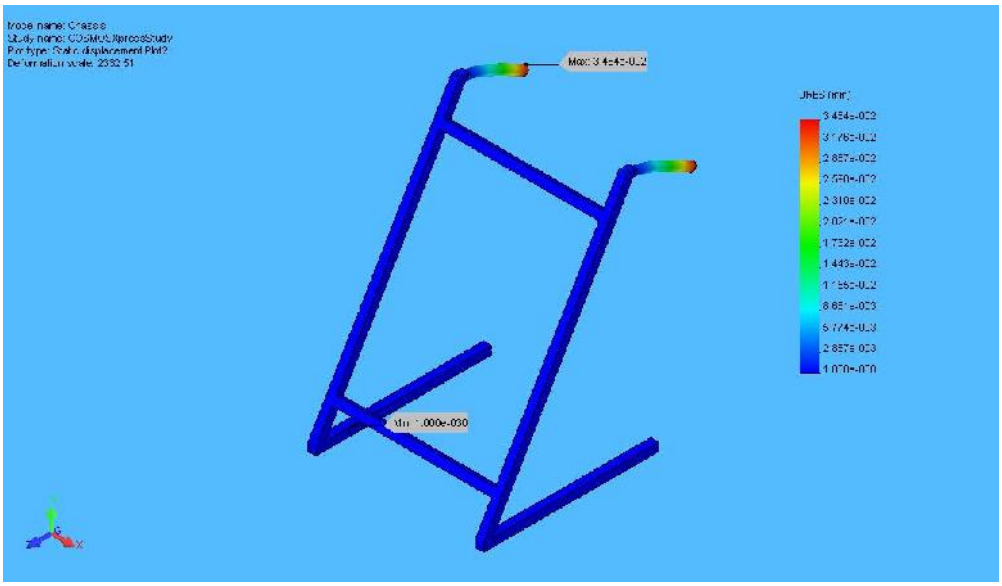


Figure 4.3: Result of displacement

4.4.1.3 Deformation

Deformation is a change in the shape or size of an object due to an applied force. This can be a result of tensile (pulling) forces, compressive (pushing) forces, shear, bending or torsion (twisting). Deformation is often described in terms of strain.

As deformation occurs, internal inter-molecular forces arise which oppose the applied force. If the applied force is not too large these forces may be sufficient to completely resist the applied force, allowing the object to assume a new equilibrium state and to return to its original state when the load is removed. A larger applied force may lead to a permanent deformation of the object or even to its structural failure.

- Elastic Deformation

This type of deformation is reversible. Once the forces are no longer applied, the object returns to its original shape. Elastic deformation is governed by Hooke's law which states:

$$\sigma = E\epsilon$$

Where σ is the applied stress, E is a material constant called Young's modulus, and ε is the resulting strain. This relationship only applies in the elastic range and indicates that the slope of the stress vs. strain curve can be used to find Young's modulus. Engineers often use this calculation in tensile tests. The elastic range ends when the material reaches its yield strength. At this point plastic deformation begins.

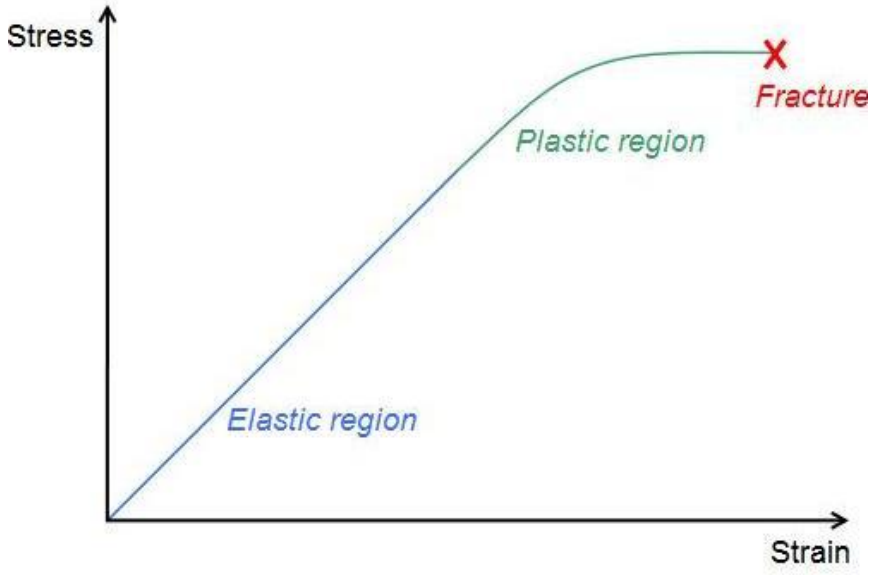


Figure 4.4: Stress-strain curve

- Plastic Deformation

This type of deformation is not reversible. However, an object in the plastic deformation range will first have undergone elastic deformation, which is reversible, so the object will return part way to its original shape.

Under tensile stress plastic deformation is characterized by a strain hardening region and a necking region and finally, fracture (also called rupture). During strain hardening the material becomes stronger through the movement of atomic

dislocations. The necking phase is indicated by a reduction in cross-sectional area of the specimen. Necking begins after the Ultimate Strength is reached. During necking, the material can no longer withstand the maximum stress and the strain in the specimen rapidly increases. Plastic deformation ends with the fracture of the material.

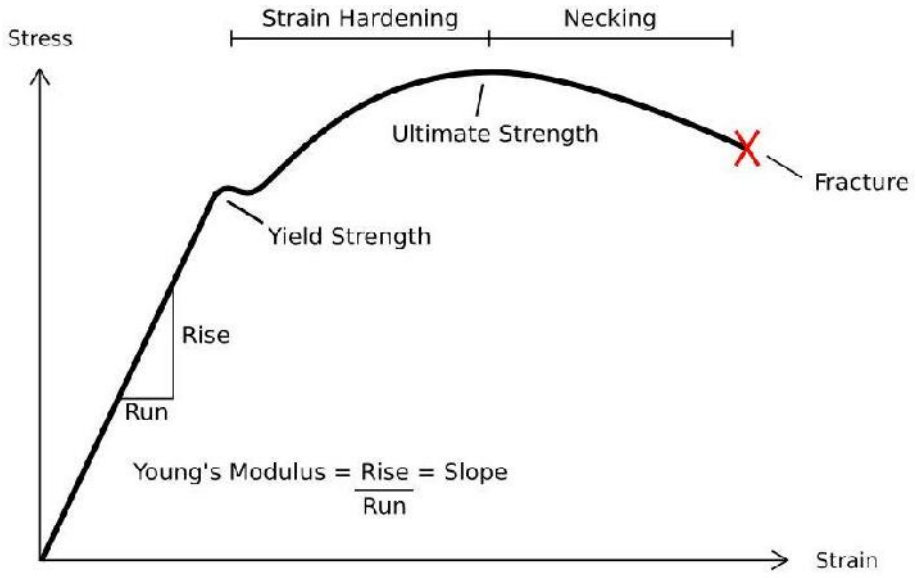


Figure 4.5: Typical stress vs. strain diagram with the various stages of deformation

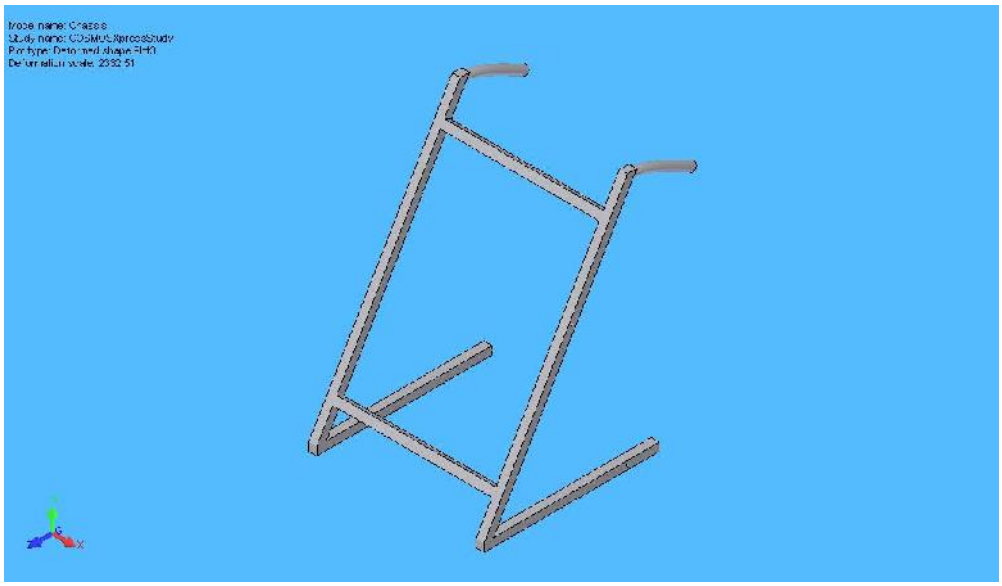


Figure 4.6: Result of deformation

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 CONCLUSION

As the conclusion, the product which has been produce meets all the objectives of the project. This is because after done some analysis like Stress Analysis and so on, it is proved that the product has high strength and also can support certain weight capacity. So this product can helps half paralyzed people either in rehabilitation process or move well in their daily activities. Other than that, the concept of the product can helps them effectively in order to fulfill their need to have walking aid that suitable for them based on selected criteria like can be use easily, lightweight and other criteria. Lastly, development of this project based on selected method which is Pugh Concept Selection Method, static analysis and other methods.

5.2 RECOMMENDATION

From this project, some improvement can be done such as make the product foldable so that it can be more portable. Other than that, safety issues like braking system need some improvement so that it can be more effective to help half paralyzed people to use it without any compromise.

5.3 SUGGESTION FOR FUTURE WORK

Some aspects of the product should be improved in the future in order to give satisfaction to the user of the product. The important aspect need to be considered is about ergonomic aspect on the product. The handle or height of the product needs to be adjustable so that can fix with user height in order to make them comfortable when using the product.

Other than that, other material which is height strength but lightweight need to be used so that it will make the product easier to move and can support heavy load. An example of suitable material is stainless steel which has the quality mention above and more stylish than material used in this project.

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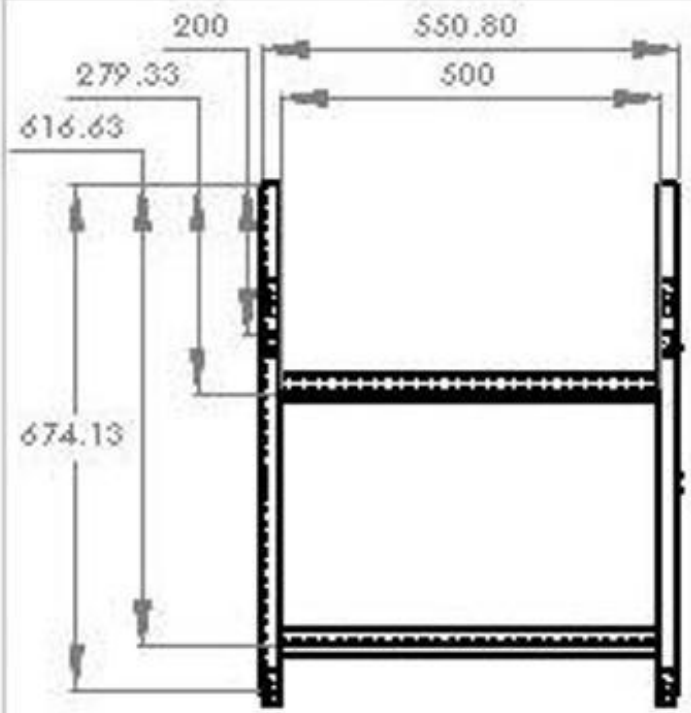
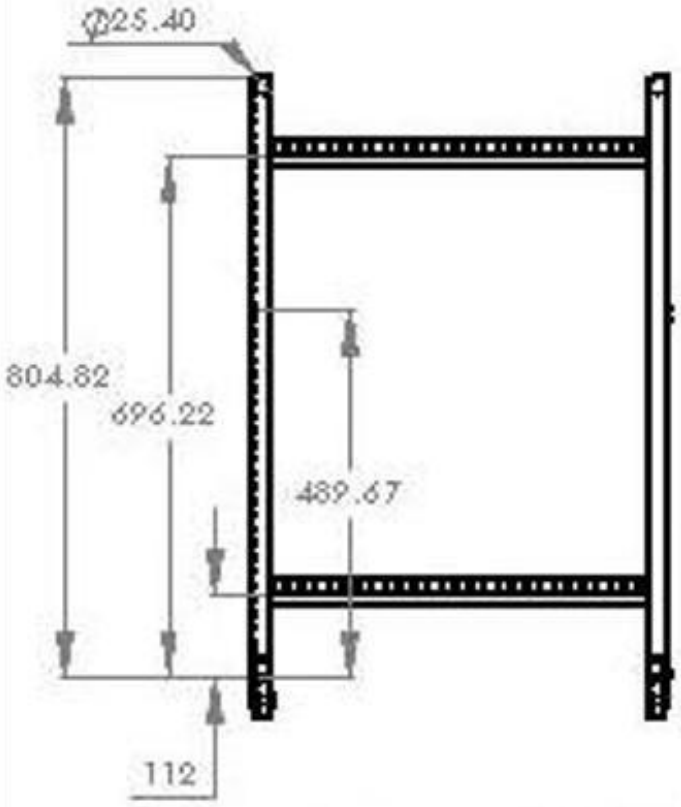
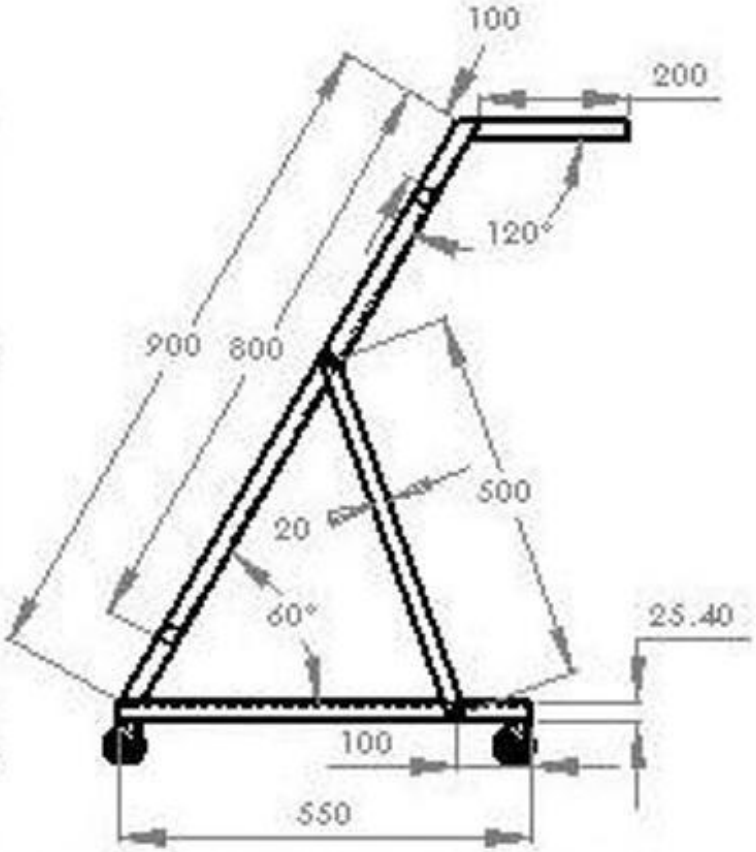
APPENDIX A

Details drawing







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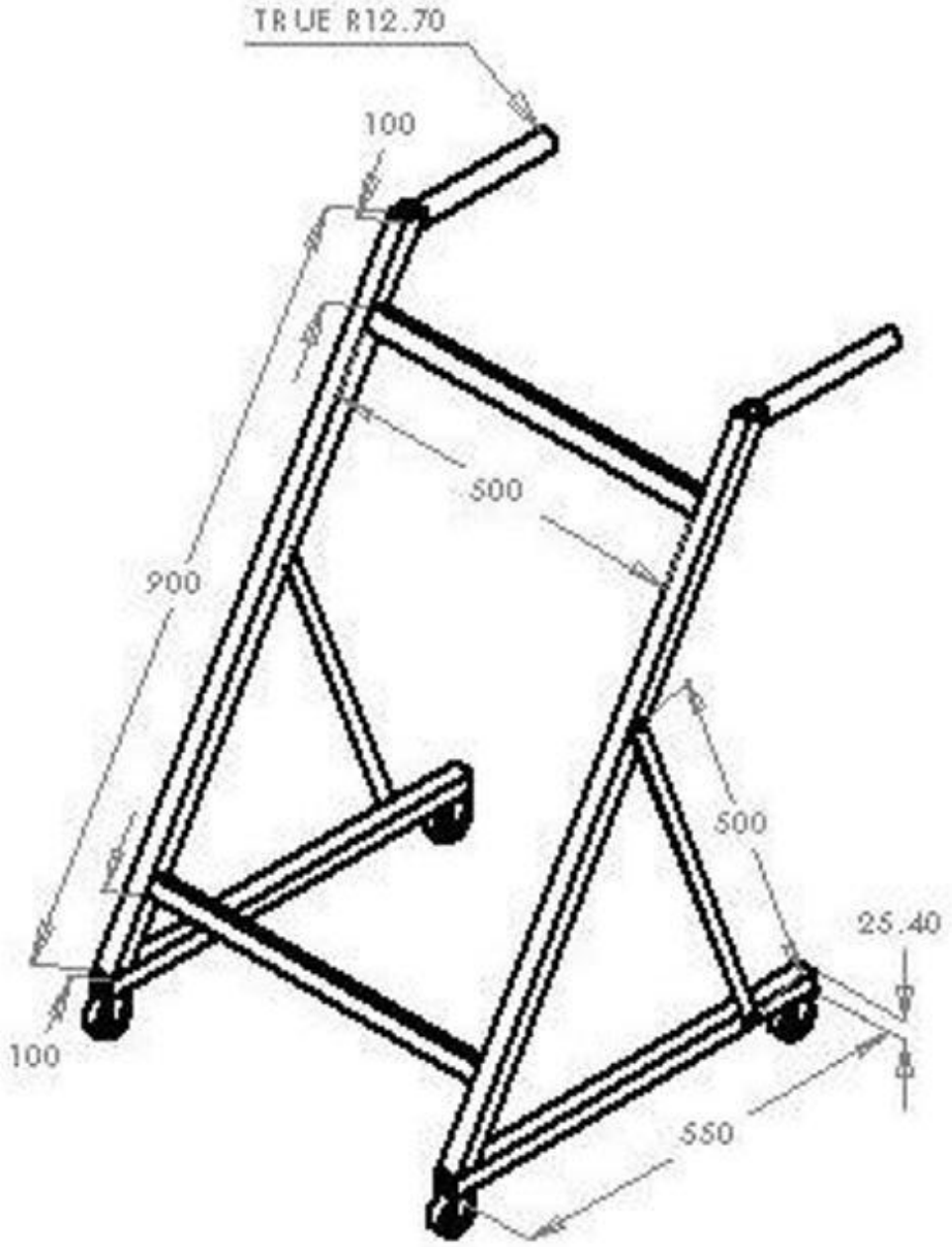
Orthographic View

Drawing 1

ITEM NO.	PART NUMBER	DESCRIPTION	MATERIAL	QTY.
1	chassis	1. 1 in. x 1 in. Hollow Tube 2. 1 in. (Diameter) Hollow Pipe	Steel	1
2	support bar	520 mm x20 mm x3 mm Bar	Steel	2
3	wheel	50 mm (Diameter)	Plastic	4



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Isometric View

Drawing 2

APPENDIX B

View of final product

Front view

Side view

View from back

Isometric view