

# UNIVERSITI MALAYSIA PAHANG

## BORANG PENGESAHAN STATUS TESIS

**JUDUL: DESIGN AND FABRICATE THE WELDING MACHINE CART**

**SESI PENGAJIAN: 2012/2013**

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DESIGN AND FABRICATE TANDEM BICYCLE : FRONT PART

IZZATZIKRI BIN MUSA

Report submitted in partial fulfilment of the requirements

for the award of

Diploma in Mechanical Engineering

Faculty of Mechanical Engineering

UNIVERSITI MALAYSIA PAHANG

JANUARY 2013

### **SUPERVISOR'S DECLARATION**

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

Signature

Name of Supervisor: ROSMAZI BIN ROSLI

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Date:

### STUDENT'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 project has not been accepted for any diploma and is not concurrently submitted for award of other diploma.

Signature

Name: IZZATZIKRI BIN MUSA

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**Dedicated to my parents**

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## **ABSTRACT**

This thesis deals with creating the tandem bicycle for 2 person. The objective of this thesis is to develop a procedure of creating this tandem bicycle that started with designing process till fabrication process. There is many type of bicycle created for certain activity. And every bicycle has its own characteristics. Objective of this project is to create a recreation tandem bicycle that can be use for outdoor activity and suit for adults and kids and can be ride with 2 person cycling. This tandem bicycle equipped with body stand seats that suits for an older person. The seats made using sponge and leather. This tandem bicycle also equipped with the foot rest for the rider to place their feet when not in cycling position while the other rider can continue cycling unmolested. The mobile phone charger using dynamo is placed on this bicycle for ease of the rider to charge their electronic devices that requires electricity without worrying run out of battery. The battery charger use the usb cable that produce limit with 5v of current supply.

## ABSTRAK

Tesis ini membincangkan mengenai penghasilan basikal selaras untuk 2 orang. Objektif tesis ini adalah untuk menerangkan langkah diambil dalam penghasilan bermula dari proses reka bentuk hinggalah ke proses penghasilan. Terdapat berbagai jenis basikal dicipta untuk aktiviti tertentu. Dan setiap basikal mempunyai ciri-ciri yang tersendiri. Objektif projek ini adalah untuk mencipta sebuah basikal selaras rekreasi yang boleh digunakan untuk aktiviti luar dan sesuai digunakan oleh golongan dewasa dan kanak-kanak dan boleh dinaiki seramai 2 orang pengayuh. Basikal selaras ini dilengkapi dengan kerusi penyandar yang sesuai digunakan oleh golongan dewasa. Kusyen dibuat menggunakan span dan kulit. Basikal ini juga dilengkapi dengan penahan kaki bagi yang hendak merehatkan kaki apabila berhenti mengayuh dan dalam masa yang sama pengayuh yang lain dapat meneruskan kayuhan tanpa gangguan. Alat pengecas telefon bimbit menggunakan dinamo dipasang di basikal ini bagi kemudahan kepada pengguna untuk mengecas peranti elektronik tanpa risau kehabisan bateri. Alat pengecas bateri menggunakan kabel usb yang boleh menghasilkan arus elektrik sehingga 5v sahaja.



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**LIST OF SYMBOLS**

$\mu\text{F}$     Microfarad

**LIST OF ABBREVIATIONS**

CAD            Computer Aided Design

FYP            Final Year Project

GMAW        Gas Metal Arc Welding

MIG            Metal Inert Gas

## **CHAPTER 1**

### **PROJECT INTRODUCTION**

#### **1.1 INTRODUCTION**

This chapter explained about the problem statement, project objective, project scope that been conducted. Besides that, this chapter also covers project flow and the progress project are follows the gantt chart duration of time.

#### **1.2 PROBLEM STATEMENT**

Many tandem bicycle were invented for travelling activity. So, the tandem bicycle component must have good quality in order to keep it comfortable. Plus, the total cost for create this bicycle were very expensive. Moreover, tandem bicycle is a rare product on this country and the price were too expensive. Then, many tandem bicycle were create connecting the front and rear pedal and it will be difficult if if the second riders feel tired to make a stroke for the second pedal, there will be no place to rest their feet while the other one keep stroke the first pedal and vice versa.

### **1.3 OBJECTIVE**

The objective of this project is to design and fabricate a tandem bicycle for front part

### **1.4 SCOPE**

This tandem bicycle is design according to the scope decided by our group members. The tandem bicycle will be use for the recreation purpose and the front part of the tandem must be ride by teenager or adult and limit with 1 person. The tandem bicycle also must be an affordable type. Designing the tandem bicycle must follow this scope in order to success create the tandem bicycle.

### **1.5 PROJECT BACKGROUND**

This project started with defining job scope and the objective before deciding to fabricate because scope is used to fabricate the bicycle according the scope decided. Job scope is set as parameter to determine the production of a product and it is needed to specify the target of the product Next, I schedule myself using the gantt chart. The production process were planned from the first week to the last week. This were made to ensure my project were guided and progress were not interrupt. The gantt chart also were use as reference for my project. The gantt chart can be refer at Appendix B for full view of the project flow.

.After done deciding the project , I continue with my research about the tandem bicycle from the internet, books , and others material to the project title. Duration of literature review takes about a week to complete.

Next, after deciding the product, I proceed on my product design with my partner. Various concept design will come out during our brainstorming session. We have 3 concept design that requires to create the tandem bicycle and will be evaluate to create the final design. So, by doing this method, problem of creating the bicycle will be encountered and creating the final design of the bicycle using CAD software and done with the analysis.

Next step is defining material before proceed to fabricating and testing the tandem bicycle. The fabricating and testing method used to determine the problem I have during fabrication process. If the problem occurred, the process will return back on checking my design.

Finally, after done fabricating and testing process, I proceed to the result and discussion process before presenting and preparing the report to validate my product by the panel and the supervisor.

## **1.6 Thesis Organization**

This thesis consist of 6 chapter that will cover the whole project. This thesis consist of introduction, literature review, design concept and selection, fabrication process and finally conclusion and recommendation.

The first chapter would be the introduction that briefly discuss about the project progress and also the starting project process that is the objective and the project scope. This chapter will also discuss the project plan from beginning to the end of process.

Then, chapter 2 that will be the literature review of the project and equipment use during fabrication. It's to ensure the better understanding about project and progress before proceed to the creating process.

Next, the third chapter that is design concept and selection discuss about the project design and selection method to finalize the project design. This chapter also discussed about the project flow using flow chart in completing the project till the end.

Then, chapter 4 will proceed on the fabrication process that discuss about project fabricating procedure that consist of material selection and fabrication process. Also include in this chapter the safety measure during fabrication process for reader awareness.

Chapter 5 then will be discussed on several component analysis and the final product after the fabrication process.

Lastly, the final chapter that is chapter 6 will conclude this thesis and provide some recommendations for future development. References and appendices are placed on the last chapter for ease of finding.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 INTRODUCTION**

A literature review is a body of text that aims to review the critical points of current knowledge and or methodological approaches on a particular topic. Literature reviews are secondary sources, and as such, do not report any new or original experimental work. Most often associated with academic-oriented literature, such as thesis, a literature review usually precedes a research proposal and results 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 be needed in the area. A well-structured literature review is characterized by a logical flow of ideas; current and relevant references with consistent, appropriate referencing style; proper use of terminology; and an unbiased and comprehensive view of the previous research on the topic.

## 2.2 BACKGROUND STUDY

Tandem is the arrangement of things facing the same direction. There are few type of tandem bicycle that is tricycle tandem bicycle, Tandem can also be used to refer to the similar working method of person or object. Tandem bicycle can be see in many type that is double steering, folding, shortwheel base and more. Tandem bicycle has double pedaling power compare to the normal bicycle. High performance of this tandem is on the flat terrain and downhill where most of cyclist power produce is used to overcome the wind resistance and the power produce from tandem is bicycle is larger than the single rider bicycle. So, mostly the tandem were create for more than 1 cyclist in a tandem bicycle. The number of cyclist were not consistent but for my project , I reduce the scope for 2 person for the tandem bicycle and my part can be ride with one person only.

## 2.3 PRODUCT REVIEW

### 2.3.1 Tricycle Tandem Bicycle



**Figure 2.1:** tricycle tandem bicycle

This is the tricycle tandem bicycle. It has a lower base and comfortable seats. However, this model is not an ergonomic way of cycling because the rider must cycle in a painful angle. This model also complex on chain and body part and cost more for maintenance process.

### 2.3.2 Thorn Tandem Bicycle



**Figure 2.2 :** Thorn Tandem Bicycle

This is Thorn Tandem bicycle that has simplest design of the body part and has 3 wheel. Can be ride limit 2 person only and difficult to be ride by a kid because have higher frame. It is stable since it use 3 wheel at the back.

### 2.3.3 Kiddy Tandem Bicycle



**Figure 2.3 :** Kiddy Tandem Bicycle

This is Kiddy Tandem bicycle. It has unique body frame and can be ride by any age level. But has complex design to be fabricate.



## 2.4 TYPE OF MATERIALS

For fabricating process, material use for joining the bicycle and seat stand is 1” mild steel and for voltage regulator casing, aluminium sheet were used for ease of fabricate. The basket and the handle bar were made of ½” of cast iron hollow bar.

For the Voltage regulator, it consist of a voltage regulator, 10 $\mu$ F capacitor and diode. This is for creating the Delon circuit for the mobile phone charger. The Delon circuit can be refer at figure 4.21.

## 2.5 TYPE OF MACHINE

Machine used for fabrication process were MIG welding machine, arc welding machine , shearing machine, bending Machine , grinding machine , drilling machine and T-jaw machine.

### 2.5.1 Welding machine

MIG welding machine were used for joining the aluminium sheet while the arc welding machine were suitable for joining 2 bicycle body frame using mild steel iron bar. The machine is placed on the welding laboratory provide continuous supply of welding rod and MIG wire.



**Figure 2.4 :** Arc welding machine



**Figure 2.5:** MIG welding machine

### **2.5.2 Shearing machine**

Shearing machine were used on cutting the sheet metal. Shearing is process of cutting a material. This machine were use in order to keep the accuracy of cutting the sheet metal instead of using manual shearing method . The shearing machine names were LVD Shearing Machine from figure 2.5.2



**Figure 2.6 :** Shearing Machine

### **2.5.3 Grinding machine**

Then the grinding machine were used in this project. Grinding is a finishing process used to improve surface finish, abrade hard materials, and tighten the tolerance on flat and cylindrical surfaces by removing a small amount of material. Information in this section is organized according to the subcategory links in the menu bar to the left. The grinding machine can be refer from figure 2.5.3. It is the double wheel grinder.



**Figure 2.7 :** Double wheel grinding machine.

#### **2.5.4 Drilling machine**

The drilling machine were used to create a hole on a workpiece. Drilling machine used were mounted at the table and it is fixed. The drilling machine can be refer to figure 2.8.



**Figure 2.8 :** Table Drilling Machine

#### **2.5.5 Bending Machine**

Bending machine were use to bend any metal using wheel. There are two type of bending machine that is for sheet metal and for the bar. The image for both machine can be refer to figure 2.9 and 2.10. This two type machine has same function that use foot for the operation but bend the different material.



**Figure 2.9** : Bar Bending Machine



**Figure 2.10** : Sheet Metal Bending Machine

### **2.5.6 Saw machine**

Finally, the saw machine were use to cut smallest shape of the sheet metal compare to the shearing machine that cut through all. The brand for this machine is T-jaw machine and it can cut a 90° angle of sheet metal compare to the shearing machine that cut through all of the sheet metal. This machine were placed at the welding laboratory. The image of the machine can be refer at figure 2.5.6



**Figure 2.11** : Saw Machine

## **2.6 CONCLUSION**

For this chapter, we can conclude this chapter is a body of text that aims to review this project of current knowledge. Beside that, this chapter shows the project guidelines to generate this project successfully. From this chapter, it can give more information to do the project base on the design of the project.

## **CHAPTER 3**

### **DESIGN CONCEPT AND SELECTION**

#### **3.1 INTRODUCTION**

This chapter deal with the method of designing the tandem bicycle before proceeding to the fabricating process. This chapter consist of flow chart , concept design, concept screening , final design and summary.

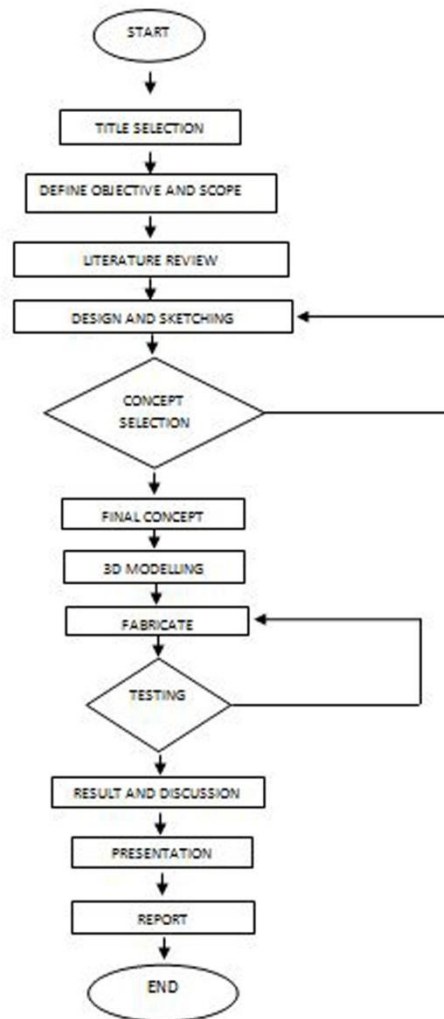
Next , the flow chart discussing about the project flow from the starting point until the last step and must be follow for fabricating the required product.

Then the purpose of concept design is to generate list of ideas for creating the tandem bicycle that is done by the brainstorming session with the team member and supervisor.

Then, after done generating concept design, proceed to the concept screening that is purposely for getting the best characteristics for generating the product.

Finally, after done the concept screening, the final design of the product will follow and can be improvise from the concept screening result. This will determine the best characteristics for the product.

### 3.2 FLOWCHART



**Figure 3.1** : Flow chart

### 3.3 CONCEPT DESIGN

For this project three concepts have been generated. From the three concepts, one of the best concepts has been chosen based on concept variants as a final design.

#### 3.3.1 Concept Design 1



**Figure 3.2 :** Concept design 1

Figure 3.3 shows the first concept design that uses a double steer method for a tandem bicycle. The method is by joining the main body frame using a bar. By using this type of joint, both of the riders can steer the tandem bicycle. Table 3.3.1 explains about the advantages and disadvantages of this concept design.



**Table 3.1** : Evaluation of concept design 1

<b>Advantage</b>	<b>Disadvantage</b>
Independence steer	High maintenance cost
Simple design	Easy to fracture
Stable	Many component
Large space	

### 3.3.2 Concept Design 2

**Figure 3.3** : Concept design 2

Figure 3.3.2 shows the second concept design that use double steer method but only using one body frame for the tandem bicycle. Both rider can steer the bicycle. Table 3.3.2 explain the advantage and disadvantage of this concept design.

**Table 3.2** : Evaluation of concept design 2

<b>Advantages</b>	<b>Disadvantages</b>
Attractive	Not stable
Independence steer	Easy to break
	Compact

### 3.3.3 Concept Design 3



**Figure 3.4 :** Concept design 3

Figure 3.4 shows the third concept design that place the second rider backward instead of side by side. It has a simple and thoughtful design for the body frame of the bicycle. The advantage and disadvantage of the concept design can be refer at table 3.3.

**Table 3.3:** Evaluation of concept design 3

Advantage	Disadvantage
Simple	Not balance.
Stable	
Attractive	
Large space	

### 3.4 CONCEPT SCREENING

**Table 3.4 :** Concept screening

<b>Characteristic</b>	<b>Concept 1</b>	<b>Concept 2</b>	<b>Concept 3</b>
<b>Simple design</b>	√		√
<b>Stable</b>	√		√
<b>Affordable</b>		√	√
<b>Durable</b>			√

### 3.5 CONCEPT SCORING

**Table 3.5 :** Concept scoring

<b>Characteristic</b>	<b>Concept 1</b>	<b>Concept 2</b>	<b>Concept 3</b>
Simple design	3	0	5
Stable	5	0	3
Affordable	0	2	4
Durable	1	0	3
<b>Total</b>	<b>9</b>	<b>2</b>	<b>15</b>

### 3.6 FINAL DESIGN

This is the final design of the tandem bicycle. It has lower body frame that can be ride by any age level. This concept also equipped with the carrier suitable for the recreational activity. The image for the final design concept can be refer at figure 3.5 and for the drawing view can be refer at the appendix A.



**Figure 3.5 :** Final design of the tandem bicycle

### 3.7 CONCLUSION

The final design were made according to the concept scoring and concept screening. The characteristics of the final design were based on all concept design advantage. The final design must overcome the disadvantage of the concept design and for my project, the final design is following my scope that is for recreational activity.

## **CHAPTER 4**

### **FABRICATION PROCESS**

#### **4.1 INTRODUCTION**

The fabrication process of the tandem bicycle started with the material selection of the body part. The bicycle has a fixed type of material that is body frame, tyre, fork, handle, brake, and pedal. The main part of my project were the handle, carrier, voltage regulator, the seat post.

Then continues to the fabricating procedure that is measuring, cutting, shearing, bending and more. The last part of fabrication were assembling the tandem bicycle. The chain must have to be calculated so that when it is attached it will not long or shorten. So, for the fabrication process, tools were selected according to the tandem bicycle component before start to avoid any problem and safety precaution step must be taken to avoid any accident that might occur.

## 4.2 MATERIAL SELECTION

**Table 4.1 : Material selection**

No	Item	Quantity	Price per unit (RM)	Price
1.	Bicycle body frame	1	50	50
2.	Brake pedal	2	5	10
3	Inner cable lead	3	3	9
4	Brake shoe set	2	3	6
5	Aluminium Bottle holder	1	8	8
6	Bicycle Seat	1	10	10
7	Chain ring	1	15	15
8	Pedal	1	8	8
9	Fork	1	20	20
10	Tyre	1	25	25
11	Rim	1	40	40
12	Chain	1	12	12
13	Handle bearing	2	2	2
14	Pedal bearing	2	1	2
15	Tyre bearing	2	1	2
16	1 pin Dynamo	1	35	35
17	Voltage regulator IC 7805	1	5	5
18	Diode	2	3	6
19	Capacitor	2	2	2
20	Circuit board	1	10	10
21	Red Wire	½ m	4/m	2
22	Black wire	½ m	4/m	2
23	1/2" Round hollow beam	5 ft	3/ft	15
24	1" round bar	2ft	10/ft	20
25	Mobile phone holder	1	37	37
26	Usb cable	1	15	15
27	M12 nut	6	1	6
28	M04 nut	1	1	1

29	Rivet	2	2	4
30	Aluminium sheet	1m <sup>2</sup>	15/m <sup>2</sup>	15
31	Tyre tube	1	6	6
<b>Total</b>				<b>400</b>

### 4.3 FABRICATING PROCEDURE

#### 4.3.1 Measuring

Before the fabrication process start ,length of bicycle body frame that we need and the material length size is measured before joining the bicycle by using the measuring tape. The measurement is taken from the final design and need to be accurate in order to achieve perfect length of the material.



**Figure 4.1** : Measuring the bicycle Body frame.



**Figure 4.2** : Marking the length of material to be cut

### 4.3.2 Cutting

After done with measuring process, the cutting process started according to the mark using the measuring tape. The material is cut using the cutter .In order to get the accurate measurement, the cutter blade thickness have to be calculated before proceed to the cutting process. The cutting process were used for back body frame, the handle bar and seat stand. The cutting process use the cutter from figure 4.3. For safety, use suitable speed for cutting process and wear safety gear that is safety boots and google in order to prevent any injuries that may occur.



**Figure 4.3:** Cutter used for cutting process.



**Figure 4.4 :** Cutting Process started



**Figure 4.5 :** Cutting the backpart of the tandem bicycle.



### 4.3.3 Shearing

After done cutting the material, I proceed to the shearing process that involve in cutting of aluminium sheet metal for the mobile phone holder, voltage regulator casing and covering the fracture at the recycle body frame. The shearing process were done using the shearing machine. The shearing machine can be refer at figure 2.6.



**Figure 4.6** : shearing process

### 4.3.4 Bending

After done cutting and shearing process, the process then proceed to the bending process for the handle bar that use 1/2" round hollow beam and covering the fracture at the seat post that use 1mm alluminium sheet metal. The machine were control by foot from figure 4.3.4.2.



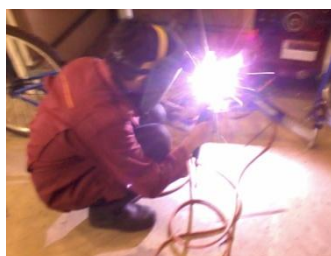
**Figure 4.7** : Bending process



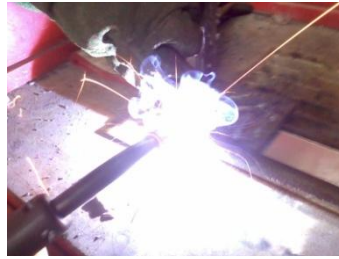
**Figure 4.8 :** Foot pedal for bending machine

### 4.3.5 Welding

Then the welding process started for the body frame assemble , voltage regulator, foot rest and mobile phone holder. The MIG were used for building foot rest and bicycle basket that use 1/2" round hollow bar. MIG welding also used for the voltage regulator casing and mobile phone holder that use aluminium sheet metal. The arc welding were used to assemble the the body frame and also the seat post that use the mild steel solid bar. The solid bar were weld at the body frame that made from chrome steel iron. So, the voltage must be adjust to get the perfect weld. Safety helmet and glove must always be wear to prevent any injuries.



**Figure 4.9 :** Joining the bicycle body frame using Arc Welding



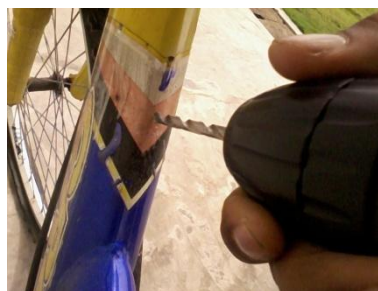
**Figure 4.10 :** Welding ½” hollow beam using MIG welding



**Figure 4.11 :** Welding Sheet metal using MIG welding

#### 4.3.6 Drilling

Drilling process started after all the part were weld together. The drilling process involve in creating hole for the dynamo, voltage regulator, mobile phone holder and bicycle basket. Drilling process also involve in meshing the bottle that need to be riveted to the bicycle body frame. For drilling process, hand drill and table drill were used.



**Figure 4.12 :**Drilling for the bottle Holder using Hand drill.



**Figure 4.13 :** Drill the bicycle carrier using table drill machine.

#### 4.3.7 Grinding

Grinding process purposely for clearing the welding slug and burr and get the clean surface. The grinding process started after the welding, cutting and drilling done. This is due to the slug and burr produce after the following process done.



**Figure 4.14 :** Grinding Process started using double wheel grinding machine



**Figure 4.15 :** Grinding the bicycle body frame using hand grinder.

#### 4.3.8 Riveting

The drilling process were used to joint the bottle holder to the body frame. This is to create a fix bottle holder for better fastener. The riveting process started after the coating process because the color of the bottle holder are not same with bicycle body frame and the joining process is riveting that is permanent fastener.



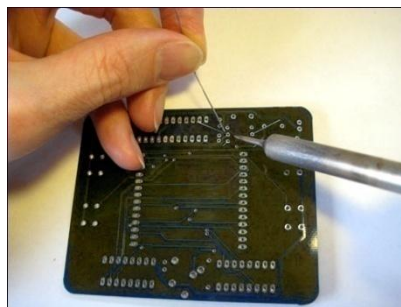
**Figure 4.16** : Riveting process

### 4.3.9 Soldering

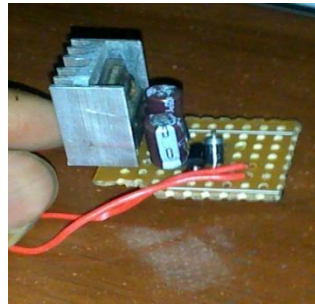
Soldering process were used to create the voltage regulator. Voltage regulator consist of voltage regulator 7805, 2 diode, 2 10 $\mu$ F capacitor that were solder according to the Delon Bridge circuit from figure asdsasd . The soldering process start with the voltage regulator, then the capacitor placed directly to the voltage regulator and finally the diode that placed parallel with the capacitor. Then the wire were soldered with the female usb cable and the dynamo.



**Figure 4.17** : Soldering process



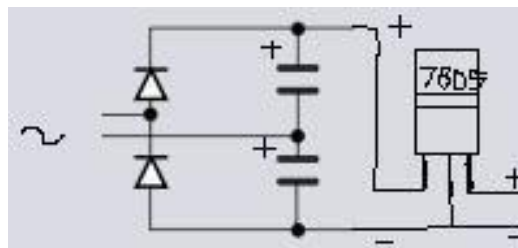
**Figure 4.18** : Soldering using iron and solder.



**Figure 4.19:** Circuit for voltage regulator



**Figure 4.20:** Soldering usb female cable with voltage regulator wire.



**Figure 4.21:** Circuit for Delon Bridge circuit.

#### 4.3.10 Wiring

Wiring process involve in creating the current flow from the dynamo to the mobile phone charger. The current will flow from the dynamo to the voltage regulator and then to the usb cable that produce 5v of current. The dynamo that attach with the tire will produce a 6v current and will be reduce and stabilize at the voltage regulator.



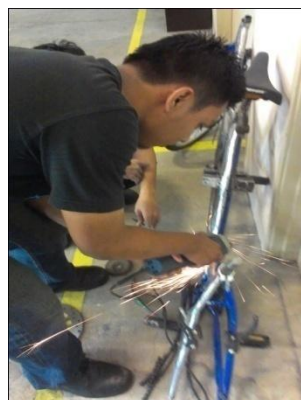
**Figure 4.22 :** Joining wire with the dynamo



**Figure 4.23:** Wiring the voltage regulator at the bicycle.

#### **4.3.11 Sanding**

Sanding process were done to clear the coating. Instead of using the sand paper, I use the hand grinder that change to the polishing process by changing the tool and create a clear surface before proceed to coating process. Polishing process was done to all of bicycle component and that is as long as it is steel. The process then proceeds to the coating process.



**Figure 4.24:** Sanding process



**Figure 4.25:** Done sanding process.

### 4.3.12 Coating

Coating process is the final step for creating the tandem bicycle before assembling. I use yellow color for the body frame and fork while flat black for the other part such as handle bar, seat post, mobile phone holder and more. This coating process is done in order to avoid rust and give an attractive appearance of the tandem bicycle.



**Figure 4.26:** Coating process



**Figure 4.27:** Can spray





**Figure 4.28:** Done coating process

### 4.3.13 Assembling

After done all the fabrication process, the tandem bicycle were assembled according to the planned. The joint were use spanner and plier for the assembling process. The part consist of tire, carrier, handle, foot rest, seat and brake.



**Figure 4.29:** Assembling the seat



**Figure 4.30:** Assembling handle bar



**Figure 4.31:** Assembling the tire

#### **4.4 SAFETY PRECAUTION**

In order to maintain the safety work, all the safety gear must be wear during fabrication process. During fabrication process, any body accessories must be removed. For welding process, glove and the safety visor must be wear. For the grinding , drilling and cutting, safety goggle must be wear and for best performance, also wear jacket to avoid the chips from all the procedure mention before. But for shearing, grinding and drilling, it is not safe to use glove during fabrication process because the workpiece will slip off.

#### **4.5 CONCLUSION**

The tandem bicycle was fabricate according to the final design. The tandem bicycle consist of the carrier and the mobile phone charger for the recreational activity. This is according to the project scope. All the precaution step were take in order to overcome any accidents possibilities.

## **CHAPTER 5**

### **RESULT AND DISCUSSION**

#### **5.1 INTRODUCTION**

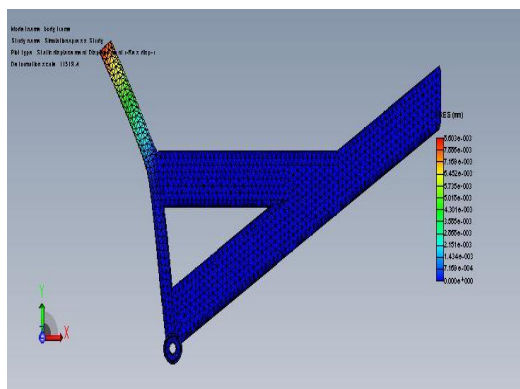
This chapter discussing about the completed of tandem bicycle after testing and also some simple analysis using CAD of the product . Then, it also provide the tandem bicycle analysis result by using solidwork software.

#### **5.2 ANALYSIS RESULT**

The analysis were done to test the strength of the material before proceed to the fabrication process. The result consist of the seat post, fork and the wheel shaft. This were the main component that receive the force distribute from the cyclist.

##### **5.2.1 Analysis of the seat post**

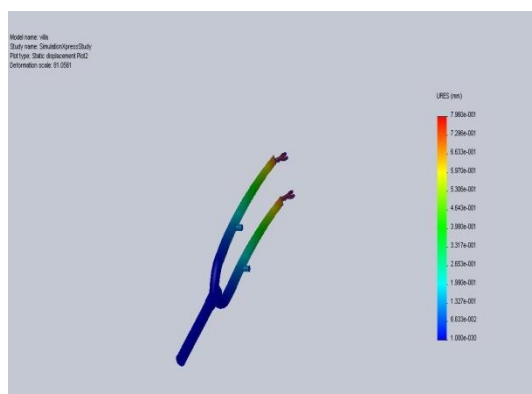
Figure 5.1 shows the displacement of the bicycle body frame at the seat post. The bicycle body frame receive 686.7 N from the rider and it shows that this bicycle body frame has 11519.4 deformation scale. The red part show the maximum position of the seat post before fracture.



**Figure 5.1** : Analysis of the seat post

## 5.2.2 Analysis of the fork

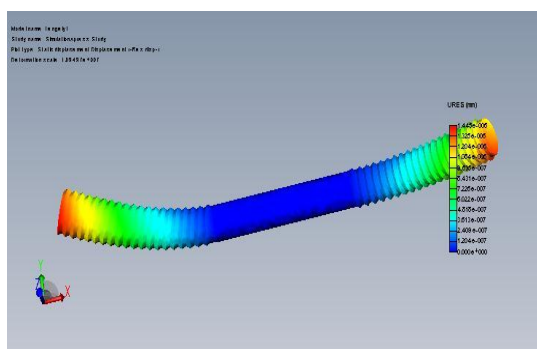
Figure 5.2 shows the analysis of the bicycle fork. The fork has a red sign at the bottom part that connected to the wheel shaft. The stress from the cyclist distribute to both point of the fork and the force were divide half. The fork has 81.0561 deformation scale and has 172338992 of yield strength.



**Figure 5.2** : Analysis of the fork

### 5.2.3 Analysis of the wheel shaft

The analysis was done on the wheel shaft that receive pressure from the fork. The analysis from figure 5.3 shows that the wheel shaft has 180000000 of yield strength that can support the rider. The red part show the maximum displacement of the wheel shaft if the weight of rider exceed the analysis weight.



**Figure 5.3 :** Analysis of the wheel shaft

### 5.3 Final product

This is the final product of the product that is tandem bicycle.



**Figure 5.4 :** Final product

## **CHAPTER 6**

### **CONCLUSION AND RECOMMENDATION**

#### **6.1 INTRODUCTION**

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

#### **6.2 PROBLEM ENCOUNTERED**

The problem I have encountered for this project is on the fabrication process. The bicycle body frame that I manage to obtain were rust and need a cover up. So I have to create a new surface for the rust body frame by using the 1mm aluminium sheet. Then the next problem I encountered is the limitation of tool since I share the laboratory with the other student. So I have to share the tool and machine with other student that cause a late of fabrication and away from the schedule. The next problem is tire I buy for the bicycle is not suitable for the dynamo and I have to test the dynamo on the motorcycle to prove the dynamo can work and the problem is the tire.

### **6.3 CONCLUSION**

By succeeding creating the tandem bicycle , the project objective were achieve. This bicycle are suitable for recreational activity that following project scope because this bicycle have a dynamo mobile charger that charge any electronic device that use the usb cable for any activity that requires electricity. This bicycle also can bring any age level that suit for family activity.

### **6.4 RECOMMENDATION**

For this project, I recommend to create a free wheel for the front part so that either both rider can stop cycling without interrupting the the other rider. Next, try to increase the budget amount so that student can create another genius brilliant product and not restricted to the budget amount.

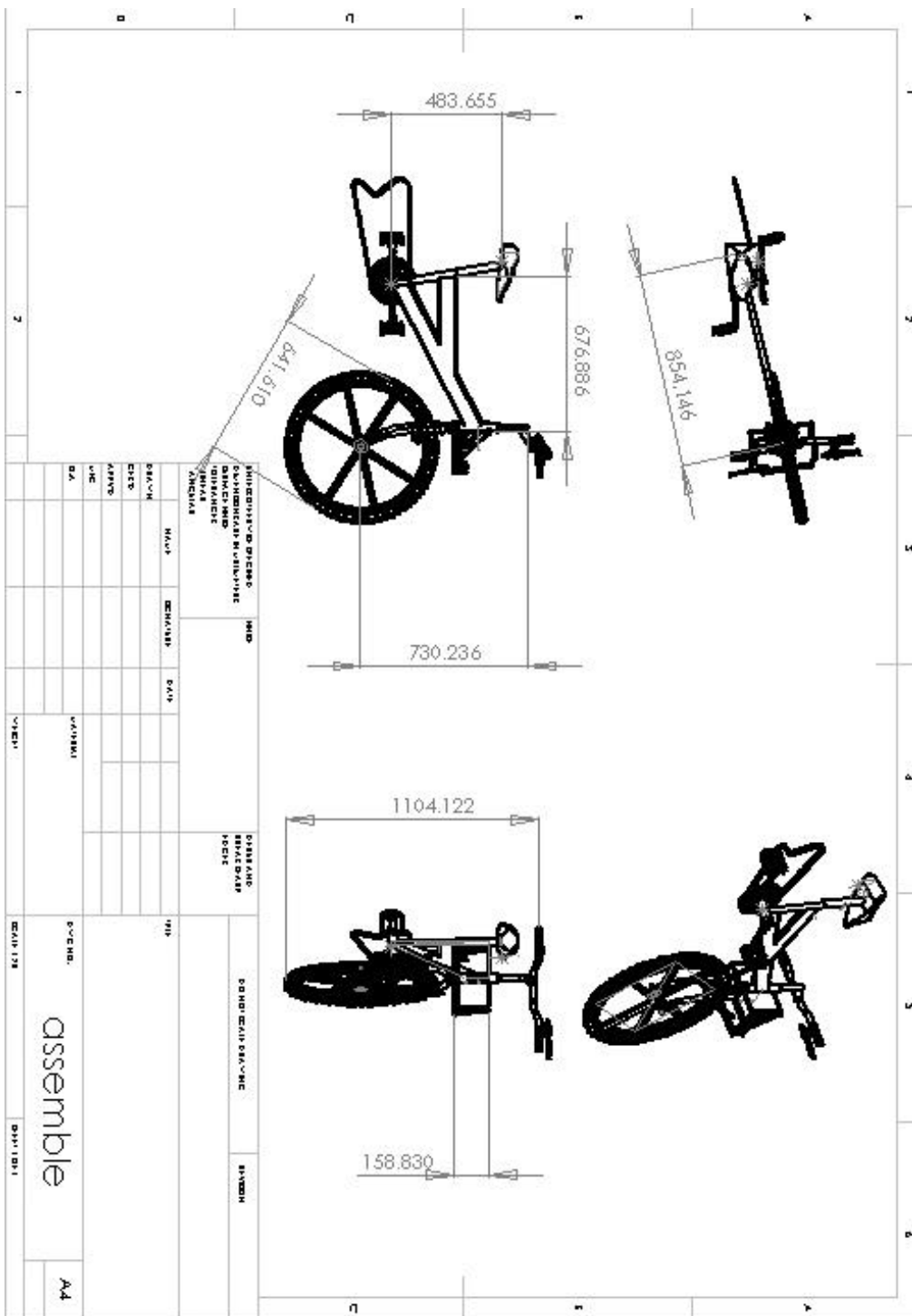
## References

This guide is prepared based on the following references

1. <http://www.bicycle.net/resources/bicycle-manufacturer-directory> , dated on 16th September 2012.
2. <http://www.bucka-lassen.dk/klaus/tandem/> , dated on 16<sup>th</sup> September 2012.
3. [http://en.wikipedia.org/wiki/Voltage\\_doubler](http://en.wikipedia.org/wiki/Voltage_doubler) , dated on 7th October 2012



**Appendix A**



APPENDIX B

