DESIGN AND FABRICATE TEST RIG KICKING SOCCER BALL

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JUDUL: Design and Fabricate Test Rig for Kicking Soccer Ball

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b	Width of square bar	(mm)
h	Height of square bar	(mm)
t	Thickness of square bar	(mm)
x	Length of square bar at x axis	(mm)
y	Length of square bar at y axis	(mm)
I	Moment of Inertia	(mm^4)
F	Force	(N)

LIST OF ABBREVIATIONS

AL	Aluminium
CAD	Computer Aided Design
MIG	Metal Inert Gas Welding
UMP	Universiti Malaysia Pahang
PIX	Pixel
ASTM	American Society For Testing And Materials

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

The chapter will explain details about the project background, problem statement, objective project, and scope of the project that has been conducted.

1.2 PROJECT BACKGROUND

Soccer is the major game in our world today. Soccer has undergone various revolutions to make its more entertainment to watch and play. With additional technology today, there a lot of improvement to make it more better with running some experiments onto soccer aspects.

One of the aspects is experiments about kicking the soccer ball. Kicking ball is most important basic in soccer game. From the beginning soccer game exist until now, there have many kind of kicking style that repeatedly perform by players in the world. From the kicking style, we can collect data, interpret data and finally improve quality of kicking style.

The improvement of quality kicking will be able to increase velocity, angle and direction of ball kicking by testimony players. In market now, there are many example of test rig for kicking machine. The famous one is machine from ADIDAS that supplied with hydraulics system. There are also machine from motor system and electronic components system.

1.3 PROBLEM STATEMENT

Football is activities where players kicking the ball. By kicking soccer ball, deformation and velocity of the ball can be calculated. To calculate the deformation and velocity of kicking soccer ball, several players is chosen kicking ball test. Players need kicking the ball at same mark position and high camera definition will record data when ball release. The experiments test repeatedly doing the same time in several times to get final results. At these rate, the problem is human cannot achieve constant velocity when kicking the ball. The force produced by human is change due to single time. Besides that, human also has limit which is fatigue if continuously doing the same things in several time. If extensive human kick is used, the collection data need long time to analyze and may be errors.

1.4 OBJECTIVE

The objectives of this project are:

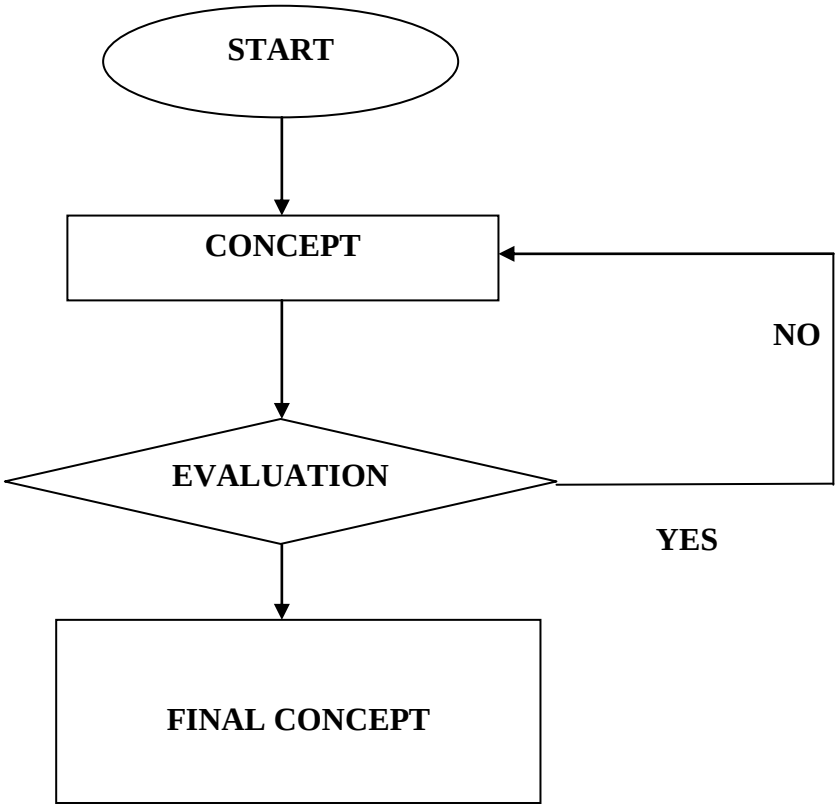
1. Design and fabricate test rig kicking.
2. Analyze the experiments of test rig kicking

1.5 SCOPE

1. Create conceptual design for test rig kicking and analyze the results.
2. Develop the solid work drawing to details each part of project and to welding fixture for test rig kicking.
3. Use square bar, rod bar and sheet metal in fabricate.
4. Fabricate by use measuring, marking, cutting, drilling & milling and welding process.
5. Joints each part by use bolt, screw and nut.
6. Analyze the capture of ball velocity and ball deformation during kicking.

1.6 PROJECT FLOW CHART

Figure 1.1 shows the project flow chart that uses as guide to manage the project.



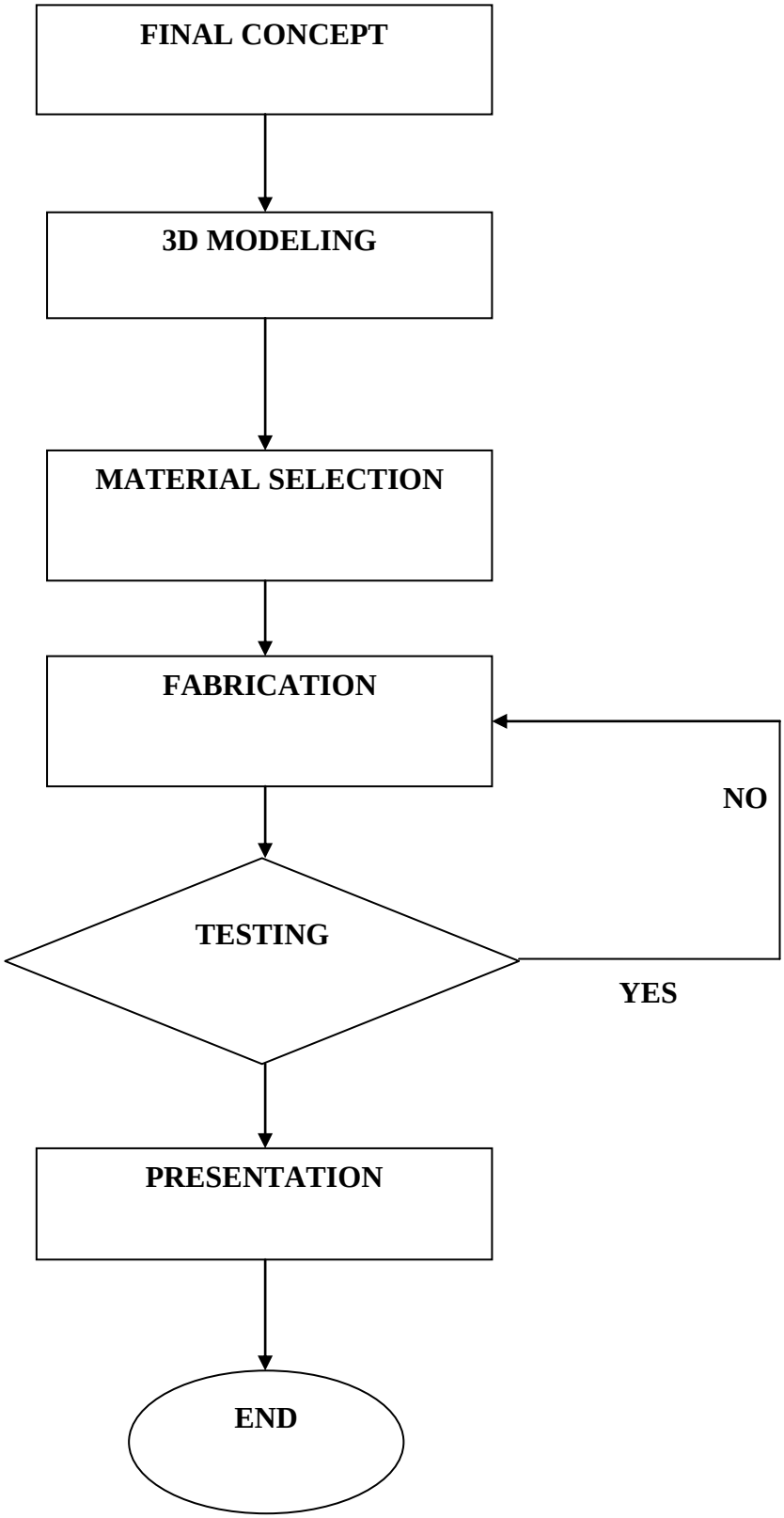


Figure 1.1: Project flow chart

From the project flow chart in figure 1.1, the project has been start off by identify example products that exist in market. Then design new concept of test rig for kicking based on survey in market. Tabulate data of each concept design with sketch concept screening. Evaluate each design with score each concepts design based on selection criteria given. Choose final concept based on the higher score.

After choose final concept, use solid work software and auto-CAD software to sketch the shape of final concepts design. In solid work, sketch part by part of product with accurate dimension. After that, combine parts by mate each part to another parts. Finally explosion view is created to give detail shoot of combination part of product.

After that, select the material by list and prepare all material need to be fabricated. Material such as square bars, hollow bars, round bars, flat bars, and sheet metal are used. Then starting fabricates the materials using cutting, drilling and welding process. Finally, finishing process is carry out. The product will be grinding surface area to remove rough surface and rust area and follow by paint the product.

1.7 PROJECT GANTT CHART

Task		W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	W15
Choose title and brief by supervisor	Plan															
	Actual															
Literature review	Plan															
	Actual															
Concept Design & select final concept	Plan															
	Actual															
Draw using solid work software	Plan															
	Actual															
Analyze final concept	Plan															
	Actual															
Pre- Presentation	Plan															
	Actual															
Process fabrication/evaluative/experiments	Plan															
	Actual															
Final report	Plan															
	Actual															
Final presentation	Plan															
	Actual															

Figure 1.2: Project Gantt Chart

1.8 THESIS ORGANIZATION

Chapter 1 will give information about introduction, project background, project statement, objective, scope, project flow chart and project gantt chart. This chapter will be observation about the step flow on my project.

Chapter 2 which is literature review will discuss more about example product that exist in market with their own characteristics. Besides that these chapter will discuss about fabrication equipments that used in these project.

Chapter 3 which is methodology is all about the concept design and follow by finalize concept. It also discuss about type of material with specific measurements and fabrication process.

Chapter 4 which is results and discussion will focus about finalize product that has been fabricate. The experiment is done on product to analyze based on the objective project.

Lastly, Chapter 5 will mainly discuss about the conclusion project and some recommendation that can be improve on the product.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter, information about test rig for kicking is discussed. The sources of the review are extracted from journals, articles, reference books and internet. The purpose of this section is to provide additional information and relevant facts based on past researches which related to this project.

2.2 PRODUCT REVIEW

Product review is example products that exist in market with their own characteristics.

2.2.1 Product A

Figure 2.1: Soccer Player Automaton

Source: http://l3d.cs.colorado.edu/~zathras/research/images.html

This is soccer player automaton. The mechanism uses a single lobed snail cam to push the kicking leg back and a rubber band to pull the leg forward. To allow the user to continue to turn the crank while the ball travels to the net and back to the foot, a set of 3:1 spur gears is used to reduce the speed at which the leg is pushed backwards. This has the added benefit of making the mechanism easier to crank. The framework and mechanism is laser cut from basswood and wooden dowels were used for the shaft, handle, and the follower rods.

2.2.2 Product B

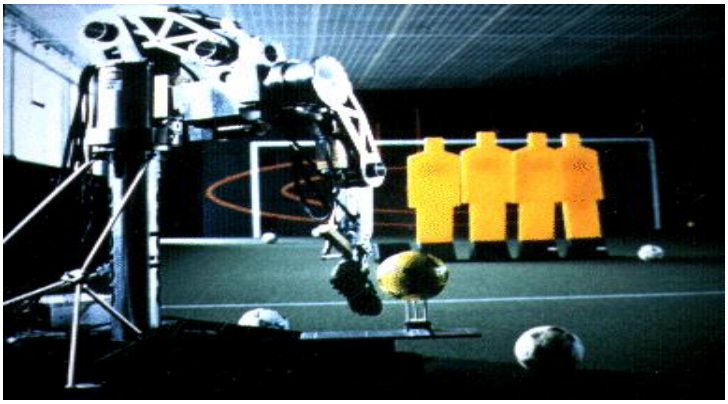


Figure 2.2: Hydraulic rig kicking

Source:
http://www.ri.cmu.edu/research_project_detail.html?project_id=199&menu_id=261

The leg was designed to approximate as close as possible to the human kinematics and dynamics during the action of kicking a soccer ball. The purpose was to provide a consistent test–bed to remove the statistical variance associated with human testing. There are also to provide objective comparison criteria to judge and drive the design of new soccer–shoe prototypes. In addition, the developed system has the advantages of providing a highly visible, high-shows, press conferences and tournaments.

2.2.3 Product C

Figure 2.3: Ass kicking

Source: http://toolmonger.com/2007/09/29/ass-kicking-machine-well-kicks-ass/

This is ass kicking .The concepts of this design is naturally manual. That means its use individual movement from the one source in every supply. The design shows that it has many different part of leg that contain variety shoe each other.

This design has two parts of materials. First part is body. The second one is for mechanical movement. For body materials, these design use piece of wood, nail and glue. In mechanical movement materials contain gear and pulley system.

2.2.4 Product D

Figure 2.4: Adidas rig kicking

Source: http://sti.lboro.ac.uk/collaboratorsfacilities-1.aspx

This is design Adidas rig kicking. The design use motor rotation movement. This machine has maximum power to lunch the ball in any direction and situation. Its also can adjust the power according different type of experiment. It also has x axis, y axis and z axis.

The materials are stainless steel, bolt and nuts, screws, rod bar, wires, conductor/rubber and motor system component. This machine is quiet hard to construct because of the main power supplies is electric current. It has many wires to joint and has different part of component chip electronic.

2.2.5 Product E

Figure 2.5: Manual rod rig kicking

Source:
http://sports.specialolympics.org/specialo.org/Special_/English/Coach/Coaching/MATP/MATP_ACT/FOOTBALL-2.HTM

This is Manual rod rig kicking. The concept of this mechanism is manual. This is very simple design for test rig for kicking. It has dual-support stand. The mechanism is lightweight and easy to carry. It is in separated part and method to uses is by joint each parts.

This simple rig kicking is only use rod bar, stainless steel, and conductor/rubber. The welding process is required to build each part. The each part is design with calculation diameter to make easy joint. Each part is finally joints by scroll the smaller diameter into bigger diameter parts.

2.3 CONCEPT SCREENING

Concepts screening is tabulate date each selection criteria from each products.

Table 2.1: Screening Concept

Selection Criteria	**1**	**2**	**3**	**4**	**5**
Ease of handling	-	+	-	0	0
Ease of use	-	+	+	0	+
Durability	-	+	+	-	-
Portability	0	-	-	+	-
Ease of Manufacture	+	-	-	0	+
Product weight	+	0	-	+	+
Product function	-	+	+	-	-
Manufacturing cost	+	0	-	+	+
Safety	-	+	+	+	0
Sum of +'s	3	5	4	4	4
Sum of 0's	1	2	-	3	2
Sum of -'s	5	2	5	2	3
Net score	2	3	1	2	1
Rank	**5**	**1**	**4**	**2**	**3**

2.4 FABRICATION EQUIPMENT

In this project, there are several equipments that used to cutting, drilling and welding product. fabrication equipments such as shearing machine, drill press, drill milling machine, grinder machine, and welding machine is used to shape, joint and structure raw material into final product.

2.4.1 Shearing Machine

Figure 2.6: Shearing Machine

Source: http://ntweili.en.made-in-china.com/product/nbxQojOMLdWe/China-QC12Y-Swing-Beam-Shearing-Machine.html

Shearing machine is cutting process machine. It can cut sheet metal type such as aluminium, zinc, and others. The machine uses hydraulic application as power sources to cutting the sheet metals.

2.4.2 Drilling Machine

Figure 2.7: Drilling Machine

Source: http://hupshenghware.com/index.php?cPath=191_192_280

Drilling machine has many types. There are in several types such as hand drill, drill press and magnetic drill. The function of drilling machine is to make a hole at the work piece. The diameter of edge cut of drill can be change using Allen key.

2.4.3 Milling Machine

Figure 2.8: Milling Machine

Source: http://www.varahii.com/vertical-milling-machine.html

Milling machine has involved in many application process. It can application drilling process, facing process, counter boring process and others. The machine is suitable uses with high width of material because it applied hydraulic system to operate the machine. The machine can applied in high diameter of edge cut not as drilling machine that has limits.

2.4.4 Welding Machine

Figure 2.9: Welding Machine

Source: http://www.mtsuae.com/work-shop-facility.php?newsid=8

Welding is a fabrication or sculptural process that joins materials, usually metals or thermoplastics, by causing coalescence. There are several type of welding machine such as Arc welding, MIG welding and others. Many different energy sources can be used for welding, including a gas flame, an electric arc, a laser, an electron beam, friction, and ultrasound.

2.4.5 Grinding Machine

Figure 2.10: Grinder Machine

Source: http://sztools.en.made-in-china.com/product/ueqEDmFoAzkZ/China-Angle-Grinder-SU03-100-.html

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. In this project, grinding machine is used to clean rough surface area and rust substances on the project before painting process.

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

This chapter also discusses about all the information and data that required and fabrication process for this project. Firstly, designing the test rig for kicking soccer ball skill in drawing and time is required. This kind of data is required to design the concept of test rig for kicking.

3.2 SYNOPSIS

Synopsis shows step or phase of project to fabricate product. This project consists of seven phases, which are:

i. Phase 1 – Measure the dimension
ii. Phase 2 – Marking the dimension
iii. Phase 3 – Cut the material
iv. Phase 4 – Drilling
v. Phase 5 – Joint the steel
vi. Phase 6 – welding the steel
vii. Phase 7 – Finishing

3.2.1 METHODOLOGY FLOW CHART

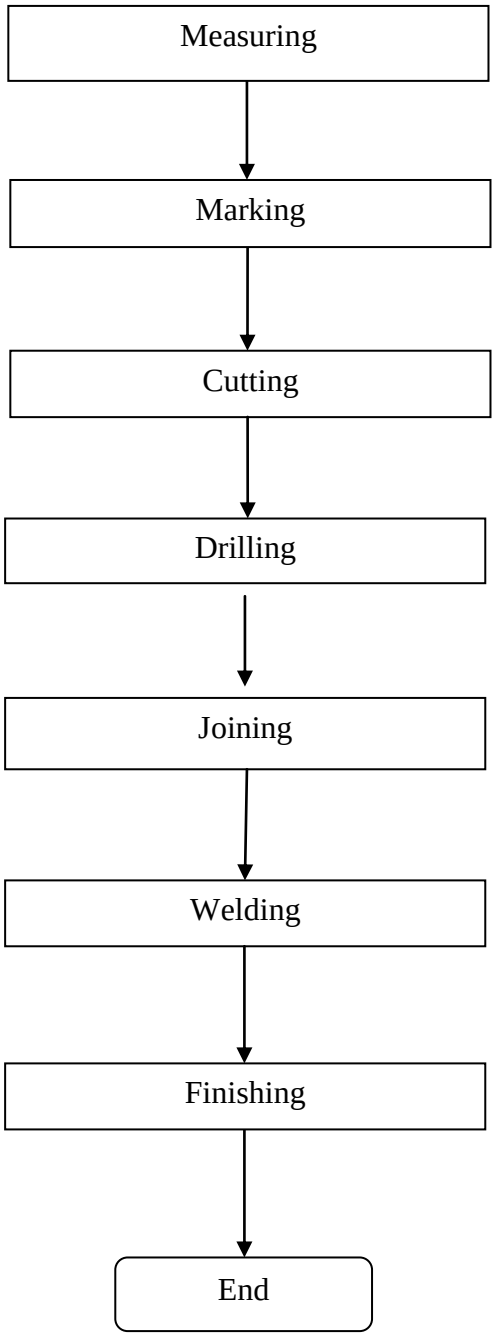


Figure 3.1: Methodology flow chart

3.3 Design Concept

Design concept is idea about the projects design. Design concepts need to imagine the model of products design with specific criteria.

3.3.1 Concept A

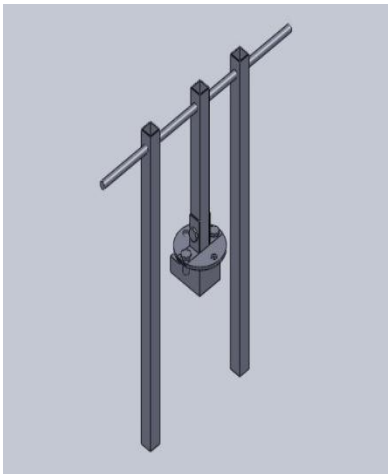


Figure 3.2: Concept A

Figure 3.1 is show design A. Design A has directional feet that can be adjustable into many direction ways. The disadvantage of these model design is it leakage of stability.

Table 3.1: Advantages and Disadvantages of Concept A

Advantaged	Disadvantage
Adjustable leg	Not Stability
Adjustable foot	Too High of Height

3.3.2 Concept B

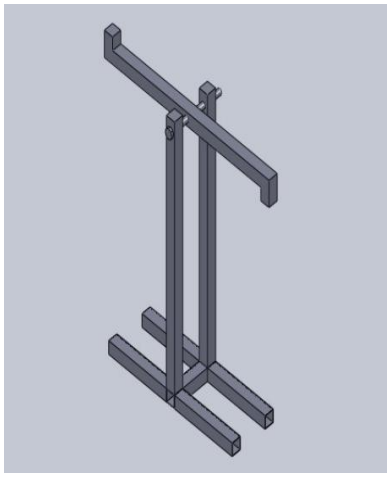


Figure 3.3: Design B

Figure 3.2 show design B. The design is more stability than design A. It also has dual feet that can produce more force and higher velocity when released. The disadvantage of the design is the feet can not be adjustable and only available with static position.

Table 3.2: Advantages and Disadvantages of Concept B

Advantaged	Disadvantaged
Support Base	Not Adjustable Leg
Dual Foot	Too High of Height

3.3.3 Design C

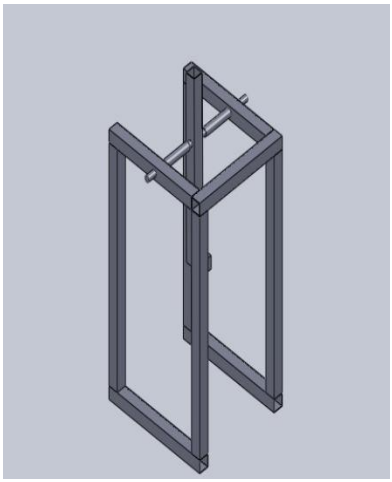


Figure 3.4: Design C

Figure 3.3 is final design for design concepts. The advantage of the design is it has more stability with more supports besides the leg and feet. It also have stopper that can reduces the velocity of the rotation leg. The disadvantage one of the design is the feet that only in static.

Table 3.3: Advantages and Disadvantages of Concept C

Advantaged	Disadvantaged
Support Base	Not Adjustable Foot
Adjustable Leg	Heavyweight
Stopper Rotation	

3.4 EVALUATION PROCESS

Evaluation process is where the concepts design will be evaluate for second phase based on other selection criteria.

3.4.1 Pugh Concept

Table 3.4: Concept Selection Criteria

Selection Criteria	Concepts			
	A	**B**	**C**	**D (Datum)**
Durability	-	-	+	0
Is lightweight	0	+	0	0
functional	-	0	+	0
Can use anywhere	+	0	+	0
Ease of manufacture	-	0	0	0
Cost of manufacture	+	+	0	0
∑+	2	2	3	0
∑0	2	4	3	7
∑-	3	1	0	0
Net Score	-1	1	3	0
Rank	4	2	1	3

3.5 Finalize Concept

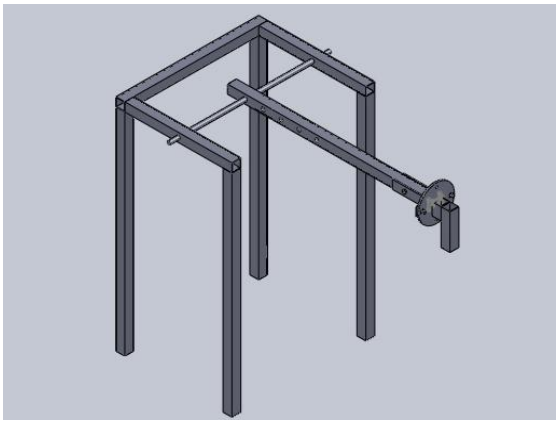


Figure 3.5: Final Concept

Study of the concept selection table shows that concept C score the highest positive signs. There is no negative sign in concept C. Therefore, concept C is the best concept to be produce.

3.5.1 Explosion View

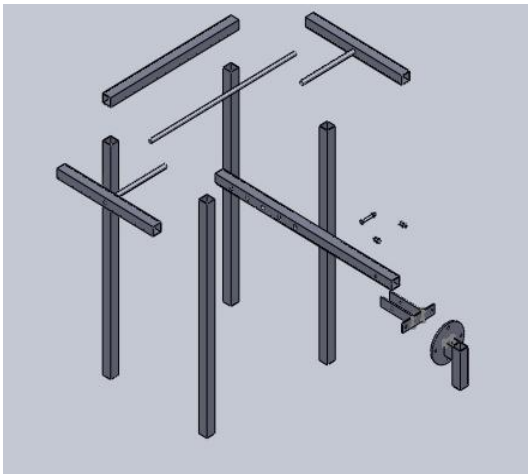


Figure 3.6: Part of Materials Joints

3.6 BILL OF MATERIAL

Table 3.5: Bill of Material

Item	Material	Dimension (mm)	Quantity
1	Square bar	50x50x3(1200)	4
2	Square bar	50x50x3(600)	2
3	Square bar	50x50x3(800)	1
4	Square bar	50x50x3(1100)	1
5	Hollow bar	25x325	2
6	Round bar	20(900)	1
7	Flat bar	50x6(200)	3
8	Sheet metal	3(200x200)	1
9	Foot plate	Standard	1
10	Bolt	12x30	2
11	Bolt	12x80	1

3.6.1 Square Bar

Square bar is some material of metals that have high weight ratio, can easily joint and available in efficient of shapes.

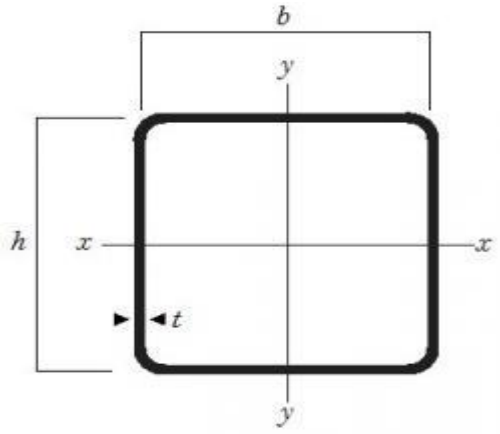


Figure 3.7: Square Hollow Bar

Source: http://www.tubecon.co.za/en/technical-info/tubecon-wiki/square-hollow-sections

Table 3.6: Square Hollow Sections Dimensions and Properties

Designation hxbxt	*m*	*A*	*I*	*Z*e	Zpl	*r*	*J*
Mm	kg/m	10^3mm^2	10^6mm^4	10^3mm^3	10^3mm^3	mm	10^6mm^4
50x50x3	4.48	0.533	0.190	7.59	9.17	18.9	0.322
3.5	5.18	0.6098	0.211	8.43	10.3	18.6	0.364
4.0	5.87	0.681	0.229	9.15	11.4	18.3	0.403
4.5	6.55	0.750	0.244	9.77	12.3	18.0	0.438
60x60x3	5.42	0.653	0.344	11.5	13.7	23.0	0.573
3.5	6.28	0.749	0.386	12.9	15.5	22.7	0.652
4.0	7.12	0.841	0.423	14.1	17.2	22.4	0.727
4.5	7.96	0.929	0.256	15.2	18.8	22.2	0.796

63x63x3	5.70	0.689	0.403	12.8	15.3	24.2	0.668
3.5	6.60	0.791	0.453	14.4	17.3	23.9	0.761
4.0	7.50	0.889	0.498	15.8	19.2	23.7	0.850
4.5	8.38	0.984	0.538	17.1	21.0	23.4	0.932
75x75x3	6.81	0.833	0.705	18.8	22.2	29.1	1.15
3.5	7.90	0.959	0.797	21.3	25.3	28.8	1.32
4.0	8.98	1.08	0.882	23.5	28.2	28.6	1.48
4.5	10.0	1.20	0.961	25.6	31.0	28.3	1.63
5.0	11.1	1.31	1.03	27.5	33.6	28.0	1.77
100x100x3	9.17	1.13	1.75	35.0	40.8	39.3	2.80
3.5	10.7	1.31	2.00	39.9	46.8	39.1	3.22
4.0	12.1	1.48	2.23	44.6	52.6	38.8	3.63
4.5	13.6	1.65	2.45	49.0	58.2	38.5	4.03
5.0	15.0	1.81	2.66	53.1	63.5	38.3	4.42
6.0	17.9	2.13	3.04	60.7	73.5	37.7	5.15
120x120x3	11.1	1.37	3.10	51.6	59.8	47.5	4.89
3.5	12.9	1.59	3.54	59.1	68.8	47.2	5.65
4.0	14.6	1.80	3.97	66.2	77.5	47.0	6.39
4.5	16.4	2.01	4.38	73.1	86.0	46.7	7.11
5.0	18.2	2.21	4.78	79.6	94.2	46.4	7.82
6.0	21.7	2.61	5.51	91.8	110	45.9	9.16
152x152x3.5	16.3	2.04	7.41	97.4	113	60.3	11.7
4.5	21.0	2.59	9.24	122	142	59.8	14.8
6.0	27.8	3.33	11.3	150	178	58.2	18.4
8.0	36.6	4.39	14.7	194	233	58.0	24.6
10.0	45.3	5.34	17.3	227	277	56.9	29.6
180x180x4.5	23.8	3.09	15.7	174	202	71.2	24.8
6.0	31.5	4.05	20.1	223	262	70.5	32.4
8.0	41.6	5.28	25.5	283	336	69.4	41.9
10.0	51.6	6.46	30.2	335	404	68.4	50.7

225x225x4.5	29.8	3.90	31.3	278	320	89.6	49.0
6.0	39.5	5.13	40.5	360	418	88.8	64.3
8.0	52.3	6.72	51.8	461	541	87.8	83.8
10.0	64.9	8.26	62.2	553	656	86.8	102
250x250x4.5	34.8	4.35	43.3	347	398	99.8	67.5
6.0	46.2	5.73	56.2	450	521	99.0	88.7
8.0	61.2	7.52	72.3	578	676	98.0	116
10.0	76.0	9.26	87.1	697	822	97.0	142
270x270x4.5	35.5	4.71	54.9	407	467	108	85.3
6.0	47.1	6.21	71.4	529	611	107	112
8.0	62.3	8.16	92.1	682	795	106	147
10.0	77.4	10.1	111	824	969	105	180
300x300x4.5	39.0	5.25	75.9	506	579	120	118
6.0	51.8	6.93	98.9	660	760	119	155
8.0	68.7	9.12	128	853	991	118	203
10.0	85.3	11.3	155	1030	1210	117	250

3.6.2 Hollow Bar

Hollow bar, known as seamless mechanical tubing, is a tubular product made with characteristics and properties suitable for subsequent transformation into a great variety of hollow products and cylindrical components for general engineering purposes.

Source: http://www.atlassteels.com.au/site/pages/carbon-alloy-and-stainless-hollow-bar.php

Table 3.7: Information of Stainless Steel

Stainless Steel	
Standard	ASTM A511 or equivalent
Size Range	32 x 16 mm - 250 x 200 mm
Grades	316
Finishes	As rolled
Condition	Annealed and pickled
Processing	Bar Cutting

3.6.3 Round Bar

Stainless steel round bar besides having the characteristic or corrosions resistance has been developed over time to encapsulate end user application.

Source: http://www.atlassteels.com.au/site/pages/stainless-steel-bar-round.php

Table 3.8: Information Of Stainless Steel Round Bar

Stainless Steel Round Bar	
Standard	ASTM A276
Condition	25.4mm and less generally drawn, above 25.4mm and less than 101.6mm is generally annealed, turned and polished.

	Sizes above 101.6mm are generally rough turned to k12 tolerance. Grades 431 and 2205 are often stocked in a smooth turned or centre less ground finish.
Size angel	3 to 304.8 mm (diameter)
Grades	303, 304/304L, 316/316L, 431 H&T, 2205, Improved Machining (303, 304, 316)
Processing	Bar cutting

3.6.4 Flat Bar

The cold-formed section are suitable for all type of welding such as spot welding, seam welding, projection welding, butt and groove welding, plug welding and arc welding.

Table 3.9: Flat Bars (Dimensions And Properties)

Thickness	Mass in kg/m for widths in mm										
mm	20	25	30	40	45	50	60	65	70	80	90
5	0.785	0.981	1.18	1.57	1.77	1.96	-	-	-	-	-
6	0.942	1.18	1.41	1.88	2.12	2.36	2.83	3.06	3.30	3.77	4.24
8	1.26	1.57	1.88	2.51	-	3.14	3.77	4.08	4.40	5.02	5.65
10	1.57	1.96	2.36	3.14	-	3.93	4.71	5.10	5.50	6.28	7.07
12	-	2.36	2.83	3.77	4.24	4.71	5.65	6.12	6.59	7.54	8.48
16	-	-	-	5.02	-	6.28	7.54	8.16	8.79	10.0	11.3
20	-	-	-	6.28	-	7.85	9.42	10.2	11.0	12.6	14.1
25	-	-	-	7.85	-	9.81	11.8	12.8	13.7	15.7	17.7
30	-	-	-	-	-	-	-	-	-	18.8	-
40	-	-	-	-	-	-	-	-	-	25.1	-

Flat bars dimensions and properties (continued)

Thickness	Mass in kg/m for width in mm							
mm	100	110	130	150	180	200	250	300
6	5.18	4.71	-	-	-	-	-	-
8	6.28	6.91	8.16	9.42	-	-	-	-
10	7.85	8.64	10.2	11.8	14.1	15.7	-	-
12	9.42	10.4	12.2	14.1	17.0	18.8	-	-
16	12.6	-	16.3	18.8	22.6	25.1	31.4	37.7
20	15.7	-	20.4	23.6	28.3	31.4	39.2	47.1
25	19.6	-	25.5	29.4	35.3	39.2	49.1	58.9
30	23.6	-	31.6	35.3	42.4	47.1	58.9	70.6
40	31.4	-	-	47.1	56.5	62.8	78.5	94.2
45	39.2	-	-	-	-	-	-	106
50	-	-	-	-	-	-	-	118

3.6.5 Sheet Metal

Sheet metal is simply metal formed into thin and flat pieces. It is one of the fundamental forms used in metalworking, and can be cut and bent into a variety of different shapes.

There are many different metals that can be made into sheet metal, such as AL, brass, steel, tin, nickel and titanium.

3.6.6 Bolt

A screw, or bolt, is a type of fastener characterized by a helical ridge, known as an external thread or just thread, wrapped around a cylinder. The most common uses of screws are to hold objects together and to position objects.

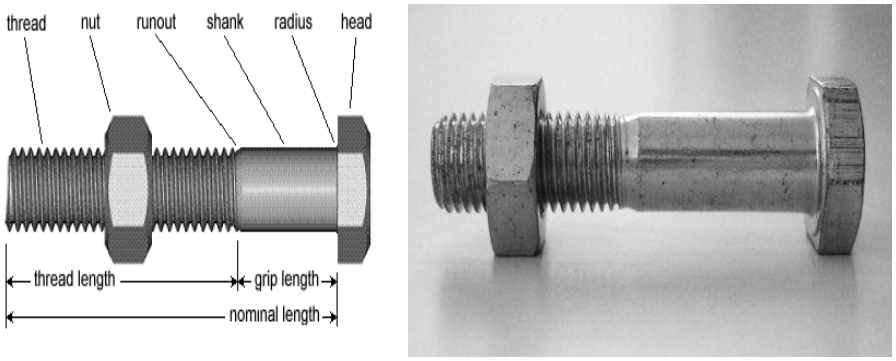


Figure 3.8: bolts

Source: httpwww.gizmology.netnutsbolts.htm

3.7 FABRICATION PROCESS

In order to make the design come to reality, fabrication process needs to be done first. The fabrication process starts from dimensioning the raw material until it is finish as a desired product. The processes that involved are:

a) Measuring Process

The materials are measured to desire dimensions or location based on design specification. All the measuring process is done measuring tape.

Figure 3.9: Measure the material using Measuring Tape

b) Marking Process

All measured materials need to be marked to give precise dimension by using steel marker.

Figure 3.10: Marking the material using Steel Marker

c) Cutting Process

The marked materials were cut into several pieces by using cutting machine.

Figure 3.11: Cutting materials by using Cutting Machine

d) Milling Process

Then, the marked holes were drilled for insert the round bar into square bar.

Figure 3.12: Drilling the holes by using Milling Machine

e) Joining and Welding Process

The material joined by using welding method.

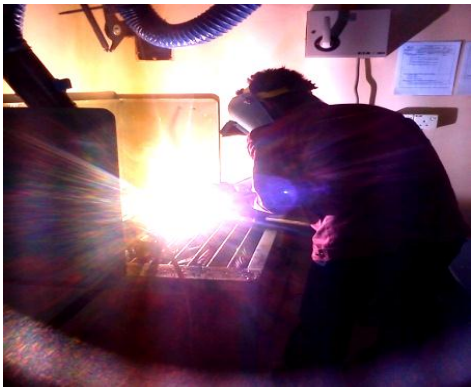


Figure 3.13: Welding each part by using Welding Machine.

f) Finishing Process

Any rough surface cause by welding spark were grind to give smooth and safe surface using grinding machine and filing by filers and sand paper to give a smooth edge and followed by painting process.

Figure 3.14: Clean roughness surface area by using Grinding Machine.

Sources: http://www.thefabricator.com/article/finishing/how-to-make-grinding-safer-and-more-productive

CHAPTER 4

RESULTS AND DISCUSSION

4.1 INTRODUCTION

These chapter will discuss about finalize product that have been finish fabricate. It also will show closely detail each part with their function. Product specification is about state of finalize product dimension and physical shape of product.

4.2 RESULTS

The finalize product is a test rig for kicking soccer ball with green in colour. The adjustable leg has five holes that is about 100mm range to another holes. The adjustable foot combine with adjustable leg and lock by using bolts and nuts.

4.3 FINAL PRODUCT

Figure 4.1: Side view of product

Figure 4.2: Edge view of product

4.3.1 Design by Part

Figure 4.3: Top view part 1

Figure 4.4: Front view part 2

Figure 4.5: Front side view part 1 And 2

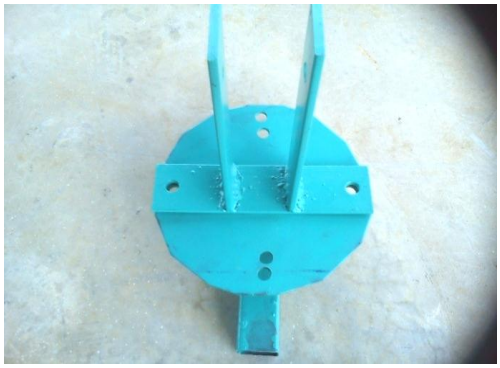


Figure 4.6: Top side view part 1 And 2

Figure 4.7: Side view part 3 and 4

Figure 4.8: Side view part 1,2,3,4

4.4 PRODUCT SPECIFICATIONS

The specifications of the product are as table below:

Table 4.1: product specifications

Specifications	**Results**
Length	800 mm
Width	600 mm
Height	1200 mm
Weight	5.50 kg
Colour	green

4.5 PRODUCT ADVANTAGE

4.5.1 Adjustable Foot

The main purpose of the product is use for adjustable the foot. Product has two pair of hole where each pair of hole can change the direction of the foot.

Figure 4.9: Adjustable foot

4.5.2 Adjustable Height of Leg

Adjustable leg has five holes with each holes diameter 20 mm. The function of leg is to rotation the test rig kicking. With addition different height of holes, the adjustable holes can change the velocity of leg rotation.

Figure 4.10: Difference Of Holes Height

4.5.3 Stopper Force

The function of the stopper force is to block the force release from going continuously react through the hollow bar. It is to prevent the product from higher vibration and easy to wear.

Figure 4.11: Stopper square hollow bar force.

4.6 PRODUCT ANALYSIS

4.6.1 DEFORMATION

High definition camera has recorded video with 900 frame/s. It means 1s equal to 900 frame.

Equation 1: 1s = 900 frame.

The figure 4.12 is experiment ball diameter has recorded as 126 pixel which is equal to 0.21 m.

Equations 2: 1m = 600 pixel.

When the test rig kicking the ball, the position ball release is recorded as a and b to get the calculation of specific information.

At position a, the ball is recorded as 0 pixel (22 frame) and the position b is recorded as 300 pixel (96 frame).

Equations 3: A= 0 pixel (22 frame)

B= 300 pixel (96 frame)

To get the distance of deformation in experiments, final position (b) is subtract with initial position (a):

Experiments distance: 300 pixel - 0 pixel

= 300 Pixel

= (300 Pixel/126 pixel)x0.21 m

= 0.5 m

The state distance of deformation in these experiments is 0.5 m.

Figure 4.12: Diameter of Ball

4.6.2 Maximum Deformation

Maximum deformation is calculation when the initial ball diameter is subtract with the final state of ball deformation diameter occur.

Equation 4: initial ball diameter= 126 pixel.

: Final state ball deformation diameter= 119 pixel.

Max deformation= 126 pixel - 119 pixel

= 7 pixel.

= (7 pixel/126 pixel)x0.21 m

= 0.011 m

= 11 mm.

The maximum deformation of the ball release is 11 mm.

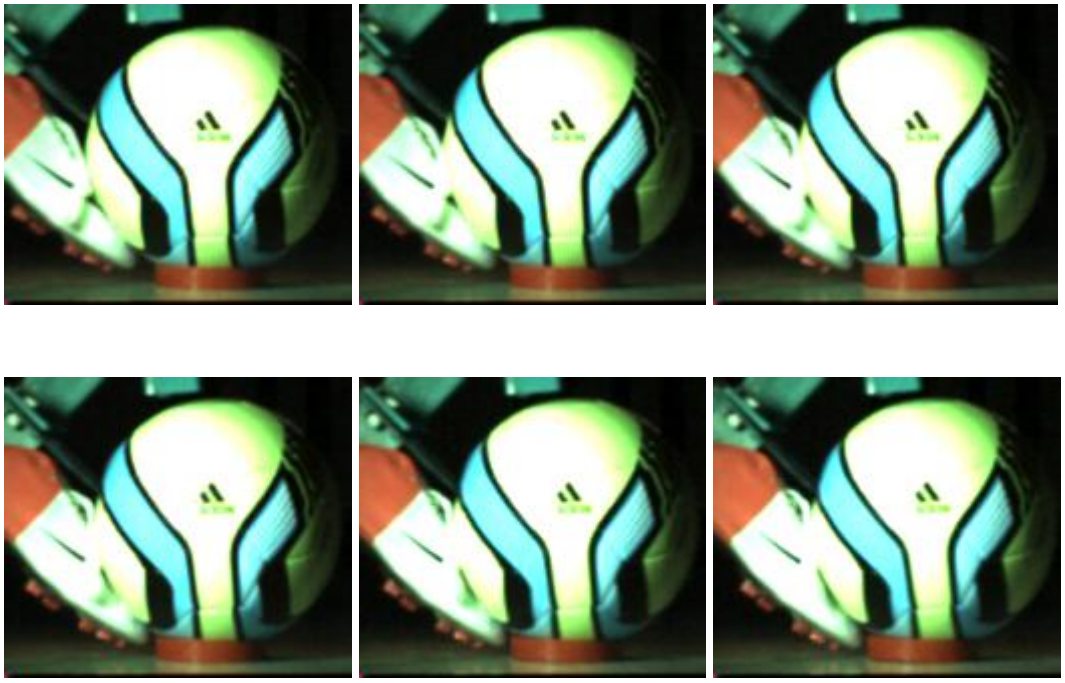


Figure 4.13: Ball deformation.

4.6.3 VELOCITY

Velocity is measure for distance against time.

In equation 3 deformation experiments,the state distance of experiment is 300 pixel equal to 74 frame.

From the equation we can get measure time.

Equation 5: 96 frame – 22 frame

= 74 frame.

= 74 frame/(900 frame/s)

= 0.082 s

Velocity of the ball deformation is**:** 0.5 m/0.082 s

= 6.09 m/s

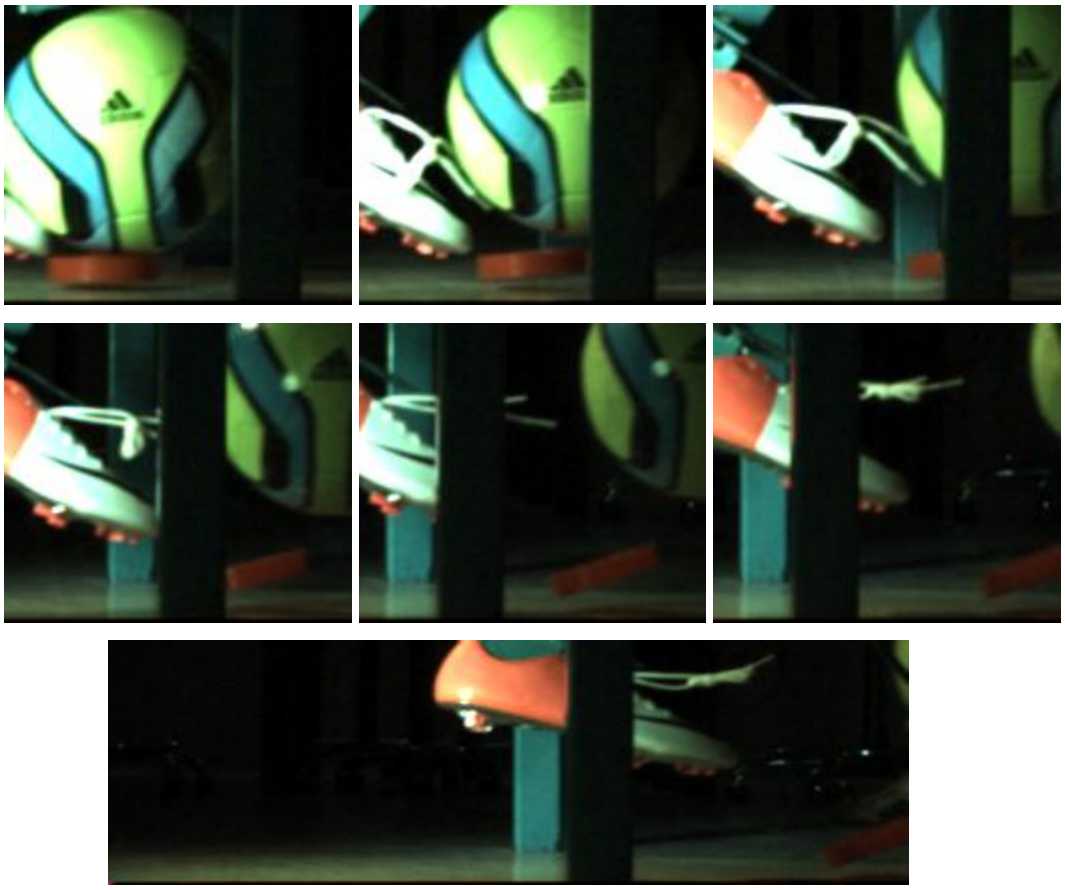


Figure 4.14: Ball Velocity

Calculation Mass Moments Of Inertia

Formula moment of inertia, I: $I + Ad^2$ for whole beam.

Moment of inertia in x axis for 800x50, $Ix = Ix + Ad^2 y$

$= 1/12\ (800)\ (50)^3 + (800)\ (50)\ (600)^2$

$= 14.4083\ (10^9)\ mm^4$

Moment of inertia in y axis for 800x50, $Iy = Iy + Ad^2x$

$= 1/12\ (50)\ (800)^3 + (50)\ (800)\ (0)$

$= 2.1333\ (10^9)\ mm^4$

Moment of inertia in x axis for 1200x50, $Ix = Ix + Ad^2y$

$= 1/12\ (50)\ (1200)^3 + (50)\ (1200)\ (25)^2$

$= 7.2375\ (10^9)\ mm^4$

Moment of inertia in y axis for 1200x50, $Iy = Iy + Ad^2x$

$= 1/12\ (1200)\ (50)^3 + (1200)\ (50)\ (375)^2$

$= 8.4500\ (10^9)\ mm^4$

Formula moment of inertia, I: $I + Ad^2$ for hollow beam.

Moment of inertia in x axis for 800x50, $Ix = 1/12\ (800)\ (44)^3 + (800)\ (44)\ (600)^2$

$= 12.6777\ (10^9)\ mm^4$

Moment of inertia in y axis for 800x50, $Iy = 1/12\ (44)\ (800)^3 + (44)\ (800)\ (0)$

$= 1.8773\ (10^9)\ mm^4$

Moment of inertia in x axis for 1200x50, $Ix = 1/12\ (44)\ (1200)^3 + (44)\ (1200)\ (25)^2$

$= 6.3690\ (10^9)\ mm^4$

Moment of inertia in y axis for 1200x50, $Iy = 1/12\ (1200)\ (44)^3 + (1200)\ (44)\ (375)^2$

$= 7.4335\ (10^9)\ mm^4$

$Ix = 4(7.2375\ (10^9)\ mm^4 - 6.3690\ (10^9)\ mm^4) + (14.4083\ (10^9) - 12.6777\ (10^9)\ mm^4)$

$= 5.2046\ (10^9)\ mm^4$

$Iy = 4(8.4500(10^9)\ mm^4 - 7.4335(10^9)\ mm^4) + (2.1333(10^9)\ mm^4 - 1.8773(10^9)\ mm^4)$

$= 4.322\ (10^9)\ mm^4$

Force release, $F = ma$

$= 1.27\ kg \times (74.268\ m/s^2)$

$= 94.32\ N$

4.7 DISCUSSION

In this project, several observations have been done with respect to the fabrication of the test rig for kicking soccer ball. The outcome test rig for kicking soccer ball was achieve the objective of this project. All the part test rig for kicking soccer ball can function in good condition for example the adjustable leg can adjust difference level of height of test rig kicking. The adjustable foot also can function clearly. It can set the shoe in difference direction angle suitable on experiments done.

However, this test rig for kicking soccer ball was too heavy according to the unsuitable material used in the fabrication process. Round hollow bar was perfect as joints supports but the round bar is to solid and heavy to stand with its. Besides that, the round hollow bar may be wears and can not longer stand the force of round bar and adjustable leg. Welding side of round hollow bar with square hollow bar can be solution due the problem.

Besides that, this test rig for kicking soccer ball also have problem with the stability. When the adjustable leg is release the test rig is shake and move lightly. The solution is test rig must be locked at each base supported when doing experiments.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 INTRODUCTION

This chapter will discuss all about conclusion and recommendation of the product. The conclusion is about the whole thing that involved during managing the final year project. There are also recommendations on the product so it can be improved to make the test rig kicking more efficiency.

5.2 CONCLUSION

As a conclusion, this project has practice and gives more knowledge about many mechanical properties such as machining and many others material during the fabrication process. Besides that, I also can gain knowledge about the material type, structure and others else. I also learn how to experiments and analyze the final projects. I can calculation deformation and velocity of ball with test rig for kicking. The final year project is very important because it can make myself more discipline and punctual. Finally, the objectives of this project that to design and fabricate test

rig for kicking with additional experiments and analyze the deformation and velocity of ball has been achieved.

5.2 RECOMMENDATION

The recommendations can improve this product in the future:

i. All materials should be lightweight and hardy such as woods. Besides that, woods also can reduce the cost because it's inexpensive and more safety.
ii. To make sure adjustable leg easy to rotate, bearing should be added. It is because bearing can reduce the friction between two surfaces.
iii. To reduce the friction collapse due each steel, rubber should be place at the holder square hollow bar.

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APPENDIX A

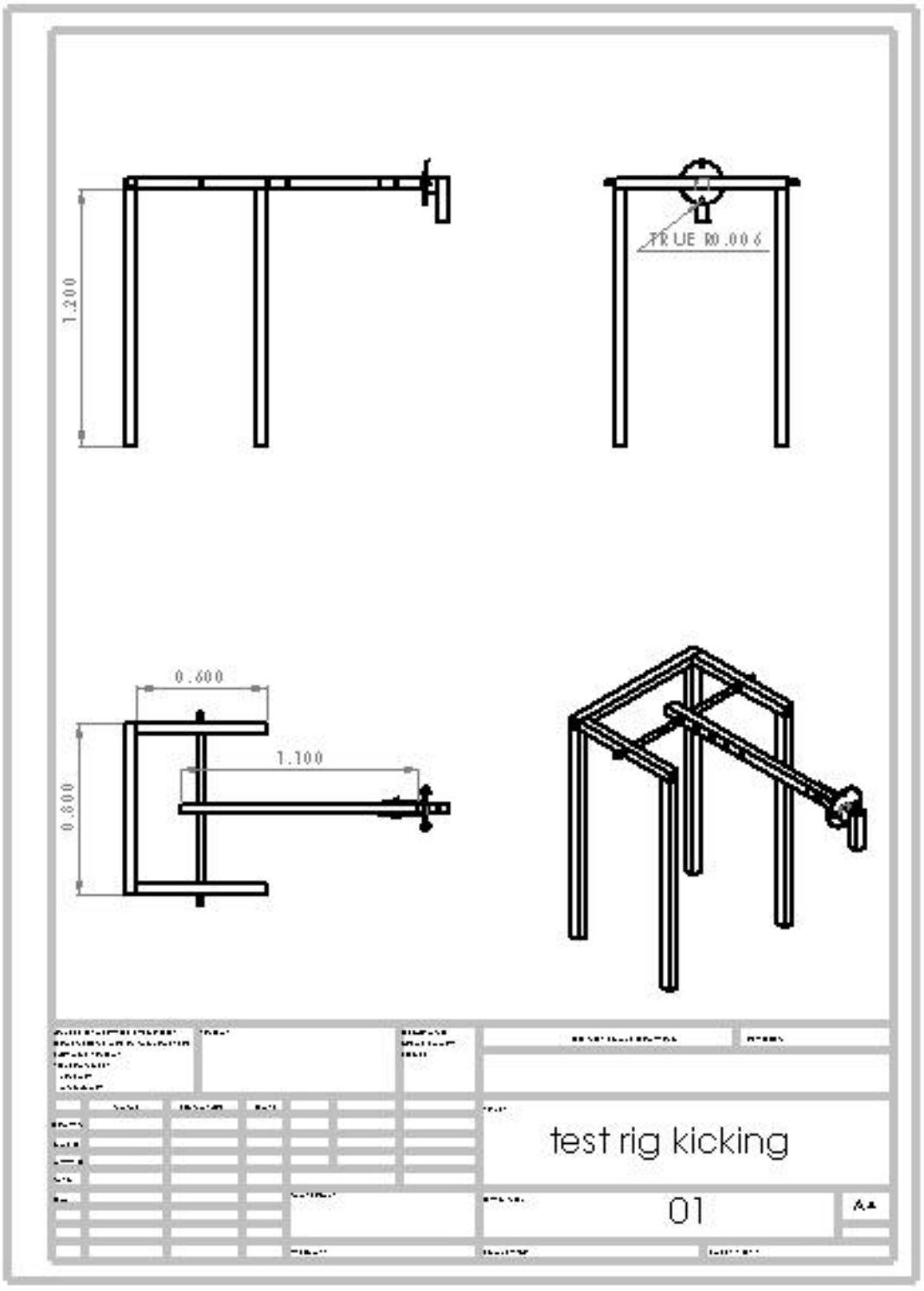

Figure 5.1: Final Product Dimension

APPENDIX B

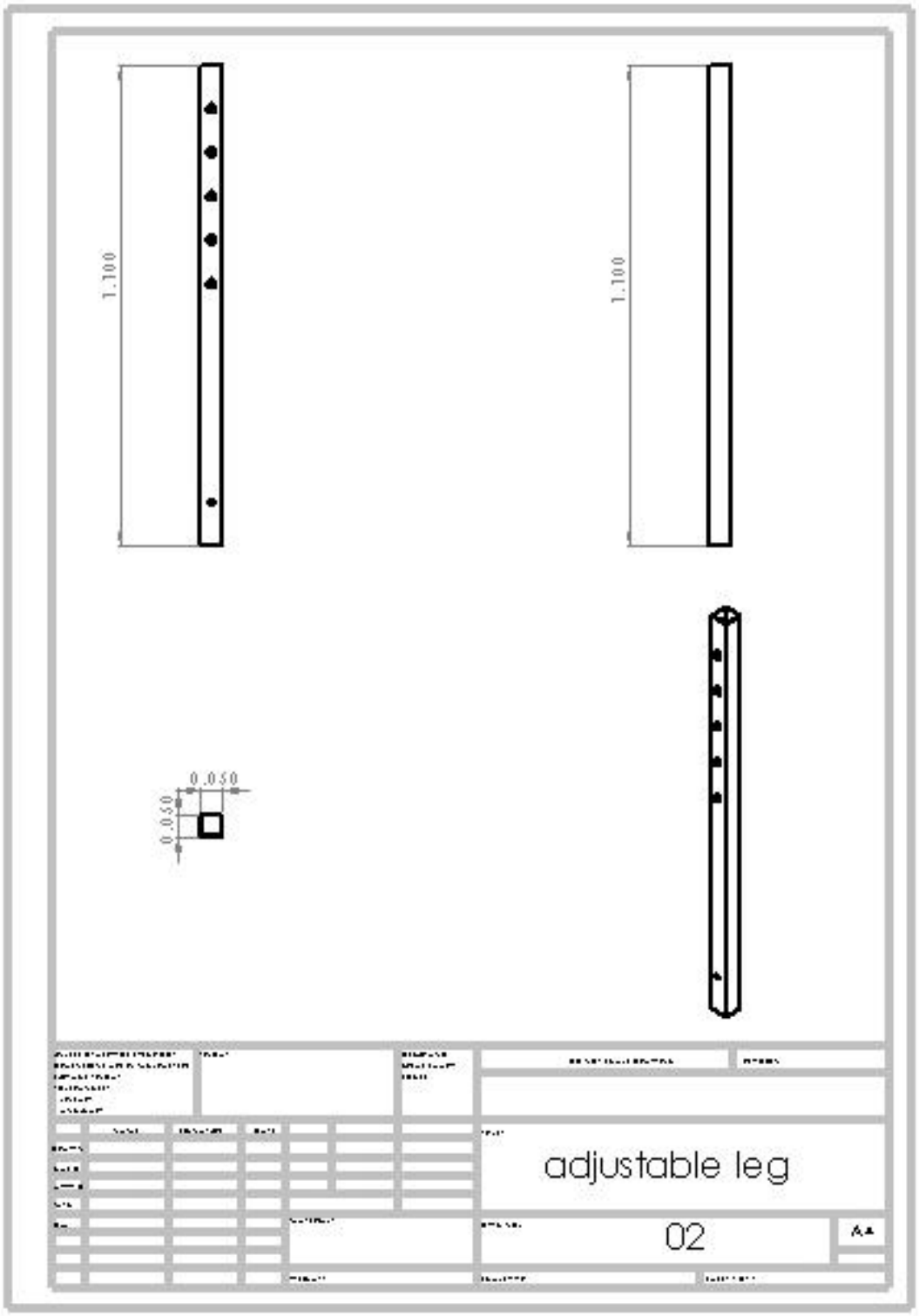

Figure 5.2: Adjustable Leg Dimension

APPENDIX C

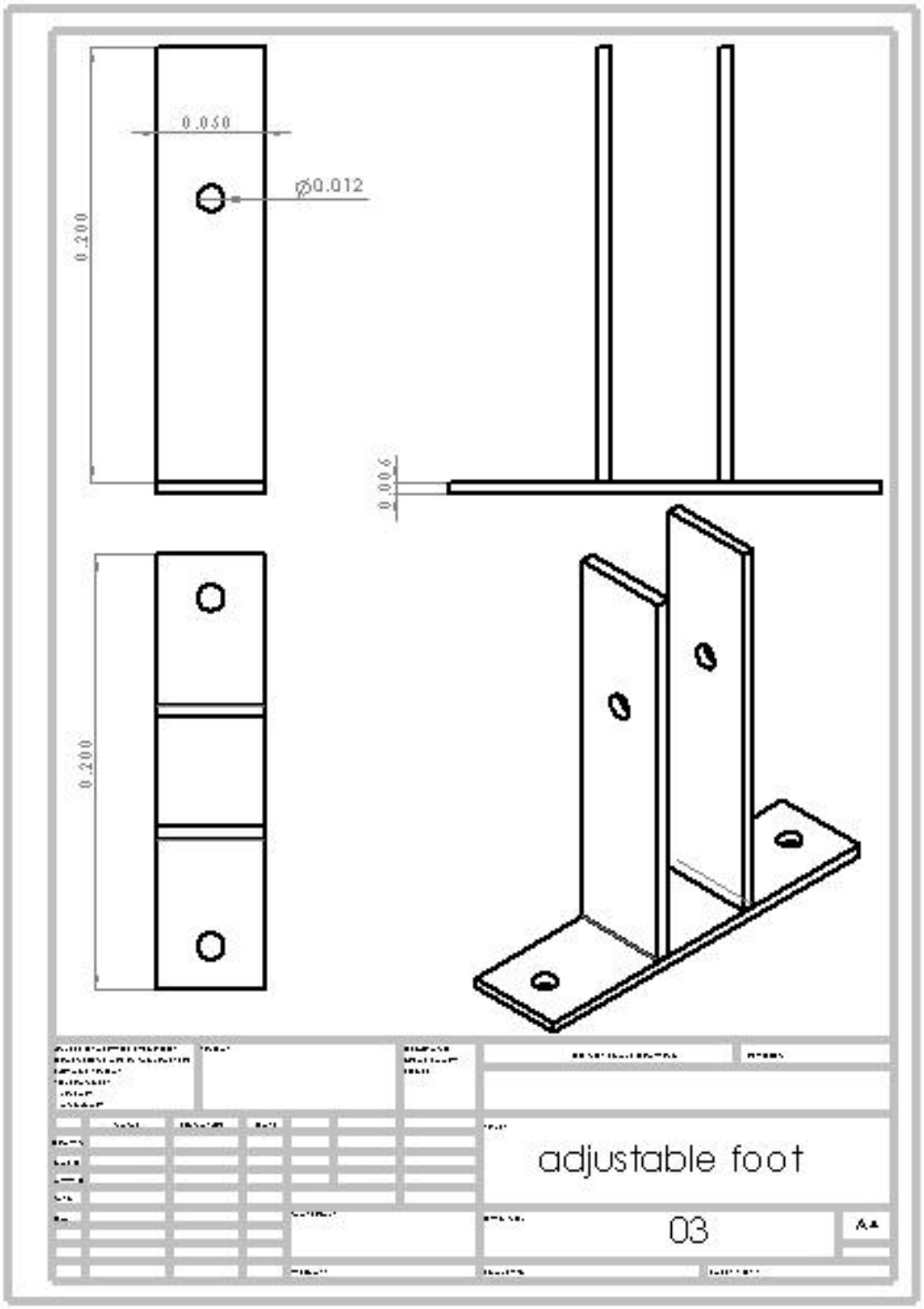

Figure 5.3: Adjustable Foot Dimension

APPENDIX D

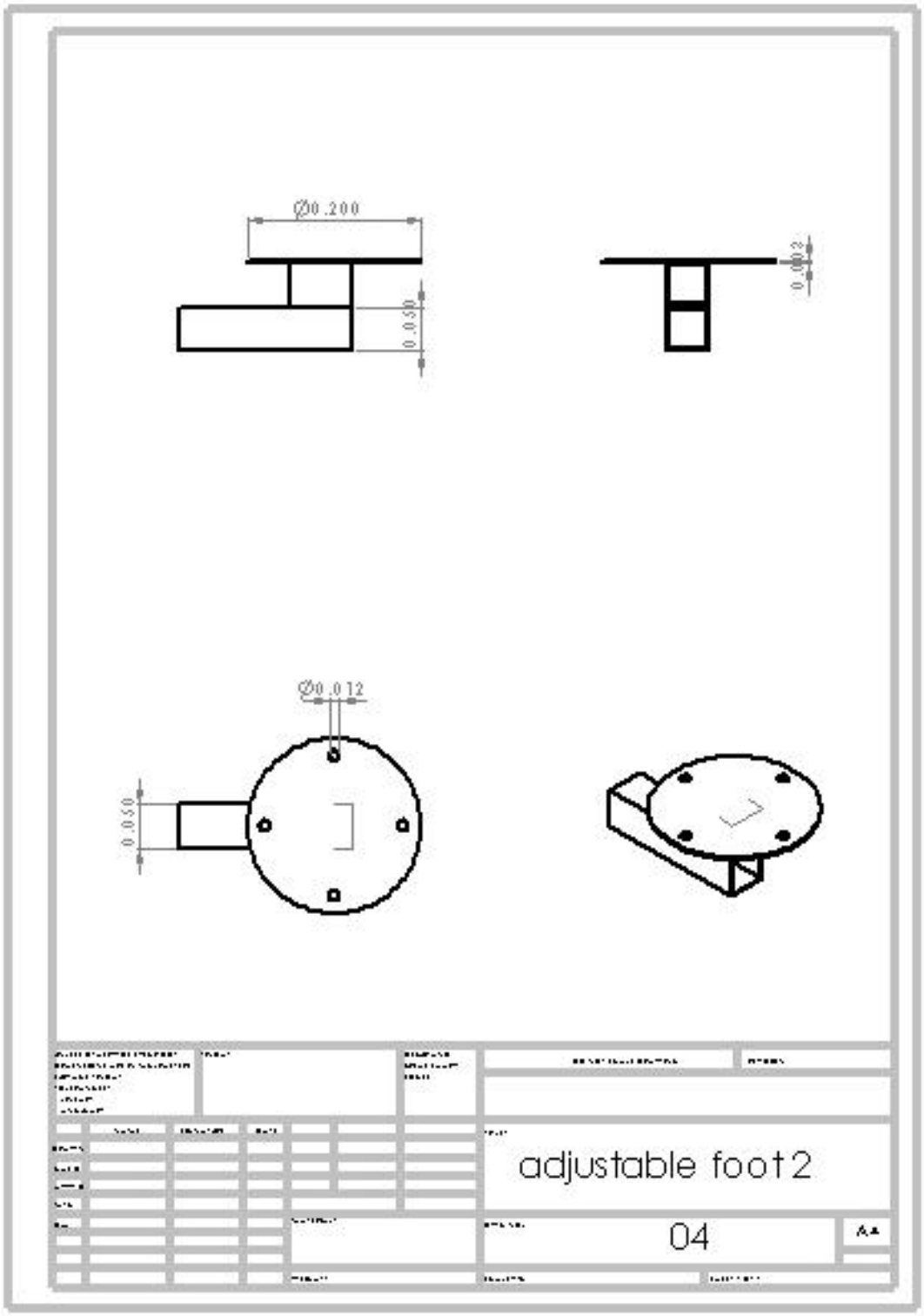

Figure 5.4: Adjustable Foot 2 Dimension

SUPERVISOR'S DECLARATION

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

Signature :
Name of Supervisor : EN ZULKIFLI BIN AHMAD @ MANAP
Position : LECTURER
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 report has not been accepted for any diploma and is not concurrently submitted for award of other diploma.

Signature :
Name : MOHD RIDWAN BIN KASIM
ID Number : MB10045
Date :

ACKNOWLEDGEMENTS

Foremost, this final year project will not be completed without the guidance of my supervisor, En Zulkifli Bin Ahmad @ Manap who inspired and advice me from the beginning of this project with patience. His encouragement and work enthusiasm motivated me to hurdle all the obstacles on completing the project. He has shared valuable information in the relevance of project study field and provided me with helpful ideas and reference sources.

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Last but not least, my family that helps me to overcome the entire problem during the fabrication of this project. During having trouble in finishing the project, my family show true effort as closer person to give very valuable support and keep cheer me up to through out the problem. They also give some opinions that really help in my project.

ABSTRACT

This project presents the development of the test rig for kicking soccer ball. By kicking soccer ball, deformation and velocity of the ball can be calculated. Several players are chosen kicking ball in test. At this rate, the problem occurs when human cannot achieve constant velocity when kicking the ball. The force produced by human is change due to single time. Besides that, human also has limit which is fatigue if continuously doing the same things in several time. The objective is to design and fabricate new test rig for kicking soccer ball and to analyze the experiments of test rig kicking soccer ball. In market, there are several products that have purpose kicking soccer ball such as "Soccer player automaton" and "Adidas rig kicking". There are built in different moving application. There are seven processes involved which is measuring, marking, cutting material with accurate measuring, drilling and milling, welding and painting. After finish the fabrication process, analysis will be take view in order to candidate the design. In the experiments, test rig will be focused on deformation and velocity of the ball. Maximum deformation was calculated when the initial ball change directly by absorb impact force and then release the ball back into it original shape. Ball velocity was calculated when the ball is moving once got the impact force between foot and ball. The result shows that the maximum deformation and maximum velocity are 11 mm and 6.09 m/s respectively. As the conclusion, the test rig kicking socccer is achieve the objective. There are severals recommendation to improve the products into some high level application of development more effective sports testing products in the future.

ABSTRAK

Projek ini membentangkan pembangunan pelantar ujian untuk menendang bola sepak. Dengan menendang bola, deformasi dan hadlaju bola boleh dikira. Beberapa pemain dipilih menendang bola dalam ujian. Pada kadar ini, masalah berlaku apabila manusia tidak boleh mencapai hadlaju malar apabila menendang bola. Daya yang dihasilkan oleh manusia berubah setiap masa. Selain itu, manusia juga mempunyai had dan keletihan jika terus melakukan perkara yang sama dalam masa yang panjang. Objektif projek adalah untuk mereka bentuk dan membina pelantar ujian baru untuk menendang bola sepak dan untuk menganalisis eksperimen pelantar ujian menendang bola sepak. Dalam pasaran, terdapat beberapa produk yang mempunyai tujuan menendang bola sepak seperti “Bola Sepak pemain automata” dan “pelantar menendang Adidas”. Ianya dibina dalam aplikasi bergerak yang berbeza. Terdapat tujuh proses yang terlibat iaitu mengukur, menandakan, memotong bahan dengan pengukur tepat, penggerudian, kimpalan dan mewarnakan produk. Selepas selesai membina produk, analisis eksperimen dilakukan terhadap produk.. Pelantar ujian akan menganalisis deformasi dan hadlaju bola. Deformasi maksimum adalah pengiraan apabila bola awal menukar secara langsung dengan menyerap daya hentaman dan kemudian membenarkan bola kembali ke bentuk asal. Hadlaju bola adalah pengiraan masa bola bergerak apabila terjadi daya hentaman pertama dari proses perlanggaran diantara kaki dan bola. Hasil kajian mendapati deformasi maksimum dan hadlaju maksimum masing-masing adalah 11mm dan 6.09 m/s. Sebagai kesimpulan, pelantar ujian menendang bola mencapai objektif projek. Terdapat beberapa penambahbaikan untuk meningkatkan produk ke tahap yang tinggi untuk pembangunan produk ujian sukan yang lebih berkesan pada masa hadapan.