# DESIGN AND FABRICATION OF GOLF BALL PICKER

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

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## SUPERVISOR'S DECLARATION

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

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## 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 degree and is not concurrently submitted for award of other degree.

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Especially for

My beloved family

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## ABSTRACT

Basically golf ball picker is often used in golf field because it would help worker to pick up golf ball after player finished played. Introducing this design of golf ball picker directly help worker to make their job much easier and reasonable. In this project also content main part that important which is describe this design or this product would perform well. In this project also it was using valve mechanism in order to pick up ball from grass surface. The main part has been manufactured outside product so that it could be assemble easily and with this method also carry out benefit that we could get from there. Overall this project has been done and finished on schedule.

# ABSTRAK

Secara asasnya pengutip bola golf meluas di gunakan di dalam sukan golf kerana ianya dapat membantu pekerja mengutip bola golf setelah pemain selesai bermain. Pengenalan kepada produk ini dapat membantu meringankan beban pekerja dengan menjadikan ianya lebih senang dan munasabah. Di dalam projek ini juga mengandungi bahagian utama yang penting di mana ianya menentukan sama ada produk berjalan dengan baik. Di dalam projek ini juga menggunakan injap sebagai mechanism untuk mengangkat bola golf dari permukaan rumput. Bahagian utama produk ini telah di bangunkan di luar daripada produk supaya ianya boleh di pasang dan di tanggalkan dimana ianya membawa banyak kelebihan yang boleh didapati. Secara keseluruhan projek ini telah di siapkan mengikut masa yang telah di tetapkan dan berjalan dengan sempurna.

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# CHAPTER 1

# INTRODUCTION

## 1.1 PROJECT SYNOPSIS

This project contains of designing and fabrication of golf ball picker. There have many differences between this golf ball picker with current design in market place. In this project we have to develop and improving it performance as well so that there has no doubt about the design and concept. This design much more portable because it easy to carry together when playing golf and more user friendly. In this project, it needs lot of skills and information and also knowledge such as Computer Aided Design software (AutoCAD), Solidworks 2005 software, using Turret Machine Trumatic 2020R FMC (punching machine), CNC Shearing Machine, CNC Milling machine, welding process and fastening process. This design obviously would help worker or player and the most important thing is get improving their activities much better. So, this design would through many processes before it get into prototype term in order to achieve the objective and off course customer need.

## 1.2 PROJECT PROBLEM STATEMENT

Nowadays the current method to pick up golf ball picker using machine and hand on only. Then the current methods are troublesome and difficult because it make user feel not suitable as well. Beside that current design would make user body posture not suitable and also make worker much more tired to pick the ball in case in big

quantity. Then material used in current design difficult to get compare this design which is more material availability because it using sheet metal in difference thickness and using PVC pipe.

## 1.3 PROJECT OBJECTIVES

Actually purpose of this project is to practice student to figure out problem using application using research and absolutely improving student skill and knowledge. This project also could train student as well before facing a real situation about producing product and then make student more independent in searching and expanding the experience and knowledge. So, objective of this project are;

i. To design and fabricate the golf ball picker for use in work that needed to pick up golf ball.
ii. To develop a golf ball picker in order to achieve the product on customer/worker need.
iii. To modified the mechanism of current product and try improving its functionality.

## 1.4 PROJECT SCOPE

In order to finish this project require precise scope of work and proper plan need to be followed because this project must through various process before it would be produce. Beside that this project title is new idea which is come from literature review about it articles and current design in market and then the most important is a as the knowledge isn't entirely covered in classes or lab. So it give us advantages to learn new process to produce this product and absolutely we could find lot of advantages neither we are realized or not. These are scope of work in this project,

Literature review about the design from any possible resource

i. Design the model of golf ball picker.

ii. Fabricate the design using material that been selected

iii. Test the design in demonstration

## 1.5 PROJECT BACKGROUND

Golf is a sport in which a player, using many types of clubs including a driver, a putter, and irons, hits a ball into each hole on a golf course in the lowest possible number of strokes. The minimum allowed diameter of a golf ball is 42.67 mm and its mass may not exceed 45.93g. The golf ball picker is functioning to pick the ball and can store until full before it get throw out. Now a days a current design and concept much advanced and there are also has troublesome method anyway. Then the design where has been choose should more ergonomics and if possible should minimum cost and one more things in material term. So the golf ball picker which is using valve system has been designed after through some of industrial design processes.

## 1.6 PROJECT SCHEDULE

| Activity | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Literature review | ■ | ■ | | | | | | | | | | | |
| Preliminary designing and conceptualization | | | ■ | ■ | ■ | ■ | | | | | | | |
| Material preparation | | | | | ■ | ■ | ■ | ■ | | | | | |
| Fabrication | | | | | | | ■ | ■ | ■ | ■ | | | |
| Analysis and Testing | | | | | | | | | | ■ | ■ | | |
| Presentation | | | | | | | ■ | | | | | | ■ |
| Thesis writing and submission | | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ |

**Table 1.1: Gantt chart**

According the gantt chart table 1.1, this project started at week 2 begun with literature review until week 4. Literature review is a way to study back past concept and

current design and find out all information and related information about golf ball picker using many way such as from internet, journal, and book and classmate opinion. With this it seems that we have foundation to start project because we have some knowledge about it.

Then, the processes continued with preliminary designing and designing process. In this task golf ball picker is sketch into three type of design. This task begins at week 4 and done with final conceptualization in 4 week. All the sketching and design would be bringing into next process which is conceptualization decision. After determine desired design, the design is draw using Solidworks software. This task finished on week 7.

After through preliminary designing, the project continued with material preparation process. It process took two week from week 6 and week 9 in order to decide the proper material that used in this project. Material suitability is very important in designing product because it would describe product properties as well whether it toughness or brittleness.

Then after material arrival the fabrication process began at week 8.The fabrication process using manufacturing process such as welding and rivet until week 11. After done with fabrication the analysis and testing about product took place at week 11 also. The result from testing process is figure out.

There has a two part of presentation about this project. First, presentation about progress of this project at week 8 and final presentation at week 14 after done fabricate. In this task we need to explain to panel about what we have done such as project objective, literature review and methodology of this project.

After that continued back with thesis writing began at week 9 until week at last this semester. The thesis writing takes about seven week to complete including all information about this entire project. In this thesis also include literature review,

methodology and result from this project Thesis writing started together with fabrication process and all the task is scheduled to be done about fourteen weeks overall.

## 1.7 PROJECT FLOW CHART

From the flow diagram on figure 3.1, this project started with discussion with supervisor about title after got from lecturer. This discussion covering project overview supervisor and throw out opinion that related about title and supervisor instruct to proposed a certain design and concept before go up to next step.

Then go to literature review about the title. The most important in these manner is a determined the project scope, objective and project planning so that we could easy get a clear overview. Then study and gather information related to the design and these entire task been done through study from internet, journal and other source.

After gather and collect all related information and obtain new idea and knowledge about the title, the project would continue with the design process. In this stage, the knowledge and idea should throw out in sketching process. After several design sketched, the best design would be choose among previous design so that we could carry on designing process. Then the selected design would be transfer to engineering drawing using SolidWork software in order to improve it capability and for analysis process.

After that material preparation which is has been confirm initially. Purpose of this process is a to determine the suitable and strength material follow the product and design requirement. This process covering purchased material, measuring material and cutting off based on requirement. Here, this process is important because the material would determine whether our product in way to failure or otherwise.

After all the drawing and material preparation done the next process is a fabrication process. This process based on dimension has been determined from

drawing.During this process, all the manufacturing process which is suitable could be used such as drilling process using CNC Machine, welding process and cutting material using CNC shearing machine.

After all process above done on schedule without any problem such as product malfunction or product brittleness, all material for report writing is gathered. The report writing process covering and including all manners from week 2 until finished. This process also included the presentation for final presentation of the project.

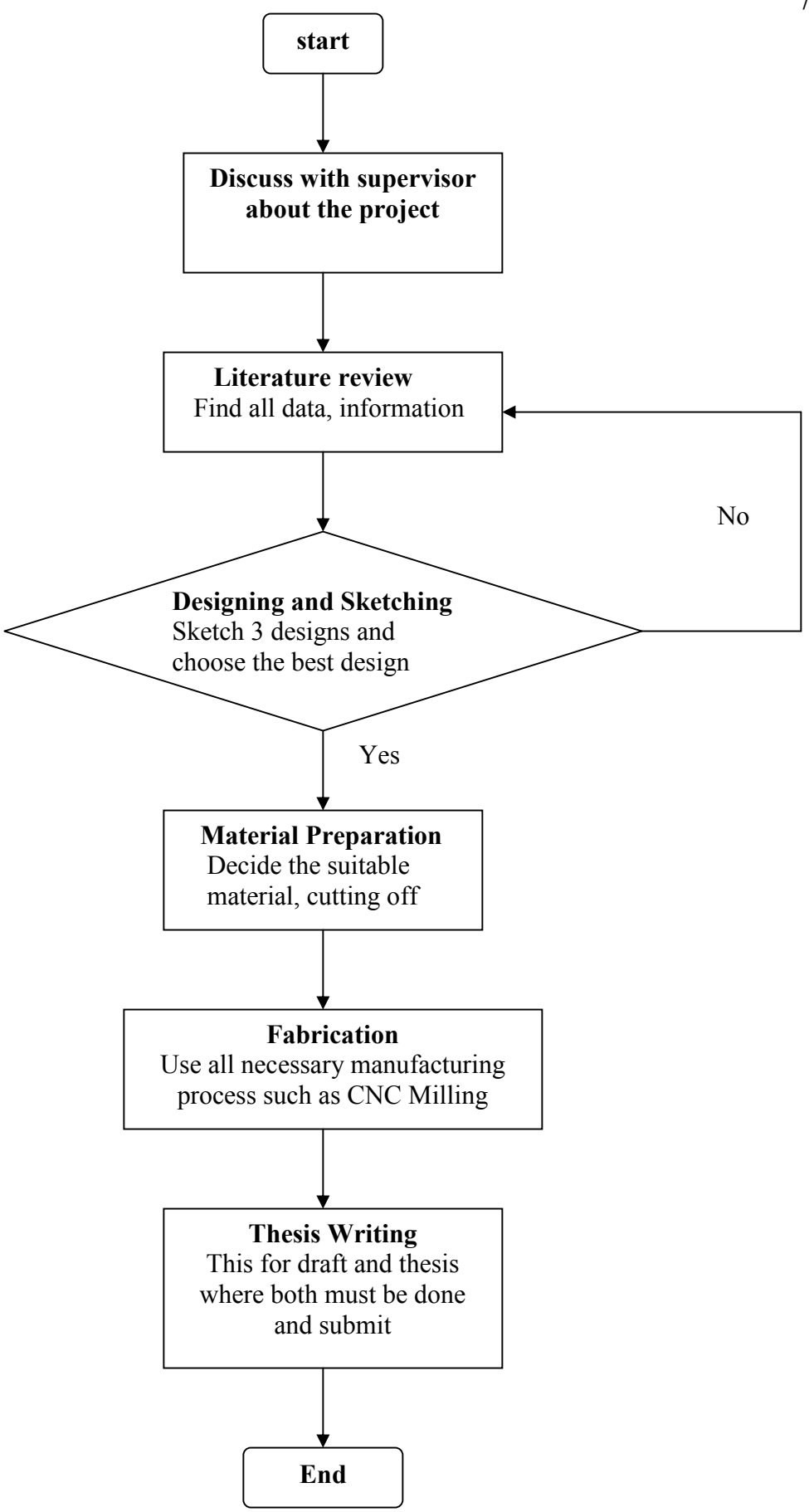


**Figure 1.1Project Flow Chart**

## 1.8 Project Expectation

i. At the end of this project student must learn and know a lot as possible manufacturing process and how to fabricate it
ii. This project would perform well and get to achieve it objective
iii. This design and it idea of function will enter current market in order to improving it functionality

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 INTRODUCTION

Today golf ball picker demand a level of quality from their range equipment that most balls retrieves don't match up to. Golf Ball Picker is a tool based on mechanical mechanism to perform it. Beside that electrical concept is often used in this product where would help worker to pick up the ball on land surface. Current design now shown the golf ball picker are design and created in big size which is could pick much ball absolutely and using lot of component even it material and perform in multi function.

Now a day the design of ball picker has been developed time to time depend on current market and customer demand. Mostly golf ball picker now has been through improvement by manufacturer but not at all. Newly engineering tires on each end of drum combined with pillow bearings provide added reinforcement that greatly maximizes strength and maneuverability.

Then now the basket or place to store the ball has totally new basket design features a locking clip that secure hopper to frame to added durability where could hold more than 350 ball and is the largest ball capacity of any lightweight ball picker. After that now a day the new mechanism which is newly design composite disc. The industry's strongest composite disc combines the best the strength and flexibility to endure the toughness picking conditions.

Study about the current design is important in order to determine what the product function really are and find out how it perform and getting out it advantages for each and then compare with other product that been review already. In this process, I decided to study about three current designs in market now in order to gain information that could help me created my new design as well.

### 2.1.1 Have-A-Ball

**Figure 2.1: Have a Ball**

#### 2.1.1.1 Advantages

i. Have-A Ball is the ultimate combination of simple design
ii. High tech materials.
iii. This innovative golf ball picker save time because pick a lot of ball
iv. Effectively picks up golf balls in tall grass and sand traps.

#### 2.1.1.2 Disadvantages

i. Material cost
ii. Easy to damage because can perform in tall grass and sand traps

### 2.1.2 Hand push ball picker

**Figure 2.2: Hand Push Ball Pickers**

#### 2.1.2.1 Advantages

i. More lightweight than Have a ball type
ii. Can pick up and store lot of ball

#### 2.1.2.2 Disadvantages

i. Much bigger and difficult to carry
ii. Hand push place not suitable because too smaller
iii. Difficult picks up golf balls in tall grass and sand traps.

### 2.1.3 Single Section Picker

**Figure 2.3: Single Section Pickers**

#### 2.1.3.1 Advantages

i. More toughness than other model
ii. Designed for lighter ball picking jobs and those hard to reach areas
iii. Can be pushed or pulled. Pull bar included.

#### 2.1.3.2 Disadvantages

i. User will face difficulty to handle it
ii. This size much bigger than difficult to carry

## 2.2 DESIGN

The design of golf ball picker must have based on much aspect actually. The design consideration must be done carefully and efficiency so that the design can be fabricate easily and the system functioning. The aspect that need to point out is a valve system where it be the most important criteria because it determine whether the product would fully function or otherwise. This valve wouldn't let the ball go down after through it and this is a important concept that would apply at all design. Then the material used in each design influence the selection thing because absolutely we need a lightweight material suitable with product size. The design is separated into three phases, firstly choose as many proposed design can be produce then choose 3 designs and try to improve it functionality and the last one is a new design with detail thing including dimension by using SolidWork software. Beside that the cost to design and fabricate must reasonable mustn't exceeded the budget given try to reduce waste.

### 2.2.1 Concept A

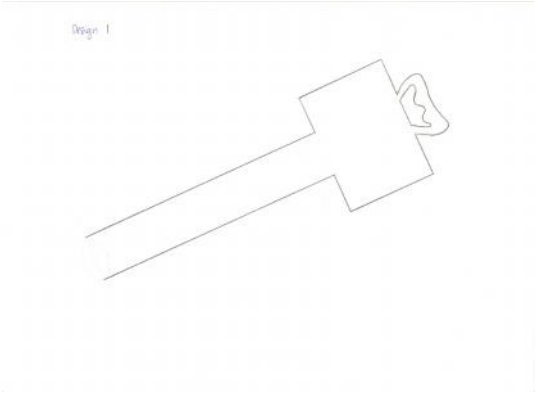

**Figure 2.4: Design 1**

The advantages of the design shown above is a this design more lightweight and easy to handling for user. Beside that this design makes body posture more suitable and this design too can store ball more than 10. Then the valve system more efficient which is using plate metal and spring in order to sniff up the ball and block it from go down back after through valve system. The disadvantages of this design are in term of material which is used PVC pipe and Aluminum plate that we know it not much toughness at all. Then it shape not stylish because the shape design is not important rather than valve system that describe design capability at all.

### 2.2.2 Concept B

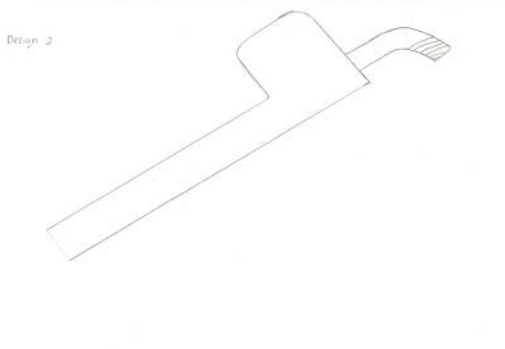

**Figure 2.5: Design 2**

The advantages of this design above are much toughness than previous design because the material used is a stainless steel at all. Beside that it is a fashionable design it easy to handling too. The disadvantages for this design it difficult to carry because it heavy and next disadvantages about it valve system where not suitable which is easy to damage because it valve system design is simple can't hold excessive burden from the golf ball.

### 2.2.3 Concept C

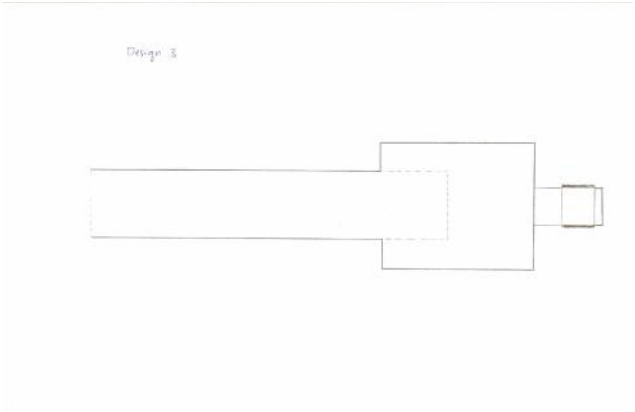

**Figure 2.6 Design 3**

The advantages of this design above are a lightweight which is used Aluminum for whole design. Then it valve system would perform well but in short term only because it might be easy to damage and can't be used again and the last one is it can store lot of golf ball because it design gave much more space. The disadvantages of this design is a about it valve system of course and the most important is it difficult to manufactured and it would make this cost going up.

### 2.2.4 Final Design

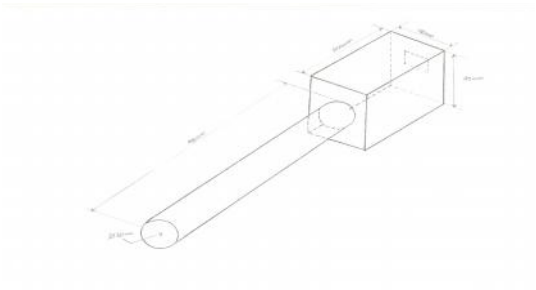

**Figure 2.7 Final Design**

After through Pugh concept table the best design has been determine where the first design or concept A been selected as a best concept**.** At this process the selected concept can be improve in order to make it performance much efficient or perform well. From that table shown that the concept A has much advantages and requirement needed such as;

i. **Easy to manufacture:** Joining component in Concept A using rivet and fastening and also little bit welding process.

ii. **Easy of handling:** Design in concept A concern about suitability when user using it especially body posture.

iii. **Material Availability:** Design in concept A using PVC pipe and Aluminum plate which is often used in market and industry. Beside that the cost are reasonable.

iv. **Able to store the ball:** Design in concept A has a space sizing same as design in concept C has but design in concept C describe it difficult to form event though it seem stylish.

## 2.3 TURRET PUNCH MACHINE

**Figure 2.8 Turret Punch Machine**

The main function of turret punch machine is a for sheet metal working machine such as forming, bending and punching. The machine is designed for fast operator set-up and cycle times. With 58 tools station 4 which are with an accuracy of 0.001 degree. This machine equipped with Fanuc 18PC Multi-Axis CNC control which is used to motion the carriage and table in the X,Y direction as well as T (tool selection) and C (tool rotation). With feed rate, ram speed and ram position control this machine can process jobs at faster rate than others would take to set-up tooling alone. Using PHNC (Power Hydraulics Numerical Control) feature to set depth of the form required can control specialized forming actions.

This Trumatics 2020R FMC has a 30 tone press capacity can handle a sheet size 1270mm x 4000mm with one reposition to a maximum of 3.2mm gauge material. Tooling for punch press consists of a punch, die and stripper. The punch is located in a guide mechanism that fits in the turret on a turret punch press. JetCAM being the software used to program for this machine is able to interact with CAD/CAM. The flexibility of this software allows for geometric file produced in a DXF or IGES format to be imported and edited in a GCD format to be machine.

The CNC Turret Punch Press gives remarkable productivity for the components having many perforations or requiring many punches. It is able to punch 3mm in M.S., 4mm in Aluminium & 1.6mm in S.S. and has vast tooling potential for the increased versatility.

This results in significant saving in production cost and noticeable increase in productivity. This has a great impact on job work cost and so we are able to do job work with excellent quality at affordable cost.

### 2.3.1 Benefits of CNC Turret Punch Press

i. The CNC Turret Punch Press gives high productivity in an economical way.
ii. It has the ability to produce variety of components without re-tooling and there by saving in production cost.
iii. Allow maximum production line for machine to run, while other component are being programmed

## 2.4 CNC SHEARING MACHINE

**Figure 2.9: CNC Shearing Machine**

Shearing is a process for cutting sheet metal to size out of a larger stock such as roll stock. Shears are used as the preliminary step in preparing stock for stamping

processes, or smaller blanks for CNC presses. During the shearing process, an upper blade and a lower blade are forced past each other with the space between them determined by a required offset.

Material thickness ranges from 0.125 mm to 6.35 mm (0.005 to 0.250 in). The dimensional tolerance ranges from ±0.125 mm to ±1.5 mm (±0.005 to ±0.060 in). The shearing process produces a shear edge burr, which can be minimized to less than 10% of the material thickness. The burr is a function of clearance between the punch and the die (which is nominally designed to be the material thickness), and the sharpness of the punch and the die.

The illustration at next page had shown a two-dimensional look at a typical metal shearing process. Note how the upper shear blade fractures the metal workpiece held in place by the workholding devices. The sheared piece drops away.

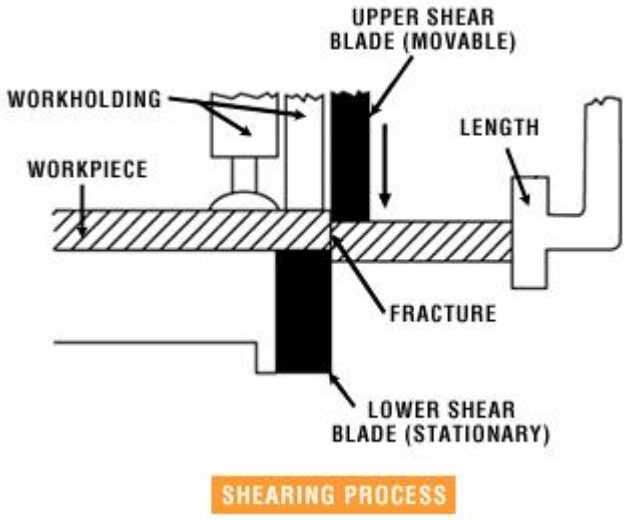


**Figure 2.10: Shearing Process Features**

Typically, the upper shear blade is mounted at an angle to the lower blade that is normally mounted horizontally. The shearing process performs only fundamental

straight-line cutting but any geometrical shape with a straight line cut can usually be produced on a shear. Metal shearing can be performed on sheet, strip, bar, plate, and even angle stock. Bar and angle materials can only be cut to length. However, many shapes can be produced by shearing sheet and plate.

Materials that are commonly sheared include:

i. Aluminum
ii. Brass
iii. Bronze
iv. Mild steel
v. Stainless steel

## 2.5 CNC MILLING MACHINE


**Figure 2.11: CNC milling machine**

A milling machine is a machine tool used for the shaping of metal and other solid materials. Its basic form is that of a rotating cutter which rotates about the spindle axis (similar to a drill), and a table to which the workpiece is affixed. In contrast to drilling, where the drill is moved exclusively along its axis, the milling operation involves

movement of the rotating cutter sideways as well as 'in and out'. The cutter and workpiece move relative to each other, generating a toolpath along which material is removed. The movement is precisely controlled, usually with slides and leadscrews or analogous technology. Often the movement is achieved by moving the table while the cutter rotates in one place, but regardless of how the parts of the machine slide, the result that matters is the relative motion between cutter and workpiece.

Milling machines may be manually operated, mechanically automated, or digitally automated via CNC (computer numerical control).Milling machines can perform a vast number of operations, some of them with quite complex toolpaths, such as slot cutting, planing, drilling, diesinking, rebating, routing, etc.

The Toolroom Mills combine the power of CNC with the ease of manual control. Haas CNC verticals have travels ranging from 406 x 305 x 254mm (xyz) on the Mini Mill and Super Mini Mill to 3048 x 1016 x 762mm on the monstrous VF-11. Workpiece sizes run the gamut, too, with tables available from 305 x 914mm all the way up to 711 x 3048mm.

The range of possible applications is as varied as the capacities: 7.5 hp Mini Mill, 15 hp Super Mini Mill, 20 and 30 horsepower motors for the VF line; speeds ranging from 0 to 7500 rpm, with options for 10,000, 15,000 and 30,000 rpm; and torque ratings up to 450 ft-lb. These machines are flexible enough for both high-torque, heavy-duty cutting as well as your finest high-speed machining operations.

## 2.6 GAS METAL ARC WELDING (GMAW)

Welding is a fabrication process that joins materials, usually metals or thermoplastics, by causing coalescence. This is often done by melting the workpieces and adding a filler material to form a pool of molten material that cools to become a strong joint. This is in contrast with soldering and brazing, which involve melting a

lower-melting-point material between the workpieces to form a bond between them, without melting the workpieces.

The method joining that able to fabricate and assembled the ball store is Metal Inert Gas (MIG) welding. The equipment used in GMAW is a welding gun, a wire feed unit, an electrode wire and a shielding gas supply. When the control switch is turned on the wire feed, electrical power and gas flow are initiated. This causes an electric arc to be struck. The gas nozzle is used to direct the welding gas evenly into the welding zone.

The figure 2.6 below shows the basic structure of MIG nozzle

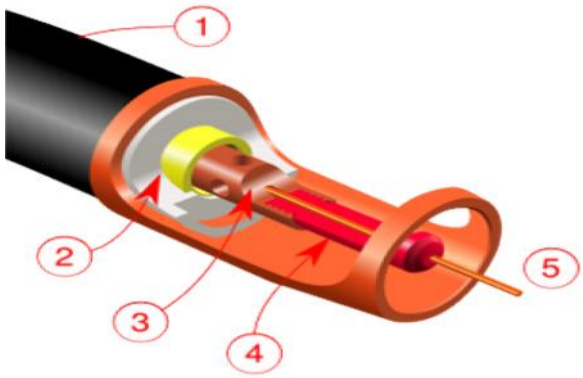


**Figure 2.12:** (1) Torch Handle (2) Molded phenolic dielectric (3) sheilding gas nozzle (4) Contact tip (5) Nozzle output

To perform gas metal arc welding, the basic necessary equipment is a welding gun, a wire feed unit, a welding power supply, an electrode wire, and a shielding gas supply.

## 2.7 RIVET PROCESS

**Figure 2.13: Rivet equipment**

Numerous types of rivets are known in the art. Blind rivets are distinguished in that the force required to set the blind rivet is not applied by force-absorbing stirrups on either side of a part to be riveted, but the head and foot of the rivet are pressed together by pulling on a mandrel passing through the interior of the blind rivet, the head being held at the part and the foot pulled towards the head by mean of the mandrel.

The advantage of the blind rivet consists in that access to only one side of the work is required. Various "designs" have been developed for self-drilling blind rivets, but the creation of self-piercing blind rivets has not been considered,
since the necessary deformability of the shank does not permit exertion of a piercing force.A disadvantage of the blind rivet consists in that holes must be drilled or punched in the work in order to set the blind rivet. This is difficult especially when two parts are to be connected to each other, the parts not being movable relative
to each other. Production of the holes in conjunction with orientation of the parts sometimes presents difficulties, so that the drilling and the setting of the rivet must take place in a fixed relative position of the parts.

## 2.8 FASTENING

The screw-fastening assembly process is one of the most widely used fastening methods in industrial assembly. However, little research has been conducted in this area in terms of the effect of the screw-fastening process on the assembly accuracy. In our

study, we observe that an order of magnitude difference (ranging from about 1 μm to over 10 μm) in the assembly accuracy may result using different screw-fastening conditions, and our analysis shows that, number of screws, datum pins, washer and holding force are the important factors affecting assembly accuracy during the screw-fastening process.

# CHAPTER 3

# METHODOLOGY

## 3.1 INTRODUCTION

After done literature review about the design where including in current market that covering up it design and functionality, the fabrication processes should be carry out by using machine and tool or equipment in lab. Basically for this design it would use familiar manufacturing processes such as milling, welding and shearing. The process should be done step by step following idea and step that been planed already. In this chapter it would covering all processes that been done and design drawing including dimension so that the explanation would be more clear and easy.

## 3.2 CONCEPT GENERATION AND EVALUATION

Three concepts for the golf ball picker were developed. These are evaluated against the datum or reference standard product in market with Pugh Concept Selection. From this table we could determine which concept will the best among other based on require criteria has been choose

| SELECTION OF CRITERIA | CONCEPT | | | |
|---|---|---|---|---|
| | Design 1 | Design 2 | Design 3 | Hav-A-Ball |
| Ease of handling | (+) | (+) | (-) | 0 |
| Durability | (+) | (+) | (+) | 0 |
| Ease to manufacture | (+) | 0 | 0 | 0 |
| Bending and stress strength | (-) | (-) | (-) | 0 |
| Material availability | (+) | (+) | (-) | 0 |
| Effiency performance (Valve) | (+) | 0 | (-) | 0 |
| Able to store lot of ball | 0 | (-) | (+) | 0 |
| Easy to maintanance by common tool | (-) | (-) | (-) | 0 |
| Light weight | (+) | 0 | 0 | 0 |
| Manufacturing cost | (+) | (+) | (+) | 0 |
| Pluses | 7 | 4 | 3 | |
| Sames | 1 | 3 | 2 | |
| Minus | 2 | 3 | 5 | |
| Net | 5 | 1 | -2 | |
| Rank | 1 | 2 | 3 | |

**Table 3.1: Pugh Concept Selection**

## 3.3 DESIGN OVERVIEW

Basically this design consist 3(three) main part or component where need to assemble together in order to get desire design. The first component is a box, the place for store the ball after being picked up. This box also has it holder and door for pick out ball from box. Main method joining for this part is a rivet process which is carries out many advantages. Then the second part is PVC pipe that connected together with box. This pipe initially in large length and after finalized design the length is reduce depend on suitability of user. Actually the function of this part as a track for golf ball that being picked up from valve into box. After that the third main part is valve system where it function seems like vacuum because it will pick up the ball or in other word inhale the ball from sand or grass surface. This valve is fully welded to joint it and using bolt and nut to joint it with PVC pipe.

## 3.4 FABRICATION PROCESS FLOW CHART

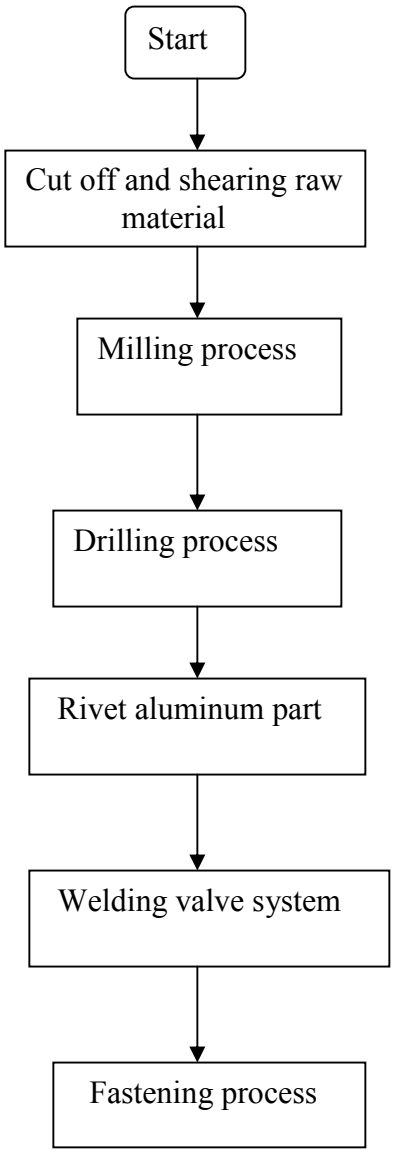


**Figure 3.1: Fabrication process flow chart**

## 3.5 MATERIAL PREPARATION

Material preparation is started after all designing process is done and complete including dimension so that it could be easy to prepare a require material that needed to fabricate. In this process material is chosen according to suitable material at FKM

laboratory. Beside that the other materials that need to be use have to purchase at market. After that the design in engineering drawing will go through fabrication process after finished measuring and cutting off material

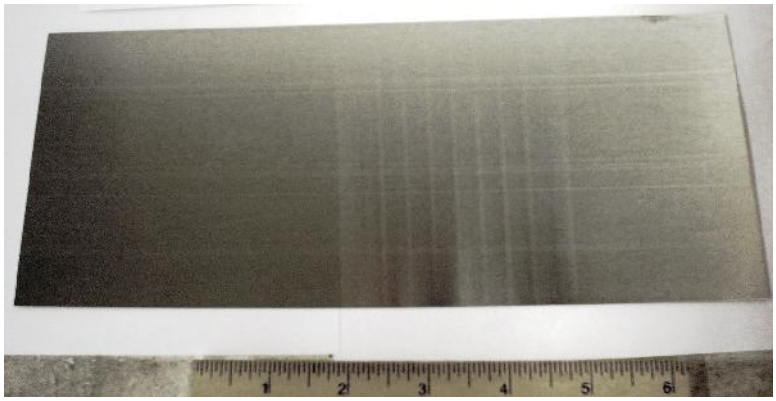

**Figure 3.2: Material Preparation And Selection**

**Figure 3.3: Material Preparation And Selection**

## 3.6 DESIGN DETAILS

Every part basically through manufacturing process and then after done or completed to be manufactured the part will be assemble together by joining with other mechanism such as using bolt and nut and by using superglue. This method is suitable

rather we manufactured lump because if one part doesn't work well the replacement could be done easily and it wouldn't affect entirely design. Then the fabrication process step by step at part by part is shown below;

### 3.6.1 Part 1

After material preparation step has been done the fabrication process start with the sheet metal cutting of by shearing machine for two set sheet metal with size 200mmX130mm, 200mmX180mm each one. At the same the PVC pipe also been cut off using saw to get desire dimension.

**Figure 3.4: Cutting Of PVC Pipe**

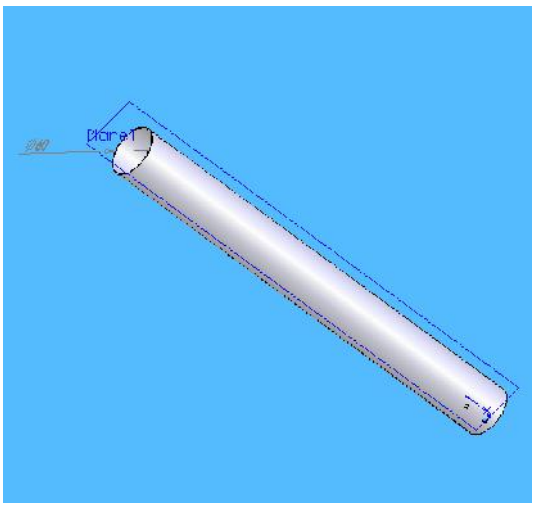


**Figure 3.5: Part 1 Drawing**

### 3.6.2 Part 2

After done it, a small sheet metal with size 40mmX30mm also been cutting off in order to start fabricate valve system which is consists spring and ensile. Valve system has been built outside and would be assemble with main structure after done it because a space it would more easy for fabricate outside main design.

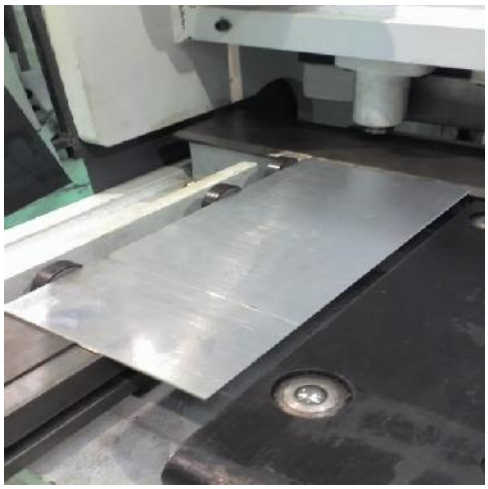

**Figure 3.6: Shearing Process**

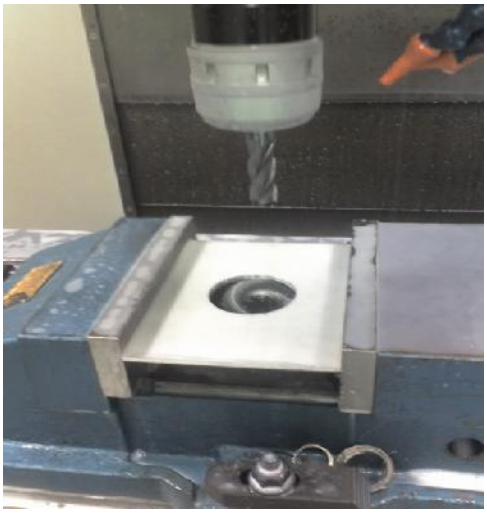

**Figure 3.7: Milling Process**

Next step in this fabrication process is a make a hole at sheet metal that been shear before. It using CNC Milling machine where basic form is that of a rotating cutter which rotates about the spindle axis (similar to a drill), and a table to which the workpiece is affixed. Milling machines can perform a vast number of operations, some of them with quite complex toolpaths, such as slot cutting, planing, drilling, diesinking, rebating and routing. We have to draw a design using MasterCam software and then would be transfer into CNC program before machine center at CNC Milling machine

read it. After that the machine would run and operate automatically until the desire shape done.

After that to joint all these Aluminum part is using rivet process. This process much easier and reasonable as well. It also often used in engineering field especially in air craft and manufacturing process. Before the rivet process proceeds the place that needs to rivet must be drill a little bit so that the rivet would work very well.

**Figure 3.8: Rivet Process**

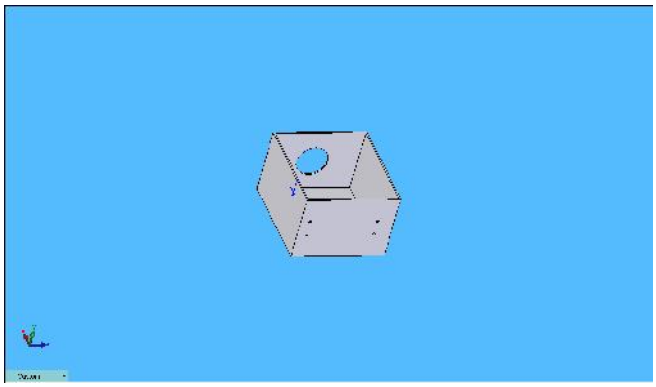

**Figure 3.9: Part 2 Drawing**

### 3.6.3 Part 3

Next go through to welding process for valve system. These processes using MIG weld with Volt and wire speed has been determined depend on situation. The reason why using this type of welding because the sheet metal that used only 1.5mm thickness and it more proper if using MIG welding than Arc welding as well. Beside that there has no much in using this welding because the place that want to be weld is only 15mm-25mm and it required skill to weld it because as we know before it would getting difficult to weld a small place or part than a bigger part.

**Figure 3.10: Welding Process**

**Figure 3.11: Cutting Off Material For Valve System**

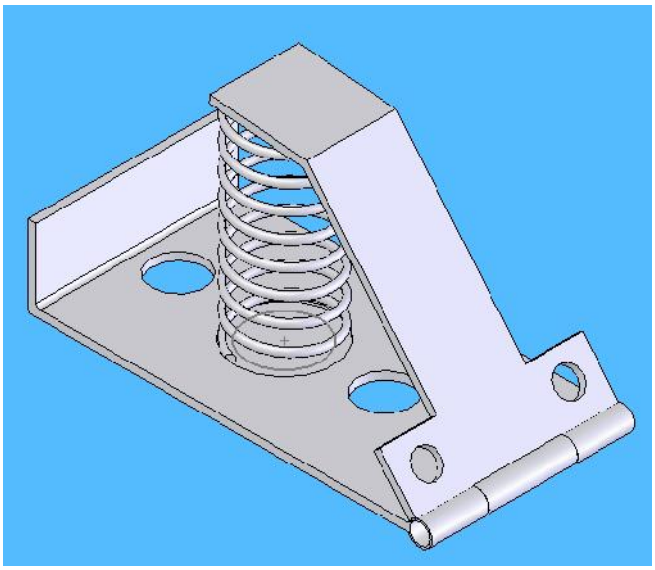

**Figure 3.12: Part 3 Drawing**

This part then would be place at end of PVC pipe and joining there using fastening process. Using this method of joining the valve part can be replace easier if the current valve damage or malfunction. Then between spring and plate it joining using superglue or 3 ton glue which is proper method because it hard to weld small spring and joint it with plate and the result would shown not good.

## 3.7 ASSEMBLE DRAWING

From this assembly drawing we could see the actual features about this design after done manufacture part by part. As noticed before this design basically consist three main components and will be assemble together then. The reason why this design is manufactured by part because it would make easy to replace any damage or failure component especially valve mechanism in case where the spring wouldn't elastic as well when we would like to use it. The assemble drawing below shown in isometrics view, back view and front view so that the clear overview could be easily to show.

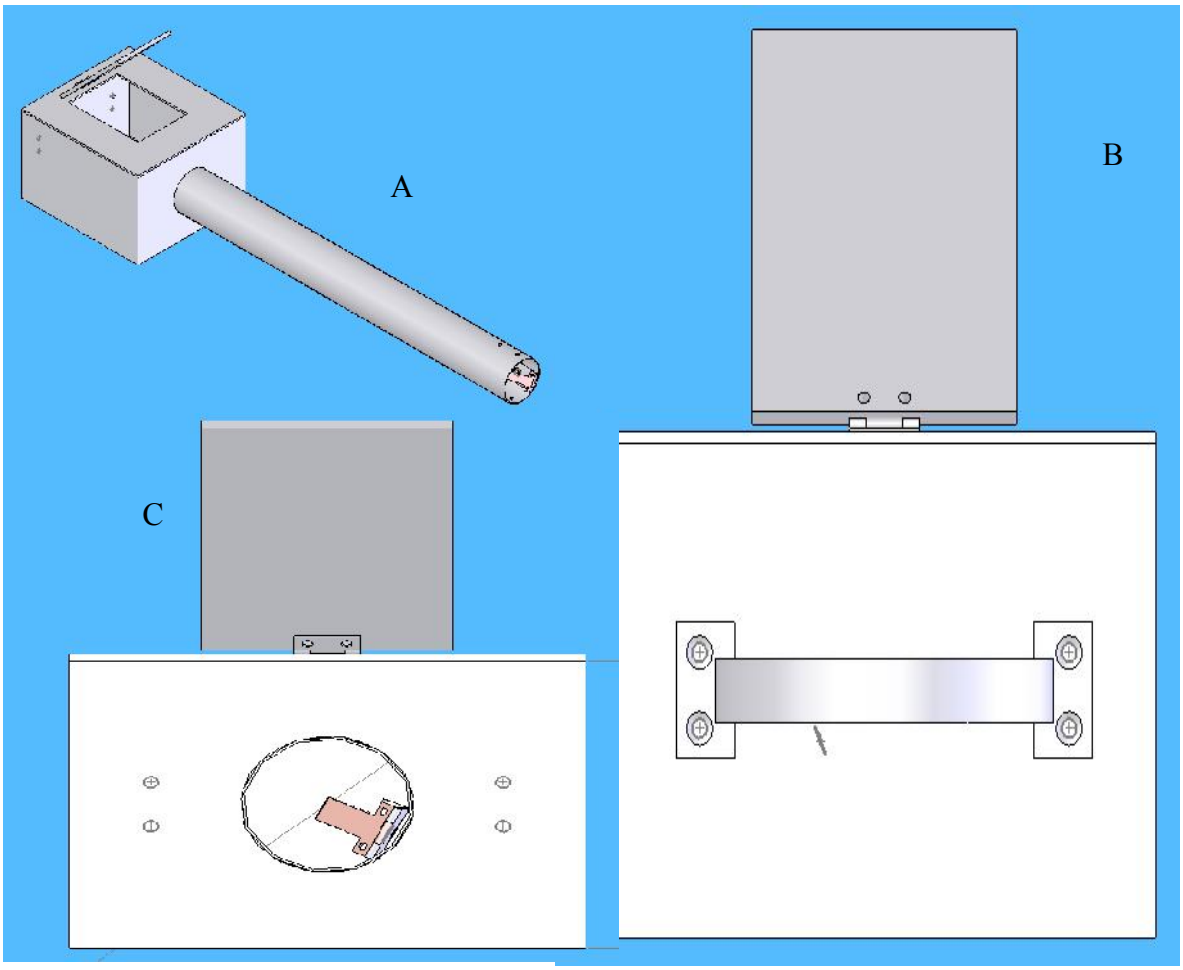


**Figure 3.13: Assemble Drawing (A) Isometric View (B) Back View (C) Front View**

## 3.8 CONCLUSION

As conclusion all design and product that intend to be manufactured basically would through various manufacturing process. In this design the process that been through wasn't strange process because this manufacturing or fabrication process was a common process such as milling, drilling, rivet and welding.

In this design the part was being manufactured part by part and then finally the assembly process would hold in order to get desire design. Beside that this method

would easier us because the damage part can be replace anytime and isn’t hard to replace it and it directly give benefit such as reduce cost and save time.

# CHAPTER 4

# DATA ANALYSIS AND DISCUSSION

## 4.1 INTRODUCTION

After done fabrication process the design would through testing process where the data would be taken and then analysis process by using Solidwork+Cosmos software where could determine the strength and ductility of product when it perform. In this process too we could notice the design functionality when the data from testing process in demonstration are gained and being tabled then. After done with it the discussion would took place which is come out from the result in testing process and all matter about the design such as it specification including it weight and dimension.

## 4.2 PRODUCT SPECIFICATION

This specification actually was change a little bit from initial plan because after through some processes such as fabrication process and material preparation process the result shown improper result. After done with it the final specification could be finalized as shown below;

### 4.2.1 Material

i. Aluminum for place of store golf ball
ii. PVC pipe
iii. Zink for valve system

### 4.2.2 Dimension

i. Refer appendix for all part dimension

### 4.2.3 Fabrication Method

i. rivet, fastening process and glue to join part by part
ii. shearing machine to cut off Aluminum plate
iii. CNC Milling to make hole on Aluminum plate
iv. welding (MIG) to joint part at valve system

### 4.2.4 Overall weight

- It was estimate 1000g

## 4.3 TESTING PARAMETER AND DATA RESULT

Basically the testing process is conducted in order to determine the design performing well when it is being used to pick up the golf ball. This result from testing process is important because from that we could improving it functionality and determine which step it would start to malfunction if the result in failure term. This process was conducted by using the design to pick up 20 golf ball and the result from testing process is shown below;

| BALL | RESULT | BALL | RESULT | BALL | RESULT |
|---|---|---|---|---|---|
| 1 | OK | 6 | OK | 11 | OK |
| 2 | OK | 7 | OK | 12 | OK |
| 3 | OK | 8 | OK | 13 | OK |
| 4 | OK | 9 | OK | 14 | OK |
| 5 | OK | 10 | OK | 15 | OK |

**Table 4.1: Testing process table**

From the table that shown above we could notice that initially there has some trouble because the ball wasn't stuck as well at the valve and need to push up so that the ball would stuck. After that the second ball was being picking up very well and so on because the next ball would push up the ball at the valve.

Beside that after got all data from testing process obviously the conclusion could be make whether the design perform well or otherwise. Testing process held in grass surface and sand surface because the surface there totally not same with floor in our daily life. After got the full data from testing process the improving work could be conducted because the first result of analysis for this design is already know.

## 4.4 PRODUCT ANALYSIS

When the first golf ball stuck at valve system, there have forces that acted on plate in valve system. We need to determine and study the effect on that which is bringing up by golf ball. To study the effect whether design would failure to perform well or it would damage when demonstration is held. By using Solidwork+Cosmos analysis software it would help us to study the stresses that acted on design and determine the condition of design such as crack and bending at design. Basically this process is very important because for engineer or designer who intend to fabricate and designing new product the analysis should be held because it directly help us a lot of benefit such as got reduce cost and know the design capable off.

### 4.4.1 Valve part

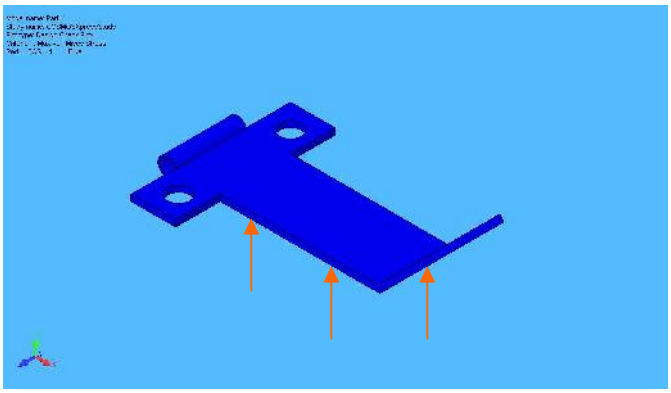

**Figure 4.1: Valve Part Under Load 10N**

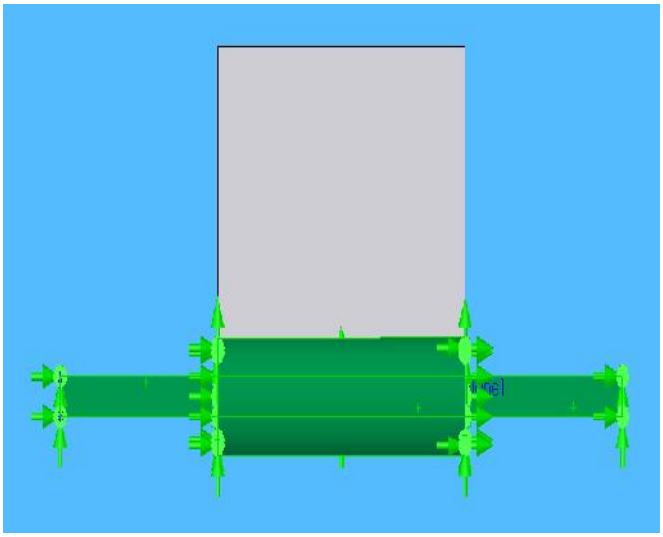

**Figure 4.2: Restraint**

### 4.4.2 Analysis valve part

| Bil | Part Name | Material | mass | volume |
|---|---|---|---|---|
| 1 | Valve Part 1 | Copper | 0.00516263 kg | 5.80071e-007 m^3 |

#### 4.4.2.1 Stress Result

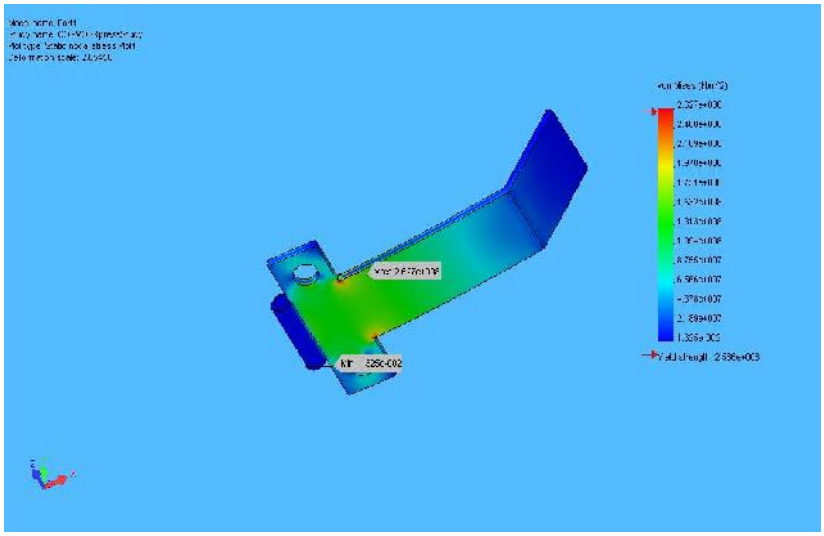

**Figure 4.3: Part1-COSMOSXpressStudy-Stress-Plot1**

| Type | Minimum | Location | Maximum | Location |
|---|---|---|---|---|
| VON: von Mises stress | 0.0132468 N/m^2 | (-2.7593 mm, 0.152954 mm, 7 mm) | 2.62651e+008 N/m^2 | 7.40976 mm, 1 mm, 18 mm) |

Based on data result that shown from **figure and table 4.3.2.1** the maximum and minimum stress is located at edge at plate that been analyzed because there has no much area to distribute the force acted on it and then the plate surface around it in good condition and suitable because no crack or too much bend occur there.

**Engineering stress defined as force divided by original area** The engineering tension test is widely used to provide basic design information on images/the strength of materials and as an acceptance test for the specification of materials. An engineering stress-strain curve is constructed from the load elongation measurements.

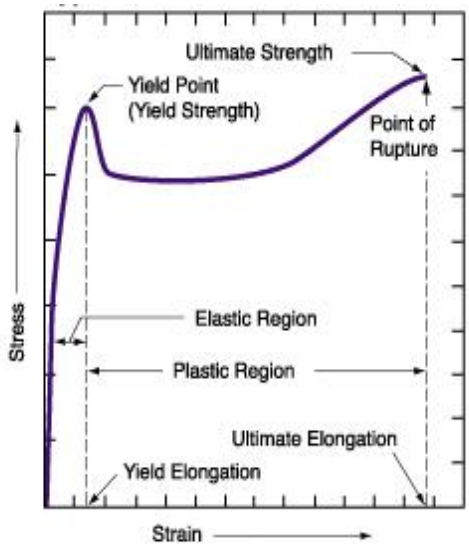


**Figure 4.4: Stress-strain Curve**

The two regions indicate two distinct forms of behavior:

i. Elastic region – prior to yielding of the material
ii. Plastic region – after yielding of the material

#### 4.4.2.2 Displacement Result

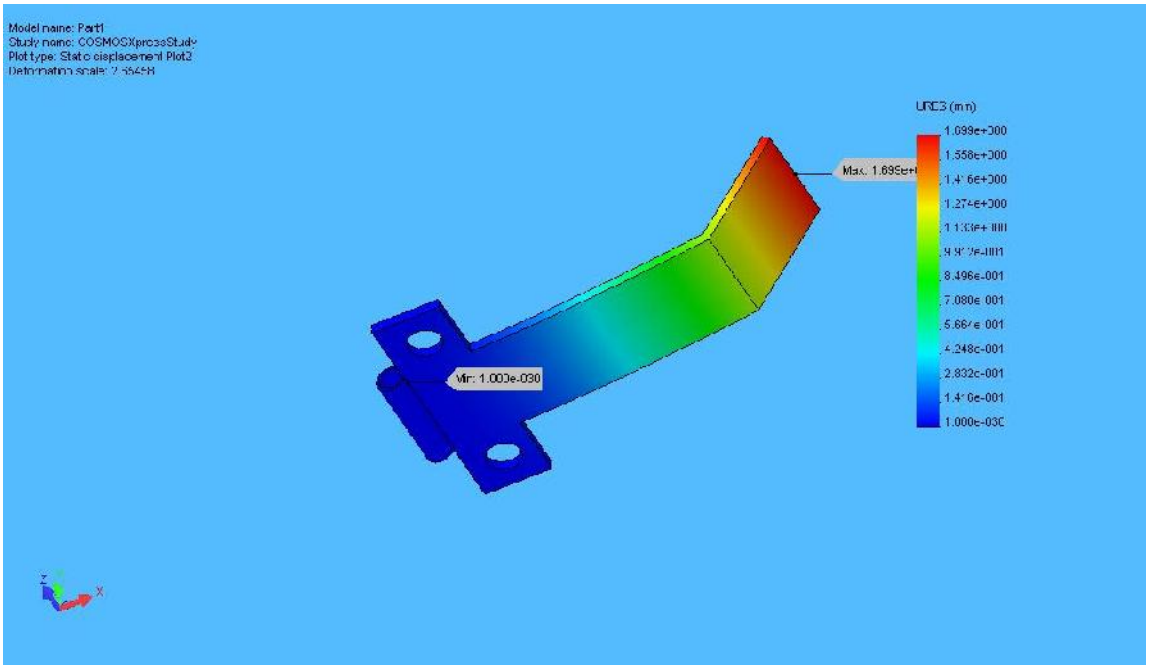


**Figure 4.5: Displacement Result**

| Type | Minimum | Location | Maximum | Location |
|---|---|---|---|---|
| URES: Resultant displacement | 0 mm | (-0.05 mm, 0.5 mm, 7 mm) | 1.69916 mm | (40.4853 mm, 8.48528 mm, 18 mm) |

#### 4.4.2.3 Deformation Result

**Deformation** is a change in the shape or size of an object due to an applied force. As deformation occurs, internal inter-molecular forces arise which oppose the applied force. Type of deformation is depending on the type of material, size and geometry of the object, and the forces applied, various types of deformation may result.

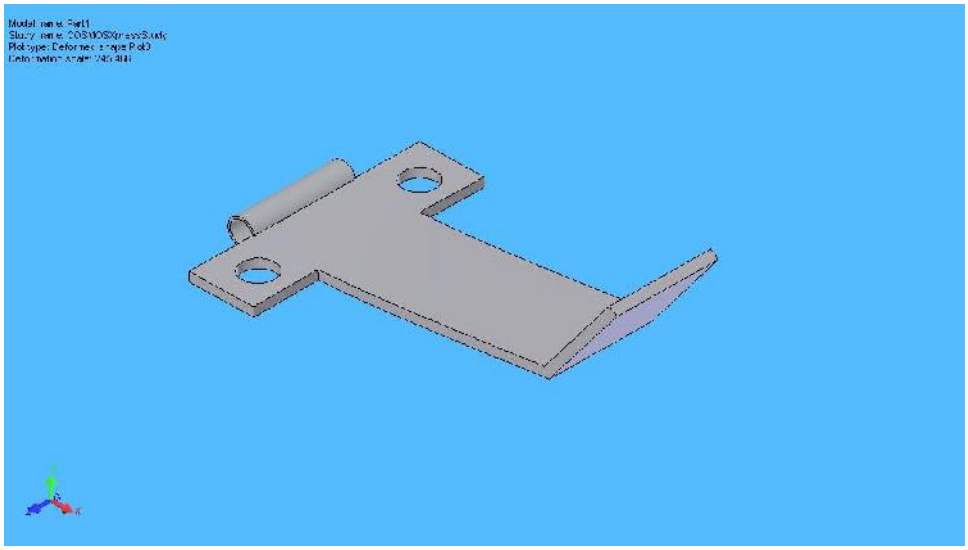

**Figure 4.6: COSMOSXpressStudy-Deformation**

The result shown the deformation scale is 2.6546 and when the all result that we analyzed it shown this design wouldn't failure at all because there has no image of crack and the value of stresses are in proper value.

#### 4.4.2.4 Analysis Report

| Property Name | Value | Unit |
|---|---|---|
| Elastic modulus | 1.1e+011 | N/m^2 |
| Poisson's ratio | 0.37 | NA |
| Mass density | 8900 | kg/m^3 |
| Yield strength | 2.5865e+008 | N/m^2 |

Based on product specification we noticed that design dimension and overall weight are important because it related to user suitability in term of it. The dimension especially length of PVC pipe is measured from average height of human who might be work as a golf ball picker. Then the material actually is important too because the

lightweight of product depend on material used. For example if used Galvanized Iron it would be heavy for design despite it has smooth surface and much shinier rather than Aluminum but Aluminum is the choice because we refer to customer need which is Aluminum much more lightweight and the price is reasonable.

Then based on data that collected from analysis process this design simply the best because the design and product specification totally in specification and there has no crack or bending occur on that. Beside that based on testing process where it purposing to determine whether the designs perform well or otherwise. Based on that the design is function and perform despite it has a little bit problem initially about the first ball.

## 4.5 CONCLUSION

After gained all the data the conclusion about design whether it performing well or otherwise could be notice and then the improving work being implemented in order to overcome the failure in previous. In this chapter it used two methods to analyze the design which is one is testing manually and the other one by using software. These two processes are depending on each other because the failure only could be determine by using these two methods.

# CHAPTER 5

# CONCLUSION AND SUGGESTION FOR FUTURE RESEARCH

## 5.1 SUMMARY

Basically golf ball picker could help worker pick up golf ball easier and directly reduce their burden because there has some places still using hand on to pick up the ball and there also has using a bigger mechanism which is to heavy to carry and troublesome. Using this design it would help this party particular for those who involve in this job.

To done this project it took co operation and creativity as well because sometime the idea comes suddenly and absolutely comes when in lab or home. This final year project through various manufacturing process and apply all process that we have learned in classes and lab.

In this project the manufacturing process involved such as milling process, shearing process, welding process, rivet and fastening process. From raw material until final product it would through these process after finished literature review about this product especially in current market now and design in software which is generate dimension together.

Beside that in order to finished this project also facing problem and absolutely the solution need to come out as soon as possible because if late to counter it the

problem won't settle immediately and would effect entire project especially cost and time.

## 5.2 RECOMMENDATION

Several recommendations I would like to express myself and faculty for this final year project design is product should be used in sand surface, grass surface because theses thing would help to push up the ball entering valve system as well. Then when to pick up the ball the product should perpendicular into sand or grass surface so that the force would act perpendicular at valve. Then the maximum ball could be entering product is around 50 ball.

## 5.3 SUGGESTION FOR FUTURE WORK

In future the mechanical mechanism in this project should be improving as well in order to keep the functionality of product and make easier for user especially worker that involved in this.

Besides that trying to improving design in term of material so that the design would much toughness and easy to maintenance it. After that trying using other mechanism to snift up the golf ball for example using vacuum concept and next mechanism using roller and gear concept which is more advance and reasonable.

i. This project should using advanced material where related in term of customer need and user suitability. For example material that hardness but it's not heavy.
ii. This prototype should be made as a product for marketing stage.
iii. The box using Acrylic because it's more stylish and reasonable
iv. The spring at valve system should be more elastic so that the valve would perform well
v. This design only perform on grass and sand surface

# REFERENCES


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2. **John A.Schey. 2000.** Introduction to Manufacturing Processes**. McGraw Hill**

3. **Golfweeks magazine**

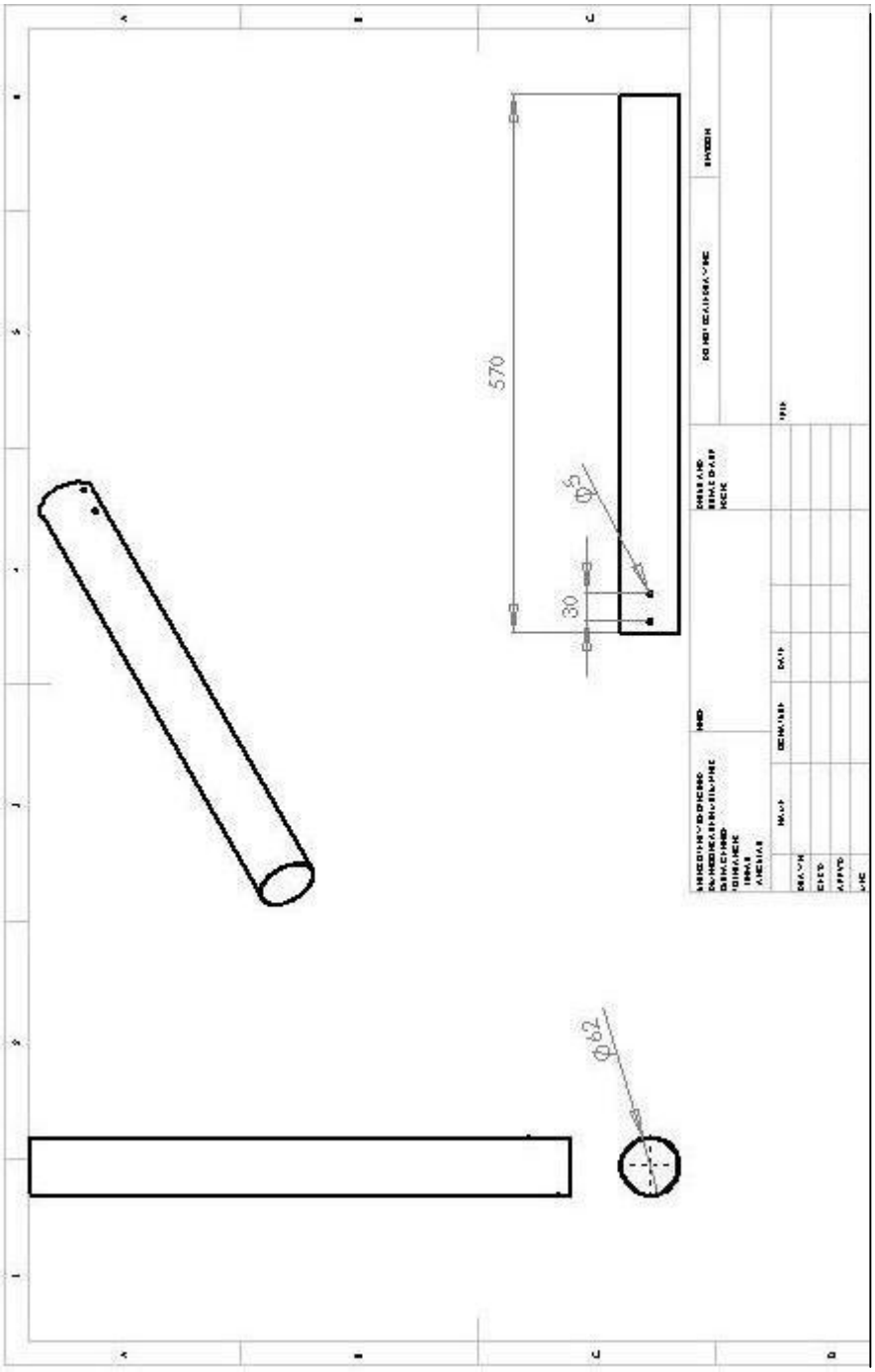
4. http://www.rbirangeballs.com

5. http://www.made-in-china.com/ Golf-Ball-Picker.html

6. **SOLIDWORK+COSMOSXpressStudy software**

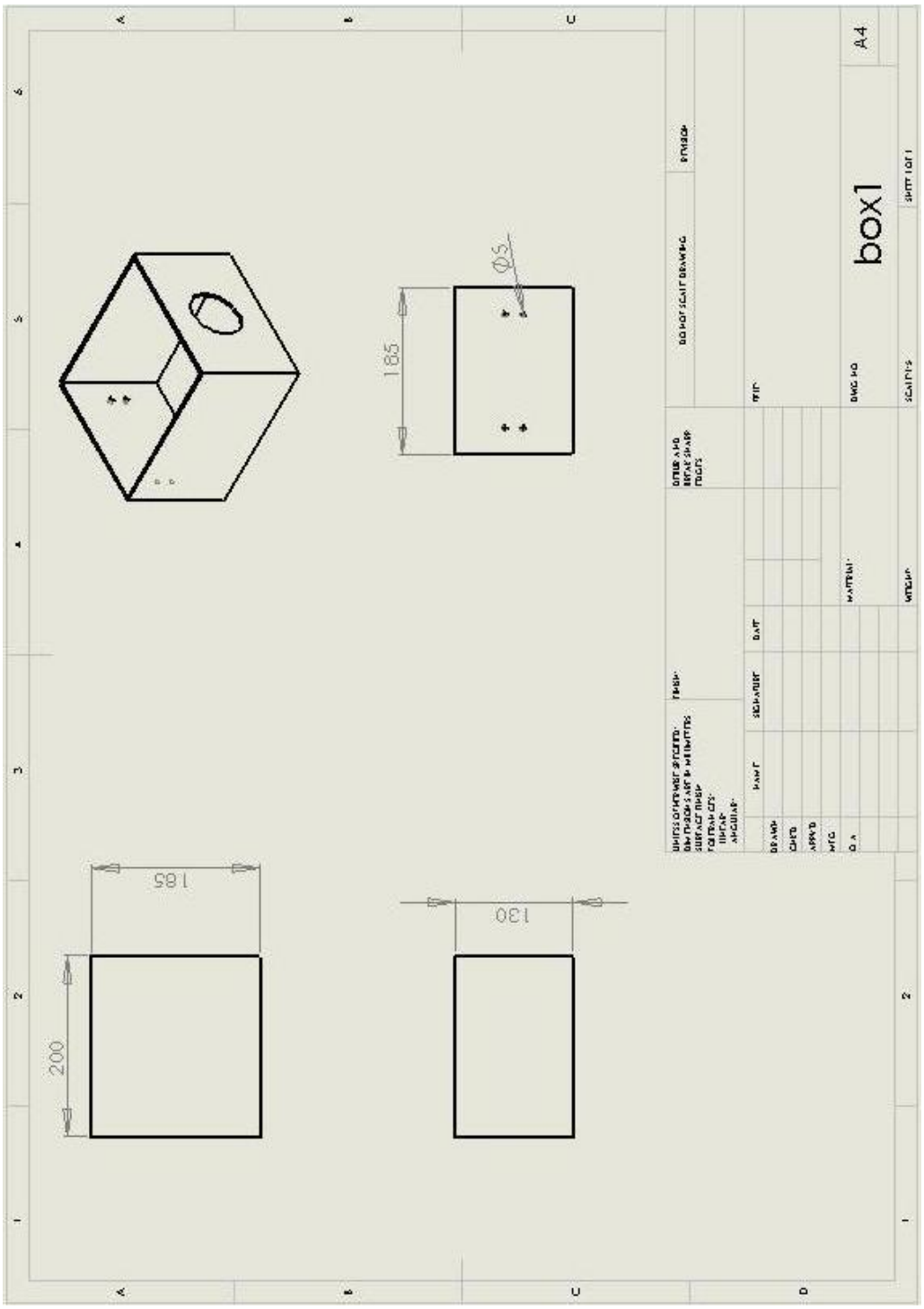
# APPENDIX A

## Part 1 Dimension



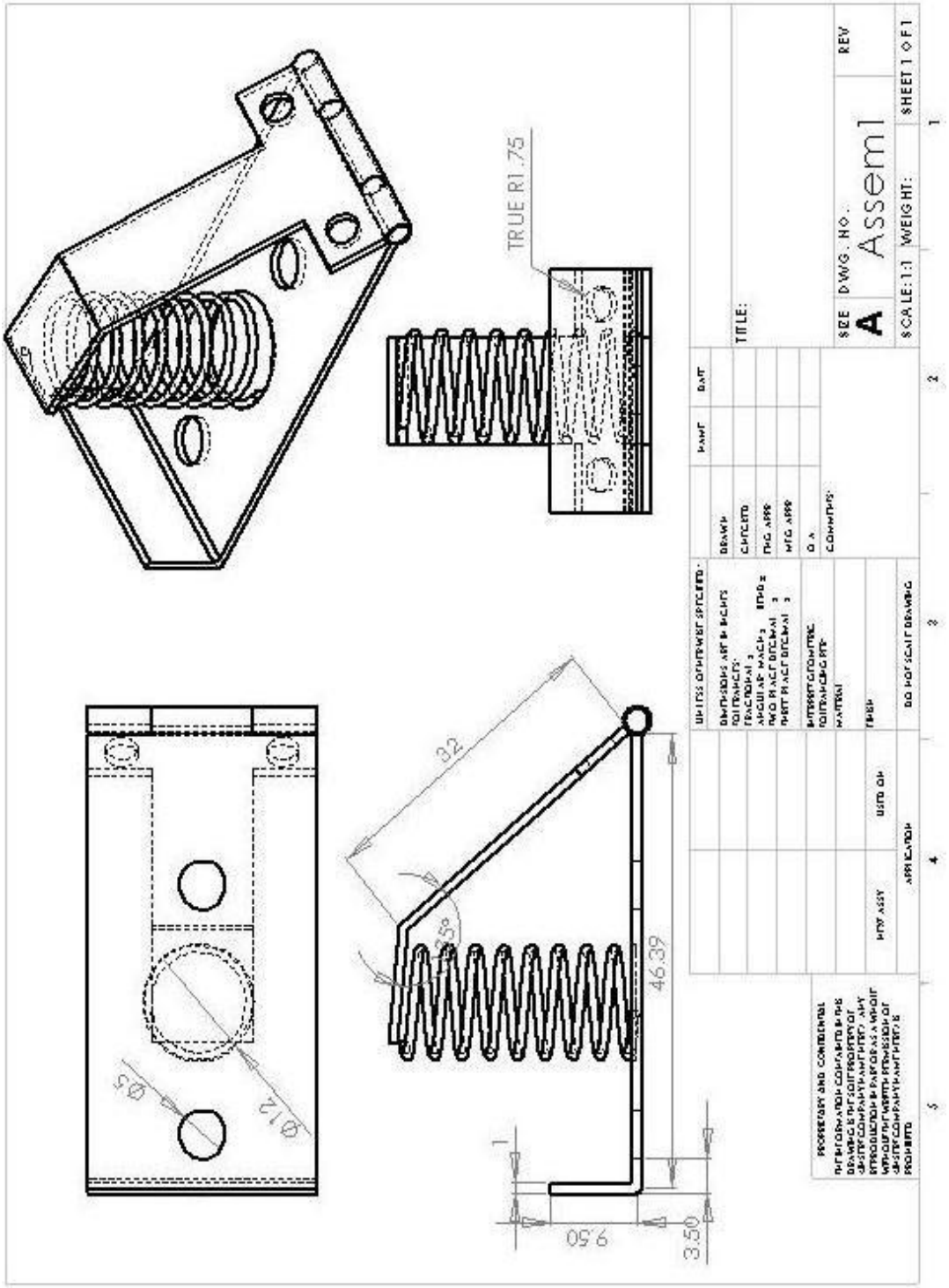
## APPENDIX B

### Part 2 Dimension



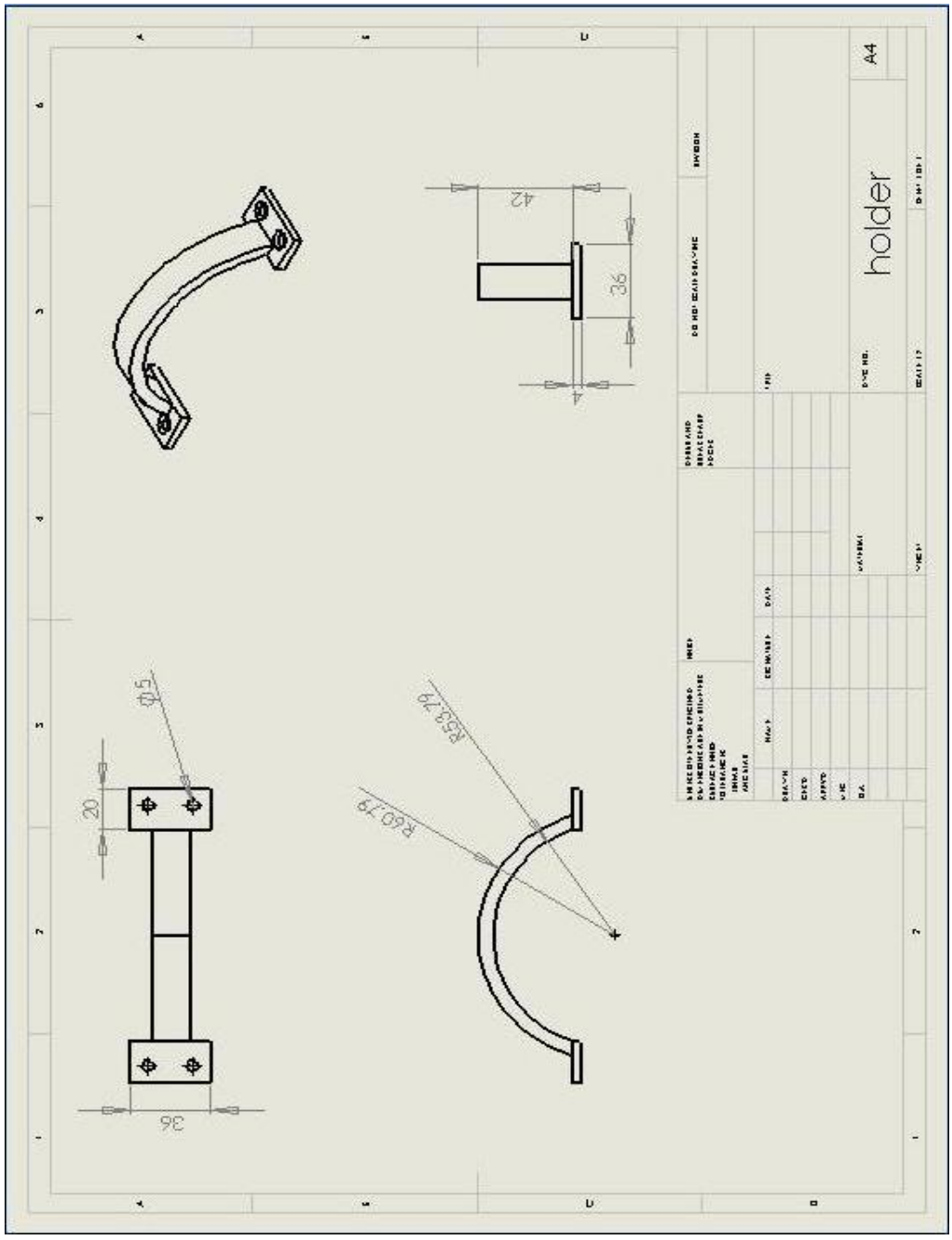
## APPENDIX C

### Part 3 Dimension



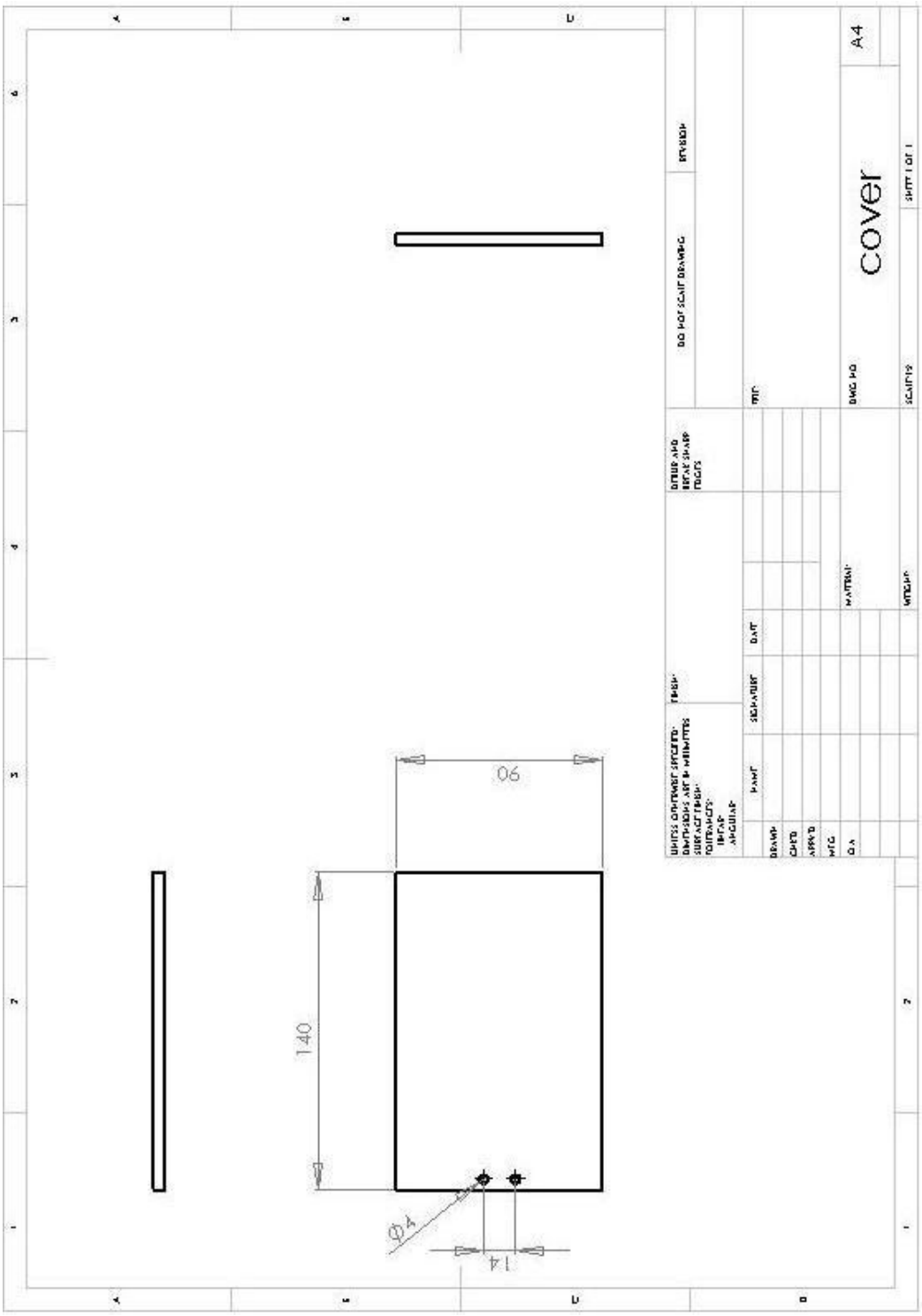
## APPENDIX D

### Holder Part Dimension



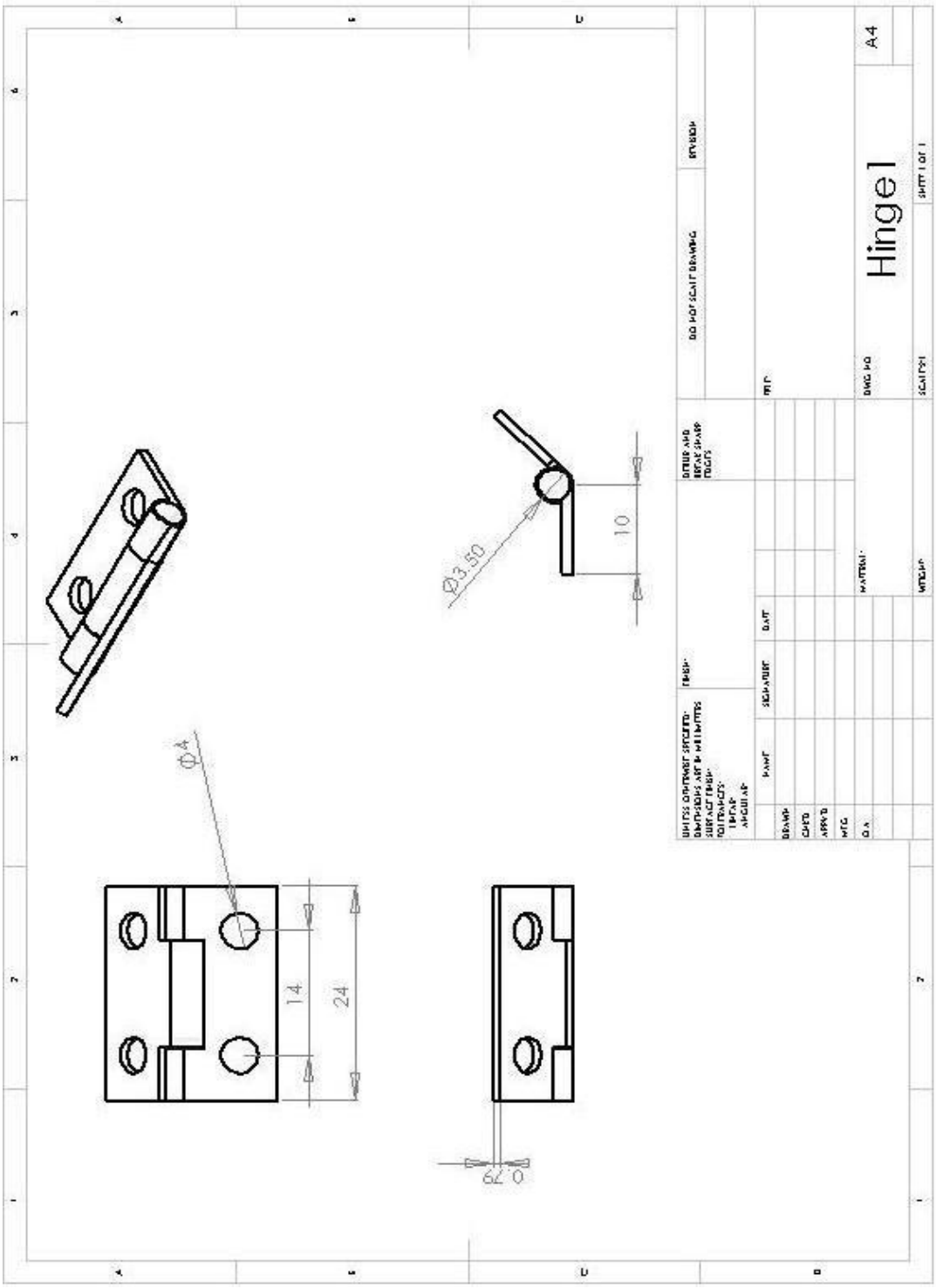
## APPENDIX E

### Acrylic Cover Dimension



## APPENDIX F

### Hinge Dimension



## APPENDIX G

### Product Features