

DESIGN A NEW CONCEPT OF RECYCLE TRASH BIN

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DESIGN A NEW CONCEPT OF RECYCLE TRASH BIN

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A report submitted in partial fulfillment of the requirements for the award of the degree
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We hereby declare that we have checked this project and in our opinion this project is satisfactory in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering

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I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged. The thesis has not been accepted for any degree and is not concurrently submitted for award of other degree.

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To my beloved father, mother and my family

Hj Jusoh bin Awang

Hjh Zaharah binti Embong

Mr Mohd Faizdzul bin Jusoh

Ms. Nur Liyana Faridza binti Jusoh

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ABSTRACT

Recycling can be defined as the “act of processing used or abandoned materials for use in creating new products”. A recycling bin is a container which used to keep garbage or disposed item before being act by the respective authority to bring it the recycling centre. Recycling bins can be found in various forms and sizes. Nowadays, there are a lot of models of recycle trash bin which do not have the correct specification and yet have the disadvantage. The trash was not compacted, so it will requires a lot of space at the landfill. As a result, some of the landfill cannot afford to take all the trash. Part of the objective of this project is to overcome the problems occur nowadays by fabricating and designing the new concept of the recycle trash bin. The main scopes of this research are for two type of trasher, which are the 325ml cans and 600ml bottles. The design of the new concept of recycle trash bin for this project is basically from the research of existing models found in the current market. It comes with the lots of advantages from two major models, which are “separated trash model” and “un separated trash model”. The main materials that being use to fabricate the recycle trash bin is metal. The cover of recycle trash bin is made from acrylic. In creating and fabricate the recycle trash bin it will use a lot of machines. After the fabrication process, this recycle trash bin will be able to compact the trash successfully. Compare to the other model that exists in today’s market, this new recycle trash bin in more suitable for the use of the household. It is because the size of this recycle trash bin is smaller and the specialty is that in one recycle trash bin, consumer will found two different containers. So it will able to reduce the space used. The shaft will connect to the compactor and the handle shaft of the recycle trash bin can support the load when being use to compress the trash. There are no failures found during compacting the trash. As the conclusion from this project, this new design of recycle trash bin will be able to help and overcome the problems occurs nowadays and give advantages to users.

ABSTRAK

Kitar semula adalah satu proses di mana barang-barang yang lama bertukar menjadi satu barang baru. Tong sampah ialah satu bekas yang digunakan untuk menyimpan sampah sebelum diambil oleh pihak berwajib dan di hantar ke pusat Kitar Semula. Tong sampah boleh di perolehi dalam pelbagai bentuk dan ukuran. Pada masa sekarang, terdapat pelbagai jenis tong sampah, tetapi kebanyakannya terlalu ringkas dan mempunyai kelemahan tersendiri. Sampah yang dimasukkan ke dalam tong sampah tidak di kemekkan terlebih dahulu. Ini akan menyebabkan pusat pelupusan sampah tidak dapat menampung sampah. Objektif bagi projek ini adalah untuk mereka dan mencipta satu rekabentuk baru yang boleh digunakan untuk mengatasi masalah yang berlaku sekarang. Projek ini memfokuskan pada dua bahan sahaja iaitu tin minuman 325mL dan botol 600mL. Rekabentuk baru ini adalah berdasarkan produk-produk yang ada di pasaran sekarang. Rekabentuk baru adalah hasil gabungan kelebihan bagi sesuatu produk yang mana terbahagi kepada 2 iaitu model tong sampah yang di asingkan dan model tong sampah yang bercampur. Bahan utama yang digunakan untuk membuat rekabentuk baru ini adalah besi. Penutup luar bagi rekaan ini menggunakan arcylic. Semasa proses membuat rekabentuk baru ini, ia menggunakan pelbagai mesin. Selepas proses membuat siap, rekaan ini dapat mengemekkan tin dan botol. Dibandingkan dengan produk-produk yang berada di pasaran, rekaan dan konsep terbaru ini adalah lebih sesuai digunakan untuk kegunaan dalam rumah. Ini disebabkan oleh ukurannya yang kecil dan mampu untuk menyimpan lebih banyak sampah kerana sampah-sampah itu telah di kemekkan terlebih dahulu. Di samping itu rekaan ini juga tedapat dua bekas berlainan yang diguna untuk mengasingkan tin dan botol. Oleh sebab itu, ia akan menjimatkan ruang di rumah. Pemegang dan penyambung yang disambung kepada pemberat boleh menyokong daya yang dikenakan apabila proses pengemekan berlaku. Tiada kegagalan pada pemegang dan penyambung semasa proses mengemekkan tin dan botol sedang berlaku. Sebagai kesimpulan, rekabentuk baru ini mampu membantu dan menyelesaikan masalah yang berlaku pada masa kini

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LIST OF SYMBOLS

mm millimeter

m meter

L Length

W Width

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Recycling can be defines as a reprocess of old materials into new products. The significant purpose is to prevent the potentially useful materials from being waste, besides, decrease the consumption of fresh raw materials and reduce energy usage. Therefore it can reduce the volume of greenhouse gas emissions compared to virgin production.

A recycling bin is a container used to keep garbage before respective authority comes and takes the container to bring to the recycling centers. Recycling bins can be found in various forms and sizes to use at homes, offices, and public areas. In order to make people easily recognize the containers, different colors has been used such as blue, yellow and chocolate to represent paper, tin or aluminum cans, and glass or plastic bottles.

Due to FYP project, it is about to produce a new concept of recycle trash bin. Nevertheless it only meant for two selective materials. They are cans 325mL and bottles 600mL only. The usage of this recycle bin is to compress cans and mineral water bottles straight away. After the materials are compressed, those will drop into the box provided. This machine consists of two main parts which are compactor for cans and compactor for the mineral water bottle.

This product is intended for homes used only. Therefore the size of this recycle trash bin is not too large compared to the size used at the public areas. Apart from that public recycle bin is consisting of three basic colours which are brown for glass, orange for aluminum or steels cans and plastic and blue colours for paper. Due to machine, actually it is no need to use colours system because it only involved two important materials.

1.2 PROBLEM STATEMENT

Lately there are a lots of recycle bin. Somehow it is only a simple and common recycle bin. It only used to keep the garbage before it drives to the landfill. Government has launched campaign by enforcing people to recycle the garbage, because our landfill cannot afford too much garbage anymore. As a result, our environment becomes unhealthy place. Recycle bin only can support limited amount of garbage. It is because the garbage is not completely compress and that make limited space provided in it. Besides, it will have more procedure to recycle the garbage after this.

1.3 OBJECTIVES OF RESEARCH

The objectives for this project are to:

- to study the existing product in the market and the needed for household
- to proposed a new design and concept of recycle trash bin
- to fabricate the recycle trash bin
- simulation of the recycle trash bin using FEA software

1.4 SCOPE OF RESEARCH

This research is focusing more on two materials which need to be compressed most prominently cans 325mL and bottles 600mL. This is because cans and bottles are the most domestic materials used by people. Besides that the research also focuses on the material and the strength of the recycle trash bin



Figure 1.1 Cans Aluminum



Figure 1.2 Plastic Bottle

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter, there are focusing on three major parts. There are explanation on recycle bin, compactor and properties of the material. First is about explanation on the definition of the recycle bin, material that can use in recycle trash bin and type and model of recycle trash bin in the market. Next is concerning on the definition, mechanism, types, safety and functions of compactor and the last one is about the material selection.

2.2 RECYCLE TRASH BIN

2.2.1 Definition of Recycle Bin

Recycle is a process of transforming garbage which already used to become new materials (Kitar Semula). According to the Oxford Fajar Dictionary, recycle is defined as treat the used material until it can be used again. Recycle bin is a bin that holds rubbish until it is collected (Wordnet).

2.2.2 Waste Material Can Use For Recycle Bin

Basically there are 4 types of material that can be recycled. Those are plastic, glass, paper and aluminum. However in Malaysia, there are only three prominent materials matter because plastic and aluminum are includes into same part. Therefore it only has three basic materials for the recycle bin.

Somehow there are several types of plastic, glass, paper and aluminum which cannot be recycled. In terms of plastic type, yoghurt containers, plastic food trays, plastic bottles that have contained motor oil and Styrofoam cannot be recycled. For glasses, the light bulbs, mirror glass, broken crockery, ceramics, pottery and florescent light tube are not included as recycle materials. For the paper, it includes hardcover books, carbon paper, facial tissue and others. The things that can not be reused for aluminum are aerosol tins, paint cans, medical wastes or needles and oil filter. (Kitar Semula)

2.2.3 Flow how it can reused

The flow which how the paper recycled is the collected papers are brought to the mill. The recover paper is sent to a pulping process where it will mix up with water and chemicals. The function is to aid in re-slashing before being cleaned to remove large contaminants. The pulp is then de-inked before further cleaning, screening and brightening. Water is then added to the pulp. This mixture is then pumped into the wet end of the papermaking machine. The paper is then smoothed by soft calendaring before being wound up into large jumbo rolls. The jumbo rolls are then cut into various roll widths, depending on customer requirements.

For the plastic, it starts when the collected plastics bring to the recycling plant. It only the simply process which the first one is all the collection will be grounded into small flakes of about 1 cm in size. It used to clean and remove any dirt on the plastics. Then the clean flakes dry in a steam of hot air. Finally it packs and sells in previous form of plastic or can.

For the third material is aluminum. The collected aluminum is sorting and crushing into small size. Then it will melt down to remove all contamination and convert it into the new product.

Last but not least is glass. Glass will be separate by colours. The colours remain the same when the glass is melted. For examples green glass will stay as green glass, brown will be brown, and so for others. The, glass will be separate by respective colours. The colour will remain the same when the glass melted. Once the glass colour-sort and clean, it can be crush and add on other raw materials to make new glass. These ingredients will be heat until they melt into soft liquid. The hot molten glass then will be press and blown into moulds where it shapes bottles and jars. The new containers then will be cold and check for flaws. Finally, they will be sent to various companies where they are filled with foods and beverages.
(Wikipedia)

2.2.4 Type and Model of Recycle Trash Bin in the Market

There are several types of recycle bin in the market. All of these have a different specification based on that model. Those are the example of the model.

2.2.4.1 Recycle Trash Bin Separated Model



Figure 2.1: Separated Model

Figure 2.1 is recycling bin which can be found in Malaysia. It is meant for outside used only. It is made from plastic. There are 3 containers with different of colours represent different materials. Glass goes into the brown recycling bin. Paper items go into the blue recycling bin. Aluminum and plastic items go into the orange recycling bin.

The intention of this product is to encourage people to use recycle bin easily based on its' colours. They can identify the slot of material through colours provided thus people will not confuse to use the recycle bin. Apart from that, the advantage is people will simply recognize because of its huge size. Besides these recycle bins can store a lot of garbage in it. In fact these recycle bins made of plastic, therefore it will be frothier.

The disadvantage for this product is the outcome in creating this product is not done yet. It is because some garbage such as bottles and cans will recycle in the form of compact condition so it will take some time to produce this outcome. The other weakness is it surely needs a lot of space to put this recycle bin. This is because these three recycle bins come together and cannot be separate. (Kitar Semula)

2.2.4.2 Recycle Bin inside use Model



Figure 2.2: Un Separated Model

This Figure 2.2 product is usually used at home. This is the simple trash bin. All garbage will put in the same slotted. Basically it comes in black colour and also made from plastic.

The advantage for this product, it is in small size. It is because there is only one big space where it meant for garbage. Furthermore, it is much weightless due to its size.

The disadvantage here is the garbage which has been thrown certainly will mix together because they have no separate or specific parts. It will cause the problem to recycle the garbage because we need to differentiate the garbage first if we want to recycle them. On the other hands the other disadvantage is this recycle bin can only support little amount of garbage because it is in small size.

2.2.4.3 Overcome problem

To overcome this problem, it need include a simple compactor which is useful for all. This usage of this compactor is to compress the materials which need to be compact for instance cans and bottles. As a result, the output will be in smaller form, plus that will reduce time to recycle those materials.

For the next problem, it should only one recycle bin, but it must be in three separate parts. Therefore it will save a lot of space. Besides that, it will not mix up all the garbage which has been thrown into the recycle bin.

2.3 COMPACTOR

2.3.1 Definition

Based on the oxford dictionary, compact in given by closely pack together. In the other side, it means the mechanism that applies in this system is to reduce the size of garbage. A compactor is a machine or mechanism used to reduce the size of waste material or soil through compaction. (AS Hornaby and A Omar, 2002)

Basically compactor made from material which has high and quality strength. This is because to ensure materials that we want to compact are well compacted or compressed. If we used low strength material to make the compactor, we absolutely cannot compact those items. In order to design a well function compactor, the

important thing to be considered is the strength of material which will be used to build the compactor. Basically, a compactor is used to crush or compress waste materials, for example, a car crusher. This compactor is used to decrease the size of a car to be much smaller than before.

Normally, a compactor is powered by hydraulics. The use of hydraulic fluid is to minimize the force that we need to use. Special fluid is used as one of the mediums to run the hydraulic system. The examples of fluid types include synthetic compounds, mineral oil, water, and water-based mixtures.

2.3.2 Mechanism of the compactor

A compactor will operate manually by an operator. When the compactor fills with refuse and waste, the operator turns the power on and starts to compact. The compactor can run to recycle automatically or the operator can manually forward or reverse the compacting ram. The compacting ram will only operate if the power is on and the door or hatch is fully closed. Doors and hatches are equipped with safety switches. (Donald P. Dykstra, 1979)

Compactors come in three general loading configurations. The first is the “ground-loaded compactor”. An employee loads refuse in through a side-hatch. The second is the “walk-on compactor”. Walk-on units should have a door, at least 42” high. Employees will walk out on the compactor to drop in refuse and waste. The third and final loading configuration is the “chute-fed model”. There may be a chute going through the business wall leading to the compactor.

2.3.3 Types of Compactor

Basically there are many types of compactors. It includes the size of the compactors itself for example like car crusher which shown in Figure 2.3. It is a big machine to crush the car. There are two main type of car crusher. The first one called “pancake” type. It uses huge descending hydraulically-powered plate to crush the old car. The second type called “baling” type. The system is the car compressed from several directions until it resembles a large cube. So the output is not in the original shape. (Wikipedia)



Figure 2.3: Car Crusher

The other machine that used compact mechanism is “WCVs” in Figure 2.4. It means waste collection vehicles. This machine is used to drive over the waste deposited to the landfill site. The “WCVs” used to increase the payload of the vehicle and reduce the number of times it has to empty. With this mechanism, the “WCVs” could carry more waste deposited to the landfill.



Figure 2.4: “WCVs” vehicle

Landfill compactor shown in Figure 2.5 which have spiked wheels used at landfill. The function is to compact the trash to the land through its weight. It is often used to reduce the size of waste material. Garbage compactors and waste collection vehicles compress waste so that more of it can be stored in the same space. It is compacted again, more thoroughly, at the landfill to preserve valuable space and to make the landfill more stable.



Figure 2.5: Landfill Compactor

Figure 2.6 is “the road roller” type. Basically it is used in construction fields. The function is for compacting crushed rock as the base layer underneath concrete or stone foundations or slabs. Usually in Malaysia, it is used to build the road. This machine uses the weight of its roller to compress the surface being rolled. The weight of the roller is usually around 100 pounds.



Figure 2.6: Road Roller Type

The simple type of compactor is can compactor which shown in Figure 2.7. This is the simplest machine that uses compact mechanism. Basically it used hand-operated level system for manually crushing a can. Generally this design for homes used, because the size is small. It only need low force to compact the cans. It used simple procedure which are the cans must be loaded, crushed and removed one-by-one by hand.



Figure 2.7: Can Compactor

2.3.4 Safety to use Compactor

The entire machines have their own safety rules. Those are same with the compactor. In order to avoid the accident, there are some rules should have to obey. Basically the rules divided into 4 major sections in concerning of the safety. There are site set up, equipment operator and equipment rental establishments. (NIOSH)

For the site set up, when the machine operates, it only needs one person to handle the machine. If there is many person, it can easily cause an accident at the small area where placed the compactor. Besides that, the entire worker must wear PPE (Personal Protection Equipment) when handle the big size of compactor.

For the equipment operator, the most important things have to deal with warning labels. This is important because different machine have different warning labels. The other important element is the respective person who responsible to conduct daily or pre-shift visual and operational checks on all equipment systems and operating controls before works on the machine. This is to ensure that all the machines are in a good condition. (NIOHS)

For the last section, it is equipment rental establishments. These parts consider the rules of equipment rental. The important is establishing a documented preventive maintenance program for machinery. The others are provided customers with machine-specific safety brochures. It is very important to tell the costumers about this machine.

2.3.5 Function of Compactor

Compactor has many functions. Generally it used in construction field such as road making process, car crusher. Retail and service businesses, such as fast food, restaurants, and hotels used to reduce the volume of non-recyclable waste as well as curb nuisance such as rodents and smell.

For the garbage compactor, it used for residential uses, which for reducing the volume of waste component, smell and rodent problems of garbage. There are frequently limits to the number of garbage bags that can be left outside for residential pickup, which further renders such compactors beneficial to such households.

2.4 MATERIAL

2.4.1 Procedure for material selection

Selection suitable material is the most important part to design new machine. There are several factors that need to consider in choosing the appropriate material. There are geometric considerations, mechanical properties, physicals properties, environmental considerations and manufacturing concern. The effect of choose the right material is it can reduce the cost of the machine, improve quality or overcome the problem or defect that has been encountered. (J.T.Black and Ronald A. Kohser, 2008)

2.4.1.1 Geometric consideration

For the geometric consideration, it includes many things. There are shape, size and complexity of a part. It needs to consider how many dimensions that must be specify. Producing the right shape is only part of the desired objective. If the part is to

perform adequately, it must also possess the necessary mechanical, physical properties and environmental consideration.

2.4.1.2 Mechanical Properties

In this section, the factor that needs to consider are the strength of the material, the toughness, resistance of the material, impacts material properties(ductile or brittle) and the others.

2.4.1.3 Physical properties

For the mechanical properties, it needs to consider several factors. There are conductivity, resistivity, thermal conductivity and any magnetic properties desired.

2.4.1.4 Environmental Considerations

The important thing in this part is identifying the lowest, highest and normal temperature of the product. Besides that, it must consider most severe environment that is anticipated as far as corrosion or deterioration of material.

2.4.1.5 Manufacturing Concerns

A final part of consideration is the variety of factors that will directly influence the method of manufacture. The things that must be concerned are quantity of the product, level of quality of the product compare to the market and identify the smallest and largest sections thickness.

2.4.2 Material in used

Materials are the most important part to produce a product. Choose the wrong material for produce the product give the bad result of the product. The product will be considered as failure.

2.4.2.1 Stainless Steel

Steel is one of the materials which have high strength. It can easily combine through welding process. It can mate from parts to other parts in variety ways. Subsequently because of it high strength, so it used to make plate, I-beam, pipe, bar and sheet metal.

2.4.2.2 Aluminum 1100-H14

Aluminum is the material which have very light weight. But this material is quite fragile and low in hardness. The price for this material is not exactly expensive. It usually used for wheel car, cans and the others.

2.4.2.3 Acrylic

Acrylic is the materials which have high strength and light in weight. But this material is quite expensive. It is form in transparency condition. It can be mate with other parts by slotting process. Basically it used in making aquarium, used in the lenses of exterior lights of automobiles, in aircraft transparencies (windows) and motorcycle helmet visors.

2.4.2.4 Bottles plastic

Plastics are the most used material nowadays. This is because it has high strength, light weight and low cost. As the most important material used recently, the usage of this material is widely utilize. In example are, plastics being used in bottles, some car components, toys, pipes and the others.

Table 2.1: Properties of Material

Material	Density (kg/m³)	Ultimate Strength (MPa)	Yield Strength (MPa)	Modulus of Elasticity (GPa)
Stainless Steel	7920	860	520	190
Aluminium 1100-H14	2710	110	95	70
Acrylic	1148.7	47.02-79.29	55-84.8	-
Plastics Polyester (thermoplastics)	1340	55	55	2.4

Source: *Ferdinand P Beer, E Russell Johnston Jr and John T. DeWolf, (2006)*

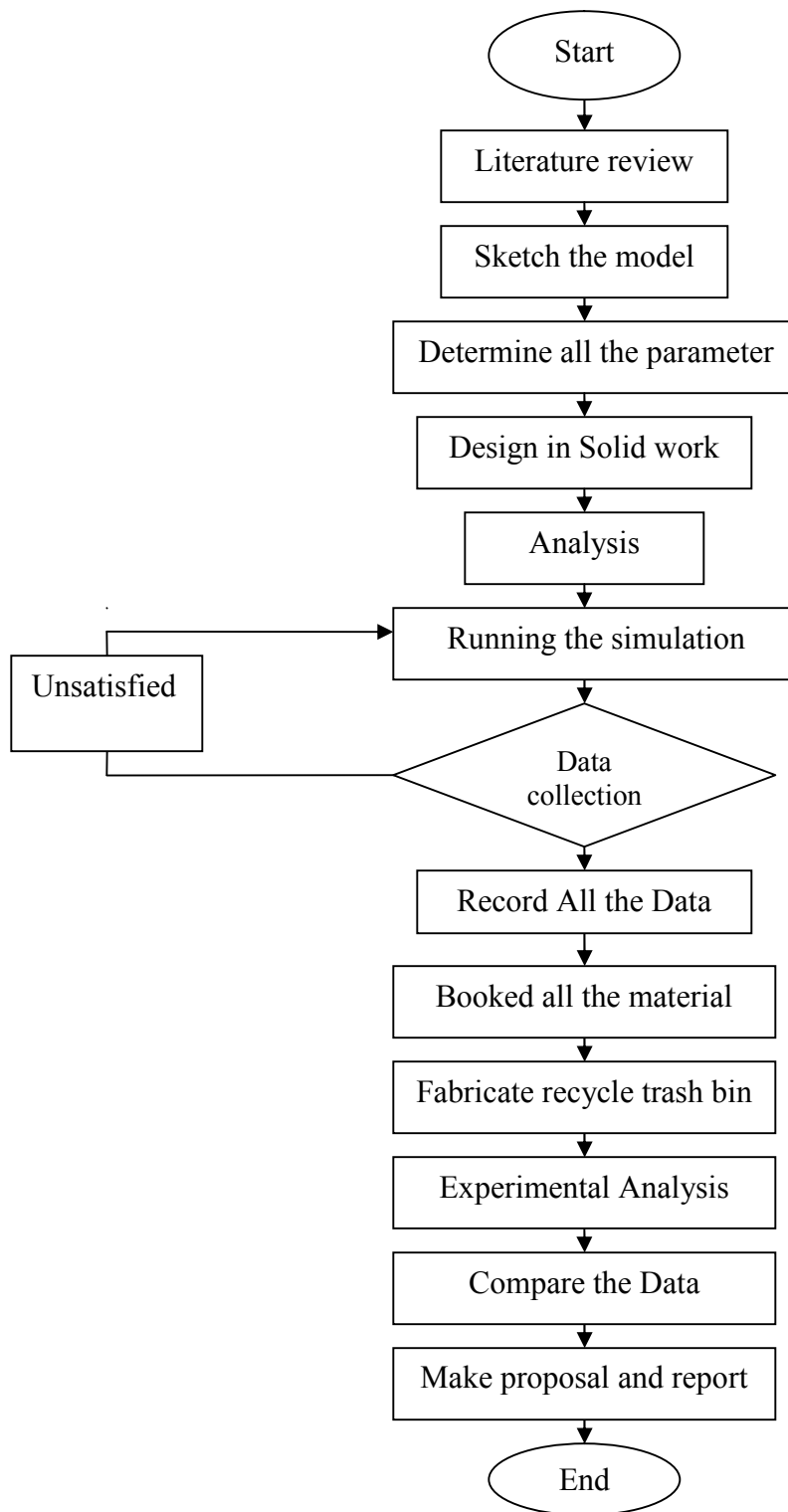
CHAPTER 3

METHODOLOGY

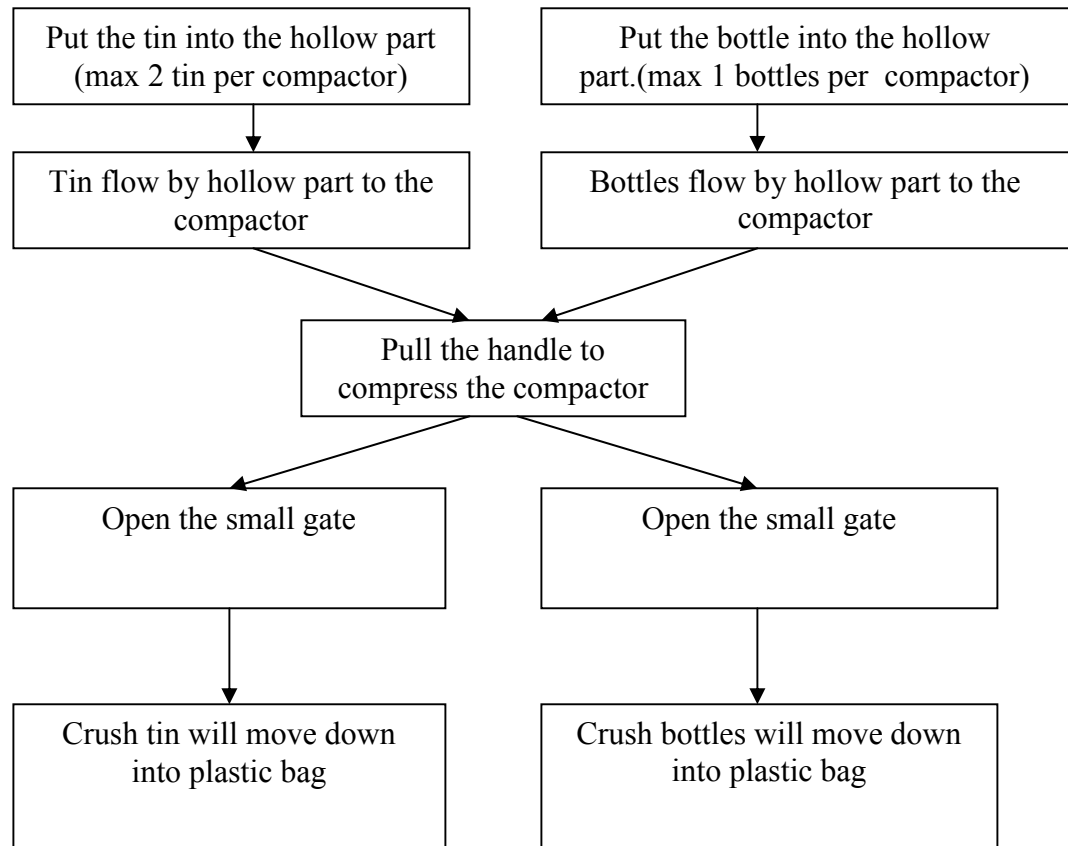
3.1 INTRODUCTION

This chapter will further describe the step how to design a new concept of recycle trash bin. This chapter is most important part of this final year project. This research flow will going to be smooth by following the right pace of progress. It is also to avoid the research to alter course from the objectives that have been stated or in other words the methodologies can be described as the framework of the research where it contains the elements of work based on the objectives and scope of the research. With this flow chart, the supervisor can know the overall view of the research and how this project will flow. This framework can help the supervisor the watch over the progress and at the same time correcting and adding element that is lacking from the research.

3.2 RESEARCH METHODOLOGY AND WORK PLAN



3.3 PROCEDURE METHODOLOGY



3.4 PROCESS METHODOLOGY

3.4.1 Literature Review

Methodology of this project begins with the studying on the literature review of the previous analysis and the journal that relate to the concept of recycle trash bin. In the literature review, all of the information needed is retrieved as to increase more knowledge in comprehending the subject. Literature review can be done by Reading books, browsing the internet, having discussion with supervisor and friends that can helped a lot in collecting the resources.

3.4.2 Sketch the Model

Based on the literature review and discuss with the supervisor, the new concept of recycle trash bin model can be sketch roughly. The sketch depends on the concept from the literature review. To choose the suitable concept, it depends on several factors such as how it operates, cost of the design and others. Ask the supervisor about the sketch. Try to apply any comments and advices from the supervisor into the sketch.

3.4.3 Determine The Parameter

After done the sketching, all parameter should be determined. The parameter that should be determined was the force required to push up the compactor and all the dimension of the sketching.

3.4.4 Design In Solidwork

With the entire sketch and all the parameters, the next step is design the model of compactor in the Solidwork. Later does the simulation to make sure that design can work or not. If the design can not work properly, try to adjust the parameter.

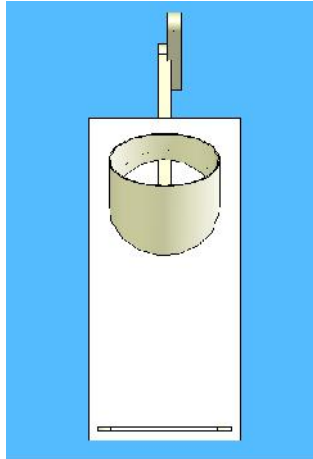


Figure 3.1 Front View Design

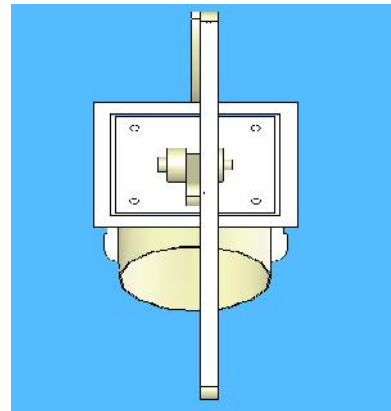


Figure 3.2 Top View Design

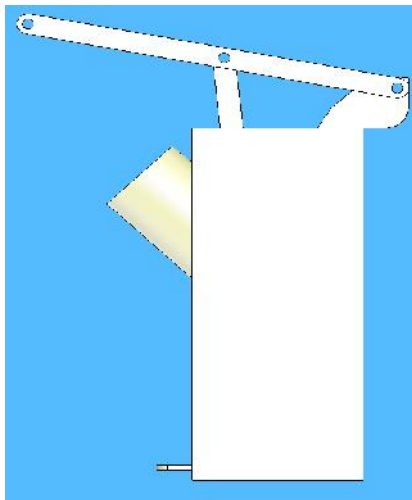


Figure 3.3 Side View Design

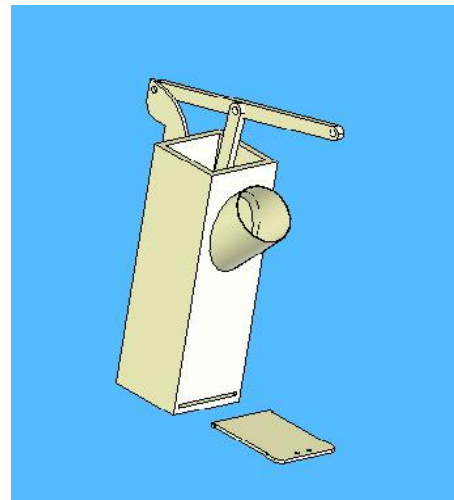


Figure 3.4 Isentropic View Design

3.4.5 Analysis

After that, use ALGOR software to do the analysis. Convert or export the model from Solidwork to ALGOR to do the analysis. Then run the simulation in ALGOR. Collect all the data. If unsatisfied, do the analysis again. After satisfied with the data, record all the result.

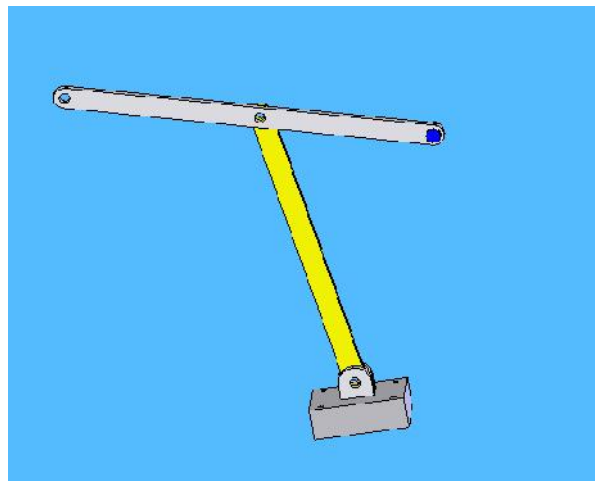


Figure 3.5: Designs from Solidwork

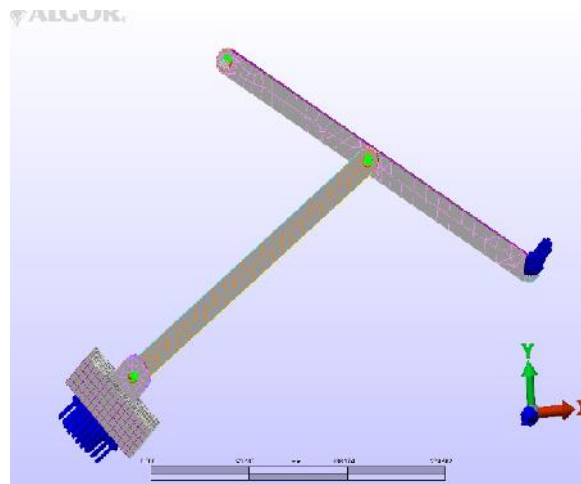


Figure 3.6: Design import to ALGOR

3.4.6 Booked the Material

When the sketch done and the design work properly, material that need to use in fabrication need to book. For book the materials, it need to fulfill the form at the lab. The material that used for this design is steels, angle iron slotted, acrylic, screws and nuts.

3.4.7 Fabricate the Recycle Trash Bin

After got all the material that need in fabricating the recycle trash bin, so the fabricate process can be start. The fabricate process need to follow the design from the Solidwork software to avoid the mistake and the product can not be run properly.

3.4.8 Experimental Analysis

When all the fabricate process done, the experiment should be done. It is to make sure that the recycle trash bin can work same as the simulation in Solidwork. There are some procedures to handle the recycle trash bin.

1. Put the can into the hollow part (max 2 cans per compactor)
2. Can flow by hollow part to the compactor
3. Pull the handle to compress the compactor
4. Pull the wire that connects to small gate to make sure the can will going down to the plastic bag.

There are same procedure when to compress the bottles.

3.4.9 Compare the Data

After done that experiment, try to compare with the data and simulation from ALGOR and Solidwork. The data will be collected after running the analysis. The results are very important in order to make comparison. It will be the proof that the recycle trash bin can be use properly.

3.4.10 Take proposal and report

Lastly, the conclusion will be build base on the results of the analysis that was done in Algor software and the Solidwork. All the result need include into this report.

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 INTRODUCTION

In this chapter will be discussing about the concept of the recycle trash bin. The concept will discover in choosing the correct and suitable machine and material to be use in the fabrication process. It will also cover the detailed fabrication part by part and the justification of the process. After the fabrication process delivers a result, an analysis of some part will be perform using the Algor software to test the result. Anyhow, the overall result obtained was as expected as in the literature review.

4.2 CHOOSE THE CONCEPT OF RECYCLE TRASH BIN

In early meeting with the supervisor, there are two different concepts to use in designing the recycle trash bin, which is the “mechanical concept” and the “hydraulic concept”.

4.2.1 Mechanical Concept

For the mechanical concept, it only used a simple concept that did not use electrical in the design. The concept is taken from old water pump concept. This simple concept only need force to run it, which will come from the people who run this water pump.

The advantage of this concept is it is economic and did not require huge budget in producing it. This is because it did not use any electrical part or motor generator. Beside that, this concept is also simple and easy to understand how it runs. So user can know easily the flow and process how to run this mechanical concept.

The disadvantages of this concept is only several people can use it. It is because to compress the trash, it requires a maximum force to use it. So children can not use it by themselves because they did not have enough energy to give the force to compress the can and bottle. Beside that, the product that use mechanical concept will take time to run it. It cannot compress many cans or bottles at one time. It only allows one can or bottle at one time. So it will take time to compact the can and bottle.



Figure 4.1: Old Water Pump

4.2.2 Hydraulic Concept

Hydraulic is a mechanism that uses fluid flow as a part to move the bigger part that requires a minimum force. It is also can be operate using motor engine. So the power can be generated from the motor to run the hydraulic. Nowadays a lot of compactor use hydraulic system to compress the trash. The example of machine that uses hydraulic compactor is “car crusher”. It is powered by motor to compact the car.

This is because to compact the car, it need maximum force. So it used hydraulic power system.

The advantage of hydraulic concept is that everyone can use the product. By using a hydraulic concept, it did not need high force to compact the trash. Every level of user including children can use the machine. The other advantage is that, it can compact the trash easily and able to compact many cans and bottles at one time. As a result, it will reduce the processing time.

It is also have the disadvantage of use hydraulic concept, where is requires lot of money in producing it. It is because some part and material need to use motor engine which in highly cost. This will results to high cost and it will be an expensive machine.



Figure 4.2: Car Crusher

4.2.3 Choose the concept

After discuss with supervisor about the concept, with the small budget available, so mechanical concept is more practical in running this project. It is

because the cost to fabricate the recycle trash bin using the mechanical concept is lower than the hydraulic concept.

Hydraulic concept will be use in further project for the next topic. In the next project, it will include the other trash to be compact. So the hydraulic concept will be more practical to be use in that project. It is because the force requires to compact the other trash is higher than this project which will need to generate hydraulic with motor engine to run it.

4.3 MACHINING USE FOR FABRICATION

4.3.1 Band saw Machine

A band saw uses a blade consisting of a band of toothed metal and powered by electric motor. Basically in this final year project, it use to cut the solid material that will use in fabricate the compactor. This is because the material are round solid steel which have diameter 100 mm and square solid steel 100x100mm. So other machine can not use to cut that material.



Figure 4.3: Band Saw Machine

4.3.2 Vertical Band saw

Vertical band saw have same concept with the band saw. It also used a blade which consist of a band of toothed metal but have small size. The different between the vertical band saw and band saw is the placement of the blade. For the vertical, the blade is in vertical direction but for the band saw there are in horizontal direction.

The usage of the vertical band saw is to cut the plate steel into a piece that can not do with other machine. It is because, other machine have range that it can cut the material, but for the vertical band saw, it have free space to cut the material because of there are only a blade running on the based. So the plate material can be dividing into two pieces.



Figure 4.4: Vertical Band Saw Machine

4.3.3 Disc Cutter Machine

Disc cutter machine use a cutter which the shape is like disc to cut the work piece. The side cutter also can be use as grinder. For the final year project, this machine is used to cut the plate steel, angle iron and angle iron slotted.



Figure 4.5: Disc Cutter Machine

4.3.4 Shearing Machine

The shearing machine is a machine that can use to cut the sheet metal into pieces. The procedure to use this machine just only put the sheet metal on the base, the keep in the length value into the program machine. After that, push the button, then the machine will cut the sheet metal.

For this project, this machine is use to cut the sheet metal that will use to fabricate the compactor casting.



Figure 4.6: Shearing Machine

4.3.5 Punching Machine

Punching in metal fabrication is the process of using a machine to press a shape through a sheet of metal and into a die to create the desired shape in the metal.



Figure 4.7: Punching Machine

4.3.6 Bending Machine

Bending Machine is a metalworking machine that allows the bending of sheet metal to form box and pan shapes, and to form bends and creases in sheet metal.

In this project, the sheet metal that have been cut out with the shearing machine then need to bend to make a box shape. This is use to fabricate the compactor casting.



Figure 4.8: Bending Machine

4.3.7 Drilling Machine

Drilling is the process of using a drill bit in a drill to produce cylindrical holes in solid materials, such as wood or metal. Different tools and methods are used for drilling depending on the type of material, the size of the hole, the number of holes, and the time to complete the operation.

In drilling process for recycle trash bin fabricate project, the size of drill bit that use is 10 mm in diameter. Drilling is use for make a hole on the shaft build from plate metal and at the acrylic.



Figure 4.9: Drilling Machine

4.3.8 Welding Machine

In this project, there are two type of welding machine. There are metal inert gas or MIG welding machine and arc welding. General meaning for welding is a fabrication process that joins materials, usually metals, by causing coalescence. This is often done by melting the work pieces and adding a filler material to form a pool of molten material that cools to become a strong joint, with pressure sometimes used in conjunction with heat, or by itself, to produce the weld.

MIG welding is use is a semi-automatic or automatic arc welding process in which a continuous and consumable wire electrode and a shielding gas are fed through a welding gun. A constant voltage, direct current power source is most commonly used with MIG, but constant current systems, as well as alternating current, can be used.



Figure 4.10: MIG Welding Machine

Arch welding uses a welding power supply to create an electric arc between an electrode and the base material to melt the metals at the welding point. They can use either direct (DC) or alternating (AC) current, and consumable or non-consumable electrodes.



Figure 4.11: Arch Welding Machine

4.3.9 Grinding Machine

A grinding machine is a machine tool used for producing very fine finishes or making very light cuts, using an abrasive wheel as the cutting device. This wheel can be made up of various sizes and types of stones, diamonds or of inorganic materials.



Figure 4.12: Grinding Machine

4.3.10 Laser Cutting Machine

Laser cutting is a technology that uses a laser to cut materials, and is typically used for industrial manufacturing applications. Laser cutting works by directing the output of a high power laser, by computer, at the material to be cut. The material then

melts, burns, vaporizes away, or is blown away by a jet of gas, leaving an edge with a high quality surface finish.

In this project, the laser cutting machine is use to cut the acrylic that use as a casting for the recycle trash bin. The design from Solidwork Software which need cut, need to export to Art Cam Software that relate with laser cutting program. The entire programs have been computerized.



Figure 4.13: Laser Cutting Machine

4.4 MATERIAL THAT NEED IN FABRICATING PROCESS.

4.4.1 Solid Steel

In this project, it will use two type of solid steel. There are round shape solid steel and square shape solid steel. These solid steel have used in build the compactor. This compactor needs the solid material to compact the can n bottle. So steel are most hardness material better than can and compactor. As a result, there will be no failure to compact the trash.

The dimension of the round solid steel is 100 mm in the diameter. The length of this material is about 40 mm. for the square solid steel. The dimension is 100x100 mm. The length of square solid material is 40 mm.

4.4.2 Plate Steel

Plate steel that use in this project have 100 mm in width, 5 mm for the thickness. This plate steel is use to fabricate the back of the compactor casting and the small gate under the compactor casting.

The second one has 50 mm in width and same thickness. It is used to fabricate the handle of compactor, shaft to connect handle with the compactor and use to hold the compactor to the casting.

4.4.3 Sheet metal

Sheet metal that used in this project is iron steel. The thickness of this sheet metal is 3 mm. the usage of this sheet metal is to fabricate the compactor casting.

4.4.4 Angle iron

Angle iron that use is 20mm in each of their side. The length used only 1 m. this angle iron used as roller to run the small gate under the compactor.

4.4.5 Angle iron slotted

Angle iron slotted has the same shape with the angle iron, but the different is on the plate. For angle iron slotted, there are holes on the plate. These are used in fabricating the frame for recycle trash bin

4.4.6 Acrylic

Acrylic is the plastic material which have transparent colour. This material has high strength. The thickness that use is 3 mm.

4.5 FABRICATE PROCESS

4.5.1 Compactor

Compactor is the part which is use to compact the cans and bottles. Basically the compactor is dividing into 3 major parts. There are handle shaft, shaft that connect compactor and the handle shaft and last part is solid compactor. For fabricate this fully compactor, it use steel. It is because the compactor need higher strength and hardness compare with the material that need to compare.

For handle shaft, it was fabricate from the plate steel which have thickness 5 mm. The width of the shaft is 25mm and the length is 300mm. from the original plate which have 50 mm in width, it have to cut using vertical band saw. The justification to do this shape is steel have high strength, so the width of this part is not important. It can support when compactor is run.

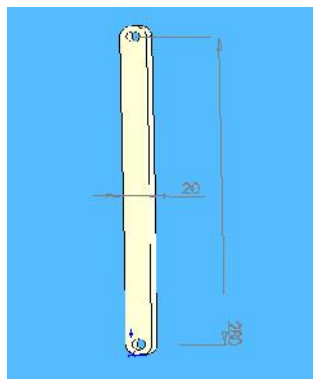


Figure 4.14: Design shaft in Solidwork

The second part is the shaft between handle and solid compactor. This shaft made by plate steel. This shaft is longer than handle shaft. There is same width which is 25 mm but the length is 350 mm.

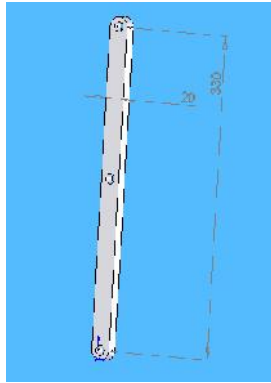


Figure 4.15 Design handle in Solidwork

The last part in compactor is the solid compactor. It uses solid steel to fabricate it. Initial design in Solidwork is in square shape. But after consider mass factor and the material that have in lab, the shape is change to round shape. When uses round solid steel, the problem occur when want to compact the can and bottle. It is because the shape of compactor casting is in square shape. So there are blank area between the square casting and round solid steel. As a result, can and bottle can not be compacted smoothly. To overcome this problem, the square shape solid steel attach to joint with round steel. After that, can and bottle can compact smoothly. The dimension of round solid steel is 100 mm in diameter and 40mm in length. For the square solid steel, the cross sectional is 100x100 mm and the length is 40 mm.

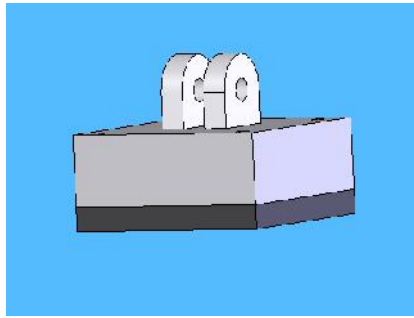


Figure 4.16: Design compactor in Solidwork

4.5.2 Compactor Casting

In fabricate the compactor casting, the material that needed were sheet metal iron steel, plate steel. The dimension of sheet metal is 300x350 mm. the sheet metal was cut with the Shearing Machine.

Then make a hole on that sheet metal. The hole use as a joint to put the can or bottle into the compactor casting. The hole is not in circle shape because there are angle between the hollow part and the compactor casting. The angle that need is 45 degree.

After that, that sheet metal needs to bend in 90 degree angle in three bend shape. So each part has the dimension 100x350 mm. The bending process use Bending Machine. The sheet metal need to joint with the plate steel which have 100 mm in width to make sure the casting become in square shape. To joint these two parts, it use Welding machine.

After joint that part, that compactor casting need to attach with the holder. The holder attach at the back of compactor casting. The function of the holder is to hold the shaft handle with the nuts. At the holder, there are a hole for attach with the nuts to joint compactor casting and the shaft handle.

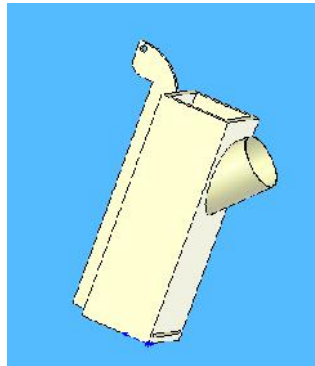


Figure 4.17: Design casting in Solidwork

4.5.3 Small Gate

The small gate is located under the compactor casting. The function is to be a base for compact the trash. When the can or bottle was put into the compactor casting, small gate will function as a base. It will block the can or bottle fall into the plastic bag.

After the can or bottle has been compacted, this small gate will open. To open this small gate, there are wires that connect to this small gate. The wire attach to the holder which is locate both side of recycle trash bin. After pull the wire, compacted can or bottle automatically will fall down into the plastic bag.

There are two springs that connect to the small gate. The function is to retract the small gate automatically after pull the wire.

The plate steel which have 100 mm in width was use to fabricate this small gate. The length of this part is 130 mm. both of end small gate, it have hole to joint with the wire and the springs.

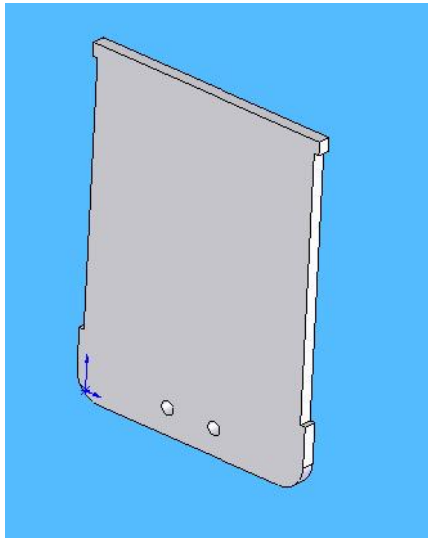


Figure 4.18: Design gate in Solidwork

4.5.4 Recycle Trash Bin Frame

For the whole frame of recycle trash bin, it use angle iron slotted. This angle iron slotted has a small slotted hole on their body. So that angle iron slotted not need to drill to joint all the part. To attach all the parts, it only needs nuts.

Basically the shape of the frame is like a box. But there are two storeys. The height of fully frame is 800 mm and the width is 400 mm.

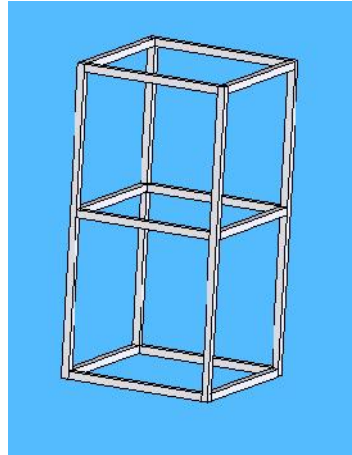


Figure 4.19: Design frame in Solidwork

4.5.5 Container Part

Container part is the part that uses to keep the compacted can or bottle. After the can or bottle has been compacted, the trash will fall down into the plastic bag. The container for this project is only a plastic bag. This is because to cut the cost. The plastic bag has to connect with the pin to make sure that the trash can fall down into the plastic bag.

After plastic bag fully with trash, so it will change to the new one. It will do the same process to change the plastic bag.

4.5.6 Acrylic For Recycle Trash Bin Casting

To fulfill the frame, it needs to cover with the acrylic. Acrylic is the material that has the same properties with plastic but have higher strength. Acrylic is a material that transparency in colour. So it is very suitable to be a cover for recycle trash bin. It is because the mechanism of compactor can be seen from outside. The

size that use in this project is the small size that 3 mm in the thickness. This acrylic is cut by Laser Cutting machine.



Figure 4.20: Acrylic for covered

4.5.7 Door to take the trash

This door is also made from acrylic. This part is one of the important parts of recycle trash bin. It is use to take the full trash in the plastic bag. The door attaches with the wires that connect to the acrylic and the angle iron slotted. At the bottom of the acrylic, it will connect using cable ties.

4.6 PROCEDURE TO OPERATE RECYCLE TRASH BIN

There are the procedures that need to follow to operate this recycle trash bin. The first step is making sure the solid compactor or shaft handle is in maximum position. This to make that the can and bottle position is under the solid compactor. Then put the can or bottle into the compactor casting through the hollow part side of

compactor casting. For the can, the maximum value is 2 but for the bottle only one per each.

The next step is pulling the shaft handle to compress the trash in compactor casting. Give amount of force until the trash will compact. After trash already compacted, pull the wire side of recycle trash bin to make the compacted trash fall down into the plastic bag. Lastly after plastic bag is full with the trash, change the plastic bag with the new one.

4.7 PRODUCT SPECIFICATION

This recycle trash bin has dimension 400x400x800 mm. the weight of this product is about 10 kg. It is weightier compare to market product. It is because all the material that use in this recycle trash bin are steel. But this recycle bin can move easily because it supports the four roller tyres. This recycle bin also did not use any electrical part.

4.8 ALGOR ANALYSIS

After done the fabrication process, nest step is doing the analysis in Algor Femcro Software. The design in Solidwork software will export to the Algor Femcro to do the analysis. This analysis only focusing on the three parts from whole recycle trash bin. There are shaft handle, shaft that connect to solid compactor and shaft handle and last part is solid compactor.

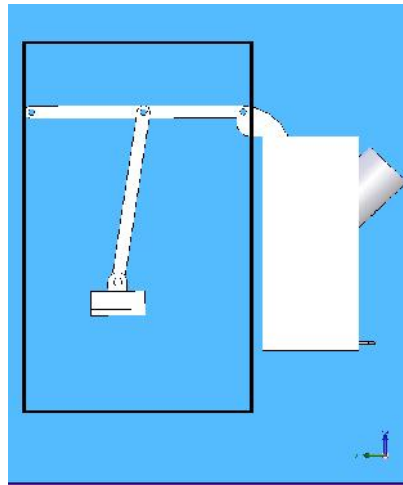


Figure 4.21: Part to analysis

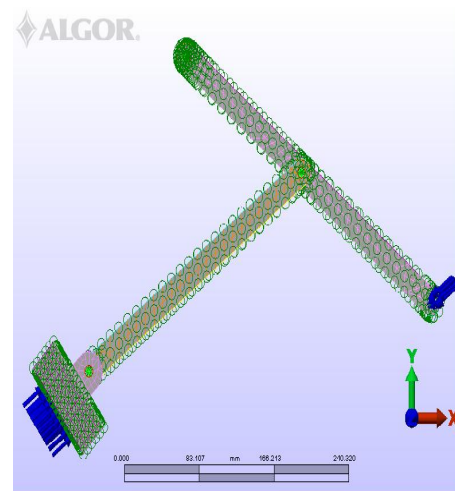


Figure 4.22: Analysis in Algor

4.8.1 Boundary condition

Analysis type that use to make analysis is MES with nonlinear material model. It is because the analysis focusing at the pin joint. From that part, there are 3 pin joint that need to analysis. The first one is at the end of shaft handle, at the middle of shaft angle and last one at the joint between solid compactor and shaft.

Element type that use in this analysis is brick. It is because it import the part from the Solidwork. The material that be used is Steel (ASTM-A36). It is same for all the parts. The assumption that force needed to compact the trash is 1000 N. there are constant force which mean when pull the shaft handle, the force is constant. Fro the assumption for reaction force, the value is 800 N. this force only attach to the some node under the solid compactor.

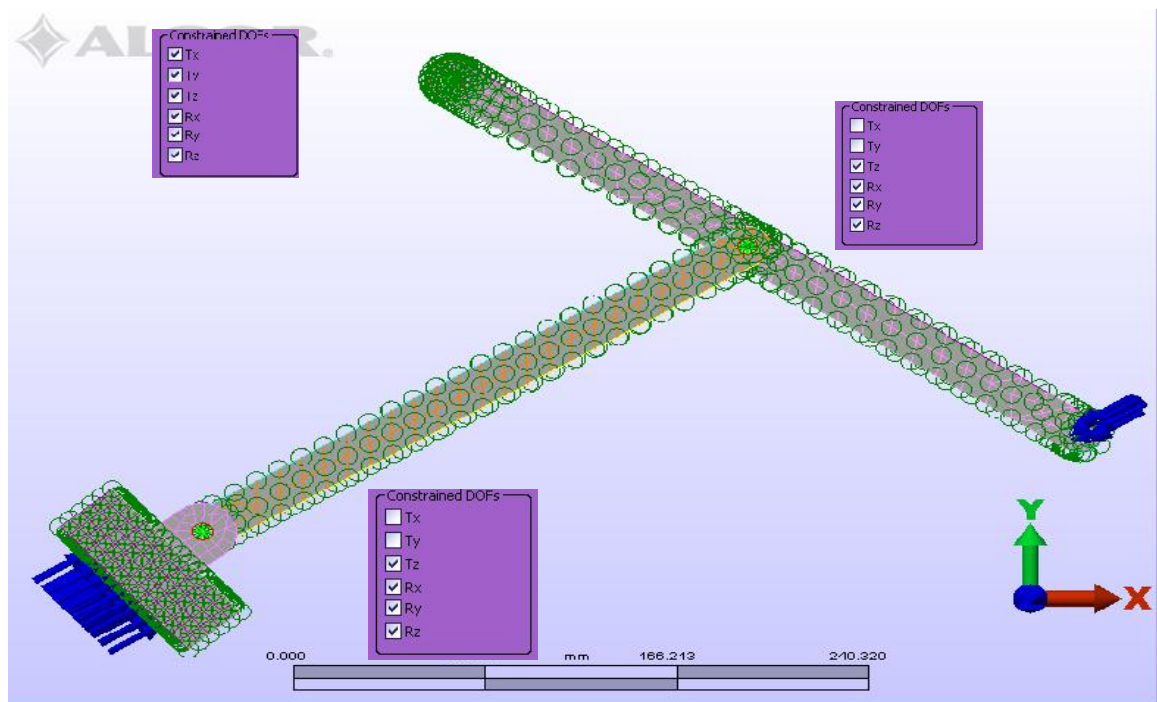


Figure 4.23: Boundary Condition

4.8.2 Displacement analysis

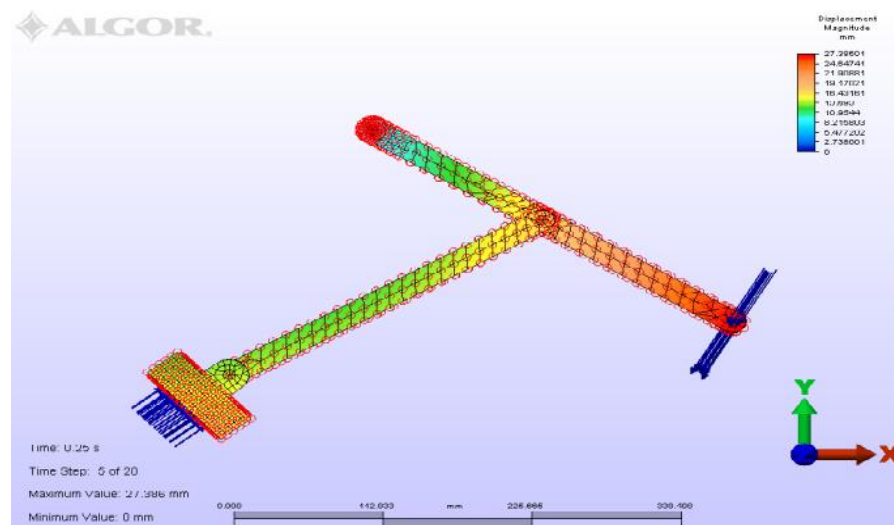


Figure 4.24: Displacement Diagram

From the Figure 4.23, it can conclude that the maximum displacement occurs at the end point that has the force. This is because one of that shaft handle is fixed, so the displacement only occurs at the part which is done not fixed.

Based on that boundary condition, the maximum value of the displacement is 27.386mm and the minimum value of displacement is 0 mm.

4.8.3 Von Misses Stress and Strain analysis

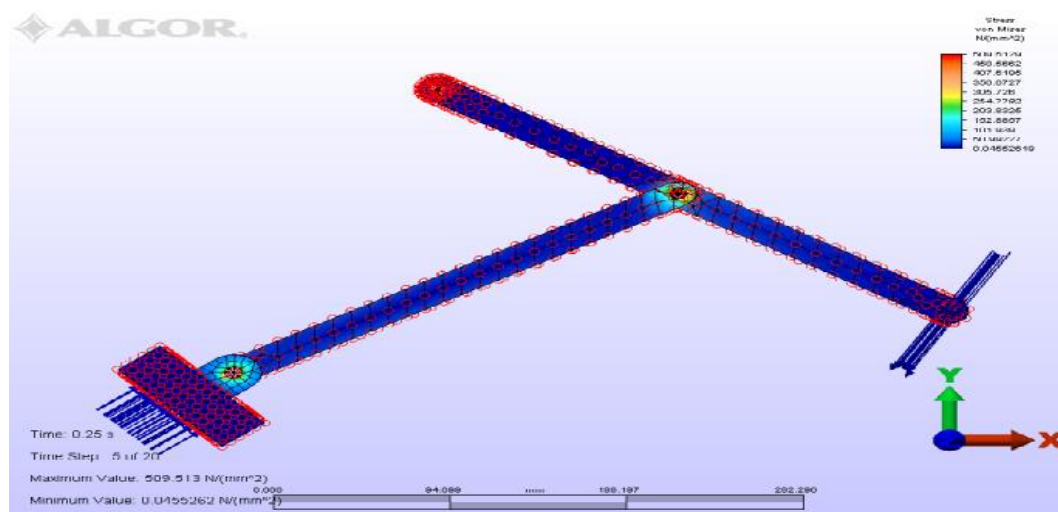


Figure 4.25: von Misses Stress Diagram

Based on Figure 4.24, the maximum von Misses Stress occurs at pin joint. It is because at pin joint, there are lot of load applies on it. Beside that, the area of pin joint also fluent the value of stress The load that apply during compact the trash higher compare to the size of pin joint. If choose the wrong material for pin or nut at pin joint, the failure could be occurring.

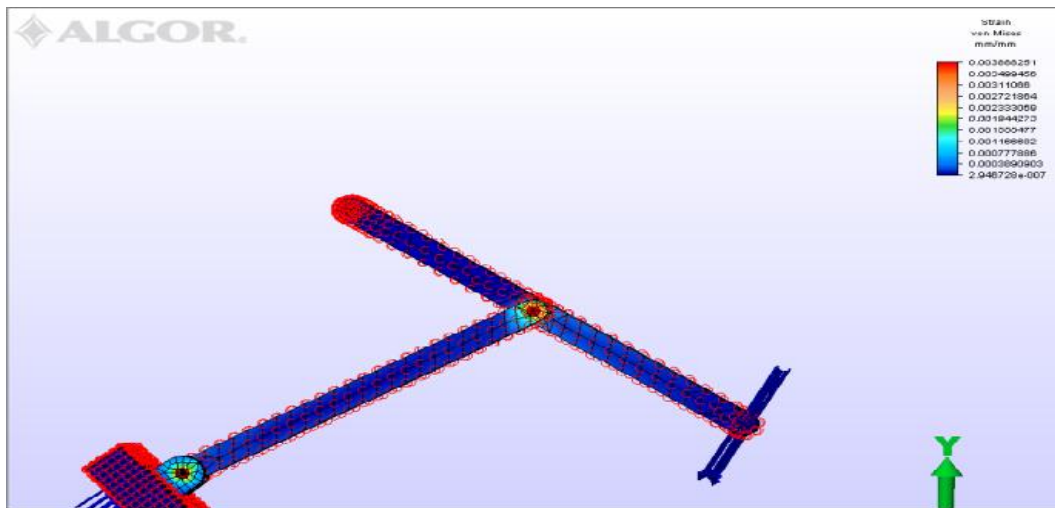


Figure 4.26: von Misses Strain Diagram

For the strain analysis in Figure 4.25, the maximum value also occurs at pin joint. There are two pin joint for that analysis. The factor that fluent the maximum strain at pin joint maybe because of the joint is directly with the force given during the compacting trash.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

As per the title of this projects which to design the new concept of the recycle trash bin and also to design the simple mechanism of the compactor, the following will conclude the success of the projects.

The main objective of this project is to study and perform research of the needs towards the community in example the government and also the household. In this project it also include the proposal of the new design of the recycle trash bin which hope can overcome the current issue faced by the community indirectly and also the government directly in the issue of recycling programmed.

In order to “fabricate” this product, the “compactor” was also designed to be included in this new concept of the recycle trash bin. By designing both of the new concepts, it is hope that the projects will be able to leads to the “Green Environments Life”.

This new design and concept of recycle trash bin is the combining the advantages of the current trash bin product in market today. Now the advantages of this recycle trash bin are it can support more trash in that container. It is because, the trash have been compact by using compactor that include into this recycle trash bin.

The other advantage is, it also can divide the trash based on the material. This recycle trash bin include with two different containers which are for can and bottle. The last advantage for this new design is small size. As a result, it only needs a small area to put this recycle trash bin.

These new concepts of compactor that include with this recycle trash bin have their own disadvantages. There are need high force to compact the trash. This project only use mechanical concept. The other disadvantage is the weight of the recycle trash bin. Based on the materials that use to fabricate the recycle trash bin, which are the steel, as a result the product is weightier.

From the FEA analysis, it shown that pin joint is the critical part to have the failure. It is because, at the pin joint, there are maximum von Misses Stress and Strain occurs on it. So to avoid the failure occur to this product, it need to choose the right material to use as a pin. The pin should be from the material that has high in strength. Because of that, it can avoid failure occurs to pin joint.

5.1 Recommendation and Suggestion

Basically there are several suggestions for improvement and further project. It is because, for this new concept of recycle had some part that need to improve to make sure this design is perfect. The first suggestion is to change the material that is use before this. It needs to use lighter material to fabricate the recycle trash bin. With the high budget, the material can be change due to lighter material. For this project, it only uses the steel. As a result, the product recycle trash bin is weightier.

The second suggestion is change the system. For this first model, it use mechanical concept. For the next project, it should hydraulic system in compress the compactor. It is because for this project, it only uses a power force. So that, children or women also can use this recycle trash bin.

The third and last suggestion is to expend the research to biofuel. It means that the recycle trash bin can compact the chicken bone. Nowadays people like to eat chicken, so from this recycle trash bin, it can transfer the chicken bone into the biofuel energy.

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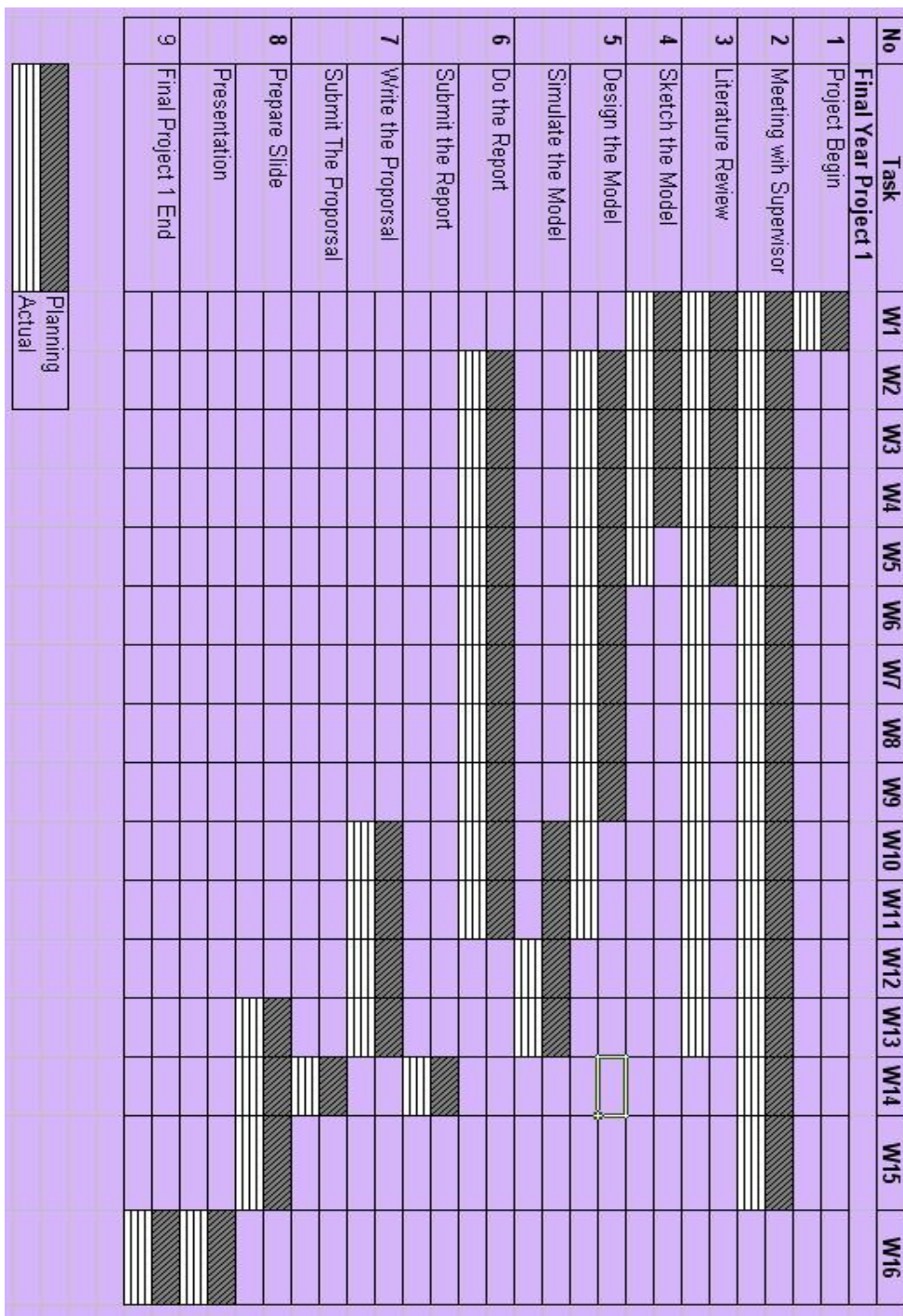
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APPENDIX A1

Gantt chart for FYP1



Gantt chart for FYP2

Gantt chart for FYP2

APPENDIX B

Can use in experiment



Bottle use in experiment



APPENDIX C

During Drilling



During fabrication process



During use Laser Cutting Machine



During Welding



APPENDIX D

Recycle Trash Bin after fabrication process

