DEVELOPMENT OF CLOTHES DRYER MACHINE

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for the award of the degree of
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SUPERVISOR'S DECLARATION

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

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STUDENT'S DECLARATION

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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Finally, I express my gratefully to my beloved parents, brothers and sisters that has give me a lot of courage during finished this Final Year Project. I also thanks to all my classmates that also give me a lot of support and idea to done this project. Special thanks to my fiancé that also give me the zest during this whole semester otherwise I might not possible to undertaken this project successfully.

ABSTRACT

Development of Clothes Dryer Machine is a project that suggested by the lecturer Faculty of Mechanical Engineering for Final Year Project title. This project focusing in designing and fabricating including develop the system and also the body structure. The objective of the project is to develop and improve the Clothes Dryer Machine. To achieve the project objective, the Clothes Dryer Machine needs to have all the criteria including aspect of strength, safety and ergonomic. To making the project a success, flow of work should been follow start by designing, analysis and lastly fabricating.

Diploma Final Year Project will take the whole semester to complete this project. This is an individual project that the candidate has to do it by ourselves. This project also give the opportunity to the candidate to apply their knowledge's and skills in using either machinery or even computer software for designing and analysis. In this project, time management is the important things to make sure the project is done correctly according to the planning. It also a step to run the progress better and in the linear progress works. So, overall from this project is to make a superior project we need high discipline and also candidate interested to finish this Final Year Project.

ABSTRAK

Memajukan Mesin Pengering Pakaian adalah sebuah projek yang dicadangkan oleh pensyarah Fakulti Kejuruteraan Mekanikal untuk tajuk Projek Tahun Akhir. Projek ini tertumpu dalam mereka bentuk dan pembinaan termasuk pembinaan sistem dan struktur badan. Objektif projek ini adalah untuk memaju dan menambah baikkan Mesin Pengering Pakaian. Untuk mencapai objektif projek ini, Mesin Pengering Pakaian harus mempunyai semua kriteria termasuklah dari aspek kekuatan, keselamatan dan ergonomic. Untuk menjadikan projek ini satu kejayaan, aliran kerja haruslah diikut bermula dari reka bentuk, analisis dan akhir sekali pembinaan.

Projek Tahun Akhir Diploma ini akan megambil sepanjang semester untuk disiapkan. Projek ini adalah projek individu dimana calon harus menyelesaikannya dengan sendiri. Projek ini turut memberi peluang untuk calon mengaplikasi pengetahuan dan kemahiran mereka dalam menggunakan mesin mahupun perisian komputer untuk mereka bentuk dan analisis. Dalam projek ini, pengurusan masa adalah penting untuk memastikan projek berjalan dengan betul berdasarkan perancangan. Ini juga langkah untuk menjalankan perkembangan projek lebih baik dan dalam perkembangan kerja yang berterusan. Jadi, kesimpulan dari projek ini adalah untuk membina projek yang mantap kita perlulah mempunyai disiplin yang tinggi dan calon juga berminat untuk menyiapkan Projek Tahun Akhir ini.

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LIST OF SYMBOLS

θ	Diameter
“	Inch
∑	Sum
̊c	Celsius
N-m	Moment units
N	Force units
m	Length units
kg	Mass units

LIST OF ABBREVIATIONS

GMAW	Gas metal arc welding
MIG	Metal inert gas
MAG	Metal active gas
RM	Ringgit Malaysia
FOS	Factor of Safety

CHAPTER 1

INTRODUCTION

1.1 PROJECT SYNOPSIS

The project is about to develop a clothes dryer machine. This project will make the differences between the dryer machines in the current market that is basically only spinning concept to remove moisture. By this semester 1 08/09 Final Year Project will be invented using all the method that has been learn through the previous semester, that is include the subjects that have been learned and also the machinery that has been used. This Final Year Project must finish and achieve the target by the end of this semester. Besides that, this Final Year Project will be able to give the student a bunch of knowledge and skills in using the machinery. Furthermore, this also can be the step of learning and also be able to know how to apply their understanding to solve the problem that appear.

1.2 PROBLEM STATEMENT

The problems that usually face in current time is base on the customer need. Although this Final Year Project not willing to compete with the product nowadays but it apply our skill to develop machine that can fulfill the needed. Usually the issues that always been claims are:

I. The product must be economic and efficient in manner.
II. Must be energy efficient.
III. The type of machine also must be consider although gas or electric dryer.

IV. How hot the machine can produce and how long it will take time to dry the cloths.
V. The size also take place, bigger is not necessarily when it comes to clothes dryer.
VI. The looking of the dryer machine.

1.3 PROJECT OBJECTIVES

The project is about to develop a clothes dryer machine that using bulb as the medium of dryer and also moveable with wheel. The project required all the skill and knowledge about metal rod and plate, connecter, engine (optional), mechanical design and also welding skills. The project objectives as follows:

I. Develop the Clothes Dryer Machine that can dry clothes in a short time.
II. Design the Clothes Dryer Machine with suitable shape.
III. Analysis the beam structure (rod that support the load of clothes) of the machine.
IV. The time taken to dry the clothes using material that has been choose.

1.4 PROJECT SCOPES

The project is about to design the mechanical part of machine and to fabricate the mechanical part of the system from the title that has been given. Besides that it is also need to apply all the knowledge and skill that require to make it done. In order to achieve the main objective there are some guide that must be follow to successfully done the project:

I. **Literature**
- The literature is including doing the research about the Clothes Dryer Machine. The sources are the journal from sciencedirect, search from internet and also people around.

II. **Design concept**

- Four (4) design concepts had been sketched. Before analyzing using metrics chart and Pugh concept, some criteria had been considered first. After that, the final concept will come out from the analysis tools
- The fabrication process will refer to the design concept that has been produce with their dimensions and criteria.

III. **Detail drawing**

- Detail drawing was developed from the final concept. The project feature will be more easy to understand and also used for the next steps of the project.

IV. **Fabricate**

- Fabrication is one of the most important parts in this project. The fabrication will only achieve when the analysis, material, and detail drawing had been finished. The fabrication process also includes the welding process, fastening, machinery and many more. While doing this part, all the knowledge's and skills will be applied.

V. **Report**

- The report will submit to the lecturer after all the information and all the work have done. The report consist all the work that have been done through the semester. The presentation slide also must been done while making the report. So that at the end of the project the presentation will take placed.

VI. **Others**

- The produce size that in planning is 1.4 m with a θ 0.6 m
- Load can be applied up to 5 kg.
- Using bulb as medium of drying.
- Moveable with wheel attached.

- Easy to install or replaced part.
- Time that takes to dry the 5 kg moist fabrics.
- The materials that use to build up the machine are aluminum sheet, ductile iron rod, hollow steel (½"x ½") and fastener.

1.5 PROJECT BACKGROUND

The clothes dryer machine also known as tumble machine used to dry a load of moisture textiles. There are many types that have been released in the market. Their purpose and function kindly the same and most of them used spinning concept as their way to remove moist from the clothes. Besides that, there are many shapes and sizes come with several of load that can be fill in the machine. Basically, majorities of the machine are unmovable and also difficult to replace the equipment that brake down. Develop a machine that can fulfill those criteria are the objective of this Final Year Project.

1.6 PROJECT SCHEDULES

This Final Year Project will be arranged through this semester with advice from supervisor En Zulkifli B Ahmad@Manap. It starts from week 1 until week 16. The planning process is to make sure the project run smooth and finished before the due date. Besides that, these also use to manage the objective and solve the task without having problems of time. Candidate can teach their self to arrange between Final Year Project and other subject.

In the industries, time management is important. If these kinds of skill do not been look over, it may give a big trouble to us in the future. Furthermore, the planning through this semester is shown by the Gantt chart that is in **Table 1.1**.

Table 1.1: Gantt chart

Project Activities		Week															
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Briefing about PTA by the lecturer	*Plan*																
	Actual																
Choose the Project that listed	*Plan*																
	Actual																
Project been given and start meet the supervisor	*Plan*																
	Actual																
Do some literature review and gather information	*Plan*																
	Actual																
Do the skethcing, gantt chart and material listing	*Plan*																
	Actual																
Do the Solidworks and Pugh and Metric Chart	*Plan*																
	Actual																
The analysis of the Clothes Dryer Machine	*Plan*																
	Actual																
Making progress report and mid presentation	*Plan*																
	Actual																
Show progress report and solidworks to supervisor	*Plan*																
	Actual																
Continue with the fabricating process	*Plan*																
	Actual																
Finish the final report and the fabricating	*Plan*																
	Actual																
Start to make the slide for presentation	*Plan*																
	Actual																
Present the Final Year Project	*Plan*																
	Actual																
Sent the final report to the co-ordinator	*Plan*																
	Actual																

CHAPTER 2

LITERATURE STUDY

2.1 INTRODUCTION

A clothes dryer or tumble dryer is a household appliance that is used to remove the moisture from a load of clothing and other textiles, generally shortly after they are cleaned in a washing machine.

Most dryers consist of a rotating drum called a tumbler through which heated air is circulated to evaporate the moisture from the load. The tumbler is rotated relatively slowly in order to maintain space between the articles in the load. In most cases, the tumbler is belt-driven by an induction motor.

2.2 PRODUCT REVIEW

There are two general classes of rotating dryers: electric and gas. Both of these refer to the method used to raise the temperature of the air flowing through the tumbler, since the tumbling action is usually electrically powered.

The electric dryer generally uses a coiled wire that is heated with electric current. The amount of electric current is varied to adjust the air temperature.

The gas dryer employs a gas burner that burns natural gas, propane, or butane to form a jet of hot gases that are directed into a venturi chamber, which uses Bernoulli's principle to pull in ambient air and raise its temperature. The air temperature can be altered by adjusting the size of the gas flame or, more commonly,

by merely extinguishing it and relighting it. Gas dryers require electricity to spin the clothes, but the amount of electricity is much smaller than in an electric dryer removing the need for a special connection.

2.2.1 Spin Dryer

This machine simply spins their drums faster than a typical washer could in order to extract additional water from the load. They may remove more water in two minutes than a heated tumbler dryer can in twenty, thus saving significant amounts of time and energy. Although spinning alone will not completely dry clothing, this additional step saves a worthwhile amount of time and energy for large laundry operations such as those of hospitals.

Figure 2.1: Spin dryer

2.2.2 Condensation dryers

Just as in a normal dryer, condensation dryers pass heated air through the load. However, instead of exhausting this air, the dryer uses a heat exchanger to cool the air and condense the water vapor into either a drain pipe or a collection tank. Afterwards, this air is run through the loop again. The heat exchanger typically uses ambient air as its coolant, therefore the

heat produced by the dryer will go into the immediate surroundings instead of the outside, increasing the room temperature slightly. In some designs, cold water is used in the heat exchanger, eliminating this heating, but requiring increased water usage.

Figure 2.2: Condensation dryer

2.2.3 Dehumidifier Dryers

By keeping a low humidity, dehumidifiers encourage fast evaporation without high heat. This type of dryer is suitable for clothes that can withstand tumbling but not high heat.

Figure 2.3: Dehumidifier dryer

2.2.4 Heat pump dryers

Whereas condensation dryers use a passive heat exchanger cooled by ambient air, these dryers use a heat pump. The hot, humid air from the tumbler is passed through a heat pump where the cold side condenses the water vapor into either a drain pipe or a collection tank and the hot side reheats the air. In this way not only does the dryer avoid the need for ducting, but it also conserves much of its heat within the dryer instead of exhausting it into the surroundings. Heat pump dryers can therefore use less than half the energy required by either condensation or traditional dryers.

Figure 2.4: Heat pump dryer

2.3 HISTORY

Contrary to Internet rumors, the first tumble dryer was not invented by American George T. Sampson. A hand-cranked version was created in 1799 by a Frenchman named Pochon. Sampson's United States patent (number 476,416), which he received on June 7, 1892, was for an improved rack for holding wet clothes near a heat source. Electric tumble dryers appeared in the 20th century.

2.4 MACHINERY

2.4.1 Gas Metal Arc Welding

Gas metal arc welding (GMAW), sometimes referred to by its subtypes metal inert gas (MIG) welding or metal active gas (MAG) welding, 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 GMAW, but constant current systems, as well as alternating current, can be used.

a) Equipment

GMAW torch nozzle cutaway image. The image is shown by **Figure 2.5** below:

1. Torch handle
2. Molded phenolic dielectric (shown in white) and threaded metal nut insert (yellow)
3. Shielding gas nozzle
4. Contact tip
5. Nozzle output face

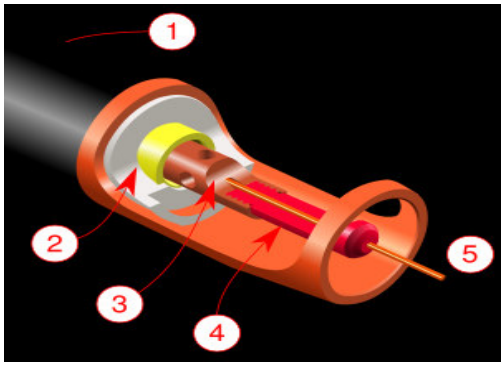

Figure 2.5: GMAW torch nozzle cutaway image

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 shielding gas supply. **Figure 2.6** below shown the GMAW wire feed unit that also in used to perform the welding process.

Figure 2.6: A GMAW wire feed unit

b) Operation

The operation in the GMAW is easy to understand. How the electrode is burn and joining process is taken also easy to know how does it works. **Figure 2.7** below show how the process happened.

1. GMAW weld area.
2. Direction of travel
3. Contact tube
4. Electrode
5. Shielding gas
6. Molten weld metal
7. Solidified weld metal
8. Work piece

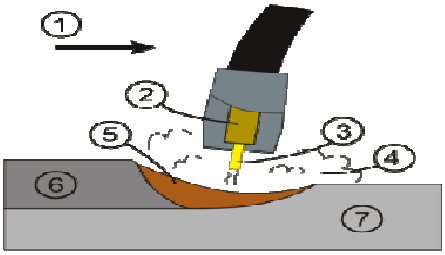

Figure 2.7: Operation of Gas Metal Arc Welding

2.4.2 Drilling

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. From **Figure 2.8** shown of component that usually have in a drilling machine.

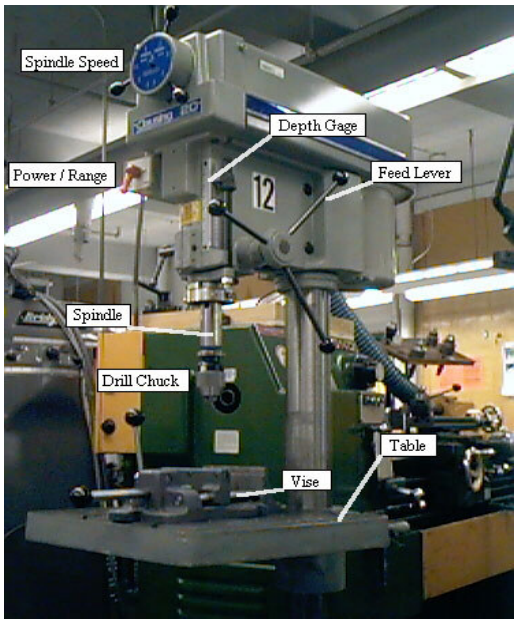

Figure 2.8: Drill machine components

a) Drilling in metal

Under normal usage, swarf is carried up and away from the tip of the drill bit by the fluting of the drill bit. The continued production of chips from the cutting edges produces more chips which continue the movement of the chips outwards from the hole. This continues until the chips pack too tightly, either because of deeper than normal holes or insufficient backing off Lubricants and coolants are sometimes used to ease this problem and to prolong the tools life by cooling and lubricating the tip and chip flow.

b) Consideration for drilling

Because drilling can often be such a critical process there are a number of considerations that should be taken in order to ensure the most accurate drill hole possible. There are a few steps that can be applied to fulfill this consideration. Below are a few tips that can be applied to making a good finishing result:

I. The bottoms of the hole should match the standard drill point angles. Avoid flat bottom holes or odd shapes.
II. Create through holes instead of blind holes when possible.
III. If a blind hole must be drilled and tapped, it should be drilled deeper than the tapped depth.

2.4.3 Tin Snips

a) Purpose of Tin Snips

Tin snips as **Figure 2.9** below are shears which are designed to cut through thin sheets of sheet metal. While their design resembles scissors, they are much stronger, with heavier blades which are designed to make metal cutting as easy as possible. Many hardware stores carry tin snips, and there

are typically several options to choose from. Many people have several sets in their toolbox for different tasks.

Figure 2.9: Tin snips

b) Types of Tin Snips

There are three basic types of tin snips:

I. Left cutting
II. Straight cutting
III. Right cutting

The best tin snips have offset handles, which create an angle between the blade and the hands of the user. It is a good idea to wear heavy gloves when cutting sheet metal, because the edges can be very sharp, and shards of metal can act like splinters, penetrating your hands and causing pain and discomfort.

Figure 2.10: Cutting sheet metal with tin snips

2.5 EQUIPMENT

2.5.1 Introduction

A fastener is a hardware device that mechanically joins or affixes two or more objects together. Fasteners can also be used to close a container such as a bag, a box, or an envelope; or they may involve keeping together the sides of an opening of flexible material, attaching a lid to a container, etc.

2.5.2 Types of Fastener

There are some types of fastener that will be applied in this final year project such as:

I. Bolt and Nut
II. Screw
III. Rivet

a) Bolt

Bolts are one of the most common elements in construction and machine design. They consist of cap screws or studs that capture and join other parts, and are secured with the mating of screw threads.

In these project there are some bolt needs to join the part of machine. In figure there is some information that needs to consider holding the load of the part and also the load by the clothes itself.

i. Types of bolts

1. Cap screw
2. Machine screw
3. Stud

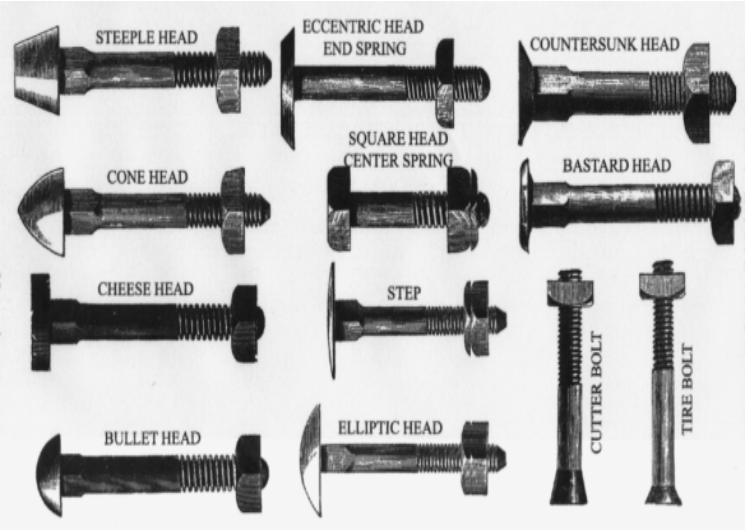

Figure 2.11: Types of bolt

b) Nut

Nut is a type of hardware fastener with a threaded hole. Nuts are almost always used opposite a mating bolt to fasten a stack of parts together. The two partners are kept together by a combination of their threads' friction, a slight stretch of the bolt, and compression of the parts.

i. Types of nut

I. Barrel nut
II. Cap nut (acorn nut)
III. Flange nut (collar nut)
IV. Hex nut and many more.

Figure 2.12: Types of nut

2.5.3 Rivet

a) What is Rivet?

A rivet is a mechanical fastener. Before it is installed it consists of a smooth cylindrical shaft with a head on one end. The end opposite the head is called the buck-tail. On installation the rivet is placed in a pre-drilled hole. Then the tail is "upset" so that it expands to about 1.5 times the original shaft diameter and holds the rivet in place.

b) Types of Rivet

I. Solid rivets
II. Blind rivets
III. Multi-grip rivets
IV. Grooved rivets and others.

Figure 2.13: Types of rivet

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

This chapter is about the methods and machineries that will be applied to build up the clothes dryer machine. Methodology can properly refer to the theoretical analysis of the methods appropriate. Basically, the process and method that involved building the dryer machine will be simplify explained in this chapter. The explanation is related to the flow chart that will be shown at **Figure 3.1**. The flow chart is about the works flow that taken through the semester. Besides that, this is the guidelines trough the semester. This will give the general view about this Final Year Project.

3.2 PROJECT FLOW CHART

From the **Figure 3.1** below, the project starts with some literature review and gathers some information about the project title. It is about to find the concept that used on the machine, the design, the type of the machine and also the differences between current Clothes Dryer Machine. The literature review is done by finding it from the journal, the internet, books, people around and etc.

Furthermore, the project is continued by design the Clothes Dryer Machine. Using the information that have been collect, from the metrics and Pugh concepts the most suitable are been chosen after the sketching done. Then the detail drawing takes part to make the design come to live and easy to understand.

After the engineering drawing is done, analysis for the machine is been tested whether it is safe or not. It is done manually calculated and using the MD solid software to comparison.

The fabrication process had been done after the entire step above is surely approved. All the dimension is been already listed in the drawing and also the material are according to the needs. During the fabrication process, a lot of skills and knowledge's will be applied such as welding skill, drilling, cutting, and others

When the process of fabricate were done. All the material and the other tools are collected. The report will be guided by the Final Year Project report writing that have been given by the lecturer. The process is including the presentation.

Finally, the Development of Clothes Dryer Machine project ended after submission of the report and the project have been present to the lecturer. After the finalize report was confirm the report will be print out and submitted to the supervisor, project coordinator and lastly to the Faculty.

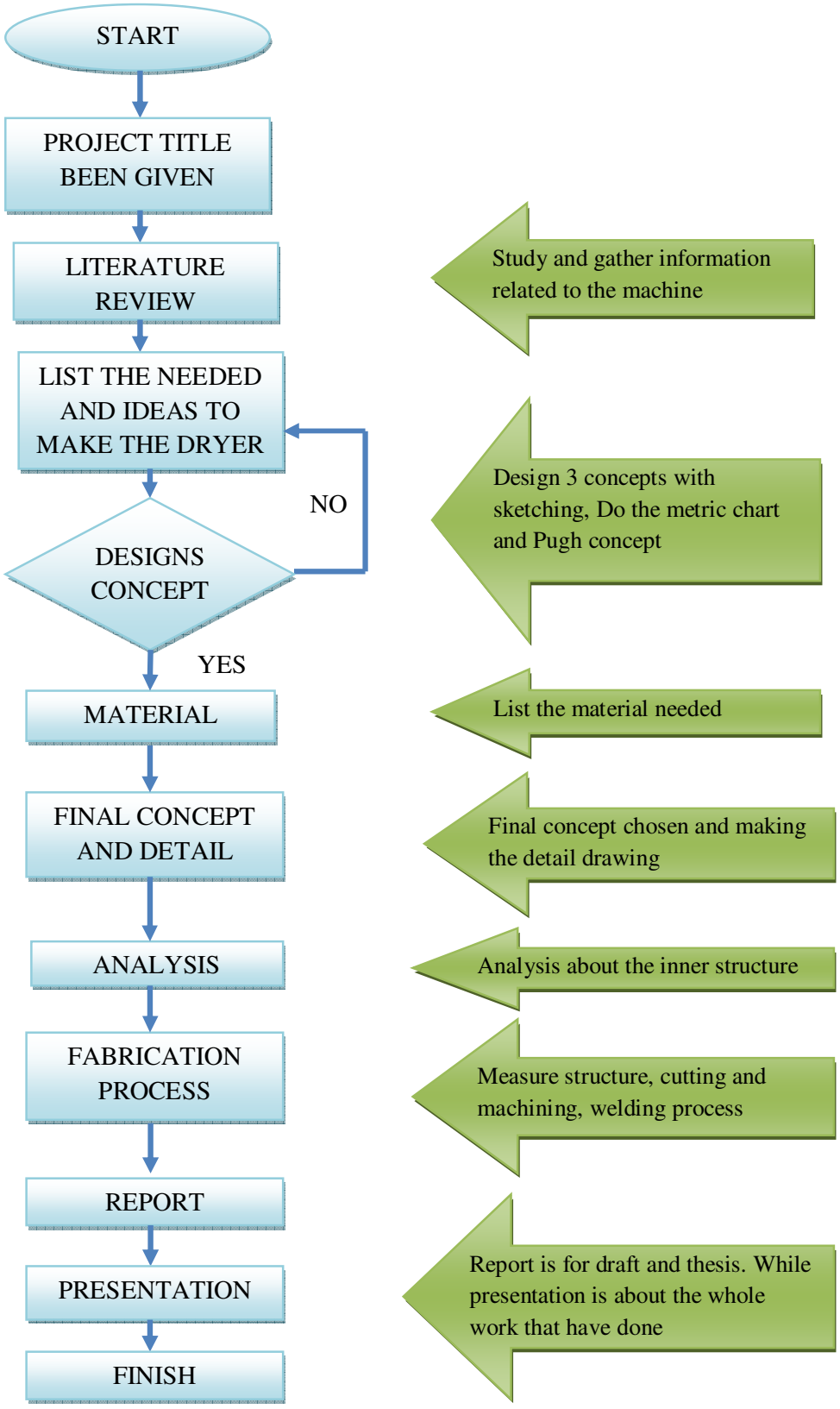

Figure 3.1: Flow Chart

3.3 DESIGN CONCEPT

The design of the Clothes Dryer Machine should compliance all the aspects. The design consideration must be done carefully then the design can be fabricated and the system will function. The dryer should be able to dry the clothes and also should be fast enough time to remove the moisture. Besides that, the load that will support by the beam inside the machine should be able to support up to 5 kg of clothes.

The material also been considered to help up the heat and dry the clothes even faster. About the appearance, it is not necessarily but still need to be considered. Then, the costs of the material that will use on the product also need to be considered. The cost should be reasonable and not over the budget given. Besides that, the machine also suit for the environment. That is because the operation will take in closed room that is from the required aspect for this Final Year Project.

3.4 SKETCHING

An outline or general delineation of anything a first rough or incomplete draught or plan of any design especially in the fine arts such a representation of an object or scene as serves the artist's purpose by recording its chief features also a preliminary study for an original work. There are four design concepts that have their own characteristic. The design concept will be graded and this will produce the best concept that will show in **Table 3.1** that is the Metric Chart.

3.5 CONCEPTS SELECTION

3.5.1 Concept A

The **Figure 3.2** is the Concept A designs. This design has a huge amount of clothes that can be stored but and also need an amount of electricity to dry the clothes. It needs a lot of raw material to assemble based

on its space. This concept used both fan and bulb as the drying process and moveable with wheel.

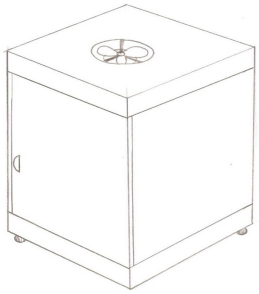

Figure 3.2: Concept A

3.5.2 Concept B

This design considers the amount of the clothes while also needs an amount of electricity. The stability also needs to be considered, by looking at the figure the design concept need to have several of support to stand the machine. It will take some cost. Besides that, it also uses the fan and bulb as the drying medium. The **Figure 3.3** below showed the design concept.

Figure 3.3: Concept B

3.5.3 Concept C

The design is the combination between the first and the second design. This design is not using the fan but only used the bulb as the drying

medium. **Figure 3.4** shown that if the larger the machine is build up, it will take a big amount of cost that will used on it. Besides that, the design concept also has the wheel to easily move the machine anywhere in the room.

Figure 3.4: Concept C

3.5.4 Concept D

The **Figure 3.5** below showed the design concept D. The design has some of the criteria from the needs. However the design still need to be upgrade based on the stability. The energy efficiency is in a good rating because the fan is not used in this concept. The drying process is applied by the bulb that installed in the machine. Besides that, it is easier to place the cloths and can be filling with a lot of fabric based on the design concept. Concept D is the best rating concept from four concepts that listed.

Figure 3.5: Concept D

Table 3.1: Metric Chart

Design / Need	1	2	3	4	Best Rating
1. Fast in drying the cloths	3	4	4	5	4
2. Can dry cloths in large amount	5	3	3	4	1
3. Adorable design	2	3	4	5	4
4. Boby strength	4	3	5	3	3
5. Easy maintainance by common tool	3	4	3	5	4
6. Easy to use and portable	2	1	3	4	4
7. Ligth in weight	2	3	4	5	4
8. Suitable price	2	3	1	4	4
9. Lower electric usage	3	3	3	5	4
10. Easy to assemble	5	4	3	4	1
11. Life expectancy	3	5	2	4	2
12. Multi-function	1	3	4	5	4

BEST DESIGN CONCEPT	4

Rating:

1 – Limited

2 – Modest

3 – Competent

4 – Good

5 – Very Good

3.6 PUGH CONCEPT

Table 3.2: Pugh Concept

Selection Criteria	Concepts				
	A Design 1	B Design 2	C GE Profile Harmony (Datum)	D Design 3	E Design 4
1. Fast in drying the cloths	0	+	0	+	+
2. Can dry cloths in large amount	+	0	0	0	-
3. Adorable design	-	+	0	+	+
4. Boby strength	+	0	0	+	0
5. Easy maintainance by common tool	0	+	0	0	+
6. Easy to use and portable	-	-	0	0	+
7. Ligth in weight	-	0	0	+	+
8. Suitable price	-	0	0	-	+
9. Lower electric usage	0	0	0	0	+
10. Easy to assemble	+	+	0	0	+
11. Life expectancy	0	+	0	-	+
12. Multi-function	-	0	0	+	+
∑+	3	5	0	5	11
∑-	5	1	0	2	1
∑0	4	7	12	5	1
Net Score	-2	4	0	3	10
Rank	5	2	4	3	1

3.6.1 What is Pugh Concept?

Pugh Concept as shown by **Table 3.2** above is on way to get the final design concepts. By this method the final concept will be come out and also the design that will fulfill the needs. The Pugh concept must contain the criteria by which concept will be evaluated. Next step is to formulate the decision matrix and clarify the design concept. Besides that, Pugh Concept must have the datum concept. That is to compare which concept is better. Lastly, is by run the matrix and evaluate the ratings.

3.7 FINAL CONCEPT

As **Figure 3.6** showed below is the Final concept that is drawn from the Pugh Concept. The concept applied all the need and also the best design suit with the title given. As the figure shown, the drying process is by using the bulb and the raw material that will be used to build up the machine also help to increase the heat, and then dry the fabrics. The wheel that installed will make it moveable and easy to move it to any space in the house. The material that will be use is Aluminum and ½" x ½" hollow steel as the cover and the frame of the Clothes Dryer Machine.

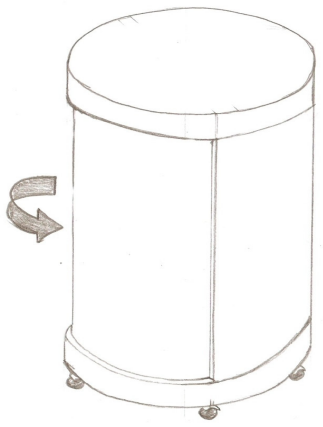

Figure 3.6: Final Concept

3.8 MATERIAL PREPARATION

Material preparation is step before making the fabrication process. The material selection is based on the design and the suitable manner of making the dryer machine. From **Table 3.3** shown below is the material listed to make the Clothes Dryer Machine. The material selection also needs to consider the costs and the strength that will ensure the machine will last for long time.

Table 3.3: Material Lists and Costs

No.	Material	Dimension	Quantity	Cost for a unit (RM)	Total (RM)
1.	Hollow steel	½" x ½" x 6 m	3	8.00	24.00
2.	Rod	1" x 1" x 0.57 m	1	8.00	2.00
3.	Aluminum plate	2.9 kg	1	58.00	58.00
4.	Wheel	-	4	7.50 a set	7.50
5.	Bulb	-	3	1.50	4.50
6.	Bulb holder	-	3	1.00	3.00
7.	Wire	4 m	-	0.60 a meter	2.40
8.	Socket	-	1	3.00	3.00

∑ All the cost = RM 104.40

3.9 FABRICATION PROCESS

The fabrication process is the step to bring up the dryer machine to its true form. The design dimension will be followed as to achieve the product characteristics. The entire dimension will be listed at the detail drawing that is attached at the back of this Final Year Project thesis. Besides that, there will be a lot of method that will be used to fabricate this project. As example the welding process, fastening, cutting process, drilling process and several more process.

3.9.1 Project Procedures

a) Machine and Equipment

The machine and equipment that involved in this fabrication process are already discussed in the previous chapter. There are:

I. Gas Metal Arc Welding
   - Use for welding the hollow steel to make the frame of the dryer machine.

II. Drilling Machine
   - Use for drilling the hole of the rivets and bolts.

III. Fastener
   - To attach the aluminum plat to the frame.

IV. Tin Snips
   - Use for cutting the aluminum plate.

b) Raw Materials

The material that used in this fabrication process are hollow steel, aluminum plate and other type of material such as wheel, bulb, bulb holder and wire. **Table 3.4** showed the material use in the fabrication process with their dimension and quantity.

The hollow steel that will be use is the ½ inch x ½ inch that is as the frame of the machine. Then a hollow rod that is diameter 1 inch will be used as the stand to hang the clothes. The aluminum plate is the cover of the machine while it will be heated by three bulbs as it medium of drying process.

The hollow steel and the rod will be cut by the disc cutter. Besides that, the aluminum plate is cut by the tin snips. The wiring process for the

bulb is simple that is will be done after all the fabrication process of the body machine has been done.

Table 3.4: Material Dimensions and Quantities

No.	Material	Dimension	Quantity
1.	Hollow steel	½" x ½" x 1.04 m	3
		½" x ½" x 1.015 m	3
		½" x ½" x 0.6 m	4
		½" x ½" x 0.57 m	2
		½" x ½" x 0.3 m	5
		½" x ½" x 0.285 m	2
		½" x ½" x 0.14 m	8
	Bending hollow steel	½" x ½" x 0.768 m	6
	Bending hollow steel	½" x ½" x 0.818 m	6
2.	Rod	1" x 1" x 0.57 m	1
3.	Aluminum Plate	θ 0.6 m	2
		1.89 m x 1.3708 m	1
		1.79 m x 1.0404 m	1
		1.79 m x 0.1654 m	2
4.	Wheel	-	4
5.	Bulb	-	3
6.	Bulb holder	-	3
7.	Wire	4 m	1
8.	Socket	-	1

c) Step of Fabrication

Before doing the dimensions and cutting process, selecting the materials that needed to make this project play a lot of part in this project. The measuring are follows the dimension that has been make. Then cutting the hollow steel follows the dimension at **Table 3.4**. Besides that, the hollow

rod also had been cut using the disc cutter. This all step are showed in **Figure 3.7 a**, **Figure 3.7 b**, **Figure 3.7 c,** below.

Figure 3.7 a: Selecting the materials

Figure 3.7 b: Measuring

Figure 3.7 c: Cutting the hollow steel and rod

After that, the drilling process will take part. **Figure 3.8** show that the drilling process is for making hole for the rivets and bolts. The drilling also used for attach the aluminum by the rivet through the hole that has been make.

Figure 3.8: Drilling Process

Bend the hollow steel for making frame of the machine. This also include in this chapter. Bend hollow steel are use to support the cover from crooked. The aluminum sheet is easy to crook so this type of method can prevent the cover from bend. **Figure 3.9** show the bending process is done.

Figure 3.9: Bend the hollow steel to making the cover support

Using the Gas Metal Arc Welding, the hollow steel that had been cut and drilled will be welding. This fabrication process is for making the frame of the machine. At **Figure 3.10** below show how the welding process is working. After welding process are done, from **Figure 3.11** show that grinding process is the step to remove the unneeded burr and also make the surface looks better.

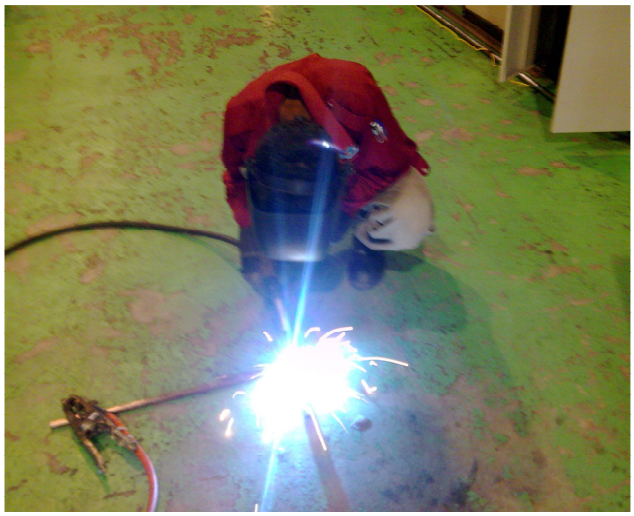

Figure 3.10: Welding Process

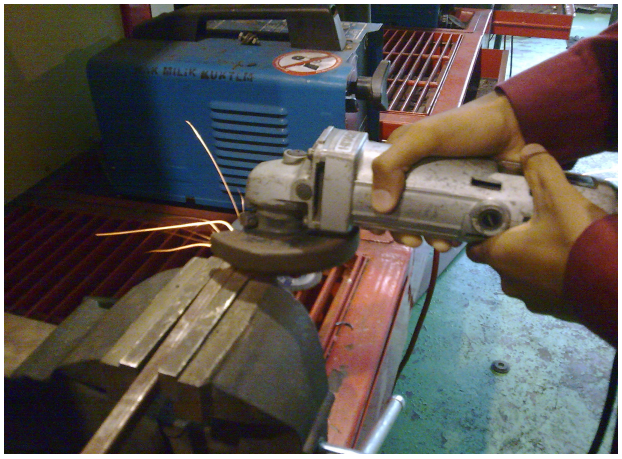

Figure 3.11: Grinding Process

The next step is to making the cover of the Clothes Dryer Machine. From **Figure 3.12** the tin ships is used to cut the aluminum plate as the dimension that listed in **Table 3.4**. The aluminum is a material that easy to cut, besides that the thickness of the aluminum plate is not too hard to cut with the tin snips. The shapes that will be come out are also not to complex that why for making the machine cover only uses the convectional process.

Figure 3.12: Cutting the aluminum plate with the tin snips

Painting the hanger rod and frame is another fabrication process in this project. The painting process is for making the frame and hanger rod looking well. Besides that, the painting will prevent the moist hit the steel. The moist will rust the steel and will affect the clothes. **Figure 3.13** showed how the painting process is done.

Figure 3.13: Painting process

Then the cover of the machine attached with the rivet through the hole that had been make. **Figure 3.14** show how the rivet is used to attach the aluminum plate to the frame. The door of the dryer machine is attached by the bolts and nuts. This is because the door is rotated that why the bolts and nuts is used.

Figure 3.14: Rivets, bolts and nuts used to join the cover, main body and door

The wheels are attached to the bottom of the machine as **Figure 3.15** showed below. The wheels are located to the hole that had been drilled and welding at the bottom of the frame. The wheels are used to make the machine moveable and easy to bring anywhere in the house without lift it.

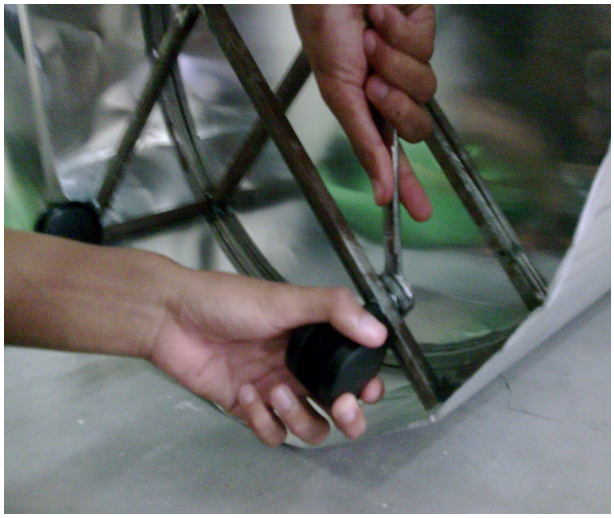

Figure 3.15: Attached the wheels

Then, attach the handle for the dryer door. **Figure 3.16** shows the process of attach the handle. Before attached the handle the frame is drilled to make a hole for the handle. The handle is for easy to open the door.

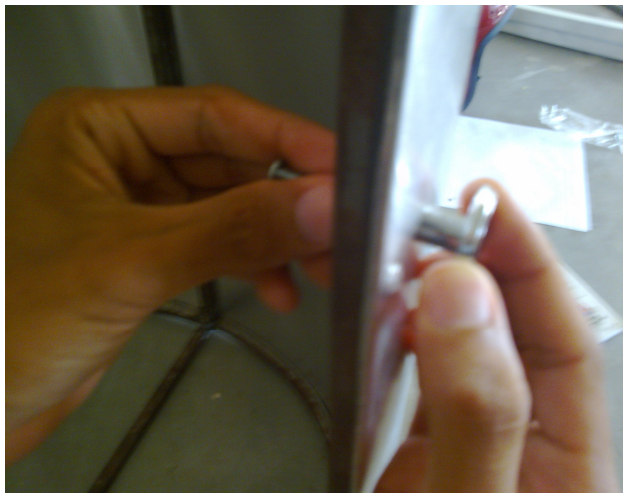

Figure 3.16: Attach the door handle

Lastly, the wiring process is been done as the bulbs, bulb holders, socket and the wire are attached at the machine. From **Figure 3.17** shown that

the bulb are installed in the machine. The drying process is by the heats that produce from the bulb.

Figure 3.17: Wiring Process

Figure 3.18 is the product that is done after all the fabrication process is done. By all the works is done, the fabrication is fully complete and the main criteria that needed for this Final Year Project is finished.

Figure 3.18: Fabrication process that has be finished

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 INTRODUCTION

In this chapter, it involves analysis of the project either at the beginning or after the end of the project. This includes the finished works, the defects, problem occurs at the product and also the specification of the product after finish assembled.

Besides that, it also consists of the troubleshooting and problem solving. The analysis of the project also been introduces in this chapter to know the strength of the machine that will used to carried loads. This chapter will bring up the final results and the ultimate strength that will achieve.

4.2 ANALYSIS BY MD Solids SOFTWARE

The analysis for this Final Year Project is focused at the rod that supports the load of the fabrics. **Figure 4.1** showed the rod that will be used to support load from the clothes. By using the MD Solid software as **Figure 4.2** showed the distributed of the loads. The maximum load that applied at the rod is 5.0 N/m while the length of the rod is 0.6 m.

Figure 4.1: Rod that used to hang the clothes

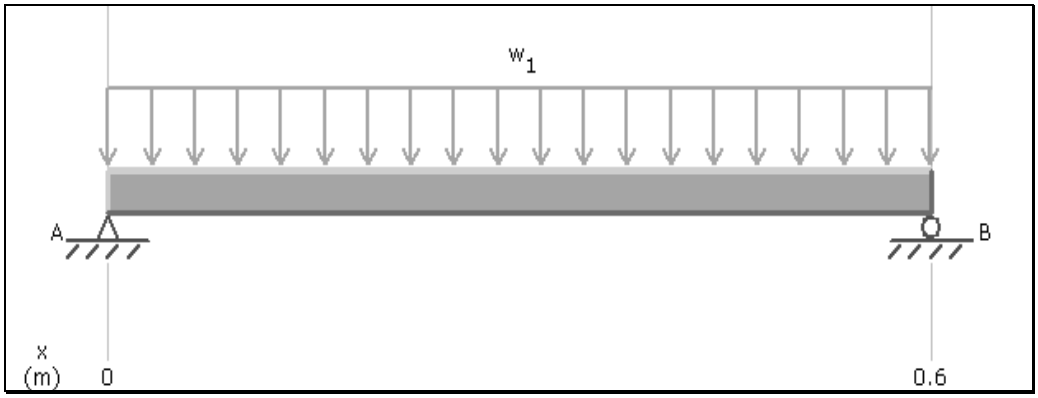

Figure 4.2: Load Diagram

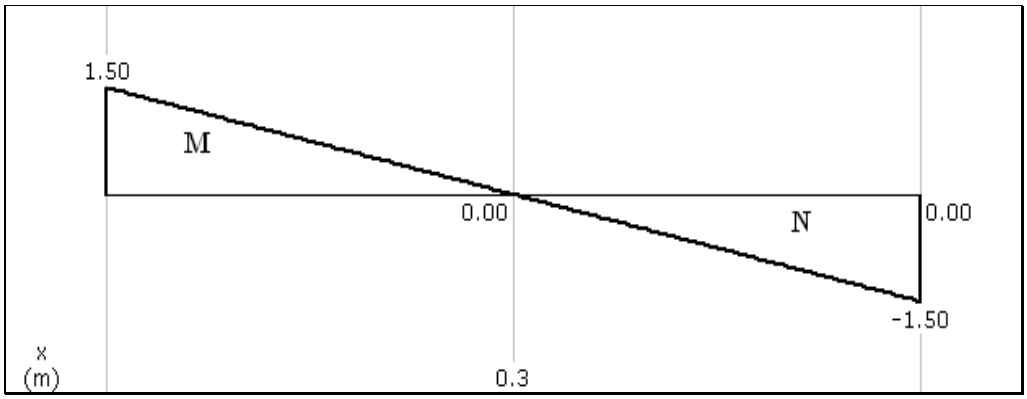

Figure 4.3: Shear Diagram

4.2.1 Description for M slope

The slope of the shear curve in this region is -5.000 N/m. The shear curve slope is defined as the change in shear divided by the change in distance. The point where the shear curve crosses the horizontal axis must be calculated. Starting at x = 0.00 m where V = 1.50 N, the shear must change by -1.50 N to reach the horizontal axis. Divide -1.50 N (i.e., the change in shear) by the slope -5.000 N/m to compute the distance from x = 0.00 m to the point of zero shear. This distance equals 0.30 m. A zero shear force occurs at x = 0.30 m. A relative maximum or minimum value of the bending moment corresponds to this location.

The change in moment between two points on the beam equals the area under the shear curve between the same two points. The area under the shear curve between points x = 0.00 m and x = 0.30 m is 0.2250 N-m. The moment at x = 0.00 m is 0.00 N-m. Adding the area under the shear curve (0.2250 N-m) to 0.00 N-m gives a bending moment of 0.2250 N-m at x = 0.30 m.

In this region, the moment curve is **parabolic** (i.e., 2nd order curve), starting with a relatively large positive slope and growing increasingly flatter.

4.2.2 Description for N slope

The slope of the shear curve in this region is -5.000 N/m.

The change in moment between two points on the beam equals the area under the shear curve between the same two points. The area under the shear curve between points x = 0.30 m and x = 0.60 m is -0.2250 N-m. The moment at x = 0.30 m is 0.2250 N-m. Adding the area under the shear curve (-0.2250 N-m) to 0.2250 N-m gives a bending moment of 0.00 N-m at x = 0.60 m.

In this region, the moment curve is **parabolic** (i.e., 2nd order curve), starting with a flat slope and growing increasingly steeper.

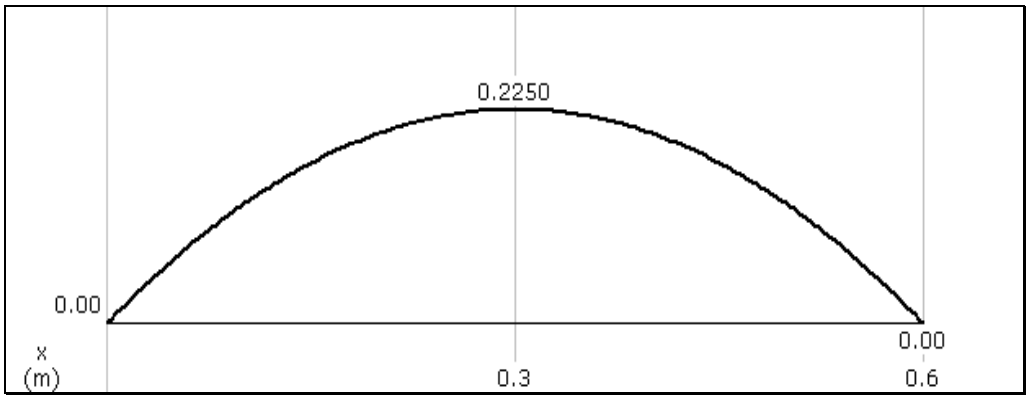

Figure 4.4: Moment Diagram

For the moment discontinuity equation, the following units are displayed:

Length units = m

Force units = N

Moment units = N-m

Moment discontinuity equation using symbolic notations:

$$\text{Moment} = Ay\langle x-0.00\rangle^1 + By\langle x-0.60\rangle^1 - w1/2\langle x-0.00\rangle^2 + w1/2\langle x-0.60\rangle^2$$

Moment discontinuity equation showing actual numeric values:

$$\text{Moment} = +1.50\langle x-0.00\rangle^1 + 1.50\langle x-0.60\rangle^1 - 5.00/2\langle x-0.00\rangle^2 + 5.00/2\langle x-0.60\rangle^2$$

When using discontinuity functions, if the term in the < > brackets is negative for a particular value of x, the quantity in the < > brackets is defined to have a value of zero.

4.3 ANALYSIS BY USING COSMOSXpress

The COSMOSXpress is a way to analysis the hanger rod under the certain conditions. It can help answer the engineering question such as will the part break? How will it deform? Can I use less material without affecting performance? **Figure 4.5** will show the Factor of Safety (FOS) hanger rod and **Figure 4.6** will show the condition where the hanger rod applied with heavy loads.

Material: Ductile Iron
Load: 5 kg
Lowest FOS: 37.4036

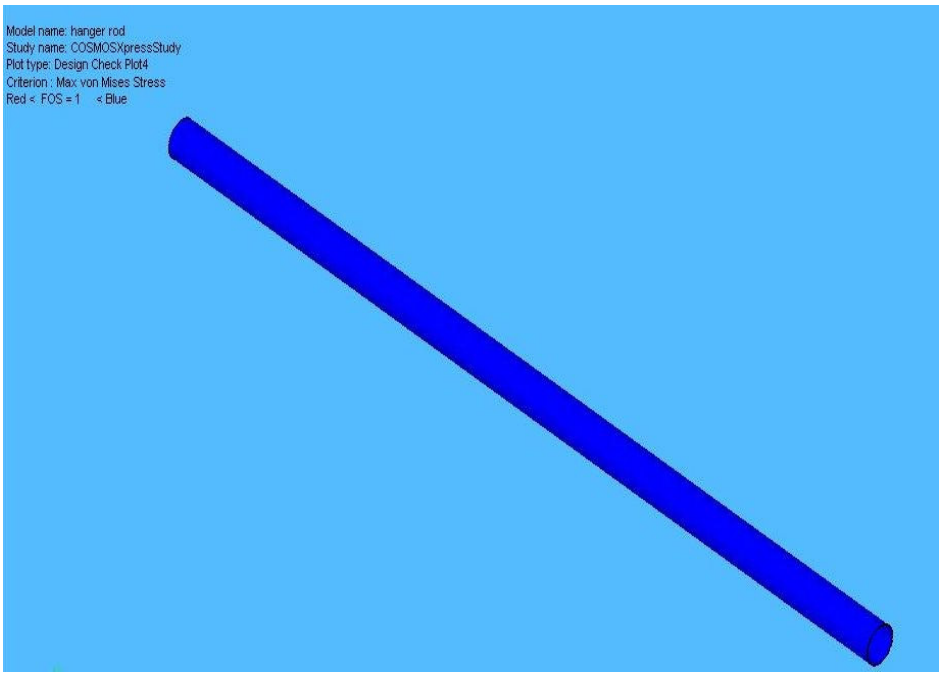

Figure 4.5: Under safety condition

Figure 4.6 show the stress at the hanger rod when the load applied on it is over the specification load. The red color is the critical place and the first place that will crack. This will make the hanger rod fall and pull off from their places. Besides that, the hanger rod also can break into two if the red color is strong enough. There are many possibilities that will appear if the load is over limit.

Material: Ductile Iron

Load: Over 5 kg

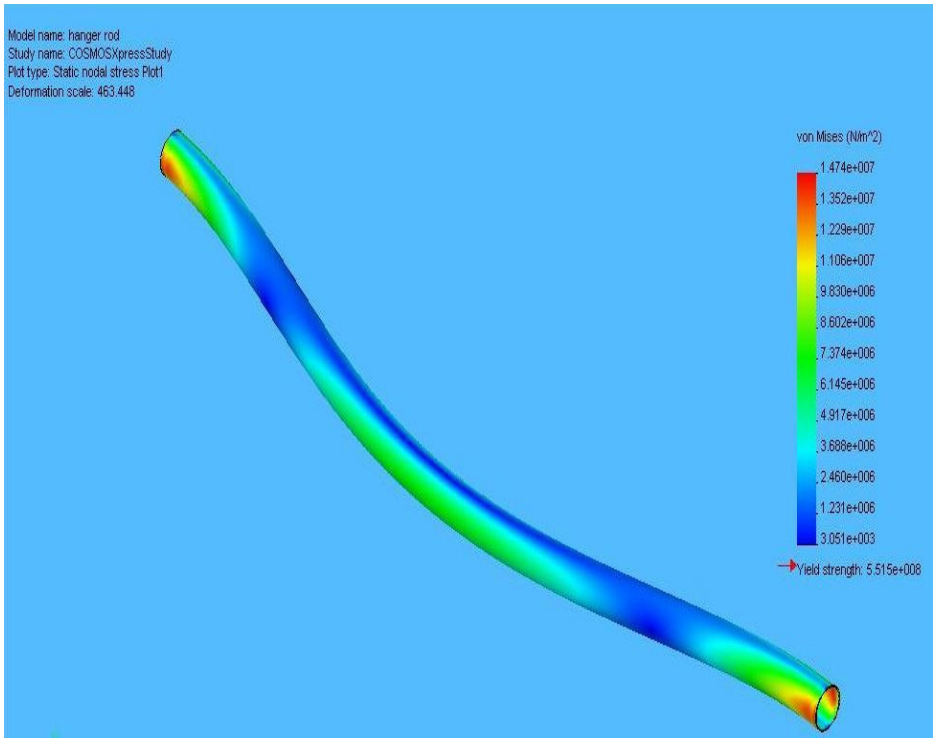

Figure 4.6: Stress distribution of heavy load applied on the rod

The critical point at the hanger rod is showed by the color. The red color is the maximum critical point. This may the first part that will crack. So, to prevent the crack from happen the load that applied on the hanger rod must not over the limit. This material that used is easy to replace if this problem happen.

4.4 PRODUCT SPECIFICATIONS

Product specifications also included in this chapter. The weight, specific sizes, color and others are included in product specifications. **Table 4.1** below shows the detail about product specifications. This specification purpose is to know the final result that had be produce when the project is fully finished. Besides that, this will give the product over view and useful information about the product.

Table 4.1: Product Specifications

No.	Type	Product Specifications
1.	Weight	7 kg
2.	Wide	0.6 m
3.	Height	1.43 m
4.	Color	Grey
5.	Maximum load	5 kg
6.	Maximum heat (temperature)	39 ̊c
7.	Time to dry 5kg moist clothes	3 hour

4.5 DEFECTS AND PROBLEMS

Defects and problems always appear while machining and finishing the product. The causes are by the weakness using the machines and tools. The good sides from these weaknesses, it can gain knowledge and skills. This will give a lot of advantages to the candidates to improve their skills of using the tools. Furthermore, the defects will be detailed below.

4.5.1 Welding bead

A weld bead is a weld deposit produced by a single pass with one of the welding processes. A weld bead may be either narrow or wide, depending on the amount of transverse oscillation used by the welder. When there is a great deal of oscillation, the bead is wide; when there is little or no oscillation, the bead is narrow. A weld bead made with- out much weaving motion is often referred to as a stringer bead. On the other hand, a weld bead made with side-to-side oscillation is called a weave bead. **Figure 4.7** shown the bead problem when welding process was done.

Figure 4.7: Weld Bead

4.5.2 Gap between covers and frames

From **Figure 4.6** the gap between the cover and frame happen when there is an addition value that appeared. Besides that, the problem is because the rivet does not perfectly join together with the frame. On the other hand, the dimension is not well done because of the difference dimension. Besides that, the door and the main body also have gaps. This is because the dimensions are a little bit off.

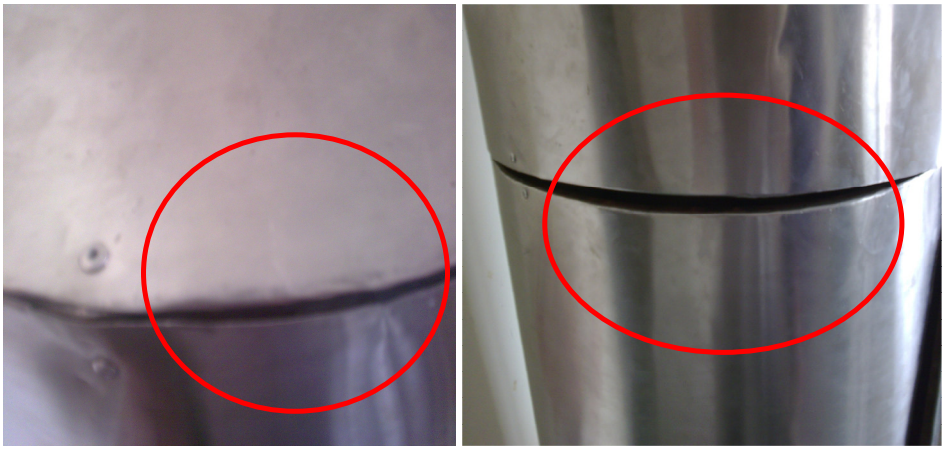

Figure 4.8: Gap problems

4.5.3 Bad surface finish

The problem is due to the welding process. The weld are not been grinding after the process is done. The surface finish is does not well done and it makes the part looks unwell. **Figure 4.9** shows how the bad surface finish that had been done.

Figure 4.9: The weld that not been grinded

4.5.4 Painting process does not well undone

Figure 4.10 showed that the painting process is not well undone. The factor is because the cover attach before painting process is done. The planning should according to the step to make sure the fabrication is run smooth enough.

Figure 4.10: Part that have not been paint

4.5.5 The cover is not perfectly circle

The bottom cover as **Figure 4.11** shows below is not perfectly circle. This is because there are no frame to support the bottom part, because of that the part does not well looking. So, to prevent it the best way is to make the frame over the whole part that will attach to the cover that is circling. This will make the project more perfect.

Figure 4.11: The bottom cover is crooked

4.5.6 The door is hard to open

The door of the clothes dryer is hard to open. The factor is the main body and the door has too little gaps. The dimension between both part is does not fit. In the future, the dimension must really be focused and build the best way to fit the dryer door so that this kinds of error should not happen. **Figure 4.12** showed below illustrations how the door was is hard to open.

Figure 4.12: The dryer door is hard to open

4.5.7 Difficulties in finished the project

Another problem that had to be faces is about the tool that applied on the machine. The tooling is not enough and difficult to find. Besides that, the welding machine also breaks down. This makes the project delay in short of time. Another problem is the rivet. The rivet tools are also does not enough and the tools are always been use by other candidates. The alternatives that have been taken to prevent the problem are by using the tool that brought from home. This makes the process much quicker and the processes fabricating done well as planned.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 INTRODUCTION

This final chapter is about the whole previous chapter and of course the Final Year Project. In this chapter, it also discuss about the recommendation and to improve the product to another stages. From this chapter, it also can expose us the new ideas or learn the weakness that has been done from the project. This will improve our skills and knowledge to give a best shot through another problem that will be face in the future.

5.2 CONCLUSION

The conclusions for this Final Year Project are listed in this chapter. This project is 70% achieve and the other 30% are the problems and defects that encountered. The Development of Clothes Dryer Machine is a title that gives a lot of new knowledge and skills. Besides that, to build this machine does not require an advanced technology but the skills and best practical that has been learned in the previous semester. The project also does not following the original idea besides there are many modifications through the project to perfectly do the project. As example, the body frame: the bend hollow steel is not been introduce in the origin idea but as the improvement to the cover (the cover will perfectly and smoothly circle). On the other hand, the inner cover for the bulb is not being attached: this is for the light to be separate to all part of the machine and this will turn up the heat to the maximum and fasten the drying process.

Furthermore, the detail drawing also must be easy to define and the important of the explode view to imagine the product or structure that will be build. This will make the fabrication process more simple and easy to understand the step to build the dyer machine. Although this Final Year Project does not compete with the outside dryer machine, this project consist the basic and simple terminology that is easy to understand the concept and also to install. How the machine works and the heating process takes place are also in simple way o understand: the heating that produce from the bulb that installed in the machine produce heat in the machine. Then the heat will be absorbed by the steel and gain the heat as the bulb remains on. In distance of time the heat will remove the moisture and dry the clothes.

Lastly, to complete this Final Year Project needs a lot of hard work and dedication. Especially, meet the supervisor and update the progress that has been done. By this action, the project will run smoothly and linear progress. Besides, a lot of difficulty that will be faces in the next step of the works. Advice from the supervisor mostly helps the candidate to improve their project and also give a bunch of new idea to make the project even perfect. There is a lot of new knowledge and new thing that has been learn from this Final Year Project. In the future, this is an advantage for candidate to handle the problems and tasks mush better and also give their best result at the end.

5.3 FUTURE WORKS

There a lot of the improvement that can be applied to the machine. The machine can be installed with a motor or fan to improve the drying process. As we know wind also one of the drying medium. Installment in the machine will make the heat rotate to all of the space in the machine and yet the drying process will be a great result.

Besides that, the inner wall of the machine can be colored in black. This will give almost best result and quicken the drying process. Black can absorb the heat and improve the heat. This will make the dryer machine even hotter.

The machine needs the improvement of flexibly. This is because there is more function and can be bring to anywhere and any places. Besides clothes, they can be use to dry shoes, small cushion, towel or any kinds of thing so long as it is fabrics. This will get the better product because of their function and flexible or moveable. The dryer machine is one of the needed things and the development of this machine can be great and also can give income to the developer yet improve the economy and give best home appliance to take care of their clothing.

5.4 RECOMMENDATIONS

There are a lot of thing that can be upgrade in this Final Year Project. These recommendations allow us to continue with a much better product that will be produce in the future. The recommendations are:

I. The dryer machine should have a motor or fan to run the machine even efficiently. Besides that, it will also shorten the time of drying.

II. Formable: easy to bring anywhere and use in any places. As example, the part of the machine can be turn into a small sizes (can be fold)

III. The inner part is colored into black. This can maximum the heat in the machine. Black color can absorb heat and build up another higher heat.

IV. Make a dryer machine that can endure more loads. Then it can dry even a lot of fabrics.

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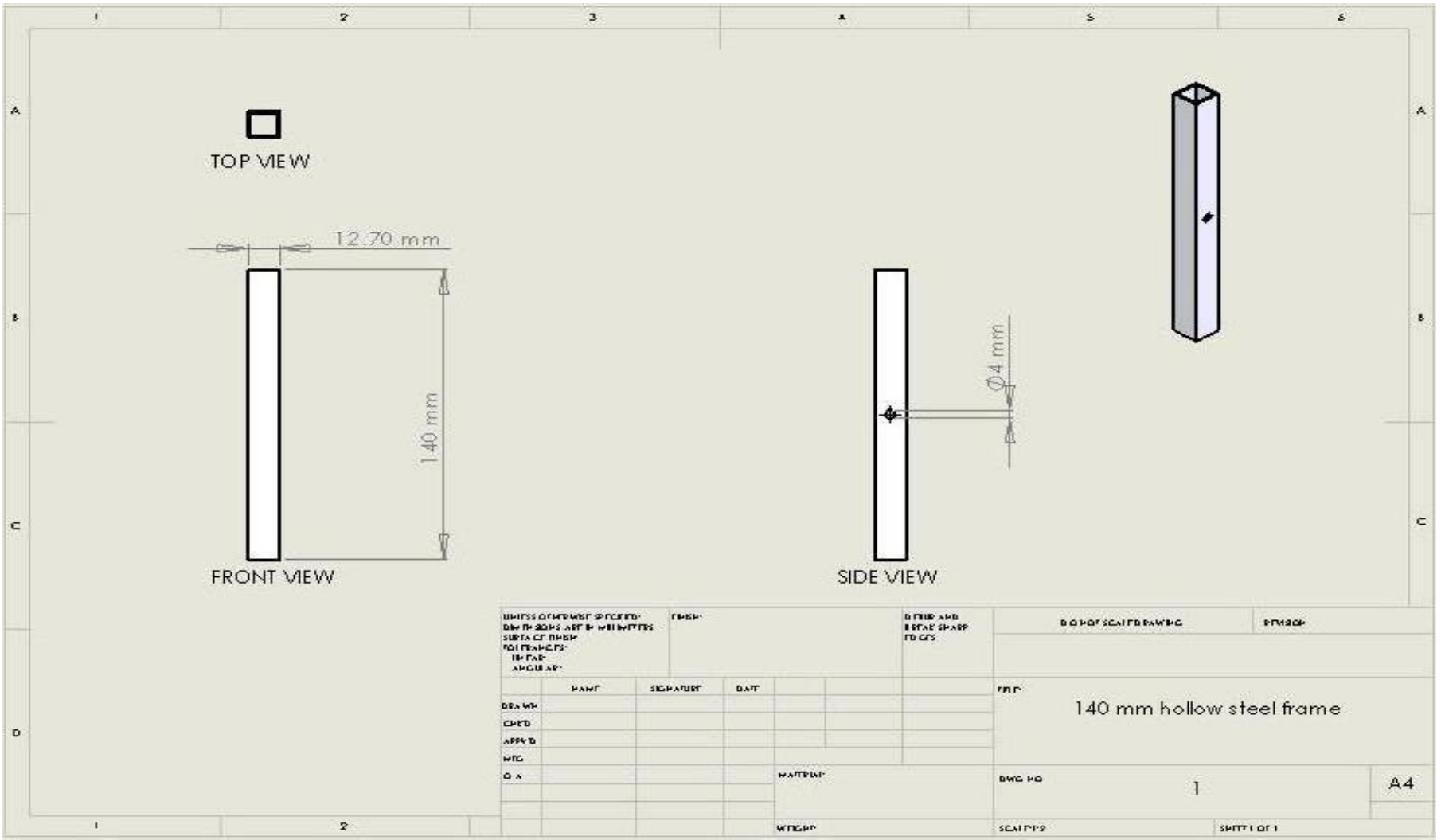
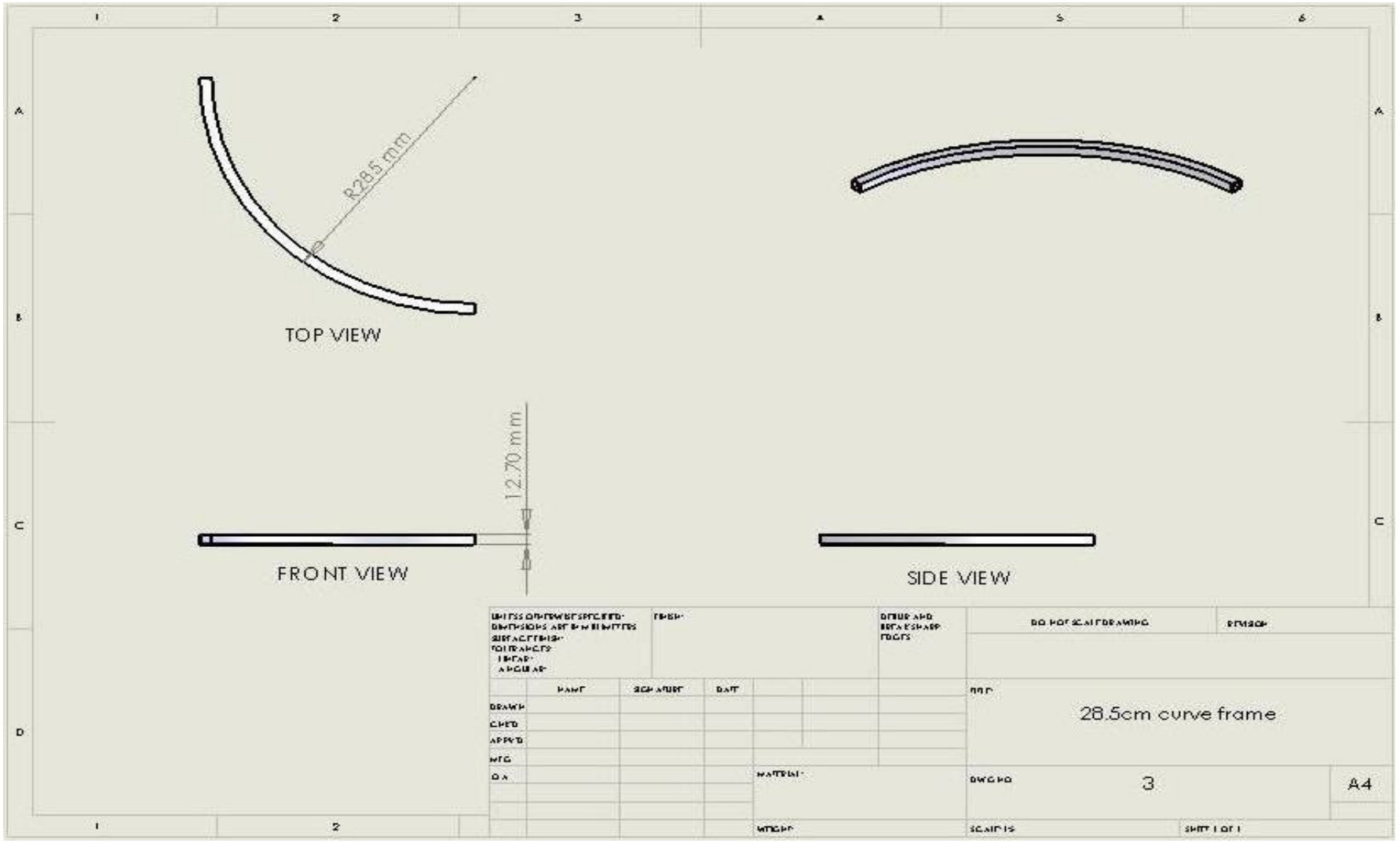
APPENDIX A

MACHINE PARTS ORTHOGRAFIC VIEW

No. of Drawing	Part Name
1.	140 mm Hollow steel frame
2.	278.65 mm Hollow steel frame
3.	26.5 cm Curve frame
4.	293.65 mm Hollow Steel frame
5.	30 cm Curve frame
6.	570 mm Hole in middle frame
7.	600 mm Frame with two hole
8.	600 mm Frame with hole in the middle
9.	101.5 cm Hollow steel frame
10.	104 cm Hollow steel frame
11.	Door cover
12.	Door handle
13.	Hanger rod
14.	Main cover
15.	Front main cover
16.	Wheel
17.	Up and bottom cover

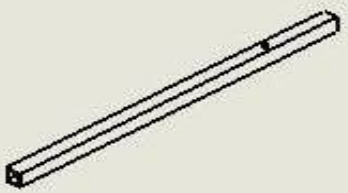

TOP VIEW
12.70 mm
140 mm
FRONT VIEW
Ø4 mm
SIDE VIEW
140 mm hollow steel frame
1
A4


TOP VIEW
12.70 mm
278.65 mm
FRONT VIEW
SIDE VIEW
DRAWN
CHK'D
APP'D
MFG
Q.A
278.65 mm Hollow steel frame
2
A4


R285 mm
TOP VIEW
12.70 mm
FRONT VIEW
SIDE VIEW
28.5cm curve frame
3
A4

TOP VIEW

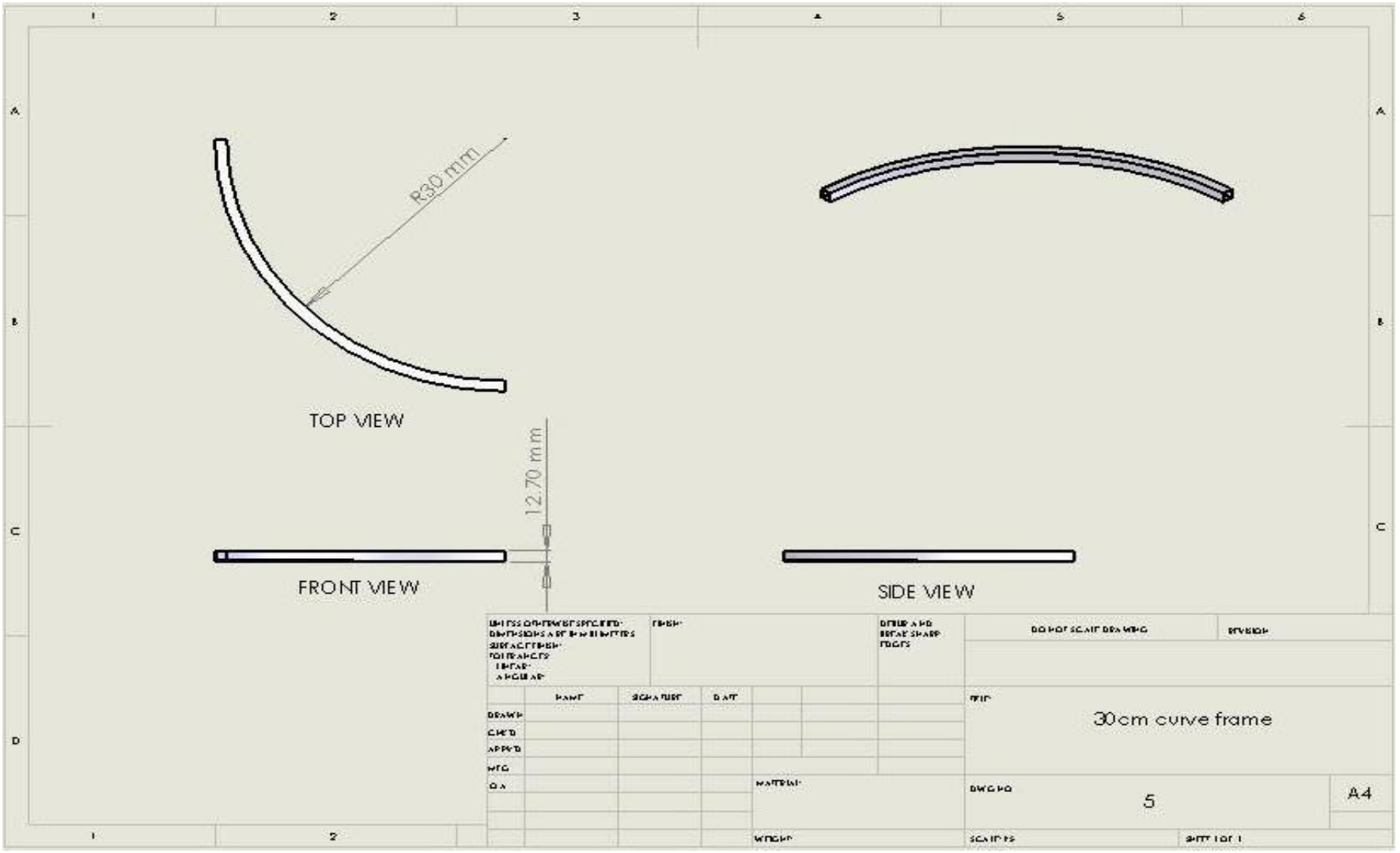
FRONT VIEW

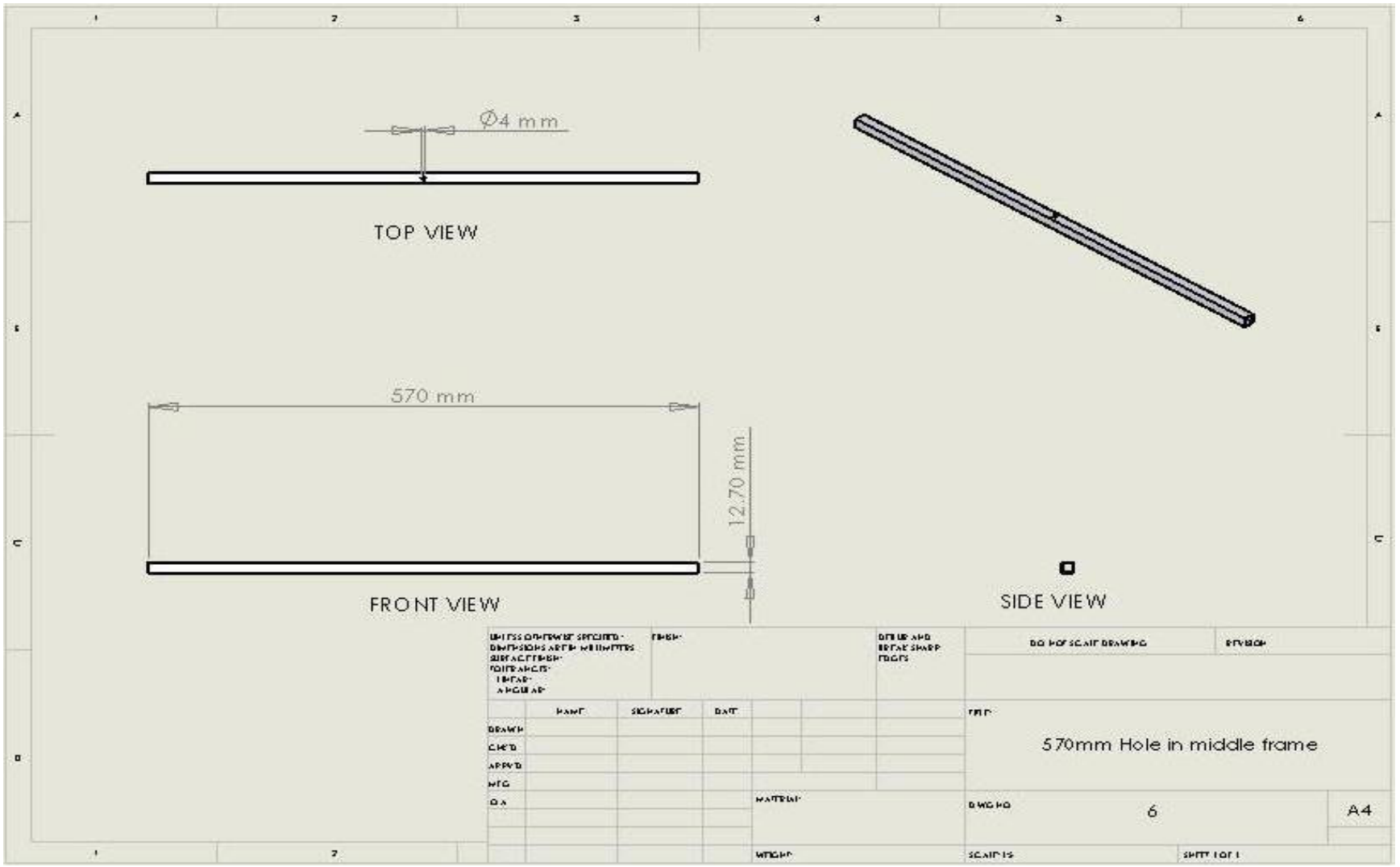


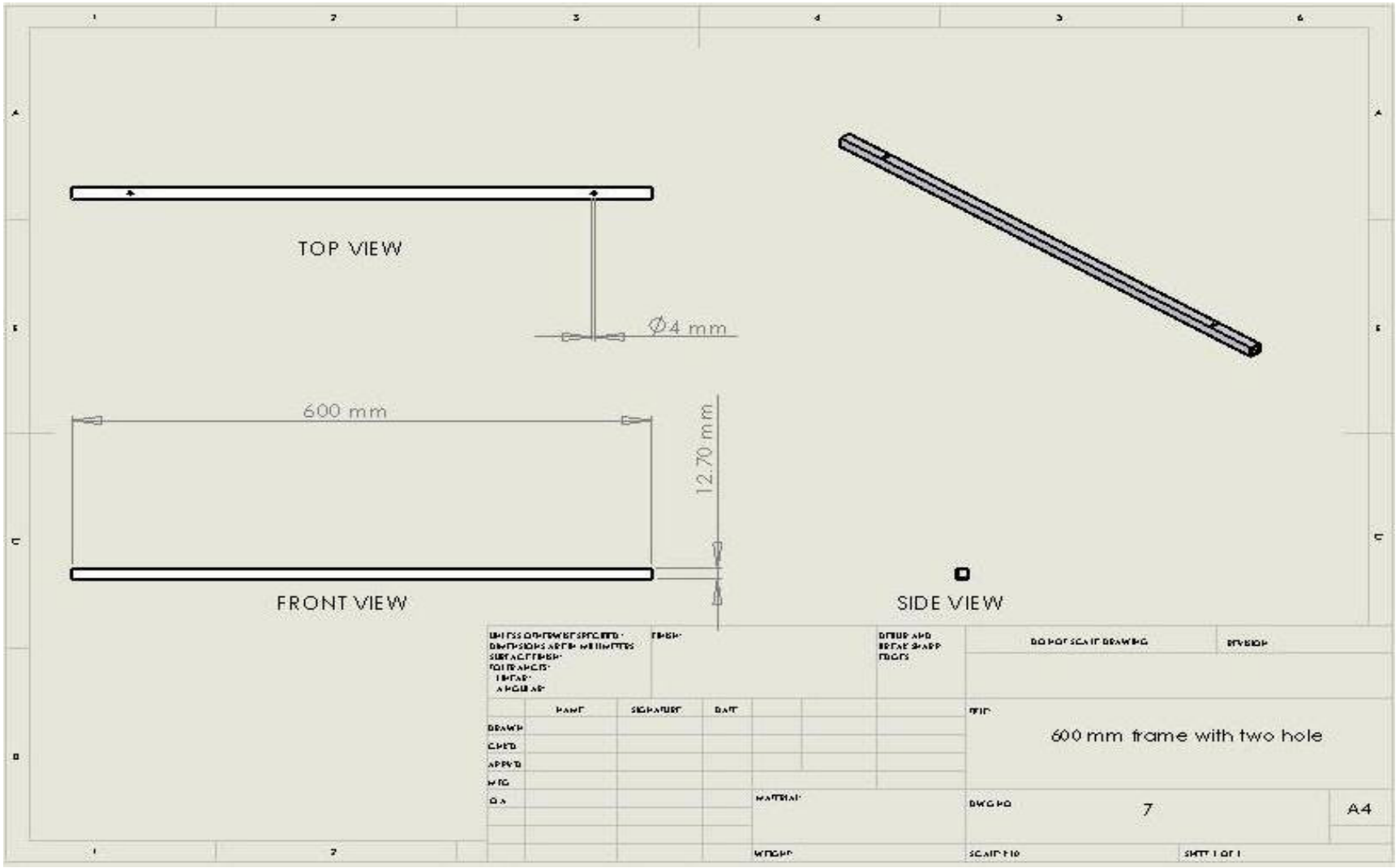
SIDE VIEW

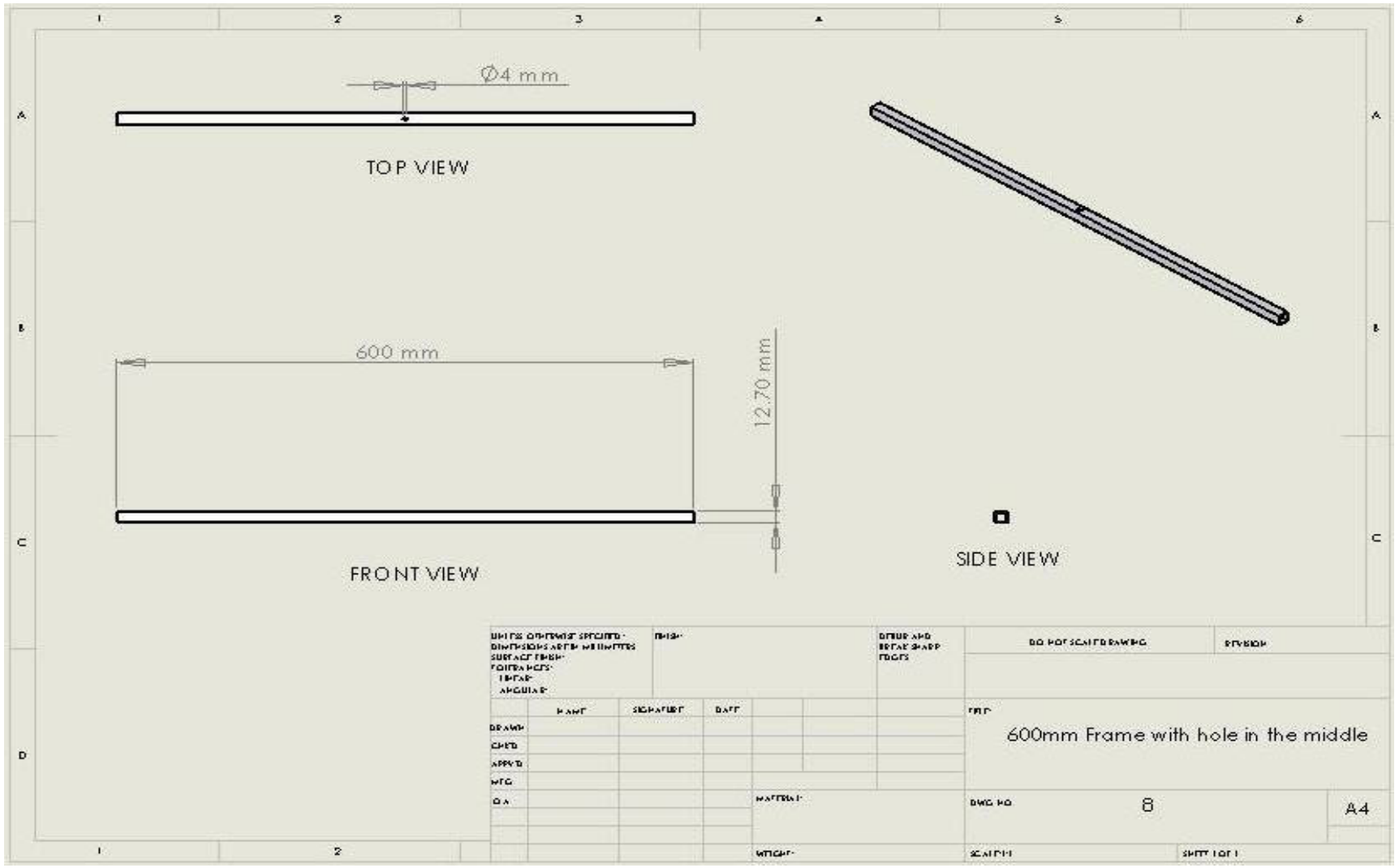
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:				FINISH:		DEBUR AND BREAK SHARP EDGES
	NAME	SIGNATURE	DATE			
DRAWN						
CHKD						
APPVD						
MFG						
Q.A				MATERIAL:		
				WEIGHT:		

DO NOT SCALE DRAWING	REVISION
TITLE: 293.65 mm Hollow Steel frame	
DWG NO. 4	A4
SCALE: 1:1	SHEET 1 OF 1


R30 mm
TOP VIEW
12.70 mm
FRONT VIEW
SIDE VIEW
30cm curve frame
5
A4

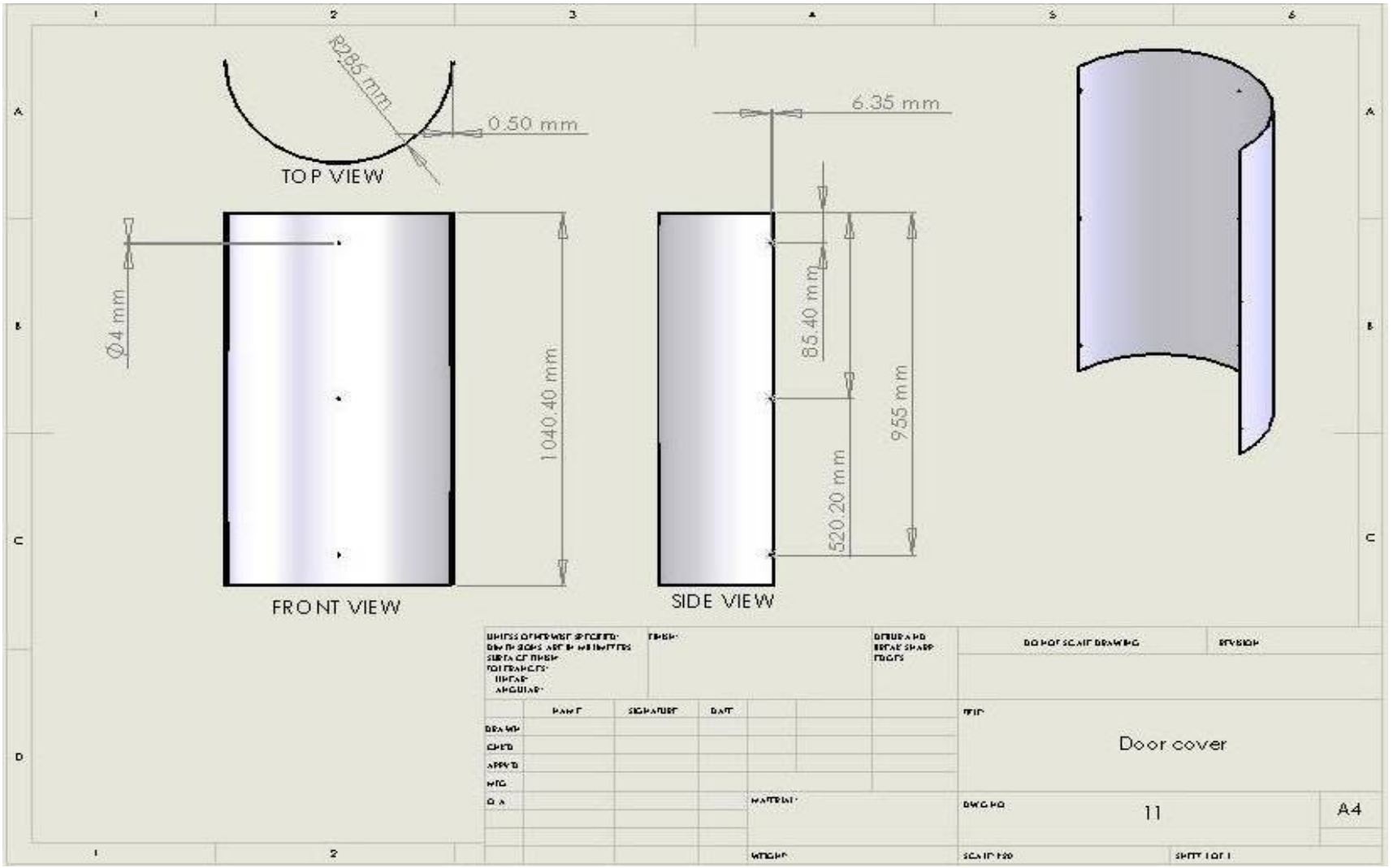

Ø4 mm
TOP VIEW
570 mm
12.70 mm
FRONT VIEW
SIDE VIEW
DRAWN
CHK'D
APPV'D
MFG
Q.A
570mm Hole in middle frame
6
A4

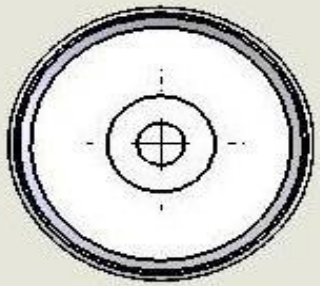

TOP VIEW
Ø4 mm
600 mm
12.70 mm
FRONT VIEW
SIDE VIEW
DO NOT SCALE DRAWING
600 mm frame with two hole
7
A4


Ø4 mm
TOP VIEW
600 mm
12.70 mm
FRONT VIEW
SIDE VIEW
DO NOT SCALE DRAWING
REVISION
NAME
SIGNATURE
DATE
DRAWN
CHKD
APPVD
MFG
Q.A
MATERIAL
WEIGHT
600mm Frame with hole in the middle
DWG NO
8
A4
SCALE: 1:1
SHEET 1 OF 1

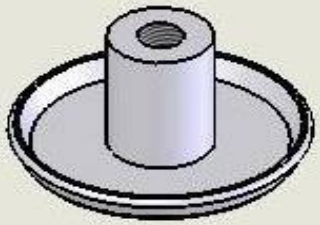

TOP VIEW
12.70 mm
1015 mm
FRONT VIEW
Ø4 mm
SIDE VIEW
DO NOT SCALE DRAWING
101.5cm Hollow steel frame
9
A4

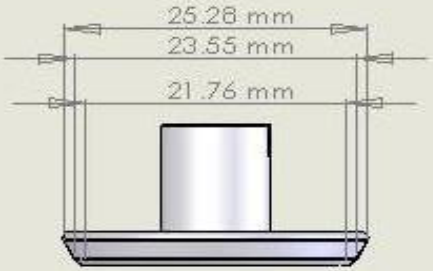

TOP VIEW
12.70 mm
1040 mm
FRONT VIEW
Ø4 mm
SIDE VIEW
104cm Hollow steel Frame
10
A4


R286 mm
0.50 mm
TOP VIEW
Ø4 mm
1040.40 mm
FRONT VIEW
6.35 mm
85.40 mm
955 mm
520.20 mm
SIDE VIEW
Door cover
11
A4

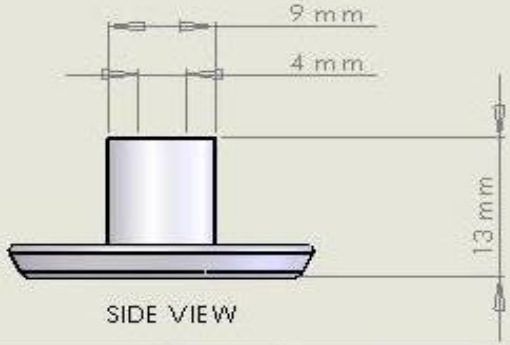


TOP VIEW





FRONT VIEW



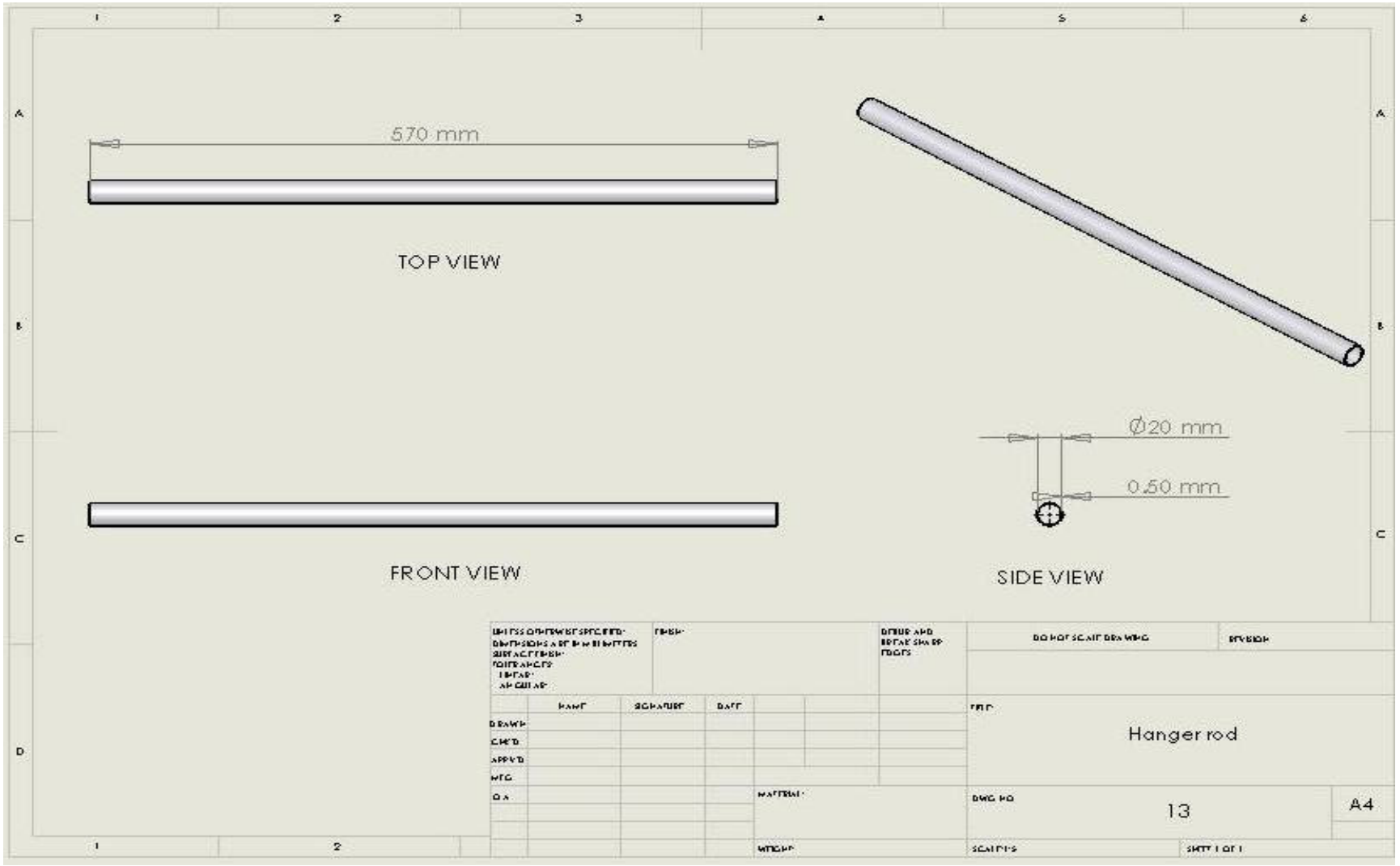
SIDE VIEW

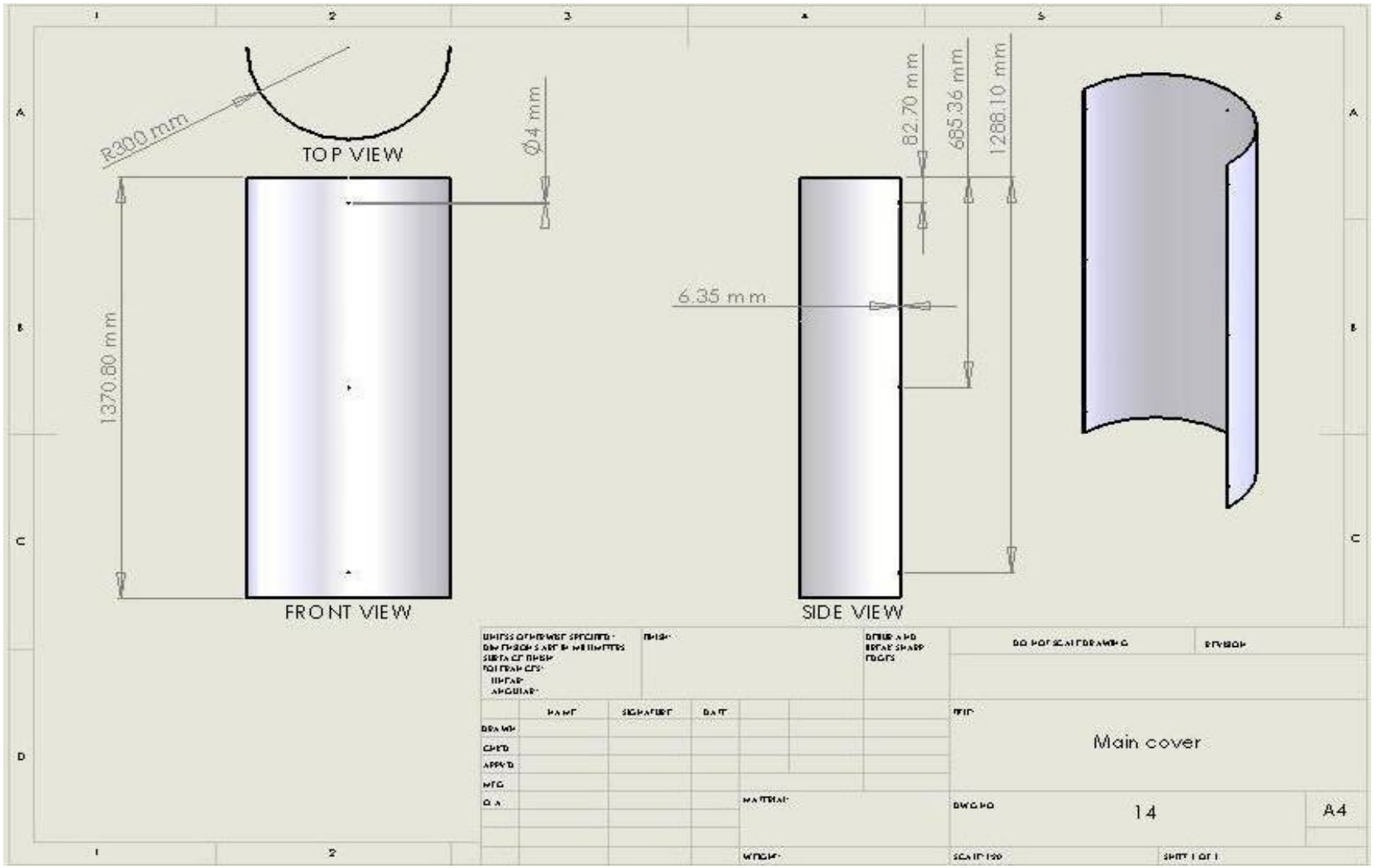
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:	FINISH:			DEBUR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING
	NAME	SIGNATURE	DATE		
DRAWN					DWG. NO.
CHKD					Door handle
APPVD					
MFG					
Q.A			MATERIAL:		12
			WEIGHT:		SCALE:1:1

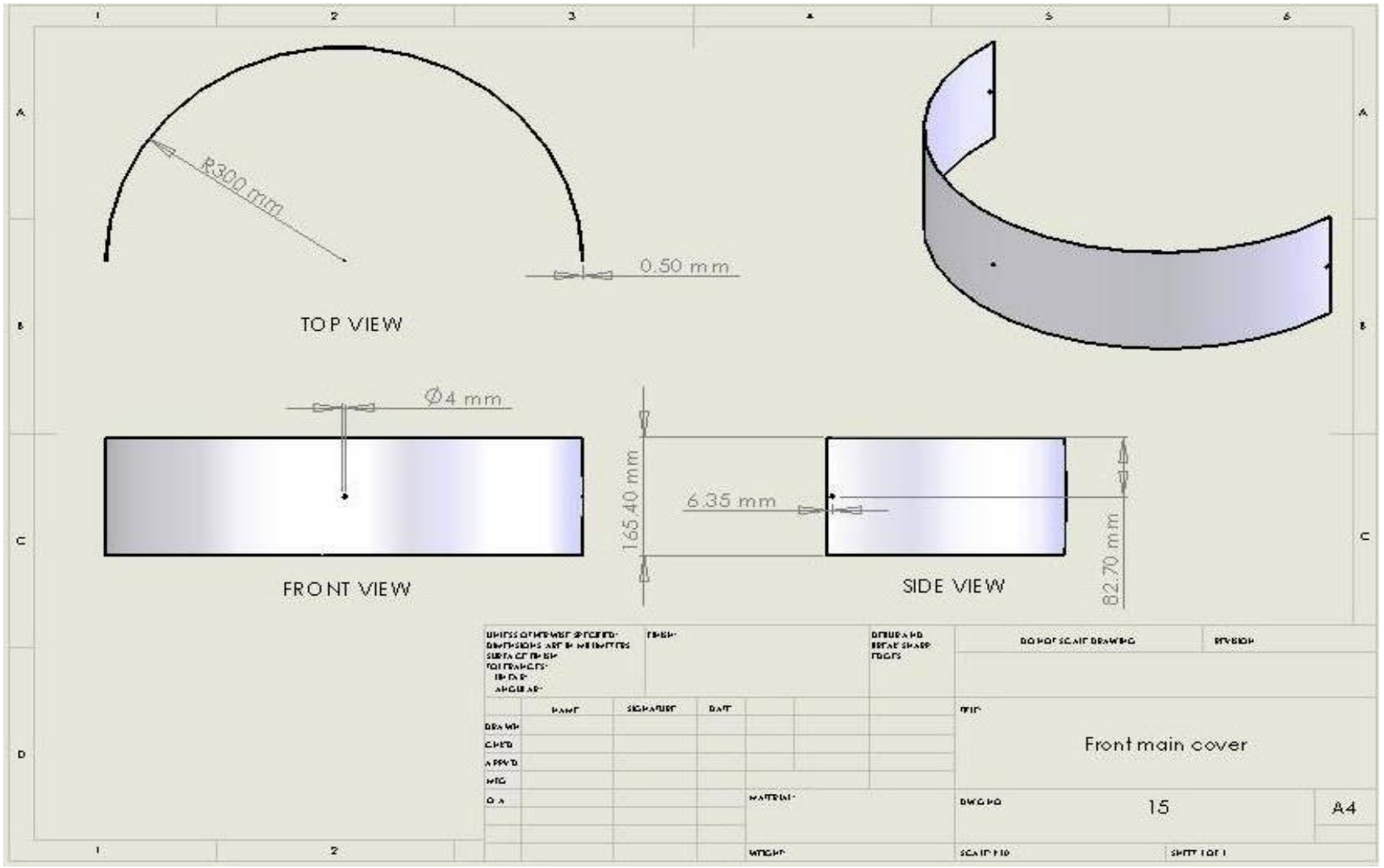
REVISION

A4

SHEET 1 OF 1


570 mm
TOP VIEW
Ø20 mm
0.50 mm
FRONT VIEW
SIDE VIEW
DO NOT SCALE DRAWING
Hanger rod
13
A4


R300 mm
TOP VIEW
Ø4 mm
1370.80 mm
FRONT VIEW
82.70 mm
685.36 mm
1288.10 mm
6.35 mm
SIDE VIEW
Main cover
14
A4

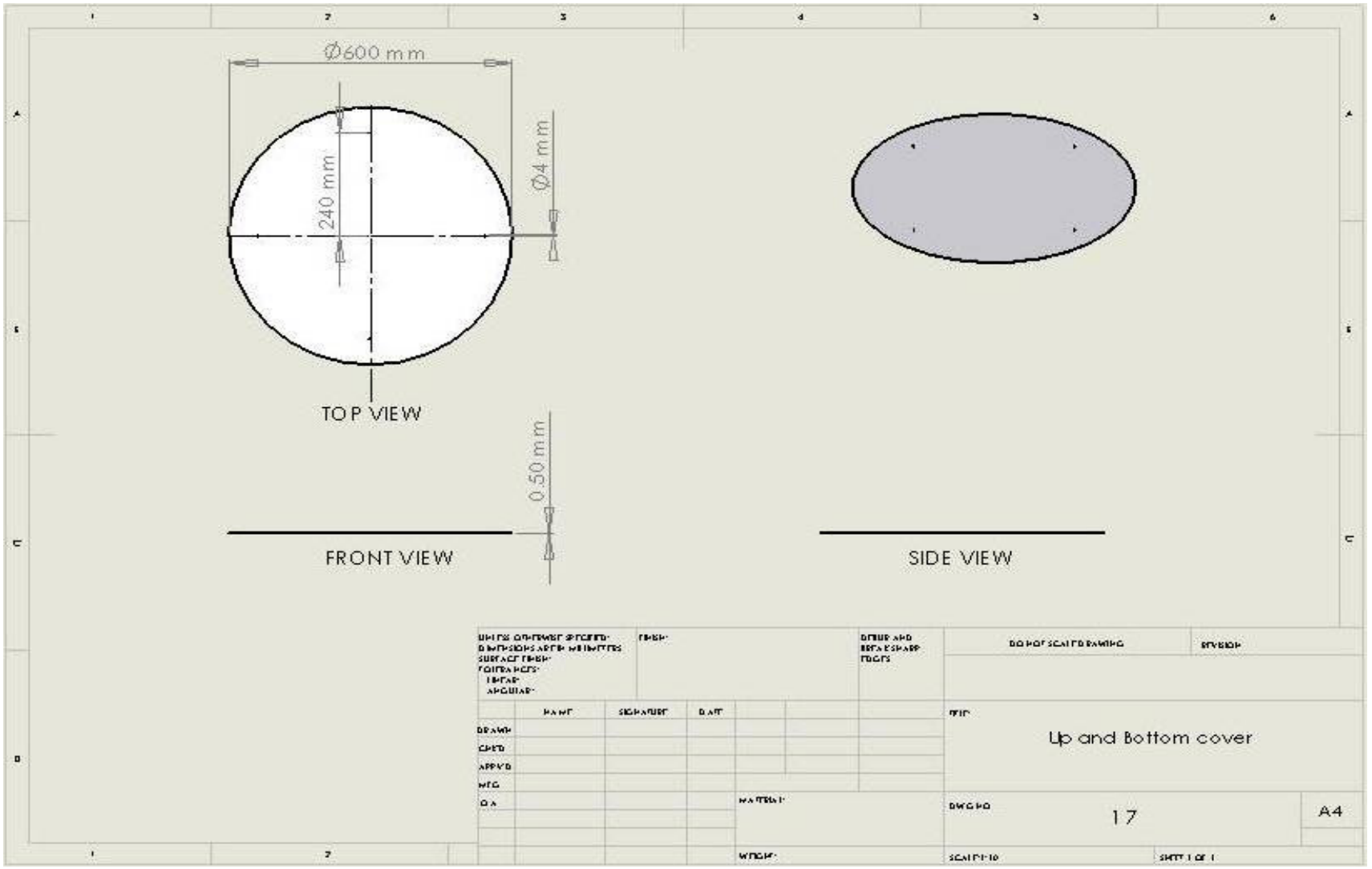

R300 mm
0.50 mm
TOP VIEW
Ø4 mm
FRONT VIEW
165.40 mm
6.35 mm
82.70 mm
SIDE VIEW
Front main cover
15
A4

TOP VIEW

FRONT VIEW

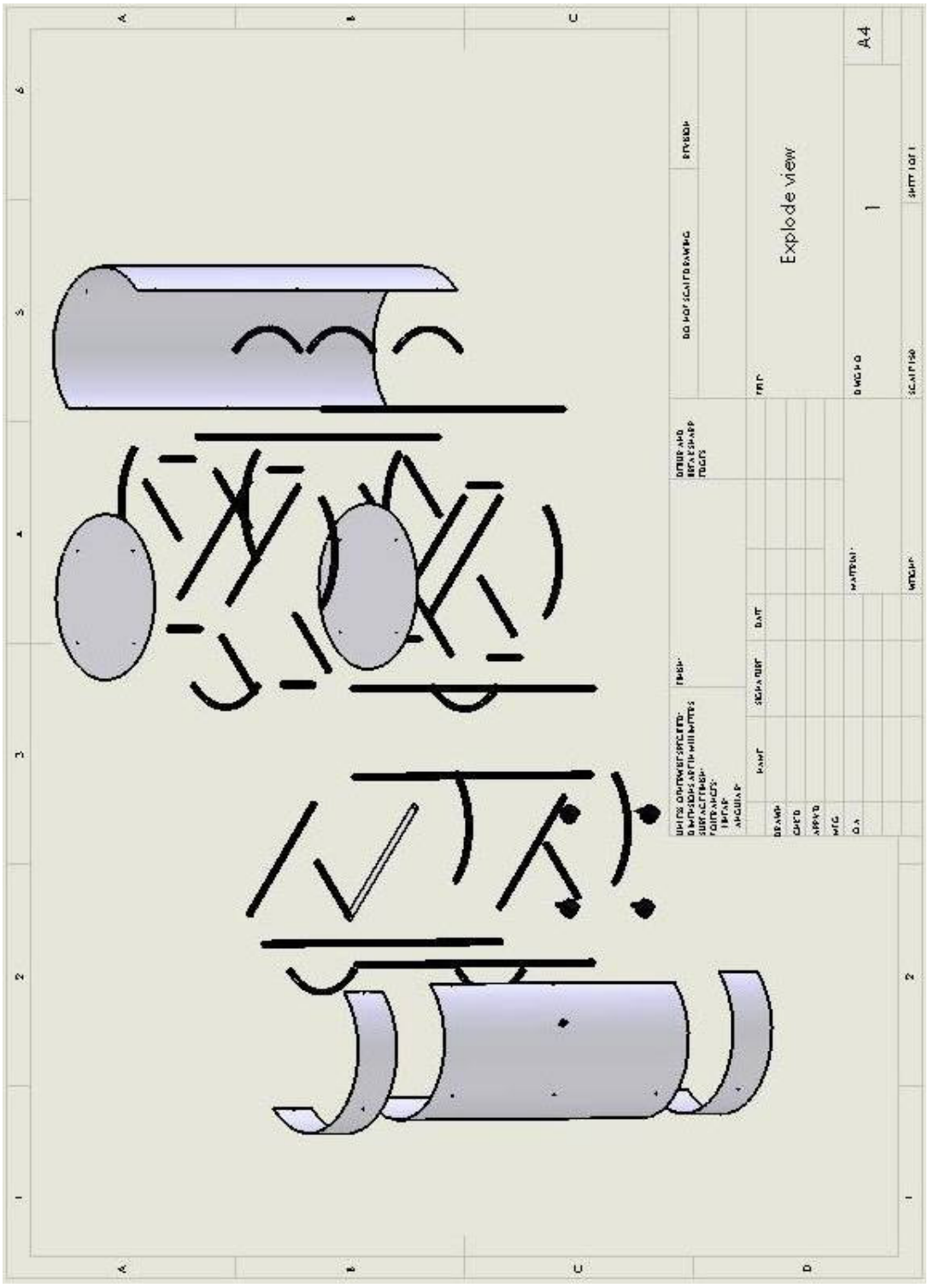
SIDE VIEW

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN MILLIMETERS SURFACE FINISH: TOLERANCES: LINEAR: ANGULAR:					DEBUR AND BREAK SHARP EDGES	DO NOT SCALE DRAWING
	NAME	SIGNATURE	DATE			TITLE: Wheel
DRAWN						
CHK'D						
APPV'D						
MFG						
Q.A				MATERIAL		DWG NO. 16 A4
				WEIGHT:		SCALE: 1:1 SHEET 1 OF 1


Ø600 mm
240 mm
Ø4 mm
TOP VIEW
0.50 mm
FRONT VIEW
SIDE VIEW
Up and Bottom cover
17
A4

APPENDIX B

MACHINE EXPLODE VIEW



APPENDIX C

ASSEMBLY DRAWING