DESIGN OF MINI COCONUT FIBER CRUSHER AND SCREENING MACHINE

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DESIGN OF MINI COCONUT FIBER CRUSHER AND SCREENING MACHINE

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A report submitted in fulfilment of the requirement for the Bachelor of Mechanical Engineering

FACULTY OF MECHANICAL ENGINEERING

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DECLARATION

I declare that this report entitled “Design of Mini Coconut Fiber Crusher and Screening Machine” is the result of my own work except as cited in the references.

Signature : …….

Name : Ahmad Khuzairi Bin Abu

Date : …….

APPROVAL

I hereby declare that I have read this project report and in my opinion, this report is sufficient in term of scope and quality for the award of the degree of Bachelor of Mechanical Engineering (Design & innovation).

Signature	:	…….
Supervisor's Name	:	Prof Madya Ir. Dr. Abdul Talib Bin Din
Date	:	…….

ABSTRACT

Mini coconut fiber crusher and screening machine is a machine that crushing and screening a coconut fiber for the purpose of agriculture and other industry. There are few companies or enterprises are producing coconut fiber crusher and screening machine in Malaysia but the size of the machine is big. The objective of this project is to design and create a mini coconut fiber crusher and screening machine where producing a product in form of coco fiber and coco peat. This machine focuses on a machine in a small size, affordable for personal used and product produced in a small scale. The basic principle of the machine operation is a coconut fiber is throw into hopper where it cause the coconut fiber fall into a crushing compartment which is upper body. The upper body of this machine consist of blade, blade holder, shaft, small pulley and semi drum. During crushing process, the coconut fiber is hammer and cut to form coco peat and coco fiber. All the product pass through the semi drum. The purpose of semi drum is to filter or segregate the partial crush coconut fiber from fall into a coco fiber drawer. The uncomplete crush coconut fiber will continue crush until it can pass through the semi drum. In the coco fiber drawer, there is a wire mesh acting as filter of coco peat. The wire mesh only allow a coco peat pass through it while the coco fiber remain inside the coco fiber drawer.

ABSTRACT

Mesin penghancur dan penyaring sabut kelapa mini ialah sebuah mesin untuk menghancurkan dan menyaring sabut kelapa untuk tujuan pertanian dan industry lain. Terdapat beberapa syarikat atau usahawan yang menghasilkan mesin penghancur dan penyaring sabut kelapa di Malaysia tetapi saiz mesin tersebut adalah besar. Objektif bagi projek ini adalah mereka bentuk dan menghasilkan sebuah mesin penghancur dan penyaring sabut mini di mana produk yang dihasilkan dalam bentuk coco peat dan coco fiber. Mesin ini memfokuskan mesin dalam bentuk yang kecil, mampu milik untuk kegunaan peribadi dan produk yang dihasilkan dalam skala yang kecil. Prinsip asas bagi operasi mesin ini adalah sabut kelapa akan dicampakkan di dalam corong dimana sabut tersebut akan jatuh ke dalam ruangan penghancur iaitu badan atas. Bahagian atas mesin terdiri daripada bilah, pemegang bilah, aci, puli kecul dan semi drum. Semasa process penghancuran, sabut kelapa akan dikutuk dan dipotong untuk menghasilkan coco peat dan coco fiber. Semua produk yang terhasil akan melalui semi drum. Tujuan semi drum adalah untuk menapis atau memisahkan sabut kelapa yang hancur separuh daripada jatuh ke dalam laci coco fiber. Sabut kelapa yang tidak hancur akan terus dihancurkan sehingga ia lepas untuk melalui semi drum. Di dalam laci coco fiber, terdapat jarring wayar yang bertindak sebagai penapis untuk coco peat. Jarring wayar tersebut hanya membenarkan coco peat sahaja melalui nya manakala coco fiber kekal di dalam laci coco fiber.

DEDICATION

A special dedicated to my beloved parents, my final year project supervisor, Prof Madya Ir. Dr. Abdul Talib Bin Din, my lecturers, my family members and all my friends which have supported me in completing this project.

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Bismillahirrahmannirrahim,

Alhamdullilah. Thanks to Allah SWT, who with His willingly give me the opportunity to complete my final year project with title “Design of Mini Coconut Fiber Crusher and Screening Machine”. This final year project was prepared for Universiti Teknikal Malaysia Melaka (UTeM), basically for student in final year to complete the undergraduate program that leads to the degree of Bachelor of Mechanical Engineering (Hons). This report was based on the methods given by the university.

Firstly, a million thanks to Prof Madya Ir. Dr. Abdul Talib Bin Din, a lecturer at Faculty of Mechanical Engineering and also assign as my supervisor who had guided me a lot of tasks during this semester. I also would like to express my deepest thanks and appreciation to my parents, family members and others for their cooperation, encouragement, constructive suggestion and full of support for this project to finish from beginning until the end of this final year project. Also deepest thanks to all of my friends and everyone that has been contributed by supporting my work and help me during the final year project until it fully complete.

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HP	Horsepower
RPM	Revolution per minute
MOR	Modulus of rapture
MOE	Modulus of elasticity
CFB	Coco fiber board
MDF	Medium density board
QFD	Quality function deployment
AC	Alternating current
CAD	Computer aided design
LED	Light emitting diode
NO	Normally open
NC	Normally close
MIG	Metal inert gas

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CHAPTER 1

INTRODUCTION

This chapter covers the background of study, problem statement, objectives and project scope. The chapter overview is also included in this chapter.

1.0 Background

The use of coconut fiber waste is still limited due to lack of public awareness of the waste that has high selling value. For example, household handicrafts that used coconut fibers only a small portion, whereas the need for coconut fibers is very high such as beds, pillows, bolsters, brooms and the latest one it can be used as a composite instead of wood. In the largest engineering field application, we need modern technology that changes about the advantages of using coconut fibers as a technical application is where it can break down by the soil so it not lead to the environmental pollution.

Coconut fiber itself is the largest part of coconut fruit. Coconut fiber if processed optimally will produce coconut fiber with good quality, providing added value from a broom and doormat because it has its own appeal made from natural fibers because the physical and chemical properties of lignocellulose possessed by coconut fiber are in accordance with human needs. That coconut fiber is cheaper than other fibers and environmentally friendly. Coconut trunk can use as a small bridge to cross a trench or small river. Besides, coconut

leaf used in making “Ketupat” for Malays traditional food while coconut milk usually used in cooking.

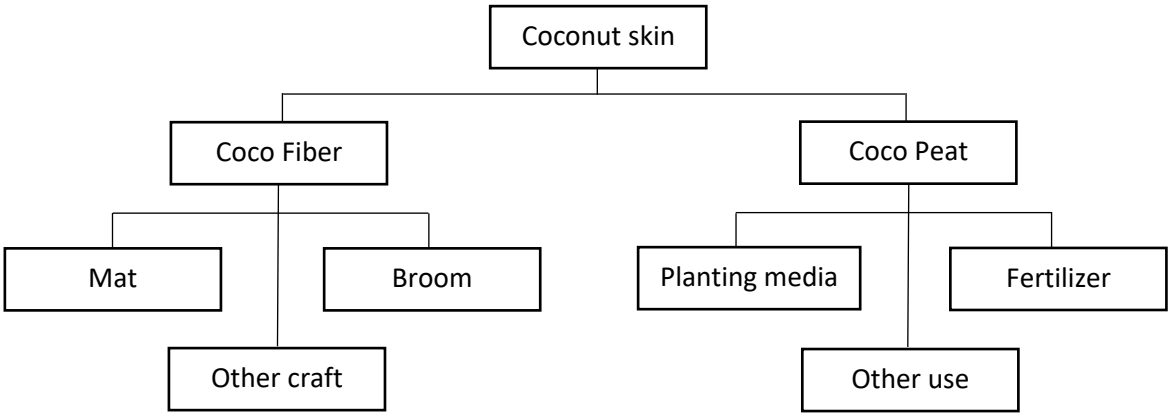


Figure 1.1: Function of coconut skin

Coir is usually refer as a waste that is only stack under a coconut plant and then left to rot or dry. The most used only as firewood. Traditionally, people have processed coir or coconut fiber to be used as ropes and woven into mats. Even though coconut fiber still has good economic value which decompose will produce coir fiber (coco fiber) and coir powder (coco peat). The most ideal and sought after processing products on the market are processed products from coco fiber, where coco fiber will be export outside Indonesia to be used as raw material for airplane seats and luxury car seats.

Coco fiber or in world trade known as coco fiber, coir fiber, coir yarn, coir mats and rugs are processed products of coconut fiber. Traditionally coco fiber is used only for making brooms, mats, ropes and other household appliances. Technological developments, chemical - physical properties of fibers and consumer awareness to return to natural ingredients make coco fiber utilized as raw material for industrial carpets, upholstery, vehicle dashboards, mattresses, pillows and hardboard. Coir fiber is also used for erosion control. Coir fiber is processed to be used as coir fiber sheet which is used for layers of car seats, spring beds and others.

Figure 1.2: Coco fiber

Coco peat is a coconut husk that is processed into cork granules, also known as coco pith or coir pith. Coco peat is a planting medium made from coconut fiber. It is easily find in tropical countries and islands such as Indonesia. Coco peat can withstand water content and chemical elements of fertilizers and can neutralize soil acidity. Because of these properties, coco peat can be used as a good medium for the growth of horticulture plants and greenhouse plant media.

Figure 1.3: Coco peat

To produce coco fiber and coco peat, a coconut fiber crusher machine is needed. The machine functions are to decompose and separate the coconut fiber from the layer of sponge or powder so that both products can be used as desired. The working principle of this coconut fiber crusher machine is to beat until separate parts of fiber and powder from coconut fruit and then transfer to the coconut fiber crusher machine hopper. Coconut fiber crusher machines can produce coco fiber and coco peat which have high economic value. Looking at the potential is still very large, processing of coco fiber requires a quality and guaranteed quality decomposition machine to produce the best decomposition and need to be shifted so that it can be separated between fiber and coconut fiber powder.

1.1 Problem Statement

In this project, a mini coconut fiber crusher and screening machine was designed and fabricated to support a small and medium farmer to produce coco peat and coco fiber as a planting medium in a small scale used for themselves. The problem statements related to the situations faced by the farmers in Malaysia are stated as below:

1. There are many coconut fiber or coconut coir that not utilized in function for other industries used.
2. Nowadays, the price of coco peat and coco fiber sells at the market is quite expensive.
3. Coconut fiber crusher and screening machine sells at the market are expensive and in a big size.

1.2 Objective

This project focused on the design and fabricate a mini coconut fiber crusher and screening machine in producing a coco fiber and coco peat from coconut fiber used as planting media. The objectives of this project are as follows:

1. To design a mini coconut fiber crusher and screening machine.
2. To fabricate a mini coconut fiber crusher and screening machine.
3. To produce a product in form of coco fiber and coco peat which is suitable for fertigation agriculture and some side product.

1.3 Scope of Project

In this project, there are few requirements that must be meet to make sure the project achieve its goals. Scope are used as a project guideline. The scope of this project are:

1. The machine must be as a mini machine and in a small size.
2. The product produce can be used for an individual and in a small scale for agriculture.
3. The price of the machine must be relevant and affordable.

1.4 Project Significant

This project was implemented by taking an interest in the needs of farmers for fertigation agriculture. The main aspect that must be concern are the quality of coco peat and coco fiber produce, short processing time use and at a same time can reduce the cost of agriculture.

The production of this machine can be owned by small and medium farmer to increase their agricultural productivity. This machine can generate side money for coconut planter. At a same time, it can increase the economy of farmers.

1.5 Report Outline

This report consist of 5 chapters started with the introduction of each chapter which will briefly explain about a mini coconut fiber crusher and screening machine operation.

In Chapter 1, it clearly stated that this project was about the design and fabrication of a mini coconut fiber crusher and screening machine. The objectives, scope and problem statements were also clarified in this chapter.

Chapter 2 discussed about the literature review of this project. This included the major components that used in order to finish this project such as the type of motor, motor power, rotation speed for the blade and the number of blades.

Chapter 3 focused more about the methodologies that have been used during completing the report. It was starting with the flow chart, Gantt chart, making surveys, quality function deployment, concept generation, concept screening and scoring, final design selection, material selection, cost analysis, testing analysis, fabrication method and prototype testing.

Chapter 4 explained deeply on the design and fabrication process. It started with the design process where every single parts or components of the machine have been design by using CATIA software. Then, the design was assembled to form a complete machine. In this state, there were a lot of processes involved during fabricating the machine.

Chapter 5 concluded the result and discussion of the project. All the components were analysed by using ANSYS software to identify the deformation of the component structure, stress, strain and also factor of safety. The simulation of the result was compared with the theoretical calculation. As a result of the machine, 1kg of coconut fiber was crushed to obtain the coco peat and coco fiber data.

Chapter 6 explained about the conclusion and recommendation where it was summarize all the achievements of the project and a problem occurred during completing this project. For the recommendation part, it stated some future improvement to the make the machine can be function better.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

The literature review is one of an important part before commencing any projects. It will provide all the information needed to start the project so that the project can be performed depend on what the researcher wish. In this chapter, it will briefly explained about the components that have to be used to complete this project and about the related past project.

2.1 Components Used

2.1.1 Motor Type and Power

According to Purnomo and Janari (2015), by using 8 HP diesel motor and reducer UCF 50 used to step down the rotation to become 50 RPM, they got crushed around 42 coconuts fiber in one hour. According to Sepriyanto (2018), 6.5 HP petrol motor used as a driver with a machine capacity to produce coco peat and coco fiber around 10 kg/hour.

According to Djiwo and Setyawan (2016), this machine used driver source in terms of 3 phase electric motor with a power of 1 HP and the voltage used is 380 volts and rotating shaft speed of 1425 RPM. According to Naik, Swamy and Naik (2014), the machine installed with 5 HP, 3 phase with 1440 rpm rotation speed. The

motor act as driver and then directly coupling with the driven, which is a shaft. According to Nuriyadi and Yohanes (2017), motor power used is affected by the load that will be moved. The motor can be calculated using a relevant formula. By using Newton's Second Laws, the force due to gravity is equal to mass of load multiplied by the acceleration of gravity:

$$F = mg \text{ (N)} \tag{2.1}$$

Where *F* is the force, *m* is the mass and *g* is the gravitational force.

By knowing the size of pulley radius and calculated force, torque value can be fine. The relationship between torque and force is:

$$T = FR\ (Nm) \tag{2.2}$$

Where *T* is the torque, *F* is the force and *R* is the pulley radius.

When the value of motor rotation was set on certain RPM, the angular velocity can be calculated.

$$\omega = \frac{2\pi n}{60}\left(\frac{rad}{s}\right) \tag{2.3}$$

Where ω is the angular velocity and *n* is the number of turns

Then the motor power is calculated by equation (2) multiple with equation (3).

$$P = T\omega\ (W) \tag{2.4}$$

Where *P* is the motor power, *T* is the torque and ω is the angular velocity.

To get the power, the normal power has been calculated multiplied by the correlation factor (fc). Choose the suitable correlation factor value based on the need for a motor with continuous load shock occur.

$$P_d = f_c \times P \text{ (W)} \tag{2.5}$$

Where P_d is the power, f_c is the correlation factor and P is normal power

Convert the value of watts (W) into horse power (HP).

Based on the literature review of motor type and power above, I can say that petrol motor is much suitable for this project compare to electric motor. This is because petrol motor is more durable compare to electric motor. By using petrol motor, the machine can run anywhere without depend on electricity source.

2.1.2 Rotation Speed of Blade

According to Djiwo and Setyawan (2016), speed of rotation effected the number of coco peat and coco fiber production. This experiment used 1 kg of coconut fiber as a raw material. With 400 RPM of rotation speed, it produced 82% of coco peat and 28% of coco fiber. For rotation speed 800 RPM, it produced 64% of coco peat and 36% of coco fiber. For speed 1200 RPM, it produced 54% of coco peat and 46% of coco fiber.

Table 2.1: coconut fiber blade test result

No	Berat sabut (kg)	rpm	Serat panjang (g)	serat pendek (g)	Cocopeat (g)	Hasil serat (%)	Panjang Serat (cm)
1	1	400	700	120	120	82	34
2	1	800	530	110	180	64	25
3	1	1200	440	100	220	54	19

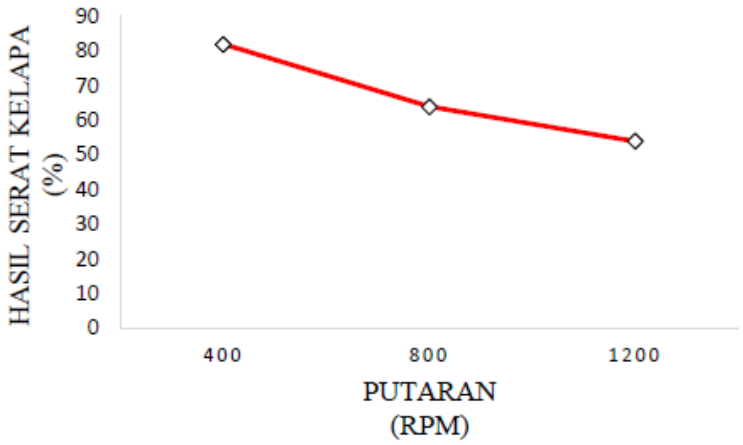


Figure 2.1: graph between rotations against coconut fiber product

According to Sepriyanto and Subama (2018), by using 500 g of coconut fiber and 2 min rotation time, the machine ran at 225 RPM, 450 RPM, 700 RPM and 900 RPM rotation speed. From four rotation speed variant, the result of coco fiber and coco peat were different of each variation. At 225 RPM rotation speed, it produced 18% of coco fiber and 48% of coco peat. For rotation speed of 450 RPM, it produced 22% of coco fiber and 52% of coco peat. Rotation speed at 750 RPM and 900 RPM, it produced 26% of coco fiber, but different at coco peat which is 56% and 58% respectively.

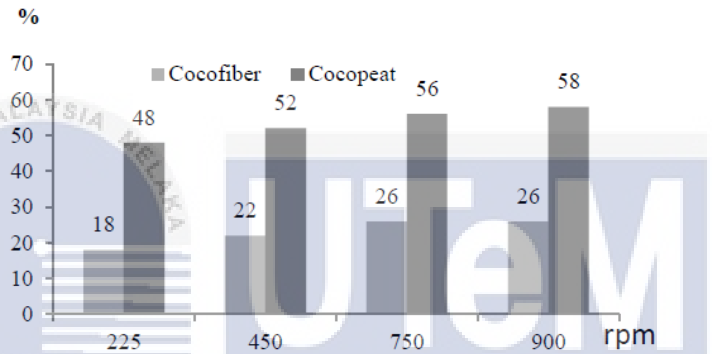


Figure 2.2: graph rotation against percentage of coconut fiber produced

According to Cahyono and Yohanes (2017), the coconut fiber was soaked for 2 hours and the blade speed variation were set at 852 RPM, 1065 RPM and 1420 RPM. When blade speed run at 852 RPM, it produced 0.0096 kg/s of coco fiber. At 1065 RPM rotation speed, it produced 0.0098 kg/s coco fiber. For rotation speed at 1420 RPM, it produced 0.0104 kg/s of coco fiber.

Table 2.2: relationship between machine rotation variations toward production capacity

Nomor	*n* Pisau Pengurai (rpm)	Kapasitas Produksi (kg/s)
1	852	0.0096
2	1065	0.0098
3	1420	0.0104

Based literature review of rotation speed above, it is found the speed of rotation affected the result of coco fiber and coco peat. Higher the rotation speed, the higher the coco peat produced. But at a same time, result of coco fiber produced and coco fiber length decrease. For this project, 3600 RPM - 5000 RPM is the suitable rotation speed of the blade. The petrol engine generated 3600 RPM at driver then the speed of rotation will be increased up to 4500 RPM by using a pulley. This because the main idea of this project is to produce coco peat as the primary product.

2.1.3 Number of Blade

According to Sepriyanto and Subama (2018), they used two type of variation in the number of blades which are 5 blade and 10 blade. Number of blade affected the mass of coco peat and the mass of coco fiber. In this experiment, they combined the number of blades with rotation speed variation to get a result. At 900 RPM rotation speed with 5 blades, the mass of coco peat and coco fiber were 290 g and 130 respectively. While at 900 RPM rotation speed with 10 blades, the mass of coco peat and coco fiber were 320 g and 120 g respectively.

Table 2.3: result of crushing coconut fiber using 5 blade

Kecepatan putaran (rpm)	Massa bahan baku (gram)	Massa *cocofiber* (gram)	Massa *cocopeat* (gram)
225	500	90	240
450	500	110	260
750	500	130	280
900	500	130	290

Table 2.4: result of crushing coconut fiber using 10 blade

Kecepatan putaran (rpm)	Massa bahan baku (gram)	Massa *cocofiber* (gram)	Massa *cocopeat* (gram)
225	500	100	240
450	500	140	250
750	500	130	300
900	500	120	320

Based on a literature review of blade number above, it is found number of blades effected the result of coco fiber and coco peat. 8 to 12 numbers of blades is suitable for this project because it can produce more coco peat than coco fiber. At a same time, the length of coco fiber will become shorter. When the amount of blades increase, it reduces the crushing time process.

2.1.4 Blade Shape

According to Cahyono and Yohanes (2017), type of blade shape was used in that experiment which is rectangular blade shape and cylinder blade shape. For cylinder blade, it used 14 mm diameter and 195 mm length. For rectangular blade, it used 14 mm thick and 195 mm length. This experiment combined with the variation of rotation speed and the result taken in time of coconut crushed. The speed of rotation used were 852 RPM, 1065 RPM and 1420 RPM.

Table 2.5: Test result for variation in rotation speed with cylinder blade

Blade rotation speed (RPM)	Time (s)	Statement
852	55	There many coconut fiber which not decomposed partly
1065	53	Fiber decomposed quite well
1420	50	Fiber is well decomposed but still some not decomposed

Table 2.6: Test result for variation in rotation speed with rectangular cutter

Blade rotation speed (RPM)	Time (s)	Statement
852	51	Fiber decomposed quite well
1065	50	Fiber decomposed well
1420	47	Fiber decomposed very well

Based on a literature review of blade shape above, it is found blade shape gave an effect in decomposition of coconut fiber. The best blade shape for this project is a rectangular blade shape. The coconut fiber decomposed very well by using a rectangular blade to compare cylinder cutter. An edge of the blade are grind to make it sharp and easier for the cutting process. At the same times, less time need for coconut fiber to decompose.

2.1.5 Pulley and Belt Selection

According to Senthill Kannan et.al (2016), the small pulley with 0.05 m diameter was fitted with the motor shaft. The power from small pulley transmitted through 0.41 m diameter large pulleys acted as driven using V-belt drive. The large pulley fitted at main shaft. To prevent vibration in main shaft, two ball bearing housed inside Plummer block used to support the main shaft which is in the main frame. By using ball bearing, it reduced the friction over the shaft. In this experiment, selection of pulley based on the calculation.

$$\frac{D}{d} = \frac{N1}{N2}\ (m) \tag{2.6}$$

Where *D* is the diameter of pulley 1, *d* is the diameter of pulley 2, *N1* is the input speed and *N2* is the output speed.

After done calculated the size of pulley for the pulley selection, it continued with a selection of the belt section. To select the belt section, it refers to the PSG design data book. Type of section depends on the number of watts. Then, the center distance calculated using the equation

$$C = 2(D + d)\ (m) \tag{2.7}$$

Where *C* is the center distance, *D* is the diameter of pulley 1 and *d* is the diameter of pulley 2.

Identify nominal pitch length

$$L = 2C + \frac{\pi}{2}(D + d) + \frac{(D-d)^2}{4C} \text{ (m)} \quad (2.8)$$

Where L is the nominal pitch length, *C* is the center distance, *D* is the diameter of pulley 1 and *d* is the diameter of pulley 2.

Calculate arc of contact

$$\theta = 180° - \frac{(D-d)}{C} \times 60 \quad (rad) \quad (2.9)$$

Where θ is arc of contact, *C* is the center distance, *D* is the diameter of pulley 1 and *d* is the diameter of pulley 2.

Based on a literature review of pulley and belt selection above, it is found pulley size based on the output speed. While, belt selection can use the formula above.

2.1.6 Selection of Shaft

According to Sanjay Kumar and Hemanth Kumar (2015), they study about designing a shredder machine for agriculture waste. On that machine, 150 mm outer diameter of cutter with 6 numbers of teeth. The Tungsten carbide material was selected as cutter tip. With 190 N of cutting force, diameter of shaft selected based on calculated value.

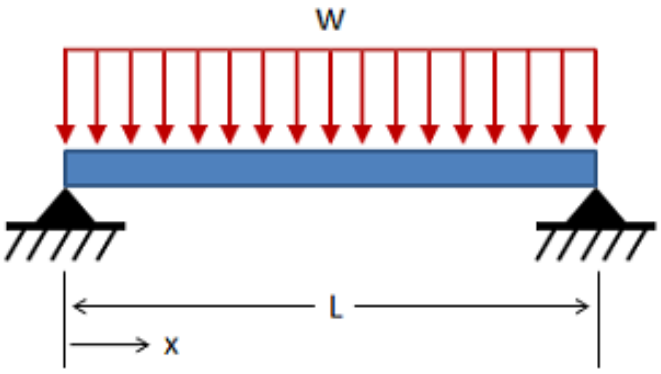


Figure 2.3: uniform normal distribution load

The force on the system may cause an object to turn. Momentum is the turning effect of a force. The magnitude of moment calculated using the equation. The moment is equal to force multiple with distance.

$$M = Fd\ (Nm) \tag{2.10}$$

Where *M* is the momentum, *F* is the force and *d* is the distance.

Torque was calculated by using an equation of:

$$T = \frac{60\ \times P}{2\pi n}\ (Nm) \tag{2.11}$$

Where *T* is the torque, *P* is the power and *n* is the number of turns.

Yield happen when the distortional strain energy the highest point value. Maximum shear stress was calculated

$$\tau_{max} = \frac{\sigma_y\ \times 0.5}{fs}\ (N/mm^2) \tag{2.12}$$

Where τ_{max} is the maximum shear stress, σ_y is the normal stress and *fs* is the safety factor.

After complete calculated torque, momentum and maximum shear stress, the diameter of the shaft was fined using the calculated data :

$$d = \sqrt[3]{\frac{(16 \times \sqrt{((K_b \times M_b)^2 + (K_t \times M_t)^2)}}{\pi \times \tau_{max} \times 0.75}\ (m)} \tag{2.13}$$

Where d is the diameter of the shaft, τ_{max} is the maximum shear stress, K_b is the stress concentration factor for normal stress, M_b is the maximum bending moment, K_t is the stress concentration factor for shear stress and M_t is the maximum torque.

Based on literature review selection of shaft above, it is found size of shaft depend on the number of forces. From the force, it calculates the momentum for the shaft. The safety factor of the shaft must be considered.

2.1.7 Screening Size

According to Soekarno, Ahmad and Afandi (2014), they run an analysis of screening machine for coco fiber. In this experiment, they used screening with the size of (0.4 x 0.4) cm^2, (1 x 1) cm^2, (2 x 2) cm^2. Coconut fiber with 100 kg load was used in this experiment and result taken by repeating experiment three times. Screening with (0.4 x 0.4) cm^2 run three times, which is 72 kg, 86 kg and 88 kg respectively. By using (1 x 1) cm^2 screening size, at first run got 70 kg, second run got 80 kg and third run got 84.5 kg. For (2 x 2) cm^2 size, it got 69 kg, 73 kg and 78 kg respectively. In continuous screening process, first repeat got 85 kg, second repeat got 85.3 kg and last repeat got 89.1 kg.

Table 2.7: coco fiber weight

Ayakan	Input	Ulangan			Total Perlakuan	Rata-Rata
		1	2	3		
(0.4 x 0.4)cm^2	100	72	86	88	246	82
(1 x 1)cm^2	100	70	80	84.5	234.5	78.17
(2 x 2)cm^2	100	87	88.7	90.2	265.9	88.63
Berurutan	100	85	85.3	89.1	259.4	86.46
Total Ulangan		314	340	351.8	1005.8	83.82

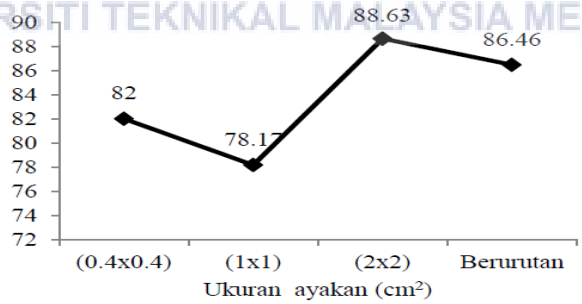


Figure 2.4: screening relationship with screening product (coco fiber)

Based on a literature review of screening size above, it is found that screen size with (2 x 2) cm^2 produce the highest number of coco fiber. But in this project (2 x 2) cm^2 is not suitable because the size is large. If the size is large this may cause the coco peat mix together with coco fiber. So (0.4 x 0.4) cm^2 or (1 x 1) cm^2 screen size is suitable for this project.

2.2 Product

Product of the machine are as per described below:-

2.2.1 Coco peat

According to Udayana et.al (2017), it studied prospect and concern utilization of coconut product in agriculture. A material added to a soil is called a soil amendment where it gives a positive impact to the soil properties to make the soil healthy. Coco peat plays a role to make it use for plant propagation and culture of plant as humic substance. Blended coir pitch enriches with calcium and magnesium nitrate suitable to act as soil amendment.

According to Arif and Yeremias (2015), coco peat and rice husk were use as (cempaka wasian) *Elmerrilia ovalis* growth media. Used of media composite provides a significant effect on growth in height, diameter, shoot dry weight and dry weight of Cempaka seedling roots. The best treatment present in Table 2. Based on the result of the further test. It can be seen that M2 media (top soil + husk charcoal rice) are the media that provides the best response to growth height, diameter, shoot dry weight and the root dry weight of Cempaka wasian seedling aged six months with the response value generated from the treatment these are 15.37 cm, 4.77 mm, 1.44g and 1.17 g. as for the use of top soil + coco peat (M1) media gives lower influence compared to control treatment (M0) with a high response value diameter, shoot dry weight and root dry weight of 10.34 cm, 3.57 cm, 0.60 g and 0.50 g. The percentage difference value increase rate response Cempaka wasian seedling growth due to treatment composite rice husk charcoal is shown in table below.

Table 2.8: analysis of variant height, diameter, seed quality index and percentage of six month cempaka wasian seed life

Sumber variasi	F hitung			
	Tinggi	Diameter	BKP	BKA
Media	14,18*	13,91*	17,48*	12,92*

Keterangan: * = Berbeda nyata pada taraf uji 0,05;tn = tidak berbeda nyata pada taraf uji 0,05

Table 2.9: Duncan further test and high growth rate, diameter, BKA and six month cempaka wasian BKA seed

Perlakuan	Tinggi (cm)	Diameter (mm)	BKP (g)	BKA (g)
M0	$13,14^{b}$	$3,86^{b}$	$0,92^{b}$	$0,66^{b}$
M1	$10,34^{c}$	$3,57^{b}$	$0,60^{c}$	$0,50^{b}$
M2	$15,37^{a}$	$4,77^{a}$	$1,44^{a}$	$1,17^{a}$

Keterangan:M0= Media *top soil*, M1= media *top soil+cocopeat*, M2= media *top soil*+arang sekam; BKP=berat kering pucuk,BKA= berat kering akar.Huruf yang berbeda menunjukkan berbeda nyata pada taraf uji 0,05.

Table 2.10: growth different percentage and high growth rate decline, diameter, BKP and six month cempaka wasian BKA seed

Perlakuan	Persentase peningkatan (%)			
	Tinggi	Diameter	BKP	BKA
M1	-21,31	-7,51	-34,78	-24,24
M2	16,97	23,58	56,52	77,27

Keterangan: M1= Media *top soil+cocopeat*,M2= media *top soil*+arang sekam padi; BKP= berat kering pucuk,BKA= berat kering akar

According to Pratiwi et al (2017), it studies about effect of a growing medium mixture of strawberry's. A mixture of plant media has an effect the real number of leaves and number of buds. Plant planted in the media planting husk charcoal with the composition of 1:2 and 2:1 has a significantly higher number of leave compared to plant that grow on husk charcoal growing media with composition 1:1 and coco peat with a composition of 1:2 but it does not have real difference against plant grown in the media planting soil and coco peat with composition 1:1, 2:1 and compost banana stem. A plant which is grown in the husk charcoal growing media with a composition of 1:1 having a number of shoots which is significantly higher than that of plants that grow on soil planting plant. Mixed planting media in the form of charcoal husk, coco peat and soil have a very strong influence to the number of leaves of plants.

According to Hasriani et al (2003), it studies about coco peat as planting media. The coco peat media has a high moisture content compared to soil media and coconut fiber + soil mixed media. Coco peat has a water content and water saving capacity of 119% and 695.4% respectively. Sengon and mahogany plants with the treatment of coco peat longer drought (dry spell). Sengon experienced drought on day of 25 and mahoni on day 55. Coco peat is more suitable for critical soil rehabilitation activities in dry climates. To increase the water saving, so that more resistant to drought requires an additional amount of coco peat more than 0.5 kg per planting hole. A dry content of media planting coco peat is lower than the other two media making it easier to transfer and distribute to the field. The lower the weight of the medium of planting media, less light and practical it is to move. By performing 15 days, the dry content of coco peat was 0.10g /cm^3 or wet content was 0.105 g/cm^3. This will facilitate transportation.

According to Mulyadi and Alphanoda (2016), they studied about the quality of coco fiber as material in making particle board. Further analysis of water content, board density, water absorption, thickness development, fracture strength, modulus of elasticity and parallel shear strength were carried out. The result of the test of water content with the initial test material, size of 5cm x 5cm x 1 cm showed that the higher density of particle board from the coco peat was lower the water content. The result of the board density test indicates that the higher the density of particle board from coco peat is higher the density. From this manufacture of particle board from coco peat it meets the industrial standard of particle board manufacturing.

$$K_a = \frac{W_a - W_b}{W_b} \times 100\% \qquad (2.14)$$

Where K_a is the water rate, W_a is the initial specimen weight and W_b is the final dry weight.

The result of the water absorption test indicates that the higher density of particle board from coco peat, lower the absorption. According to industrial standard, the particle board for medium density is 10% - 15% and high density is 15% - 50%.

$$= \frac{W_b}{V} \tag{2.15}$$

Where W_b is the kiln dry weight and V is the specimen volume.

The result of thickness test indicates that higher the density of particle board, lower the thickness development. According to industrial standard, the thickness development for medium is 5% - 15% and 15% - 40% higher.

$$P_a = \frac{W_a - W_b}{W_a} \times 100\% \tag{2.16}$$

$$P_t = \frac{T_a - T_b}{T_a} \times 100\% \tag{2.17}$$

Where P_a is the water absorption, W_a is the initial specimen weight, W_b is the final dry weight, P_t is the thickness expansion, T_a is the initial thickness and T_b is the final thickness.

The result from strength test (modulus of rupture) showed higher the density of particle board, higher firmness of fracture. The result of modulus elasticity showed higher the density of the board, higher the modulus of elasticity. The modulus of elasticity for low density is 10550 – 17850 kg/cm^2, medium 17580 – 49220 kg/cm^2 and high 24610 -70310 kg/cm^2.

$$MOR = \frac{3PL}{2bd^2} \ (kg/cm^2) \tag{2.18}$$

$$MOE = \frac{PL^3}{4\delta bd^3} \ (kg/cm^2) \tag{2.19}$$

Where MOR is the modulus of rapture, *MOE* is the modulus of elasticity, *P* is the maximum pressure, *L* is the specimen width, δ is the deflection at the proportion limit, *b* is the specimen width and *d* is the specimen thickness.

Lastly, the result of surface parallel shear strength test indicates higher the density of the board, higher the parallel shear strength value. The industrial standard, the low density is below 7 kg/cm^2, medium 7 – 32 kg/cm^2 and high 246 – 366 kg/cm^2. From the result, the particle board meets the industrial standard.

$$C = \frac{P}{bd} \ (kg/cm^2) \tag{2.20}$$

Where *C* is the linear surface tension strength, *P* is the maximum pressure, *b* is the specimen width and *d* is the specimen thickness.

Based on a literature review of coco peat above, it found that coco peat is a good soil amendment where it can improve the health of soil. The rate of water absorption of coco peat is higher than water absorption of normal soil. With the use of coco peat, it improves the plant growth where plant it grows faster than usual. The number of leaf and root also increase with the application of coco peat as planting compost. Other than that, coco peat also can be used for other purpose. It can be used as the particle board material where it meets the most industrial standard. It can be improved to become a much better product and at a same time to commercialize it.

2.2.2 Coco Fiber

According to Clivia et al (2012), they test the use of coconut fiber as a cushioning material for transport packaging. After complete doing shock test, it is found that natural fiber form is better cushioning effect compared to a pad of fiber molded with agglutinants. The effect of fiber cushioning a better because the fiber produced from coconut husk has a higher length of fiber. Use of coir can be the alternative cushioning material with the present of agglutination agent. At a same time, increase the resilience of the pad. The result shows that the utilization of agglutinants failed to increase the performance of the fiber pads as padding material.

For the shaped coconut fiber, the curves of every kind of material are compared to a static load starting from 0.11 to 0.48 kPa, and thickness of 0.025 m and 0.050 m, severally. With the increase of static load, it will decrease the impact of acceleration. The fiber coated with vulcanized rubber are not effective for cushioning purpose because it formed using a latex where it has higher acceleration value. A starch gel has a same characteristic with a latex. The coco fiber can get a better malleability after drying by adding of plasticizer into starch gel.

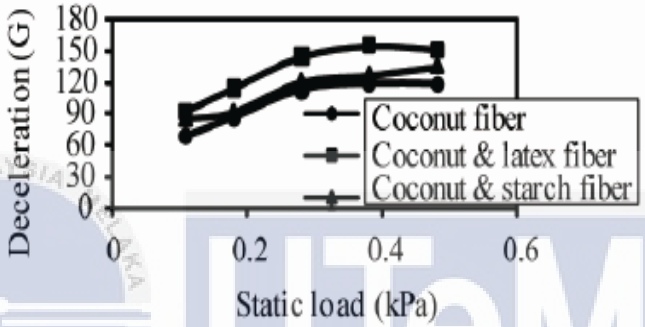


Figure 2.5: Comparison between the shock test result for pads of 0.025m thickness and made of fibrous material for a drop height of 0.30m, in the 0.11 – 0.48 kPa static load range at 21°C ± 2°C e 60% ± 3% UR.

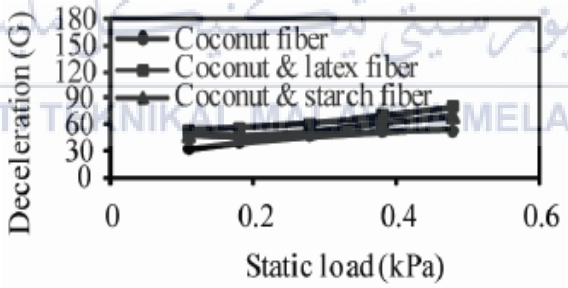


Figure 2.6: Comparison between the shock test result for pads of 0.05m thickness and made of fibrous material for a drop height of 0.30m, in the 0.11 – 0.48 kPa static load range at 21°C ± 2°C e 60% ± 3% UR.

According to Toto Indahyanti (2011), studies about utilization of coco fiber in interior and furniture planning that impact on the empowerment of poor people. Coco fiber can be processed into a variety of finished and semi – finished product that has high market value. This product included coir rope, coco mesh, coco fiber board (CFB). The fine doormat is manufactured with the highest level of complexity. A smooth doormat produced have a smooth surface, solid density and thickness.

Process of neat weaving and its structure make it strong and durable. The general size of the mat is 40 cm x 60 cm, 10 cm x 50 cm, 150 cm x 50 cm and 200 cm x 50 cm.

Figure 2.7: Doormat

Coco mesh is a net made from coco fiber. Usually it makes like a size of a volleyball net or can be adjusted to the need of land. The use of coco mesh has proven effective in preventing landslide or floods. It also functions as a growing medium for plant and very suitable for reclamation of ex – mines or beaches. The installation is adjusted to the soil structure. Can be tilted or flat and usually made in 2 layers for installation.

Figure 2.8: Coco mesh

Coco pot function as a growing medium of plant that is very suitable for plant in pot, minus nutrient and recommendation for reclamation of ex – mines. Coco fiber formed into the pot has its own artistic value and environmentally friendly because it as nutrient when it decomposed.

Figure 2.9: Coco pot

Application of coco fiber in producing sheet form or knows as coco sheet. This coco sheet was proved to be able to reduce sound and absorb noise, especially at high frequencies (2000 Hz). This coco sheet is able to compete with the use of glass wool. Another advantage of coco sheet it is cheaper. The recommended coco sheet thickness is 70 mm.

Figure 2.10: Coco sheet

Coco fiber can be processed into fiber board in type of MDF (Medium Density Board). The advantages of the coco fiber board are the quality, the strength is similar with the commercial MDF, no need chemical adhesive to make it eco – friendly, low water absorption than commercial MDF and more economical because it used simple technology. It basically used to press combined with heating at a high temperature. Used of chemical adhesive could be avoided because coco fiber contained a large amount of lignin which when heated at high temperature it become adhesive for coco fiber. High temperature used to melt the ligneous adhesive on coco fiber and

encourage the binding reaction process in the material. With enough pressure needed to obtain the density and smoothness of the surface board produced. The characteristics of the fiber board produced are strongly influenced by the size of the particle or fiber piece.

Figure 2.11: Coconut fiber cement board

Based on a literature review of coco fiber above, it found that coco fiber is multifunction use. By manufacturing a product by using the coco fiber, it can generate a profit or income for a person. The characteristic of coco fiber inside it gives an advantage to it to compete with the product in the market.

2.3 Summary

In this chapter, it is mentioned more about an understanding and how the idea of generating in design and fabricate of the machine by studying a previous journal or article related to the title. Understanding about the title is important before proceed to the next step. From the related journal or article, it studies more about the component will be used which is type of motor, motor power, rotation speed of blade, number of blades, blade shape, pulley and belt selection, selection of shaft and screening size. All the formula given from the research will be utilized in the other chapter. The product of coco fiber and coco peat have also been studied from the journal, not in detail but just to get more understanding.

CHAPTER 3

METHODOLOGY

3.1 Introduction

Upon completing of this project, the process of design and fabrication mini coconut fiber crusher and screening machine is made according to schedule. All the steps or procedures in this project are briefly explained in this chapter with the assistance of a flowchart and Gantt chart that are given below.

3.2 Flow Chart

Figure 3.1 below shows the general flow chart of mini coconut crusher and screening machine process. Firstly, a survey was made and has been distributed to the customer to identify the customer requirement. From the survey, the customer requirement was converted into quality function deployment (QFD). Next, the idea must come out by using morphological chart. At morphological chart, a few designs were sketched for a part. Then the design from morphological chart was combined and came a concept generation. The best concept generation was selected as a final design. After complete all the processes, the cost analysis was determined to identify the total cost before fabrication was started.

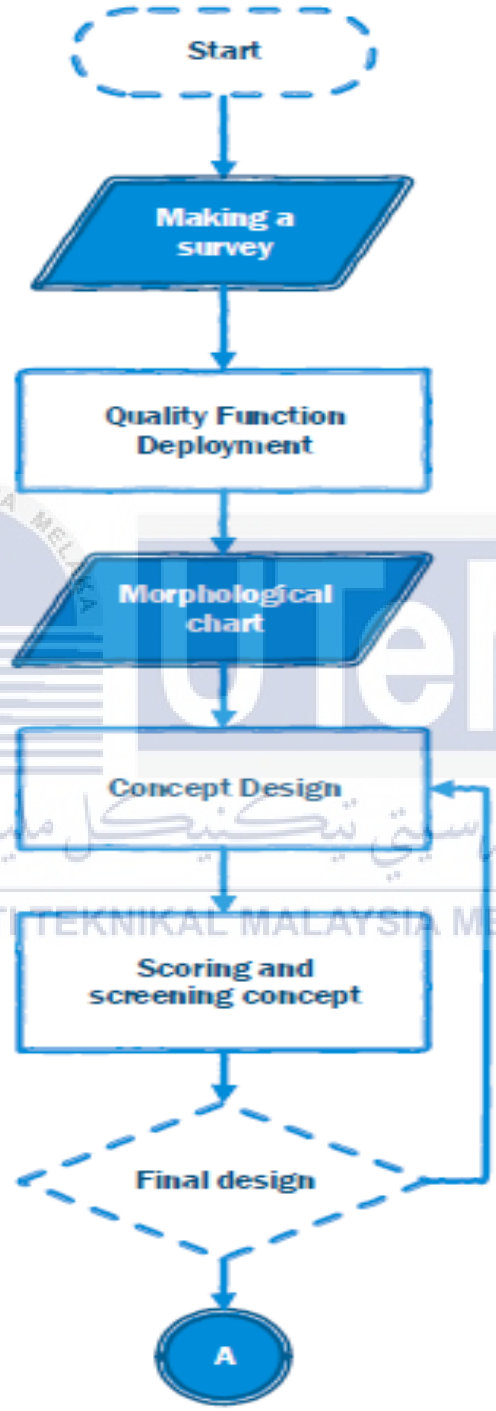


Figure 3.1: Flow chart

……continuation

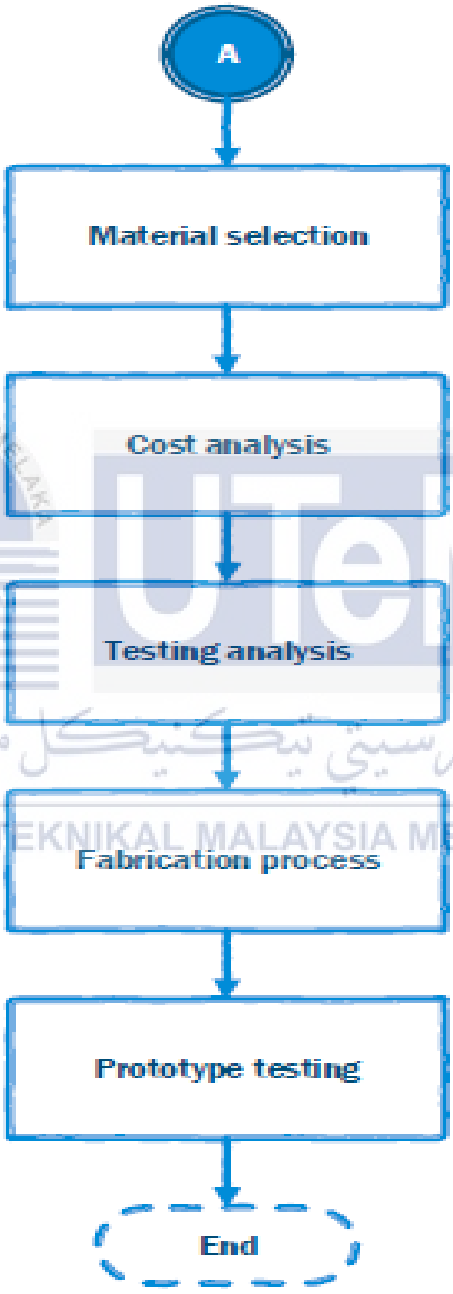


Figure 3.2: Flow chart

3.3 Gantt Chart

The Gantt chart function as a guideline for project progress. It was very important to observe how far the project implemented and the current progress. Table 3.1 below illustrates the milestone aimed for this project. Activities chart shows task conducted according to week until completion of this project. The project started from week 1 semester 1 2018/2019 where student meet the supervisor and then the supervisor explained a little bit about the project title. In week 3, it started with chapter 1 where it about identifying the introduction, problem statement, objectives and scope of the project. Next two weeks after completing chapter 1, it was continued with chapter 2. In chapter 2, it mention about the literature review which related to the project title. Most of literature review came from previous journal. At week 9, the project proceeds with the methodology until week 14. During semester 1, at least once a week I meet with the supervisor to discuss about the project progress and got some comments in order to improve this project.

Table 3.1: Gantt chart

Activities	Week														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Brainstorming and select the title															
Meeting with supervisor															
Chapter 1:Identify introduction, problem statement, objectives and scope															
Chapter 2: Literature review															
Chapter 3: Methodology															
Reference and formatting															
Submission of general conduct form and logbook to supervisor															
Poster presentation															
Submission of PSM 1 reports to supervisor and examiners															

3.4 Making a Survey

To create a product which will fulfils all the customer requirements, the product must be started by doing a survey to the customers. The survey was very important to know what the customers needs before the product was produced. Without making a survey, it was difficult to know the customer needs and sometimes the product produced does not meet with customer requirement.

The survey can be done in many ways. In terms of technologies, the survey has been done by doing an online survey. By distributing an online survey in the social media, it makes customer easily to fill an online survey by using their mobile phone or gadget. At the same time, it will saves time for a manufacturer to distribute the survey and got a feedback. Google form also the best online survey platform for making a survey. From this application, it can know the number of responded and the result of the survey was already calculated. Another method to make a survey was by an interview. An interview was the best way to meet with the customer because we can directly ask the questions to them. During the interview session, sometimes customer will come out with a good idea in order to improve the product and meet with their needs.

3.4.1 Survey Question

Kaji Selidik Mesin Penghancur dan Penyaring Sabut Kelapa Mini

Mesin penghancur dan penyaring sabut kelapa mini merupakan tajuk Projek Sarjana Muda Kejuruteraan Mekanikal saya di UTeM. Tujuan penghasilan mesin ini adalah untuk menghancurkan sabut kelapa menjadi serbuk kelapa (coco peat) dan serat kelapa (coco fiber). Mesin ini dihasilkan dalam saiz yang kecil untuk kegunaan sendiri. Serbuk kelapa (coco peat) dan serat kelapa (coco fiber) banyak digunakan untuk industri pertanian dan lain - lain.

* Required

SERBUK KELAPA (COCO PEAT)

SERAT KELAPA (COCO FIBER)

Adakah anda memahami tujuan mesin ini dihasilkan? *

	1	2	3	4	5	
sangat tidak setuju	○	○	○	○	○	sangat setuju

Adakah anda merasakan mesin ini perlu kecil dan campact? *

	1	2	3	4	5	
sangat tidak setuju	○	○	○	○	○	sangat setuju

Berapakah anggaran sabut kelapa yang akan anda hancurkan menggunakan mesin ini?

- ○ 1
- ○ 5
- ○ 10
- ○ lebih

Berapa kerapkah anda akan menggunakan mesin ini?

- ○ 1 kali sehari
- ○ 1 kali seminggu
- ○ 1 kali sebulan
- ○ lain - lain

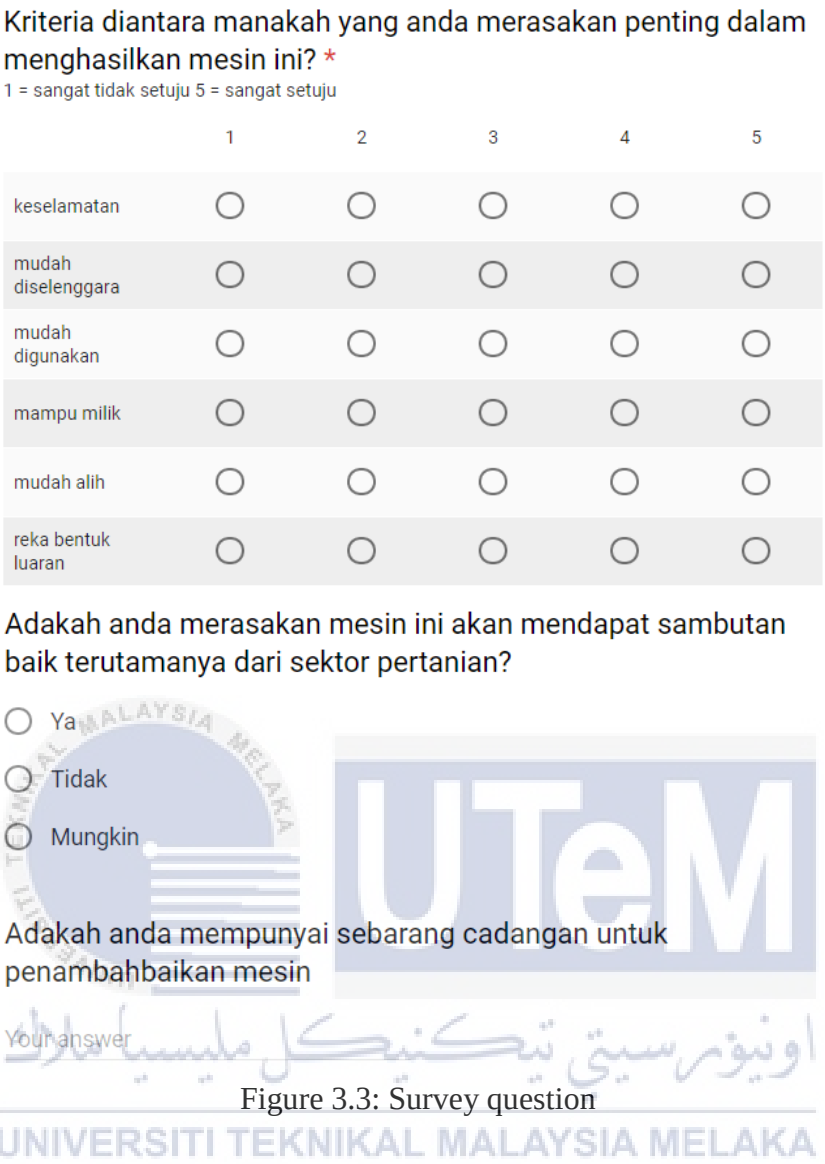


Figure 3.3: Survey question

3.4.2 Survey Responses

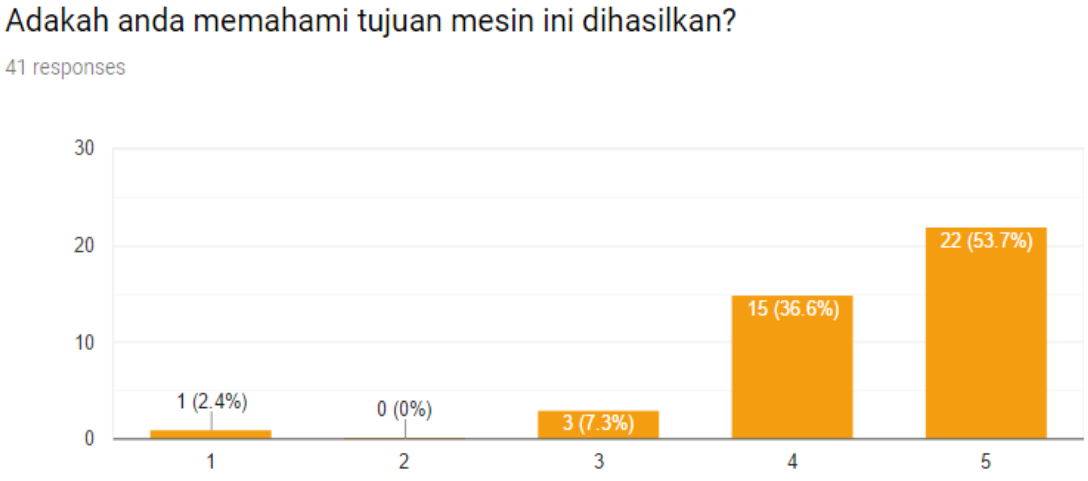


Figure 3.4: Survey response question 1

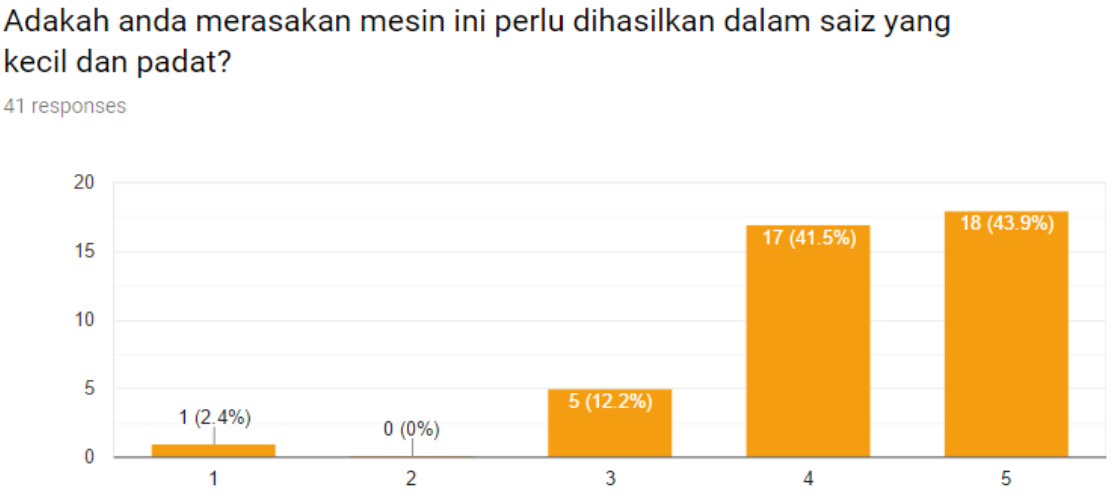


Figure 3.5: Survey response question 2

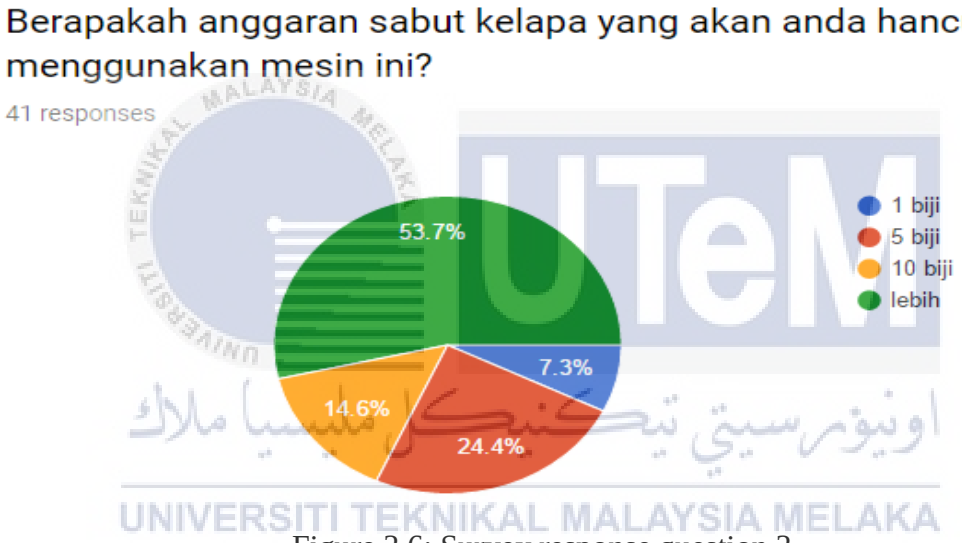


Figure 3.6: Survey response question 3

Figure 3.7: Survey response question 4

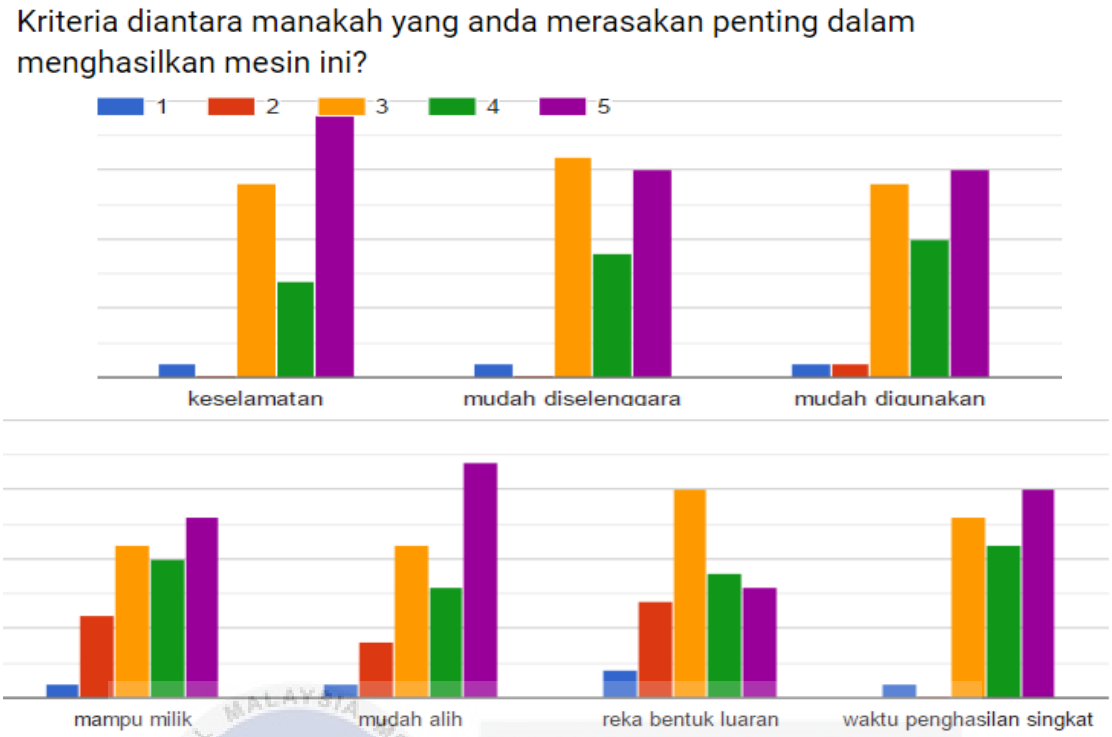


Figure 3.8: Survey response question 5

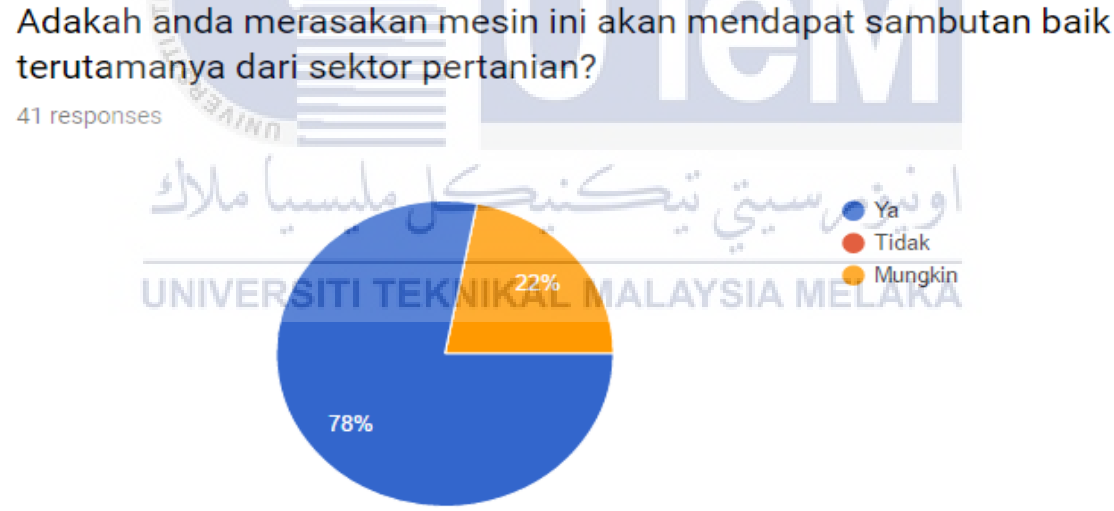


Figure 3.9: Survey response question 6

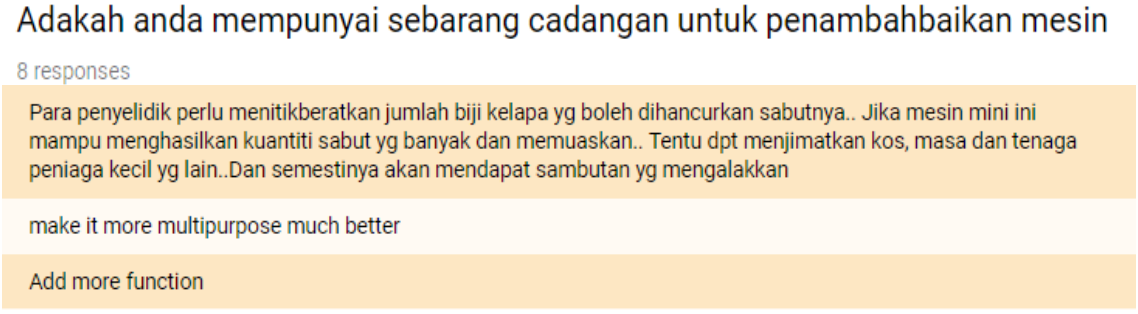


Figure 3.10: Survey response question 7

3.5 Quality Function Deployment

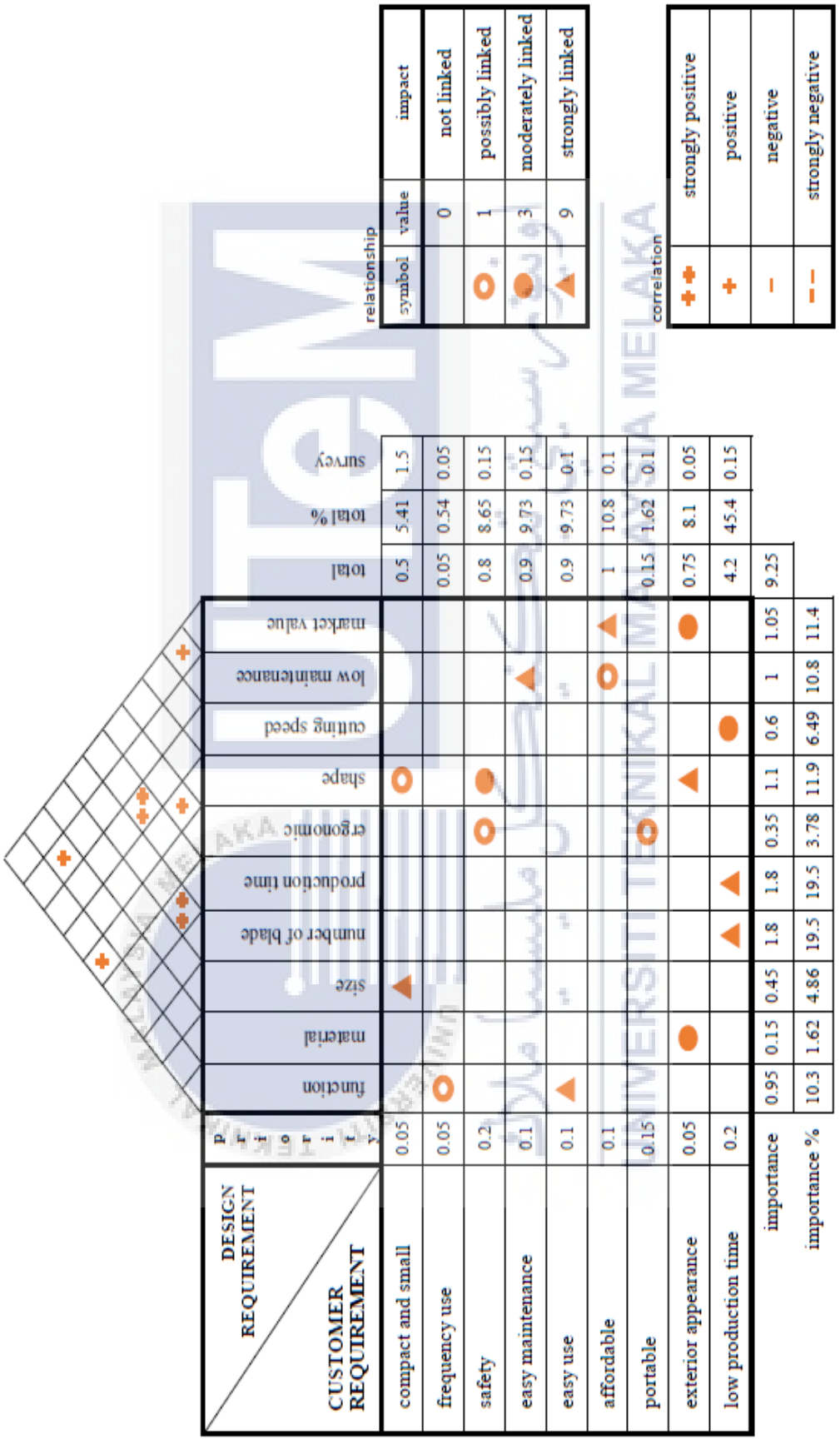


Figure 3.11: Quality function deployment

3.6 Concept Generation

In concept generation section, there was few concept designs were produced based on literature review and collected information according to coconut crusher and screening machine. Every machine parts were designed nicely to make it can be function well in term of the manufacturing process, function and material. The parts that has been designed were a caster, blade, motor, frame, handle, hopper, screener and power transmission.

For the caster, there are 3 types of designs which were linear movement, free rotation and free rotation with lock. All this caster were based on the market design. Next, the blade designs idea where comes from drum inside a washing machine, grass cutter machine and trash crusher blade. The idea of this 3 machines were applied in this machine design. For the motor design, only two types of motor were used which were AC electric motor and petrol motor. This was because it suitable for this machine. For the frame, there have four ideas which were suitable for this project. The idea itself comes from a pattern of box, current coconut crusher machine and pentagon shape.

The handle was designed based on own creativity and one of the ideas was from a supermarket trolley handle design. The hopper idea was a common hopper design in a market cone and square shape. Next, one of the screener ideas comes from the current screener machine. But in this project, it was designed in a small size. Lastly, the power transmission ideas based on current power transmission design on the market, which was a pulley and belt, sprocket and chain and coupling.

Every design produced have its own and different design between each other, but the function are still the same. Every part or components were designed in a morphological chart before the idea were combined in a concept design.

3.6.1 Morphological Chart

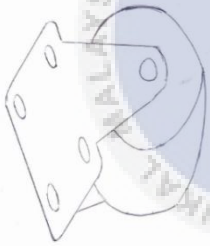
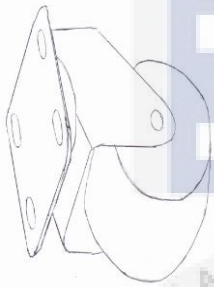
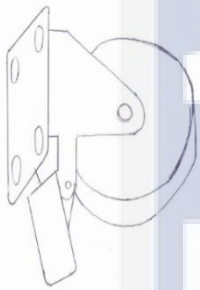
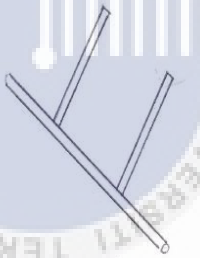
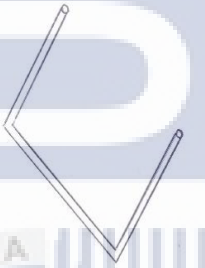
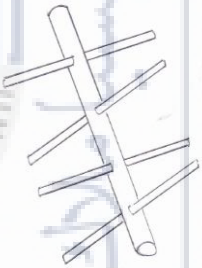
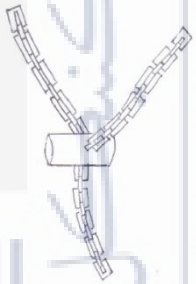
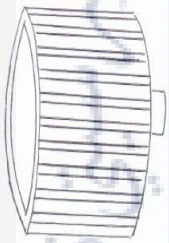
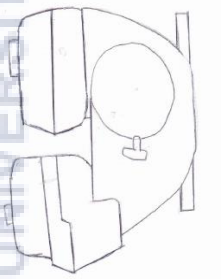
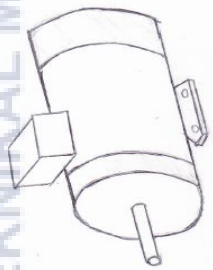
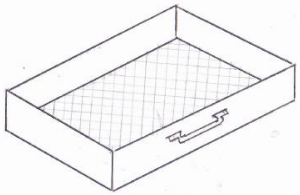
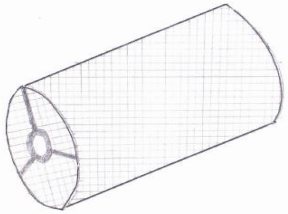
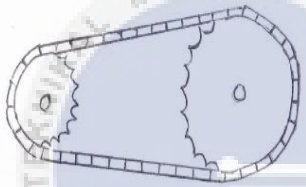
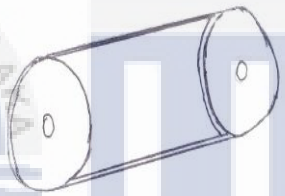
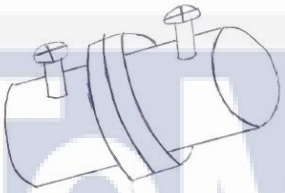
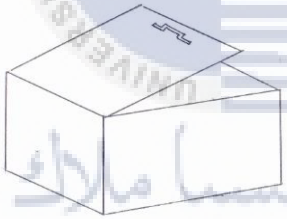
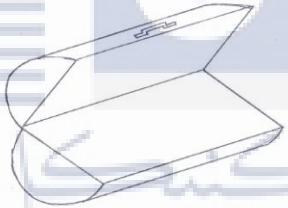
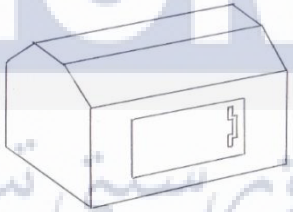
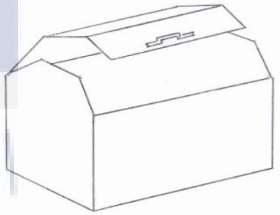
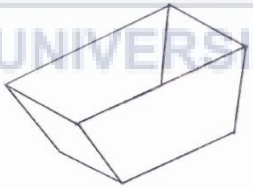
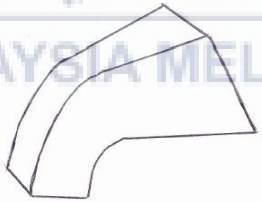
Part	Option 1	Option 2	Option 3	Option 4
Caster				
Handle				
Blade				
Motor				

Table 3.2: Morphological Chart

Screener				
Power transmission				
Frame				
Hooper				

3.6.2 Concept Design

i. Concept Design 1

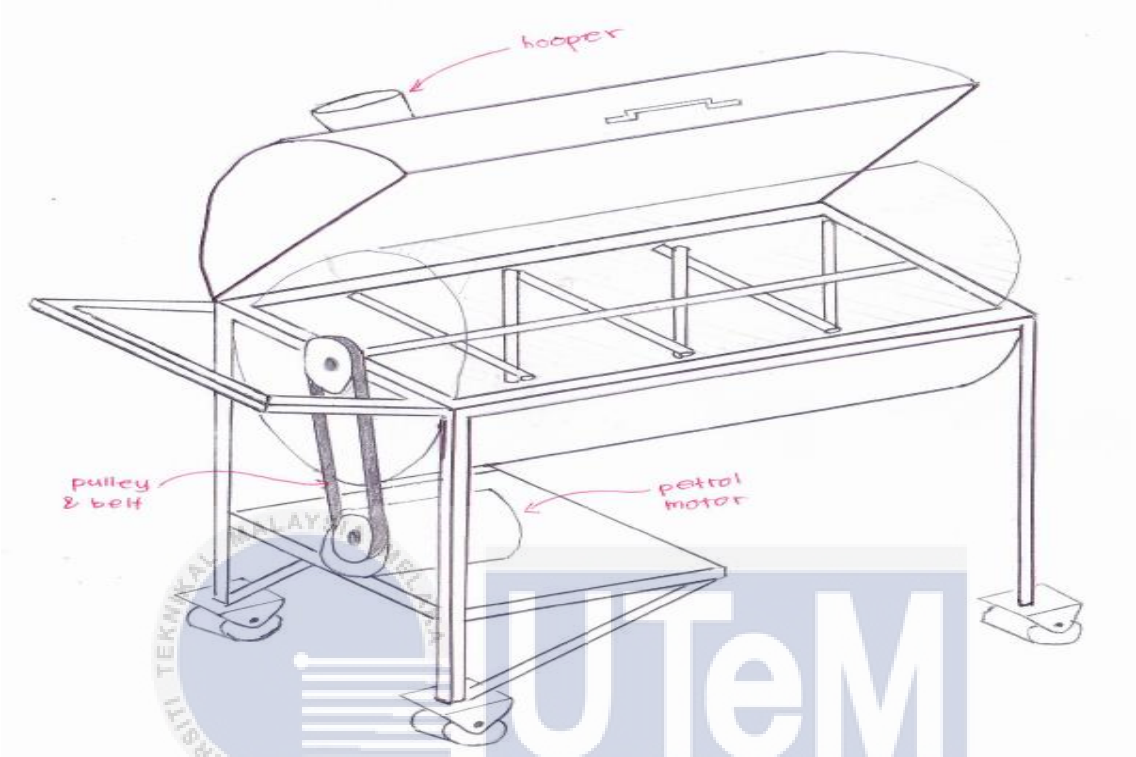


Figure 3.12: Concept design 1

The concept design 1 look a little bit similar with the current coconut crusher machine where it frames from the option 2. This frame looks like a cylinder drum and it can be open for maintenance works. This frame was attached with hopper with the option 2 which is cone shape. In the frame, there are two components inside the frame which is a blade and screener. The option 1 blade was selected for this design where it cuts in horizontal rotation. Then the screener come from the option 2. In terms of power transmission, the option 2 was chosen where it is a belt and pulley system. The machine gets the power from the petrol motor which is the option 1 and mount under the frame. For the handle, the option 2 was chosen in this design. Lastly, the option 2 caster was used as a mechanism for moving this machine.

ii. Concept Design 2

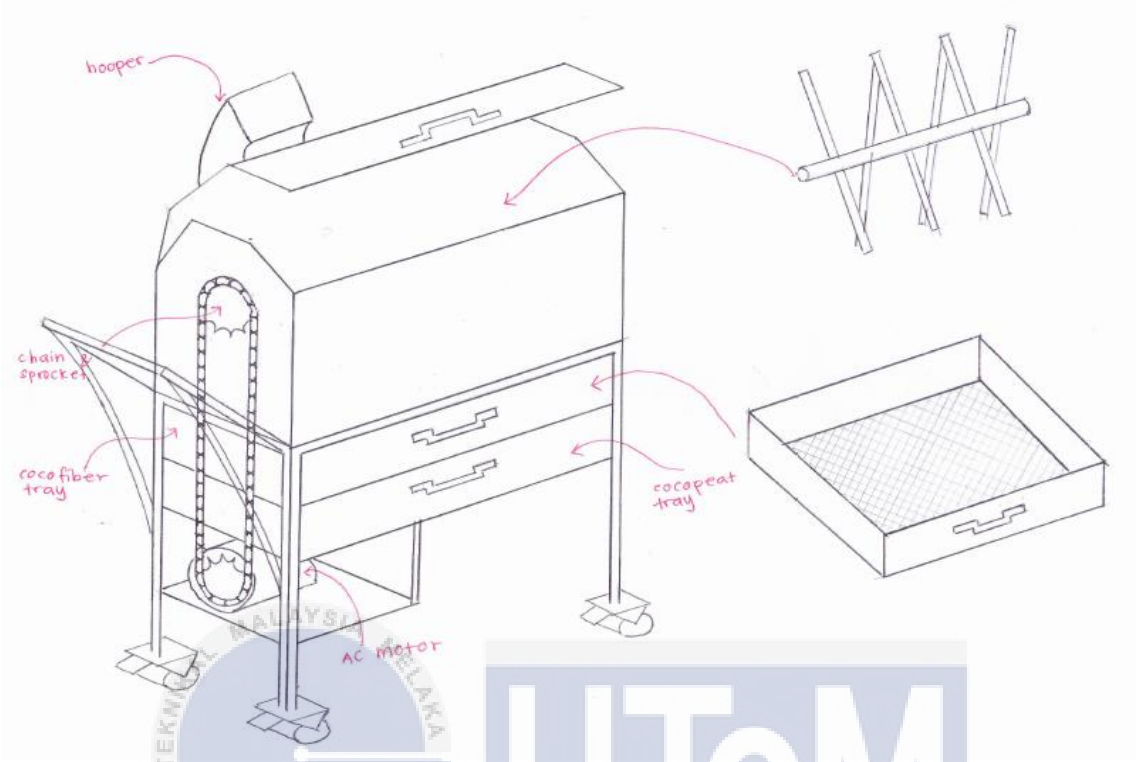


Figure 3.13: Concept design 2

From the concept design 2, the idea of the frame was coming from the option 4. The option 4 frame has a shape of a pentagon and a lid at upper side to make it easy to open for maintenance process. The lid was joint with a hopper of the option 3. The reason of the option 3 hoppers was chosen to make the user easily to put in the coconut fiber from a front side and the shape is suitable for the option 4 frames. Inside the frame, there are a blade from the option 1 which is the cutting process happening in a vertical. The product of coco peat and coco fiber was falling down into coco fiber and the coco peat tray. The function of this two tray was to collect all the coco peat and coco fiber respectively. For the power transmission, the option 1 was selected. This because it can carry high torque for load. The power of this machine came from the option 2 motor which is AC motor. The handle got an idea from the option 3 where look more ideal with the frame. Lastly, caster from the option 3 was selected because it has a lock and free rotation.

iii. Concept Design 3

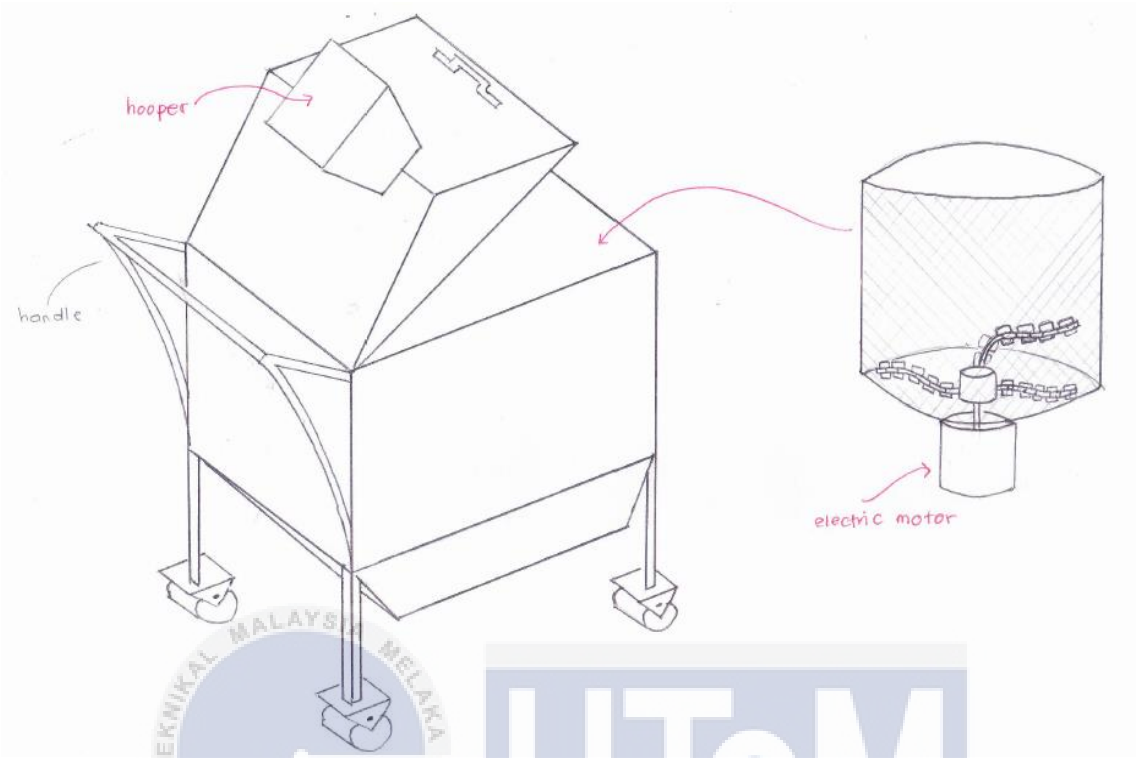


Figure 3.14: Concept design 3

In concept design 3, the frame shape came from the option 1. It has a square shape and can be open from upper side. The option 1 hopper was attached at upper side of the machine. So the coconut fiber fell directly inside cutting area. The blade from the option 2 was selected in this design where chain used as a blade. Inside cutting area, the screener was attached together by using the option 2. The coco peat fell under the frame and the coco fiber trapped inside the screener. The motor from the option 2 was used and located under the frame. It is jointed using power transmission of the option 3. The handle gets an idea from the option 3 and make it suitable to the frame design. Lastly, the caster with the option 1 was selected for this design. This caster can move in a linear direction.

iv. Concept Design 4

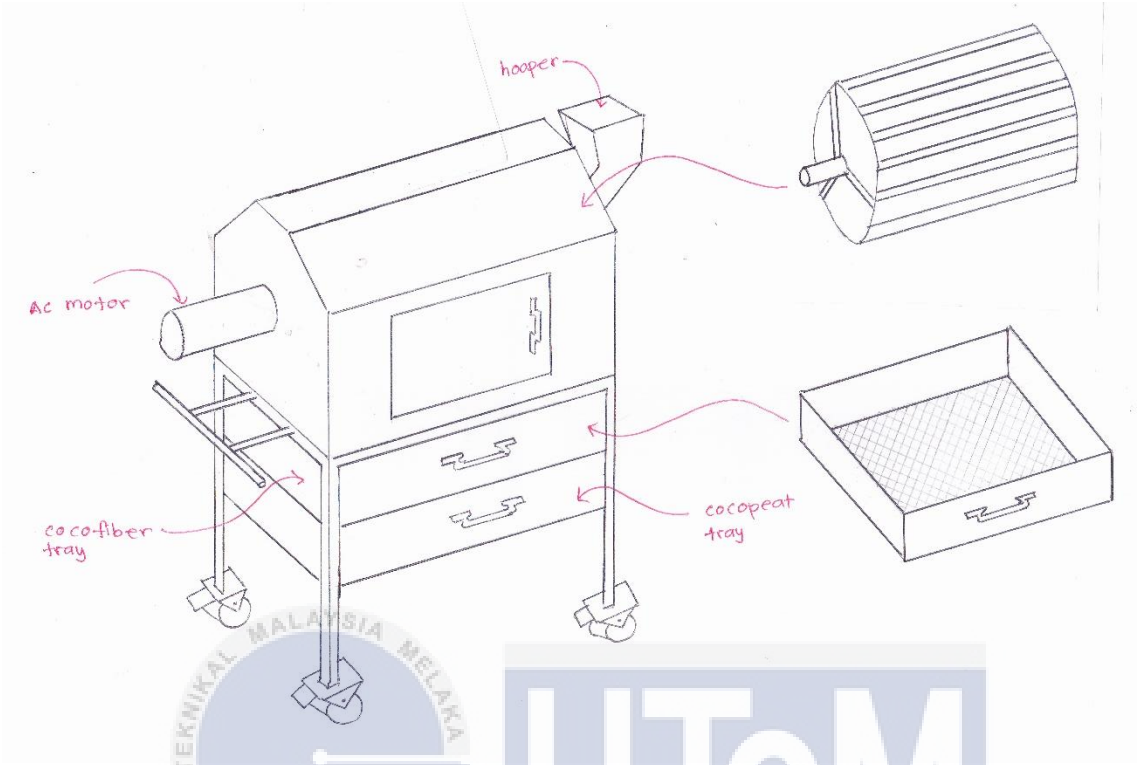


Figure 3.15: Concept design 4

The concept design 4 was almost similar to the concept design 2 but it still has its own differences. The framing idea came from the option 3 where it has a door at the front side of the frame which is used for maintenance purpose. This frame was attached with option 3 hoppers where it located on the right side of this frame. The coconut fiber slide from hopper into the blade. The blade was chosen from the option 3. It has a circular blade design and look like a drum. The blade was connected by using the option 3 power transmission, which is a coupling. In this design, motor with the option 2 was used and put on a left side of frame with horizontal position. The screener for this design was used the option 1 where it located under the frame. The option 1 was chosen as a handle pattern in this design. Finally, to move the machine, the caster with option 3 was selected in this design. It can be locked and has free direction movement.

3.7 Concept Scoring and Screening

3.7.1 Concept Screening

Table 3.3: Concept screening

Selection criteria	**Concept**			
	1 (reference)	**2**	**3**	**4**
Safety	0	0	+	+
Easy maintenance	0	+	0	-
Easy use	0	0	0	0
Affordable	0	+	0	-
Portable	0	+	-	+
Exterior appearance	0	+	0	+
Low production time	0	0	+	-
Sum +'s	0	4	2	3
Sum 0's	7	2	4	1
Sum –'s	0	0	1	3
Net score	0	4	1	0
Rank	3	1	2	3
Continue?	Revise	Yes	Yes	Revise

3.7.2 Concept Scoring

Selection criteria	Weight	Concept 1 (Reference) Rating	Concept 1 (Reference) Weight	Concept 2 Rating	Concept 2 Weight	Concept 3 Rating	Concept 3 Weight	Concept 4 Rating	Concept 4 Weight
Safety	20 %	3	0.60	3	0.60	4	0.80	3	0.60
Easy maintenance	10 %	3	0.30	4	0.40	3	0.30	2	0.20
Easy use	10 %	3	0.30	3	0.30	3	0.30	3	0.30
Affordable	15 %	3	0.45	4	0.60	3	0.45	2	0.30
Portable	20 %	3	0.60	5	1.00	4	0.80	5	1.00
Exterior appearance	5 %	4	0.20	5	0.25	4	0.20	5	0.25
Low production time	20 %	4	0.80	4	0.80	3	0.60	2	0.40
Total score		3.25		3.95		3.45		3.05	
Rank		3		1		2		4	
Continue?		No		Develop		No		No	

Table 3.4: Concept Scoring

3.8 Final Design Selection

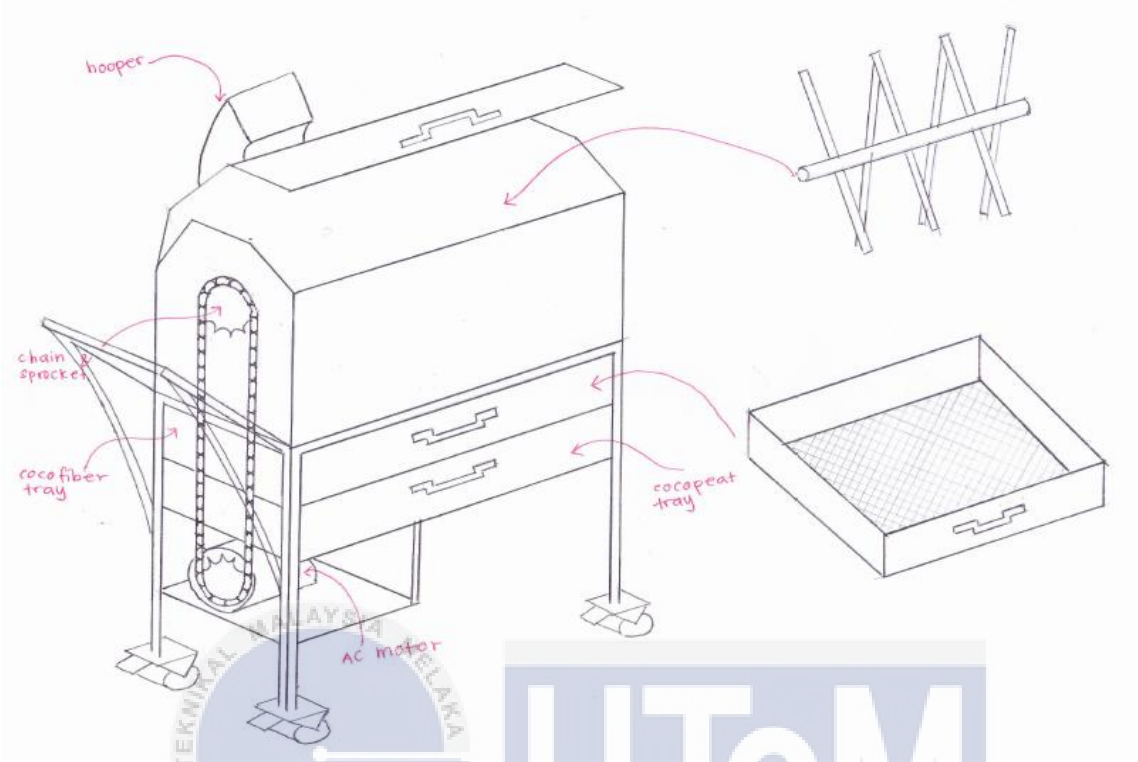


Figure 3.16: Final design selection

In the final design selection, there are four concept design that was considered and concept design 2 was selected as the best concept design. This selection based on concept scoring and concept screening method. In the concept screening and concept scoring, there are few criteria were focused which is safety, easy maintenance, easy use, affordable, portable, exterior appearance and lower production time. In the concept screening, concept design 2 get the highest net score among other three concept design which is 4. While in the concept scoring, it gets first rank with highest score 3.95. This concept design will be designed using CAD software to get an actual design detail.

3.9 Material Selection & Cost Analysis

Table 3.5 : Material selection and cost analysis

No.	Part Name	Quantity	Price per quantity (RM)	Price (RM)
1	1/2" x 6m black 'A' pipe	1	20.00	20.00
2	4.5mm x 3" x 6m M.S flat	1	53.40	53.40
3	1.2mm x 4' x 8' C.R sheet	1	95.00	95.00
4	Ethos 3" x 25 L/D brake rub wheel 'ukai'	2	16.00	32.00
5	CN 5' door pull 'TBS/CL/KNH/JH'	2	0.75	1.50
6	85mm heavy plated hasps & staples	1	1.70	1.70
7	Honda G200 engine – service carburator and change 1 pc plug	1	35.00	35.00
8	1/8" x 1 1/4" x 6m M.S angle	3	28.00	84.00
9	UCP204-29mm china bearing	2	12.00	24.00
10	CN 5mm 6 x 12 x 150m gal steel wire rope	1	1.60	1.60
11	5/16" x 1 – 1/2" x 50kg hex bolt nut	1	4.86	4.86
12	AIM 601 16" drawer slide ngee	2	4.25	8.50
13	Ethos 3" x 25 L/D rigid rub wheel 'ukai'	2	7.08	14.16
14	5/16" x 1" x 50kg hex bolt nut	1	6.38	6.38
15	Carborundum disc 105*1.5*163	5	2.10	10.50
16	HT hex bolts DIN 933 M5 x 16	8	0.20	1.60
17	Flat washer (z/p) M5	8	0.05	0.40
18	HT hex bolt DIN 933 M10 x 50	4	0.50	2.00
19	HT hex nut DIN 934 (B/O) M10	4	0.20	0.80
20	Red Carborundum discs 100*6*16	2	2.10	4.20

21	Paint brush 3 in 1 300 pcs	1	2.10	2.10
22	Rivet 4 x 10 50 in 1 192/24	1	2.10	2.10
23	Carborundum disc 105*1.5*163	1	2.10	2.10
24	Red Carborundum discs 100*6*16	1	2.10	2.10
25	SC 1.5-5	4	0.30	1.20
26	Clamp corner 75mm/3in1	1	18.77	18.77
27	Wire mesh	2	4.00	8.00
28	Bolt & nut – 100g	3	1.50	4.50
29	A1 x 4” V pulley	1	19.00	19.00
30	A58 belt	1	8.00	8.00
31	A1 x 3” pulley	1	18.00	18.00
32	HT hex bolts DIN 933 M4 x 20	100	0.13	13.00
33	HT hex nut DIN 934 (B/O) M4	100	0.03	3.00
34	J hook	1	0.50	0.50
35	S/S hinges 2’	1	2.74	2.74
36	PVC fan bush	1	2.90	2.90
37	Screw	1	0.50	0.50
38	Honda G200 engine	1	427.80	427.80
			TOTAL	934.31

3.10 Testing Analysis

Before making testing analysis, the design of the machine will be created in CAD software which is CATIA. The actual part of the machine is designed in a 3D before it fabricates. After a complete design using CAD software, the design will be tested using CAD software to measure its strength, bending and others. The result gets from the testing will be compared with theoretical calculation to make sure the result is not too different. Any bad result from the testing will be improved and modify at the machine.

3.11 Fabrication Method

i. Measuring Process

Before the fabrication start, the first process has measured process. Select material is measured according to drawing dimension. Every single material is measured correctly to ensure its accuracy.

ii. Cutting Process

After complete measuring process, it continues with cutting process. Cutting process was a very important process because most of material need to cut. Most of the cutting process used a hand grinder to cut all the material. It cut according to the mark during measuring process.

iii. Welding Process

Next was welding process. Most of the welding used to weld an angle bar and become a frame. The welding used in this fabrication process is MIG welding because it more suitable for welding thin material. To make a handle and base for caster, welding also was used.

iv. Drilling Process

Drilling process only was used for drilling screw and rivet hole. Although less drilling process occurred, but it still an important process. Commonly handle drill is used because it portable and easy to operate.

v. Bending Process

Another process is bending process. This process only used to bend a mild steel sheet to become a frame. The mild steel sheet is put at bending machine and it bend based on dimension in a drawing.

vi. Grinding Process

The grinding process occurs during removing the rough welding surface. The purpose is to make sure the surface is clean and smooth. To make a cutter blade also need grinding process. It to ensure the cutter blade is sharp enough to crush the coconut fiber. Duration of coconut fiber crushing process depends on the sharpness of cutter blade.

vii. Assembling Process

The second last process in the fabrication is assembling process. In this process, all the parts or material will be assembling according to a drawing. Some other part needs to screw using bolt and nut. All the bolt and nut are tight, firmly to avoid it from loose during machine is running. Some other part needs to river such as body for a frame and hopper.

viii. Finishing Process

The last process is finishing process. In this process, the rough surface and unwanted material are removed. The machine is painting to avoid it from corrosion, increase the machine appearance and also a market value.

3.12 Prototype Testing

After the complete fabrication process, the machine is tested by using 10 kg of coconut fiber. The coconut fiber is put into a hopper pieces by pieces. Duration of crushing and screening coconut fiber with 10 kg will be taken. Any problem or failure during testing of the machine will be repaired and improve.

3.13 Summary

The summary of the chapter 3 is about the flow or step from the beginning of generating an idea in fabricating the machine until the machine will be tested. Before generating an idea, identify the customer need or requirement first by making the survey. From the survey feedback or response, implement it into QFD. Next is concept generation where it stresses more in morphological chart and concept design. Concept design is a combination of an idea of morphological chart. Concept screening and scoring were applied to choose the best final design selection. After that, it continues with material selection and cost analysis. In this part it told more about the material will be use and budget estimation during fabricating the machine. In this chapter also told about the task for the next semester in chapter 4 which is testing analysis, fabrication method and prototype testing but not in details.

CHAPTER 4

DESIGN AND FABRICATION PROCESS

In this chapter, it explains more about how the process of machine fabricates from beginning until the machine is complete.

4.1 DESIGN STAGE

In the design stage, it discusses clearly about the design of the machine by using CAD software, which is CATIA V5R21. Every single part of the machine was designed using a software and assemble it to a product before proceeding to the fabrication process. If any error occurs during the design process, it was fixed immediately to avoid other possible problems which may happen.

4.1.1 Lower Frame

The lower frame is one of the main parts of the machine where it becomes a base and support for the machine. The lower frame was designed by using an angle bar with a size of 30mm x 30mm x 3mm. For the lower frame design, the dimension was setup with 500mm x 400mm x 500mm. At the lower frame, there are 8 slot were designed at a frame to put a drawer under it which is coco peat drawer and coco fiber drawer. There are a few holes with the size of 8mm was designed at the top and left side of the lower frame. The purpose of the holes are to join the other part with lower frame by inserting bolt and nut.

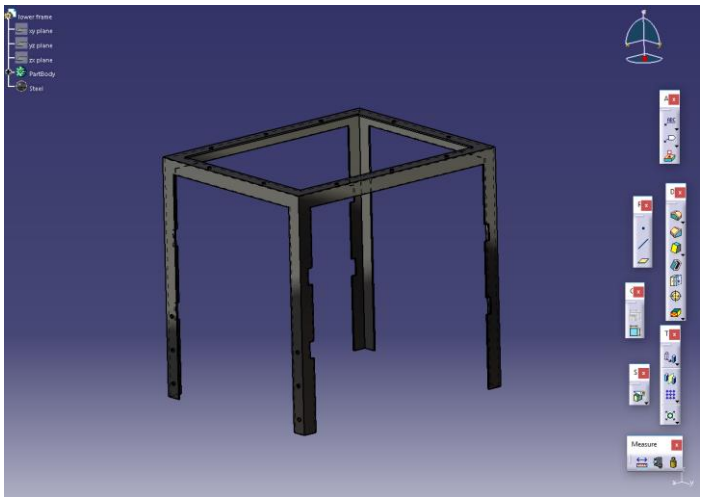


Figure 4.1: Lower frame

4.1.2 Upper Frame

Upper frame was designed to be put on the lower frame and join it by using bolt and nut. Same as lower frame, upper frame also used an angle bar with a size of 30mm x 30mm x 3mm. It is much easier to use a same size of the material. The dimension of the upper frame is 500mm x 400mm x 473.2mm. Inside the upper frame, there are many parts were put inside it which is blades, shaft, bearing, bearing frame and some the other part. Therefore, the upper frame plays a big role in crushing the coconut fiber. If the frame is not strong enough or the design is not suitable, it will cause some problem to the machine during the crushing process.

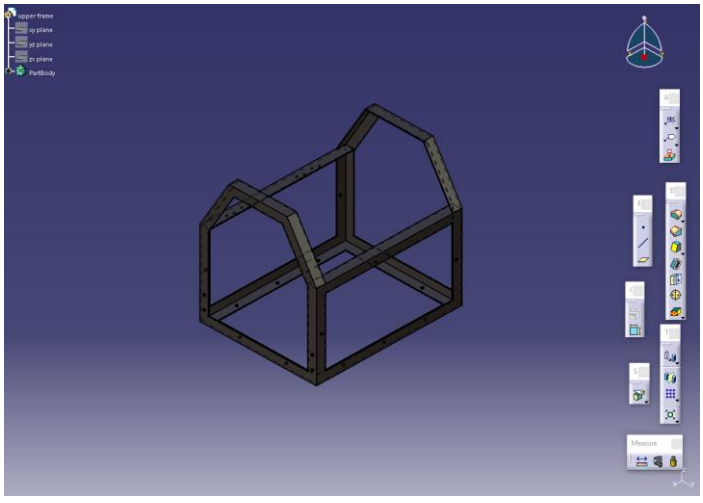


Figure 4.2: Upper frame

4.1.3 Motor Frame

The purpose of designing the motor frame is as a support for the petrol engine. This motor frame used angle bar with a size of 30mm x 30mm x 3mm. The idea of motor frame design came from a triangle shape and it was attached with lower frame using bolts and nut. Side of the motor frame used the concept of a triangle and it bottom was connected with 2 slotted angle bar. The size of the motor frame is 400mm x 300mm x 200mm. The purpose of angle bar with slot is to adjust the tension of v-belt by sliding the petrol engine to the left or right.

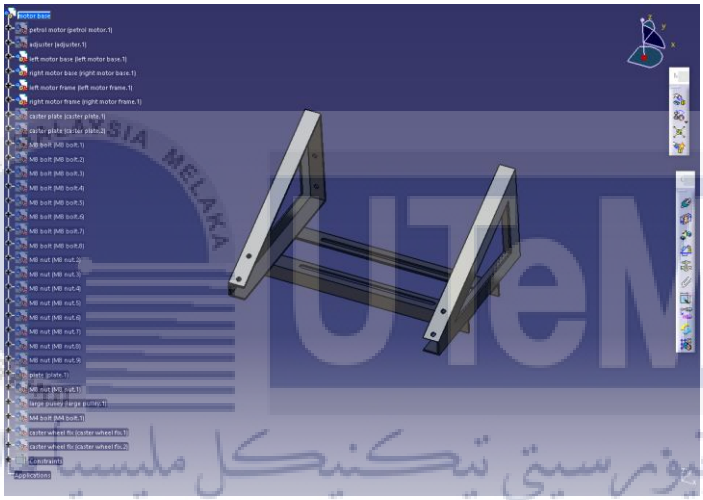


Figure 4.3: Motor frame

4.1.4 Bearing Frame

In the upper frame, a frame that holding a bearing called as bearing frame. The angle bar with 30mm x 30mm x 3mm was selected as the structure for this bearing frame. The dimension of bearing frame is 394mm. At the top bearing frame, it has a hole to join the pillow block bearing by using bolt and nut. This bearing frame was design at right side and left side of the upper frame.

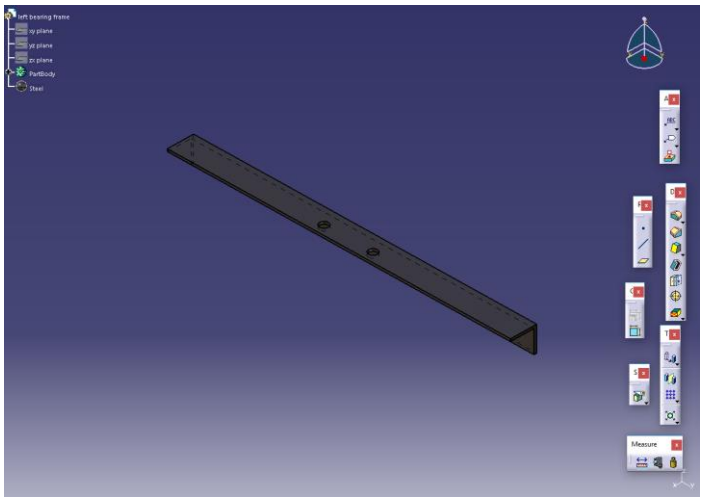


Figure 4.4: Bearing frame

4.1.5 Push Handle

Push handle was designed at the left of the machine. The purpose of this design acted as a pushing mechanism to move the machine from one place to another place. This push handle was designed to use a hollow pipe with outer diameter of 21.4mm and 18.3mm inner diameter. The height of this push handle is 700mm where it ergonomic and suitable height for user push the handle. At the middle of the push handle, it has a spot where the support was attached at the lower frame while the base for push handle attached at motor frame. The purpose of the support design is to avoid the push handle from bend during it is push.

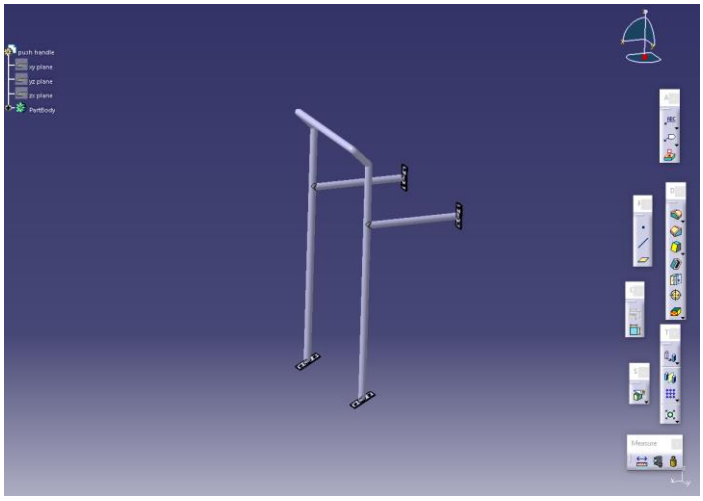


Figure 4.5: Push handle

4.1.6 Adjuster

To adjust the tension of v-belt, an adjuster was designed to put under the petrol engine and screwed it using bolt and nut. This adjuster consist of two parts, which are plated and threaded rod. The purpose of the plate is to hold the petrol engine while threaded rod acts as a tension mechanism. When the nut was rotating clockwise, the adjuster will move forward and make the v-belt tension increase. If the nut rotates anti-clockwise, the adjuster will move backward and the tension of v-belt decrease. The dimension of the plate is 100mm x 25mm x 3mm and at the end of the plate has a hole with 8mm diameter. For the threaded rod, it was designed to use diameter of 7.8mm with 360mm length.

Figure 4.6: Adjuster

4.1.7 Caster Plate

To attach lower frame with caster, a caster plate was designed. In this design, the caster plate used the material of flat bar with a dimension is 74mm x 105mm x 4mm. There are four numbers of caster plate were used in this project. Two casters at right side of the lower frame and another two at the motor frame. At every caster plate edge, it has a hole with 8mm diameter with the purpose of inserting the bolt and nut.

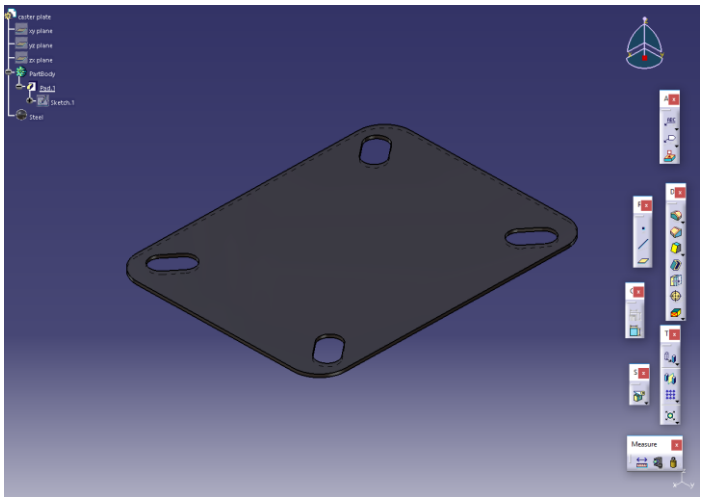


Figure 4.7: Caster plate

4.1.8 Blade Holder

Blade holder is a part where it holds a blade during the crushing process. For the blade holder design, the shape looks like a hexagon shape. The dimension for blade holder design is 74mm x 74mm x 4mm. In the middle of this blade holder, there is a hole with a diameter of 20mm. The purpose of a hole in the middle is to insert a solid shaft. To connect this blade holder and blade, there are a lot of holes with 4mm diameter was designed at this blade holder with the purpose to insert a bolt and nut.

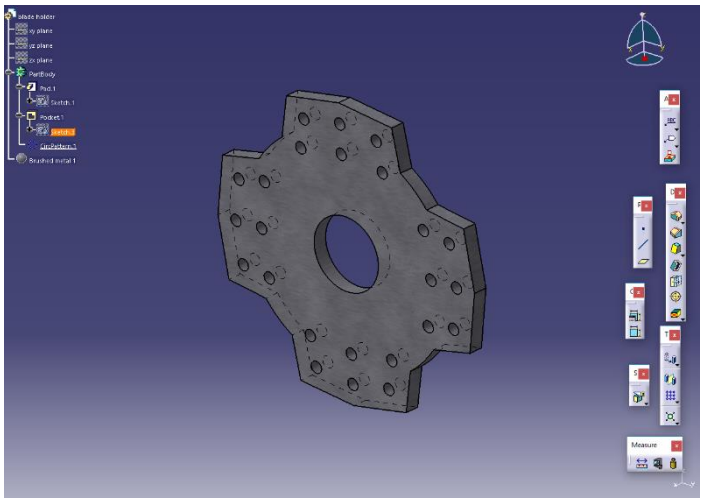


Figure 4.8: Blade holder

4.1.9 Blade

Designing a blade is a very important because the shape of blade affect the crushing process and the product. If the design of the blade is not suitable, the blade cannot crush the coconut fiber perfectly and may cause the blade to break. This blade design has a similar design with a fan blade where the area at the tip is smaller than the base of the blade. This blade was designed with 165mm long, 50mm width and thickness of 4mm. At the base of the blade area, there are a lot of holes for inserting bolt and nut. Side of the blade was designed to become 45^{o} so that make this blade sharp and reduce crushing time.

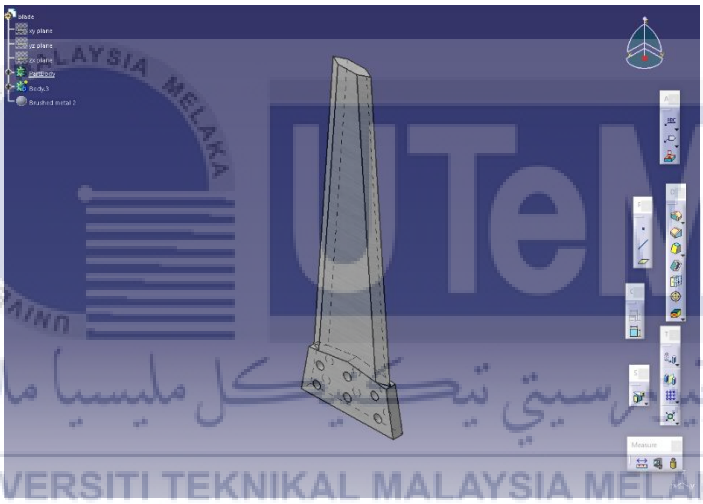


Figure 4.9: Blade

4.1.10 Shaft

To connect the blade holder with the pulley, shaft is needed. In designing a shaft, the correct size of the shaft is very important because it will affect the performance of the machine. If the shaft diameter is small, it causes the shaft bending during crushing process and if use a large diameter of the shaft will cause the crushing mechanism to become heavier. For this design, a solid shaft is selected because to ensure the firm shaft and strong enough during acting with a load. The shaft was designed with a 25mm outer diameter and 550mm long.

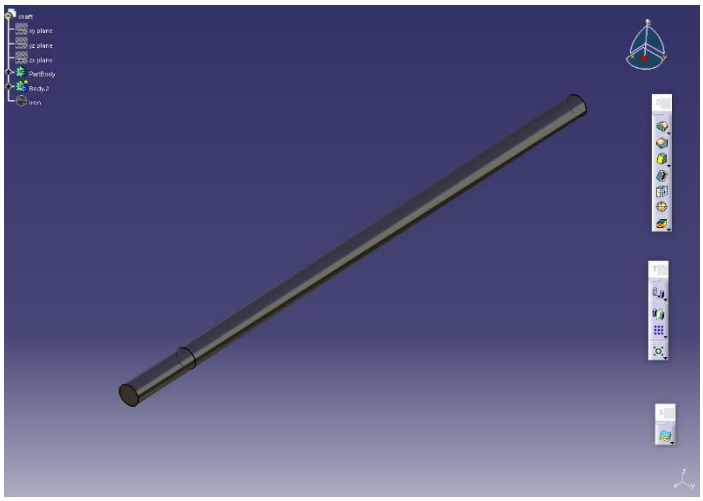


Figure 4.10: Shaft

4.1.11 Bearing

For this project, the pillow block bearing was selected according to the application of the mechanism. This bearing was designed to attach together with bearing frame by using bolt and nut. For the design of pillow block bearing, the outer diameter of the bearing must same with the diameter of the shaft which is 20mm. The design of the bearing is followed by market design. The size of the bearing is 84mm x 38mm x 72mm.

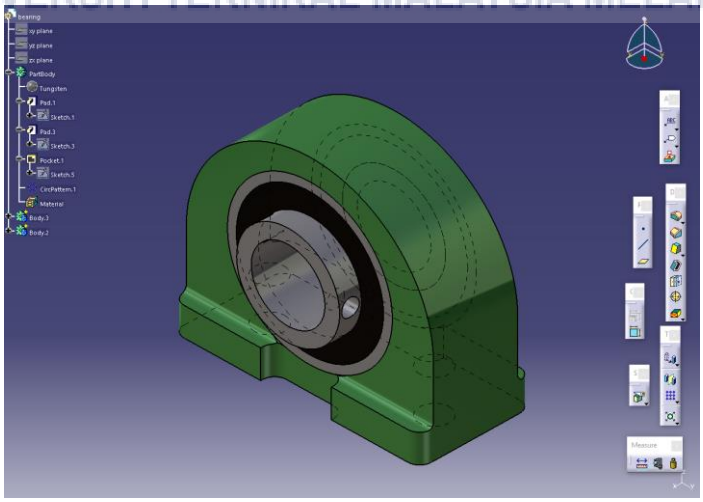


Figure 4.11: Bearing

4.1.12 Large pulley

In this project, the power was transmitted using a belt and pulley. For transmitting a power from the petrol engine, large pulley is needed to transmit power to another pulley. In designing the large pulley, a single v-belt was chosen suitable with the work run by the machine. This large pulley diameter is 100mm and thickness of 40mm. This pulley dimension follows the size in the market. At the center of the pulley, holes with 19mm was designed to insert petrol engine shaft.

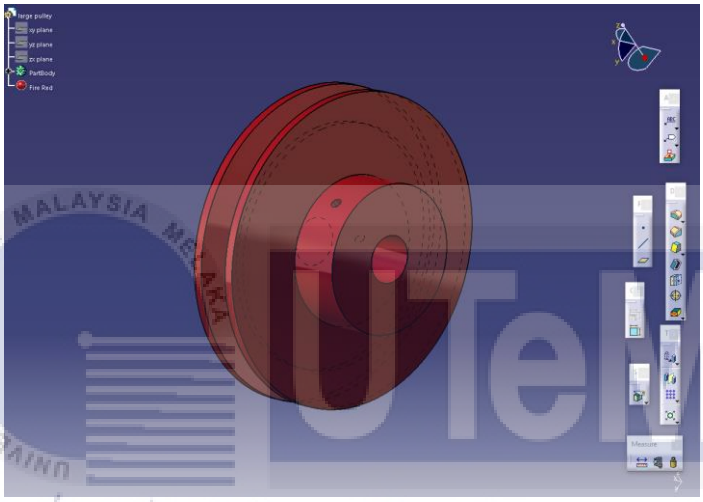


Figure 4.12: Large shaft

4.1.13 Small Pulley

The small pulley was designed to transmit a power from the large pulley to the shaft. This small pulley was designed to use the diameter of 80mm and 40mm thickness. The hole at the center of the pulley is 20mm, where it fit with the shaft diameter. Same with large pulley, the size of the small pulley follows the size of the market. This pulley was locked on the shaft by using M5 bolt.

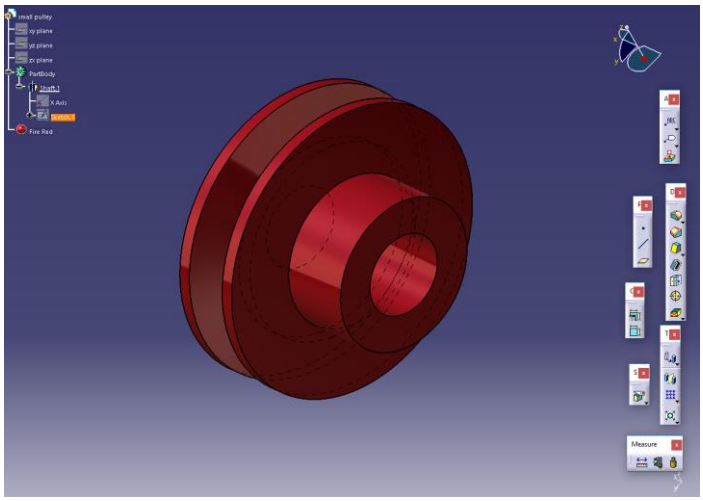


Figure 4.13: Small pulley

4.1.14 V-belt

V-belt was chosen in this design project because it more suitable for the operation of the machine where it needs more speed or rotation compare with torque. The SPA v-belt was used because the torque that required to rotate the pulley is low. In this pulley design, it used v-belt with a length of 1477mm and the design has followed the standard size of the v-belt on the market.

Figure 4.14: V-belt

4.1.15 Fix Caster

To make this project machine become mobile, there are four casters were using which is two numbers of fix caster and two numbers rotatable with lock. For the fix caster, it designs to use at motor frame where it fixes together with caster plate using bolt and nut. In this project, the caster was designed to use 3 inch caster where it more suitable with the size and load of the machine. This caster can support a maximum load of 122kg. The rubber wheel was used at this caster to give a grip to the machine during moving. The dimension of this caster is according to the standard size on the market.

Figure 4.15: Fix caster

4.1.16 Rotatable Caster with lock

The rotatable caster with lock is placed at the right side of lower frame where it easy for used to push the machine to any direction. The purpose of the lock is designed at the caster is to avoid the machine from moving during the machine is running and vibrate. Same as fix caster, this rotatable caster was designed to use 3 inches wheel size and also a rubber wheel. This caster can support a maximum load of 122kg. The dimension of this rotatable caster follows the standard size from the manufacturer.

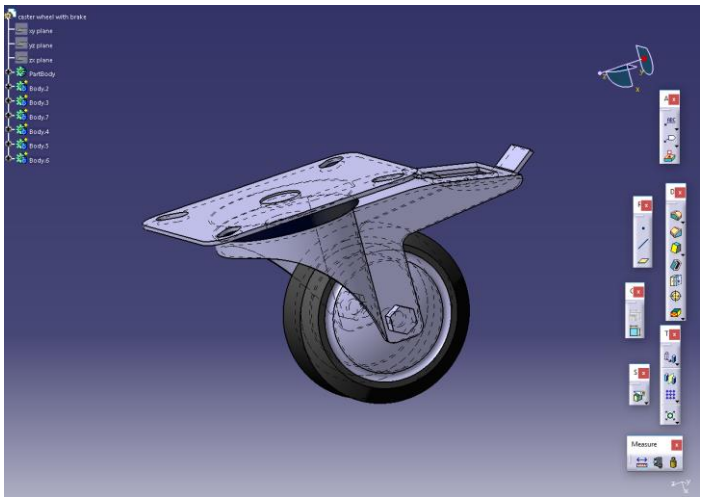


Figure 4.16: Rotatable caster with lock

4.1.17 V-belt cover

Cover is a very important for safety purpose, especially regarding on rotating mechanism. In this project, rotating mechanism that needs to cover is v-belt and pulley area. This because v-belt and pulley are rotated at high speed of rotation that may cause a hazard or an accident toward the user. The v-belt cover is designed to overcome the possible accident. This v-belt cover was designed to cover all parts of the v-belt and pulley. Height of the v-belt cover is 700mm.

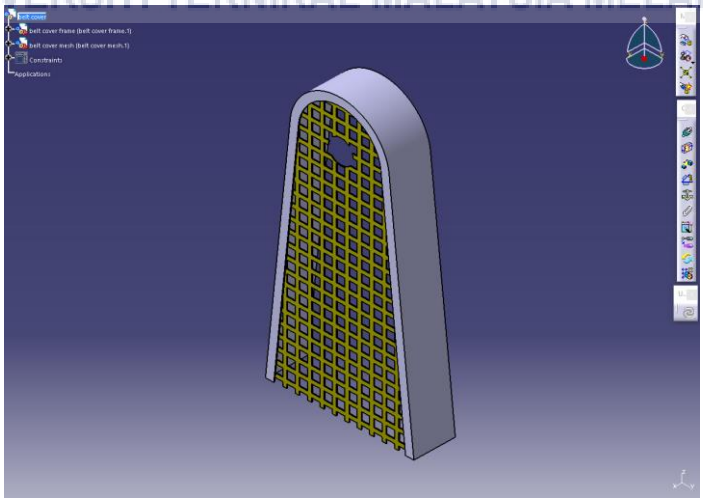


Figure 4.17: V-belt cover

4.1.18 Drawer metal sheet

The purpose of designing the drawer metal sheet is to collects the product of coconut fiber, which is coco peat and coco fiber. There are two drawers were used in this project, which is coco peat drawer and coco fiber drawer. These two drawers are assembled at lower frame with the coco peat drawer was put under coco fiber drawer. The dimension of the drawer metal sheet is 436mm x 400mm x 150mm. It uses a metal sheet with the thickness of 1.2mm

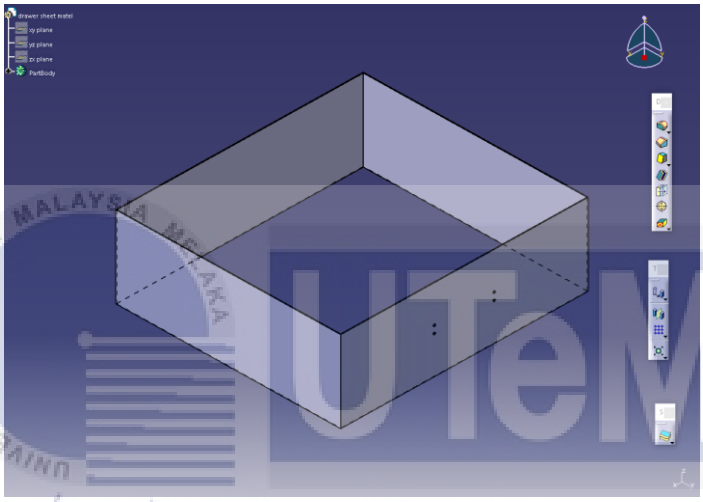


Figure: Drawer metal sheet

4.1.19 Semi-Drum

During the crushing process, some coconut fiber is not fully crushing into coco peat and coco fiber. Some are still in the form of coconut fiber. To avoid the non-fully crushed coconut fiber from going down to coco fiber drawer, semi-drum was designed to overcome the problem. The function of semi-drum is to ensure only a fully crusher of coconut fiber is allowed to pass through it. The non-fully coconut fiber will continue crush until can pass the semi-drum. The semi-drum was designed to put between blade and coco fiber drawer. The size of the semi-drum is 207mm radius and 490mm length. At a middle of the semi-drum, there is a hole with size of

50mm x 390mm which only allow a fully crushed coconut fiber pass through it. The thickness of this semi-drum is 1.2mm.

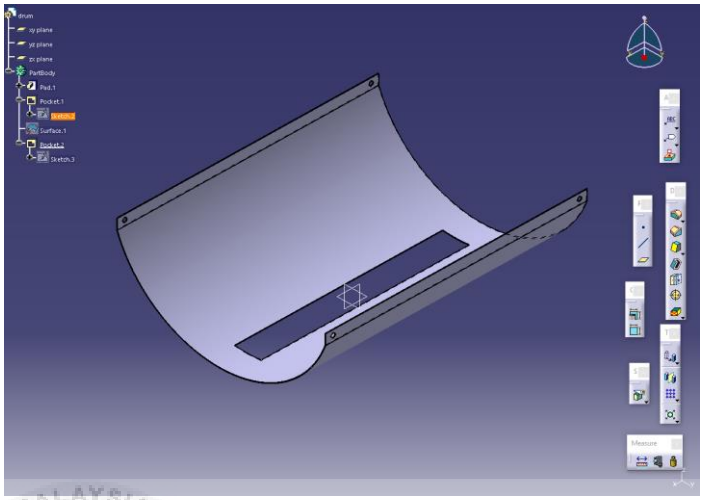


Figure 4.19: Semi-drum

4.1.20 Hopper

Hopper is an entrance part to insert the coconut fiber into a machine for crushing process. This hopper was designed to fit one coconut fiber per time. The size the entrance at hopper is 197.6mm x 140mm. The total size of the hopper was design is 210mm x 250mm. This hopper used a material of steel plate with the thickness of 1.2mm.

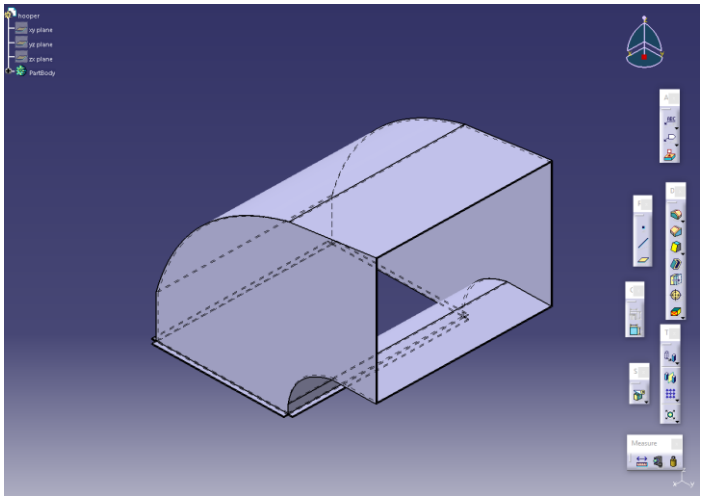


Figure 4.20: Hopper

4.1.21 Lid

The lid is a top part of the machine, which is on the upper frame. In the lid, there are few parts was attached together such lid cover, hopper, hopper door, bumper clip, pull handle and hinge. This lid was designed to attach hopper on the top of the lid cover using welding. At a front part of the lid, there is a set of bumper clip and pull handle was designed here. The purpose of placing a pull handle to make the user easily open the lid. For the safety of this machine, bumper clips were put to ensure during crushing process, the lid cover is not open. At a back side of the lid, there are two hinges were used connecting the lid with upper frame. Inside the hopper, a hopper door was placed to ensure during crushing process, a coconut fiber not flying out through the hopper and at a same time, give an extra safety to a user.

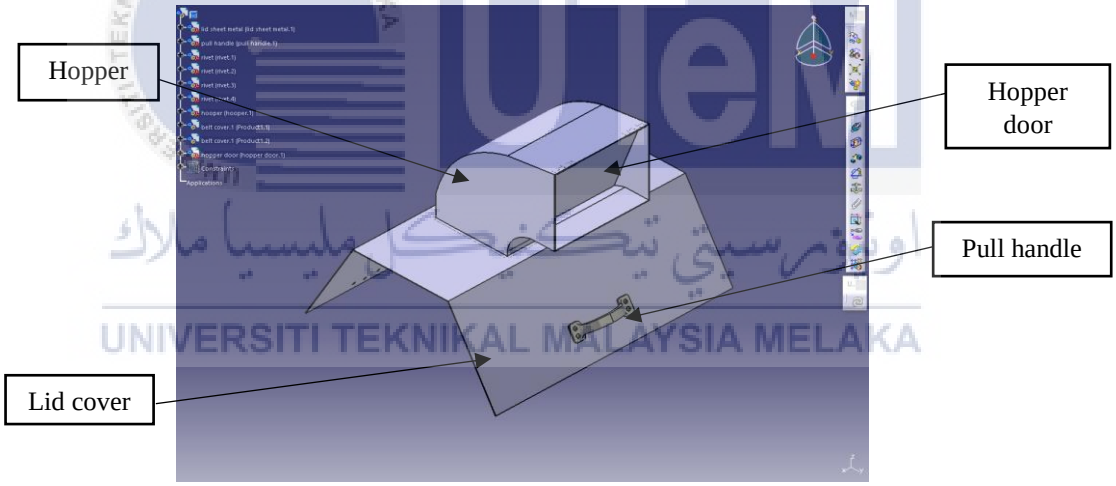


Figure 4.21: Lid front side

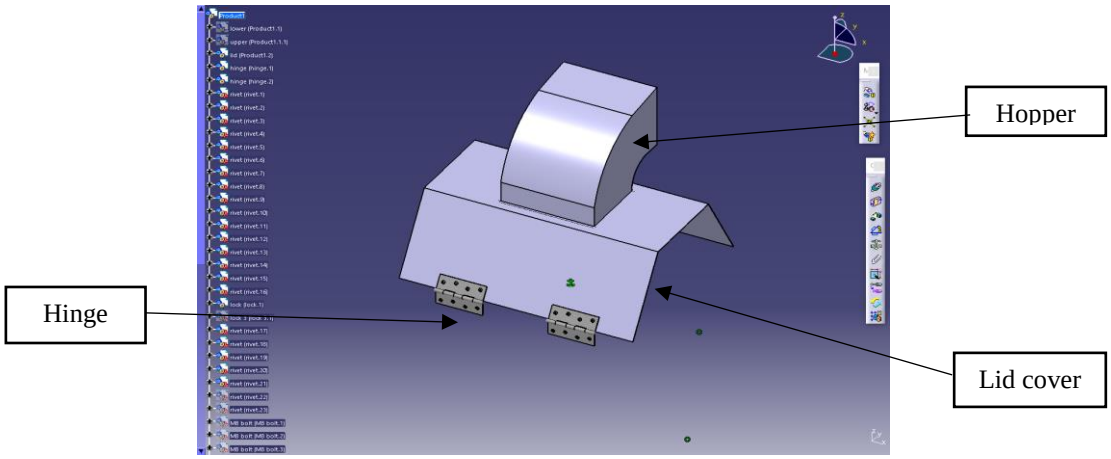


Figure 4.22: Lid back side

4.1.22 Joint Blade

Joint blade is the combination of the four numbers of blades with two numbers of the blade holder. In this design, four blades are in the between of two blade holder where it was a joint using bolt and nut. Six numbers of bolts and nut were needed at each side of the blade. The purpose of design used a lot number of bolt and nut is to ensure the blade holder has strong enough to hold the blade during the crushing process. At the same, the number load or force required the blade holder to use a lot of bolt and nut. This design also makes the user easily open the blade for grinding the blade to maintain the sharpness of the blade.

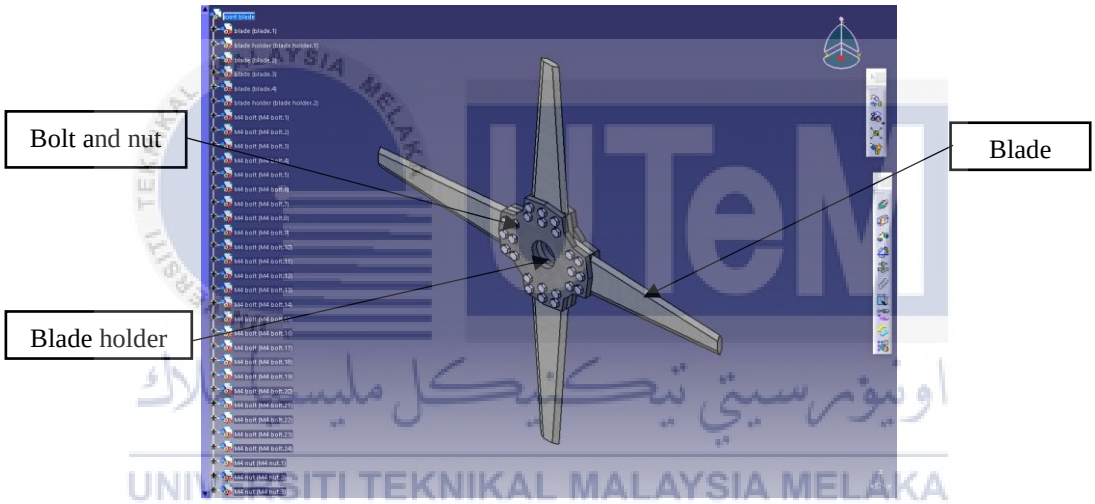


Figure 4.23: Joint blade

4.1.23 Upper Body

The crushing process occurred in the upper body where it consists of four pairs of the blade, shaft, a pair of bearing, upper frame, semi-drum and metal sheet. The shaft was connected with a blade by welding and it hold by a pair of bearing. All the parts inside the upper body is covered by sheet metal for the purpose of safety. All the coconut fiber crushed by the blade until it fully crushed while the non-fully will continue crush until it can pass through the hole at semi-drum.

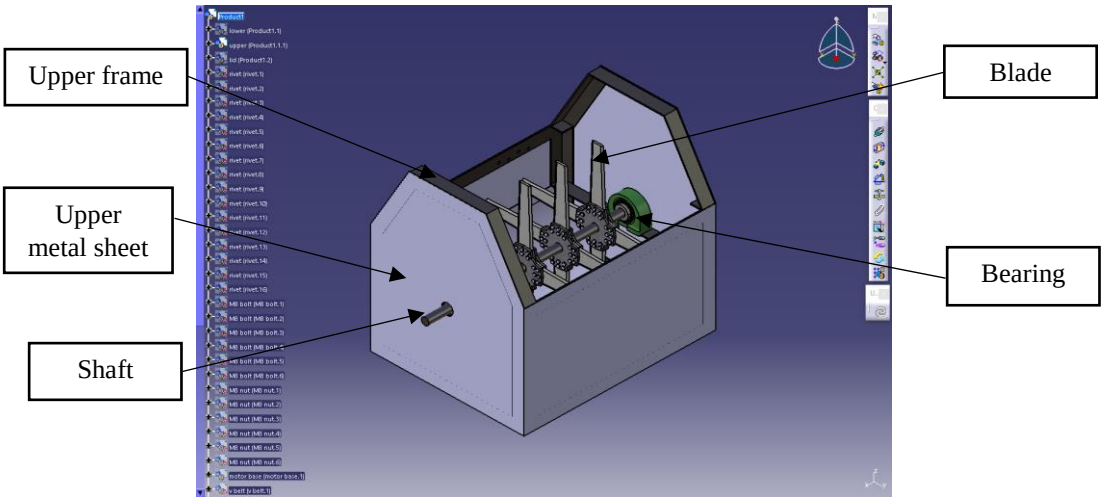


Figure 4.24: Upper body

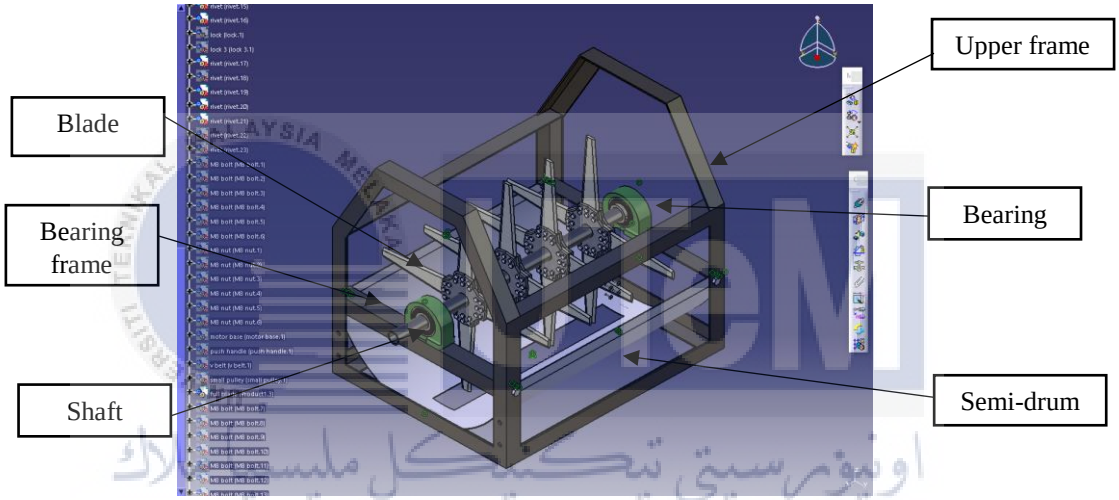


Figure 4.25: Upper body

4.1.24 Coco Fiber Drawer

To segregate between coco fiber and coco peat, one mechanism is needed to gain the coco peat by using wire mesh. The wire mesh was filter the coco fiber while the coco peat can pass through it. This wire mesh was put inside the coco fiber drawer. This drawer also has a railing at outer side of the drawer which is the user can easily pull and slide the drawer to collect the coco fiber. The coco fiber was put on top of coco peat drawer at the lower frame.

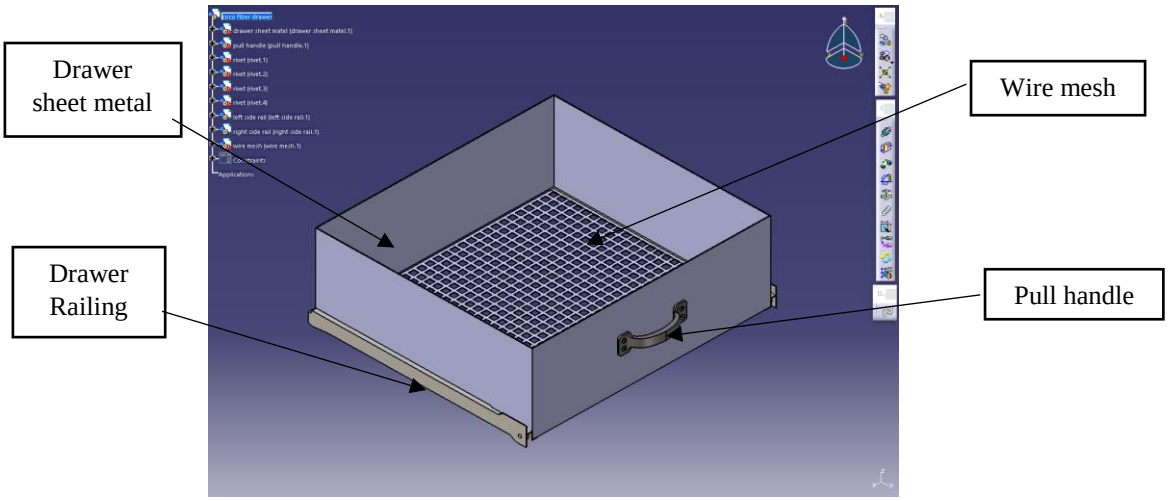


Figure 4.26: Coco fiber drawer

4.1.25 Coco Peat Drawer

In this project, coco peat drawer was used to collect the coco peat after the coconut fiber was crushed. The coco peat that passes through the coco fiber drawer fall into the coco peat drawer. This coco peat drawer consists of drawer metal sheet, railing and pull handle. This coco peat drawer was placed under the coco fiber drawer. With a pair of drawer railing, the user can pull and slide the drawer to collect the coco peat.

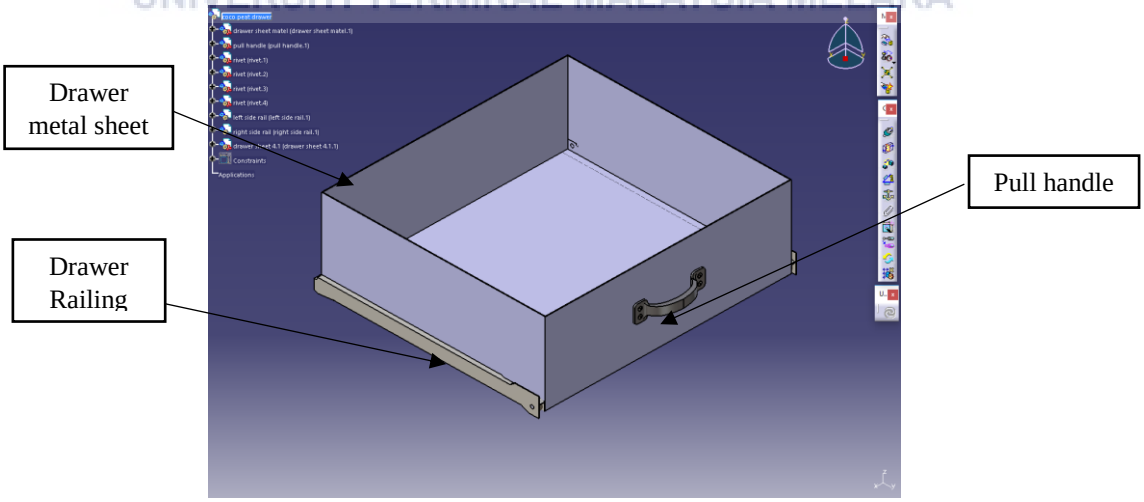


Figure 4.27: Coco peat drawer

4.1.26 Lower Body

Lower body is the part where all the product is collected such as coco peat and coco fiber. In the lower body, it consists of a few components which are lower frame, coco peat drawer, coco fiber drawer, rotatable caster and caster plat. The lower body was joint with upper body and the motor frame by using bolt and nut. The user can easily collect the coco peat and coco fiber by pulling the drawer outside.

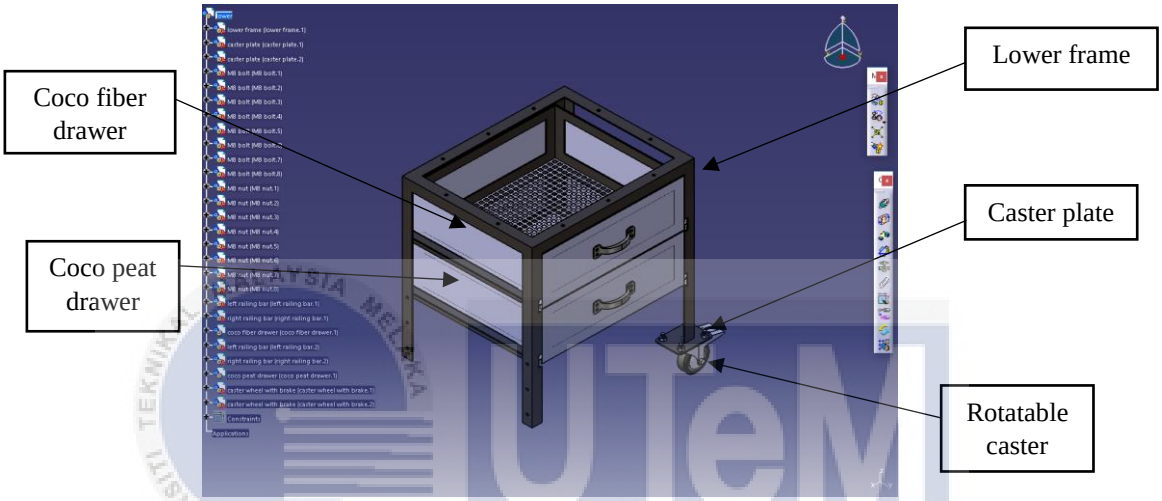


Figure 4.28: Lower body

4.1.27 Motor base

There are few components that assemble at motor base which is motor frame, petrol engine, adjuster, fix caster and caster plate. At the motor base, it used two fix caster and two caster plate where it attached together by using bolt and nut. The adjuster was put between the motor frame and petrol engine. When the nut at the adjuster is rotated clockwise or anticlockwise, the adjuster was moving left and right where it causes the tension of v-belt change. This motor base assembled together with lower body using bolt and nut.

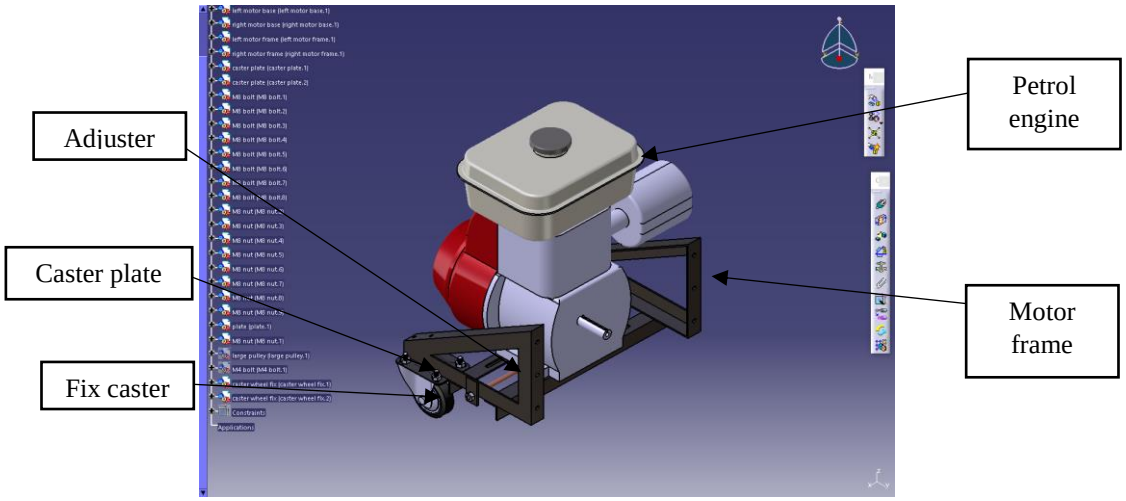


Figure 4.29: Motor base

4.1.28 Transmit Mechanism

In the transmit mechanism, it consists of large pulley, small pulley, v-belt and v-belt cover. The small pulley put at the blade shaft while the large pulley placed at the shaft of a petrol engine. This two pulley connected via v-belt. To ensure no possible accident occurs during the belt and pulley running, v-belt cover put at a front side. The v-belt cover attached at the upper body by using bolt and nut.

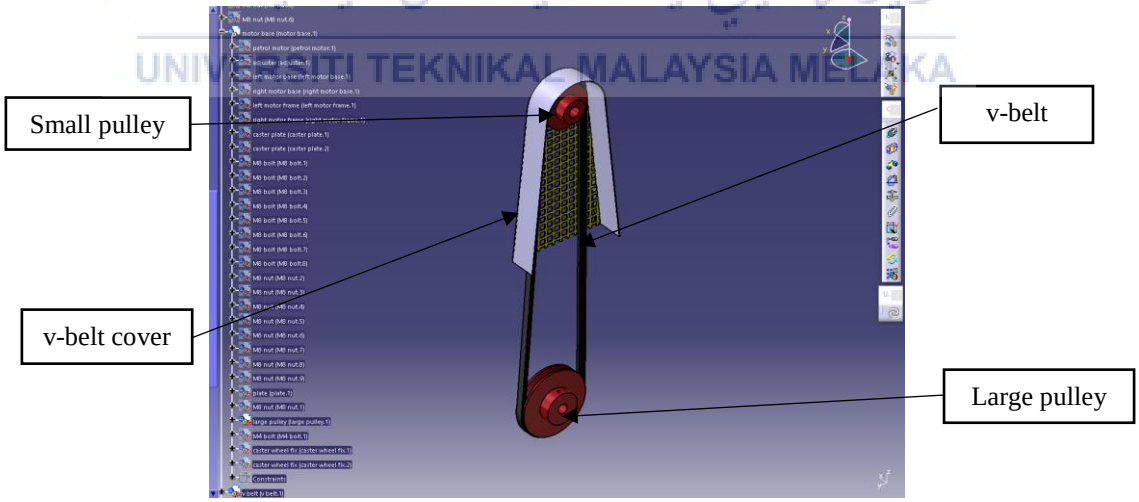


Figure 4.30: Transmit mechanism

4.1.29 Mini Coconut Fiber Crusher and Screening Machine

Mini coconut fiber crusher and screening machine is a complete machine design where all parts and component assembled together to form one functional machine. There are a lot of part and component were involved during assembled the machine design which is lower body, upper body, lid, motor base, transmit mechanism and handle. Most of the part and component were assembled using bolts and nut where the user can easily assemble and disassemble the machine in a future. This machine design also provided with push handle where the user can move the machine by push it anywhere easily.

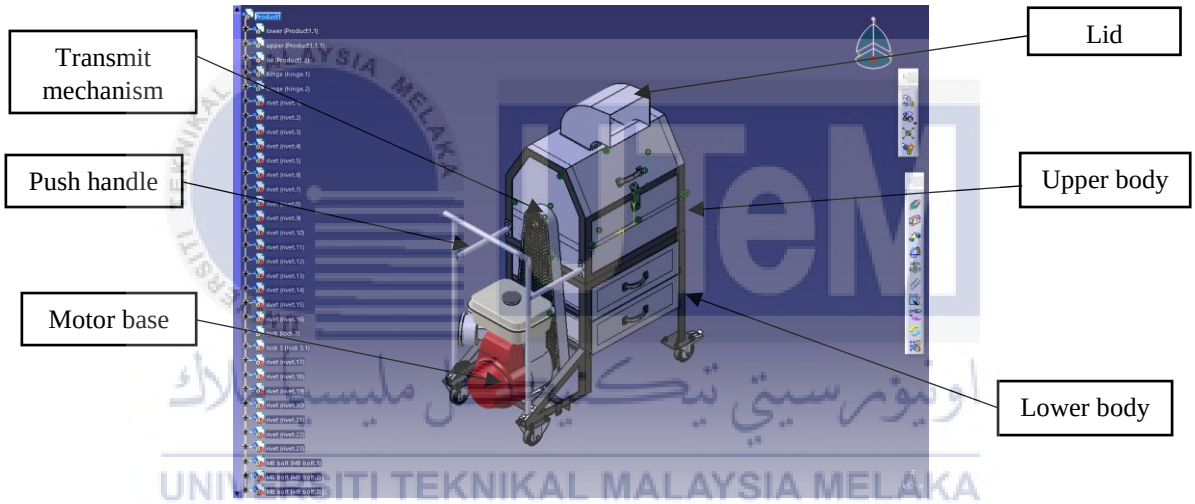


Figure 4.31: Mini Coconut Fiber Crusher and Screening Machine front view

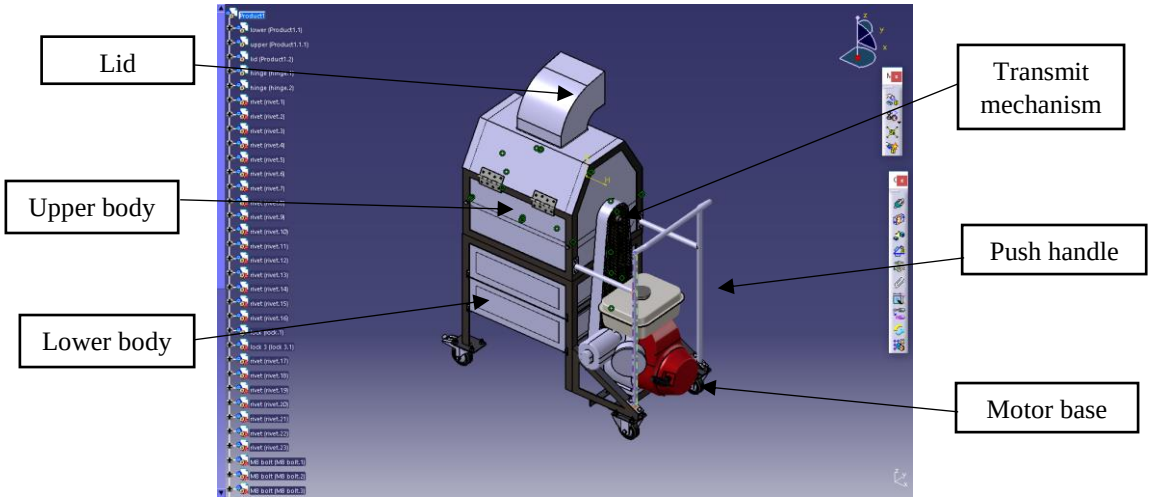


Figure 4.32: Mini Coconut Fiber Crusher and Screening Machine back view

4.2 MEASURING PROCESS

The first step before started the fabrication process is measuring process. The complete 3D machine design from the CAD software is converting into a 2D drawing on a paper including with all dimensions. From the 2D drawing, the machine part identified and the dimension of that part was getting. Then, by using a measuring tape and L shape, the angle bar measured according to a specific dimension and labelled. The measurement must be accurate, based on the dimension on the drawing. After making a marking, measure again using measuring tape to ensure the marking is correct. If the marking is incorrect, it may cause material was cut at the wrong place and it has the possibility of the cut material shorter than actual dimension. It causes cut material cannot be used and has to repeat a measuring process again.

Figure 4.33: Measuring process using measuring tape

Figure 4.34: Measuring tool

4.3 CUTTING PROCESS

After complete measuring process, it continued with the cutting process. The most material that needs to cut is angled bar and sheet metal where it cuts by using an angle grinder. Before starting the cutting process, cutting disc inserted at the angle grinder and the nut was tight using angle grinder wrench to avoid it from loose during cutting. For the safety, the angle grinder safety guard must always facing a user to avoid spark or split cutter disc hit the user. For the additional safety, wear the safety boot and goggle during handling angle grinder. The material cuts according to the marked places where it was marked during measuring process.

Figure 4.35: Cutting an angle bar using an angle grinder

Figure 4.36: Cutting tool

4.4 Welding Process

To join metal with metal, arc welding was used where it created enough heat to melt metal and it binds when melted metal cool. In this project, welding process is a major process for fabricating the machine. The angle bar was attached and welded together to become a frame such as upper frame, lower frame and motor base. The welding joint must be strong enough to avoid the material from loose when load is applied. In welding, the setting of current is very important because it affected the result of welding. If the current too high, it will cause material melt faster and produced hole. For the safety, used face shield and hand glove when welding the material where the welded metal is very hot. Welding spark is very dangerous because it may harm the eyes if exposed it without using face shield.

Figure 4.37: Welding process

Figure 4.38: Welding tools

4.5 Drilling Process

Drilling is one of the cutting method where a drill bit used to cut a hole of circular cross section. The common drill machine is electric hand drill and table drill. In this project, both hand drill and table used to drill a hole. The common drill bit size was used during drilling process are M8 and M4. M8 drill bit used to drill holes at the frame of the machine where a M8 bolt inserted into that hole. To join blades and blade holder, this two part drilled by using the M4 drill bit to produce a hole and it was joint by using M4 bolt and nut. Hand drill is easier to use compared with table drill where table drill is limited due to height and drilling space.

Figure 4.39: Drilling process using hand drill

Figure 4.40: Drilling process using table drill

4.6 Bending Process

Bending process is a process where the metal sheet was bended according to the design. There are two methods used to bend the sheet metal which is by using a folding machine and another method is forging where the sheet metal was hammered to make a shape. A folding machine is more suitable for bending a sheet metal where the bending need an angle. In this project, folding machine used to bend sheet metal for drawer and upper sheet metal part at 90^{o}. This machine makes the fabrication process faster and easier compare bend it manually with hammering the sheet metal. The limitation of the facilities at the workshop or laboratory at the faculty caused the forging method was chosen to make a shape of semi cylinder. The sheet metal hammered manually on the roller until the shape is form.

Figure 4.41: Folding machine

Figure 4.42: Forging process

4.7 Grinding Process

Commonly after a cutting process, there is a sharp edge was formed at the edge of cutting work piece and it is dangerous to a user. So, to remove the sharp edge, this part was grinded using a hand grinder until it came smooth. Grinding process usually used to remove unwanted material to make the work piece surface smooth and clean. Normally, the part needs attention to grind is welded part. Where the solidified weld metal formed rough and non-smooth surface. The grinding process started with using a grinding disc at a hand grinder where it used to remove thick rough surface. After finish remove the thick rough surface, it followed by using a flap disc to make the surface clean and smooth.

Figure 4.43: Grinding process using grind disc

4.8 Assembling Process

After complete all the fabrication process, it continued with an assembling process where all parts were joint and link together. In this project, most of the part was joint using bolt and nut where the machine easy to assemble and disassemble. The major parts such as upper frame, lower frame and motor base were joint using bolt and nut. M8 bolt and nut use to join it together and the joint must tight and firm. If a bolt is untighten, it will cause the nut loose during the machine running. Some of the permanent parts riveted using rivet and make it fixed. The example of riveting is an upper sheet metal was riveted to the upper frame. By using a rivet, it makes the assemble parts look neat and good-looking compare with screw or weld.

Figure 4.44: Riveting tool

Figure 4.45: Assembling caster wheel with machine using bolt and nut

4.9 Finishing Process

The last process for the fabrication is finishing where a few steps are needed before making it complete. Commonly after the assembling process, recheck the dimension of the machine to ensure it's accuracy and follow the dimension in a drawing by using measuring tape or Vernier calliper depend on the part that want to measure. If the dimension is misalign or not accurate, rework that part until achieving the required dimension. Once the dimension is good, the surface finish is checked to ensure the surface is smooth and clean. The smooth surface is important because it shows a good impression and make it more attractive. The rough and unclean surface commonly occurred after welding or drilling process where the surface needs to remove by grinding. Lastly, paint the machine to make it more attractive and good looking. With paint the machine, it acted as a protective layer where the paint avoided a rusting or corrosion from occurred. Before applying paint at the machine, the surface of the machine cleaned using a chemical called thinner where it acted as rust remover and cleaned the painting surface. Then proceed with painting process and keep it dry at clean environment. Avoid paint at a dirty environment where it affected the painting quality.

Figure 4.46: Painting process of the machine

CHAPTER 5

RESULT AND DISCUSSION

In this chapter, it discusses more about the calculation regarding to the project. The theoretical calculation and simulation calculation also be compared and the result will be discussed in this chapter. Calculation in this chapter was divided into major part which are structure of the machine and product gained from the machine. For the structure if the machine, the ANSYS software was used to represent the simulation calculation where the CAD file was analysed to gain the result and the simulation result was compared with theoretical calculation. While, calculation for product gained from the machine are focus more on the driven pulley calculation, speed calculation, weight and the quality of the product which is coco peat and coco fiber affected by the changes of the speed.

5.1 Calculation of machine structure

5.1.1 Blade shaft

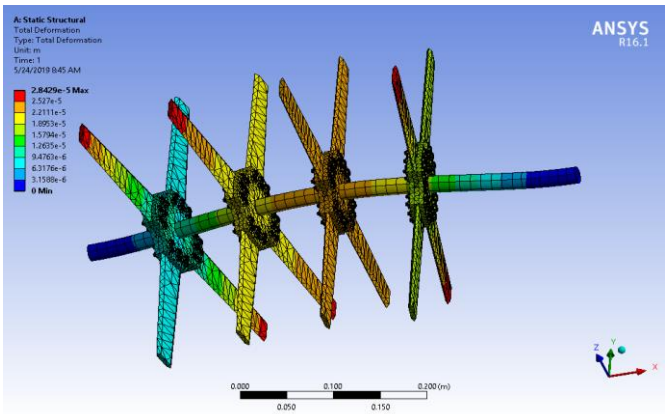


Figure 5.1: FEA bending total deformation analysis for the blade shaft part

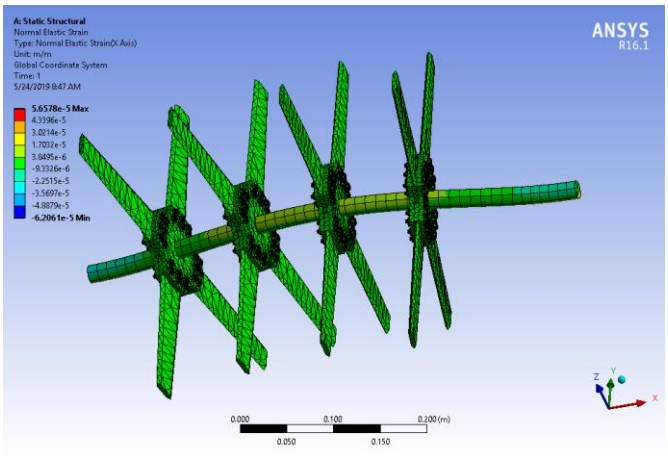


Figure 5.2: FEA normal elastic strain for the blade shaft part

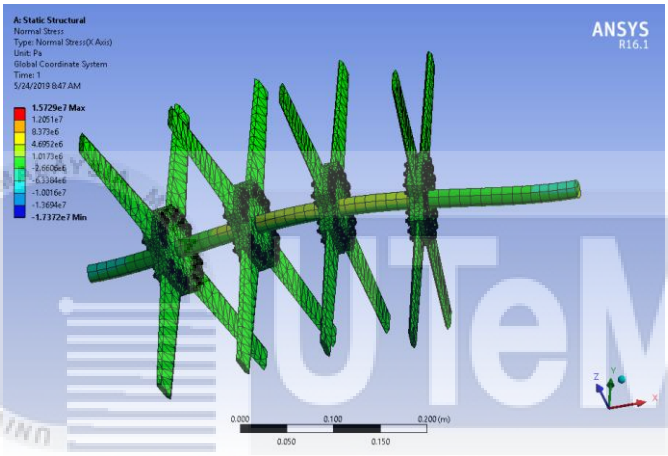


Figure 5.3: FEA normal stress for the blade shaft part

Table 5.1: Results of FEA Bending Analysis for the blade shaft part.

Object Name	*Total Deformation*	*Normal Elastic Strain*	*Normal Stress*
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Layer		Entire Section	
Definition			
Type	Total Deformation	Normal Elastic Strain	Normal Stress
By	Time		
Display Time	Last		
Calculate Time History	Yes		
Identifier			
Suppressed	No		
Orientation		X Axis	
Coordinate System		Global Coordinate System	
Results			
Minimum	0. m	-6.2061e-005 m/m	-1.7372e+007 Pa
Maximum	2.8429e-005 m	5.6578e-005 m/m	1.5729e+007 Pa
Minimum Occurs On	shaft	M4 bolt	
Maximum Occurs On	blade	M4 bolt	
Information			
Time	1. s		
Load Step	1		
Substep	1		
Iteration Number	1		
Integration Point Results			
Display Option		Averaged	
Average Across Bodies		No	

From the table 5.1, the analysis showed the total deformation at blade shaft part occurred when the force of 80 N acting on the shaft of the blade. From the analysis, the maximum total deformation is only 2.8429×10^{-5} m, where the deformation is very small. The ultimate stress for mild steel is 250 MPa.

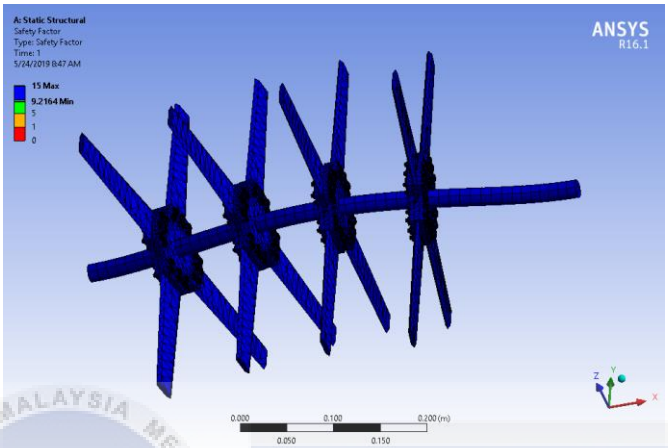


Figure 5.4: FEA safety factor for the blade shaft part

Table 5.2: Results of FEA safety factor for the blade shaft part.

Object Name	*Safety Factor*
State	Solved
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Definition	
Type	Safety Factor
By	Time
Display Time	Last
Calculate Time History	Yes
Identifier	
Suppressed	No
Integration Point Results	
Display Option	Averaged
Average Across Bodies	No
Results	
Minimum	9.2164
Minimum Occurs On	M4 bolt
Information	
Time	1. s
Load Step	1
Substep	1
Iteration Number	1

The table 5.2 showed the result of safety factor for the blade shaft by using ANSYS. From the analysis, the minimum safety factor obtained is 9.2164.

5.1.2 Adjuster

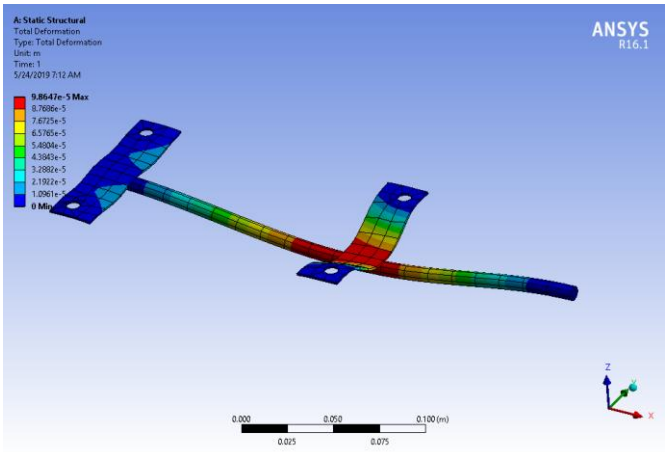


Figure 5.5: FEA bending total deformation analysis for the adjuster part

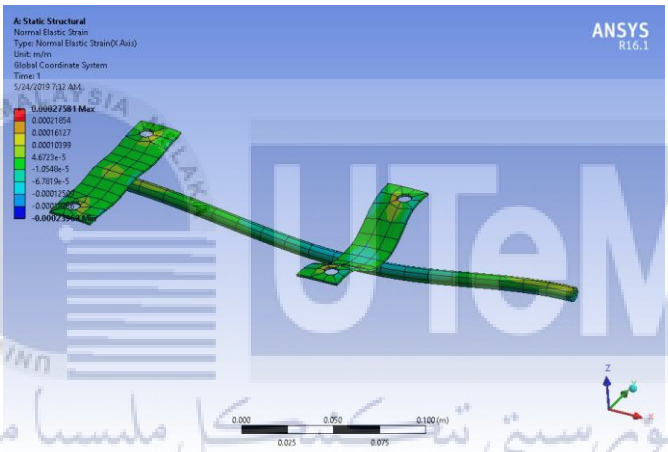


Figure 5.6: FEA normal elastic strain for the adjuster part

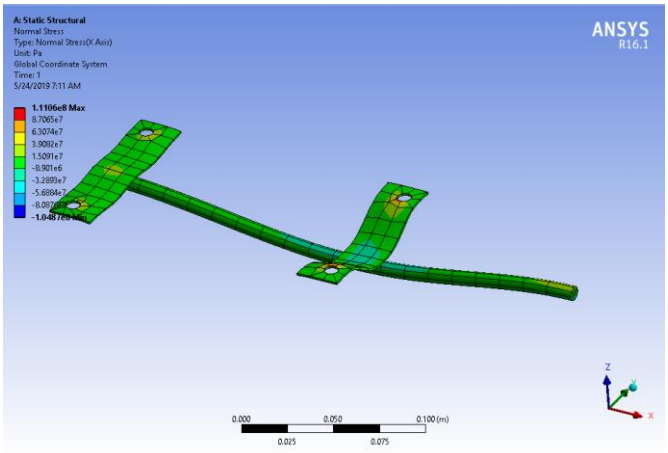


Figure 5.7: FEA normal stress for the adjuster part

Table 5.3: Results of FEA Bending Analysis for the adjuster part.

Object Name	*Total Deformation*	*Normal Elastic Strain*	*Normal Stress*
State	Solved		
Scope			
Scoping Method	Geometry Selection		
Geometry	All Bodies		
Layer		Entire Section	
Definition			
Type	Total Deformation	Normal Elastic Strain	Normal Stress
By	Time		
Display Time	Last		
Calculate Time History	Yes		
Identifier			
Suppressed	No		
Orientation		X Axis	
Coordinate System		Global Coordinate System	
Results			
Minimum	0. m	-2.3963e-004 m/m	-1.0487e+008 Pa
Maximum	9.8647e-005 m	2.7581e-004 m/m	1.1106e+008 Pa
Minimum Occurs On	adjuster		
Maximum Occurs On	adjuster		
Information			
Time	1. s		
Load Step	1		
Substep	1		
Iteration Number	1		
Integration Point Results			
Display Option		Averaged	
Average Across Bodies		No	

The table 5.3 indicated the total deformation of the adjuster where the engine was loaded on it. Then the force acting on the adjuster is 175 N, the maximum deformation is 9.8647×10^{-5} m where the deformation is small.

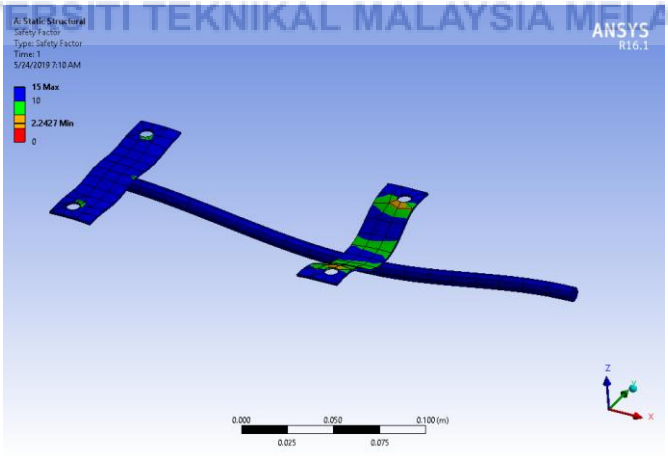


Figure 5.8: FEA safety factor for the adjuster part

Table 5.4: Results of FEA safety factor for the adjuster part.

Object Name	*Safety Factor*
State	Solved
Scope	
Scoping Method	Geometry Selection
Geometry	All Bodies
Definition	
Type	Safety Factor
By	Time
Display Time	Last
Calculate Time History	Yes
Identifier	
Suppressed	No
Integration Point Results	
Display Option	Averaged
Average Across Bodies	No
Results	
Minimum	2.2427
Minimum Occurs On	adjuster
Information	
Time	1. s
Load Step	1
Substep	1
Iteration Number	1

The table 5.4 showed the safety factor for the adjuster part where the minimum safety is 2.2427.

5.1.3 Theoretical calculation of blade shaft

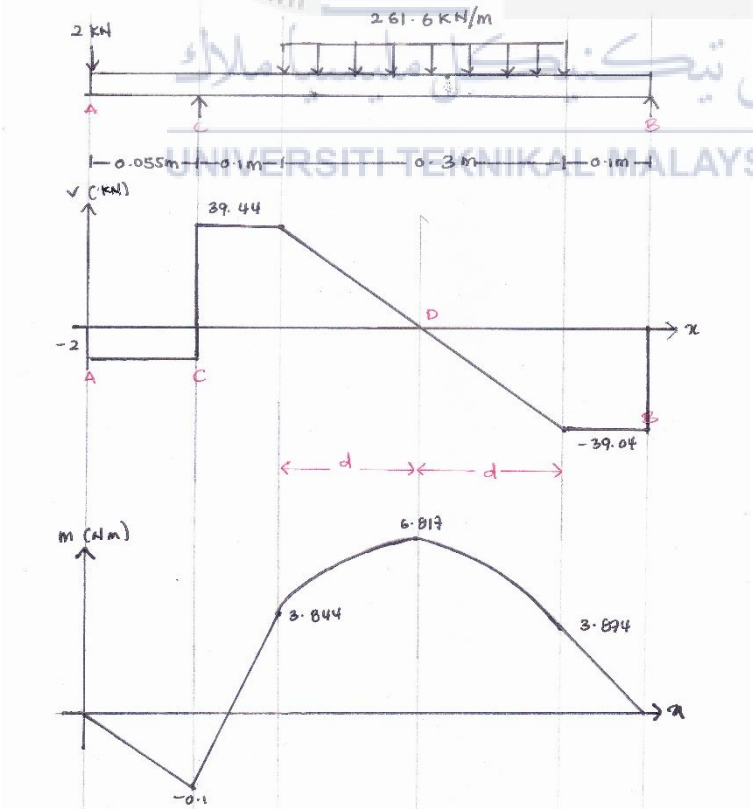


Figure 5.9: Free Body Diagram for blade shaft

$+\uparrow \sum M_c = 0 \quad : (2)(0.05) - (261.6)(0.3)(0.25) + 0.5B = 0$

B = 39.04 kN

$+\uparrow \sum M_B = 0 \quad : (261.6)(0.3)(0.25) - 0.5A + 2(0.55) = 0$

C = 41.44 kN

Shear:

A to C v = -2 kN

C v = -2 + 41.44 =39.44 kN

D v = 39.44 – 261.6(0.3) = -39.04 kN

Located point D:

$$\frac{d}{39.44} = \frac{0.3-d}{39.04}$$

39.04d = 11.832 – 39.44d

78.48d = 11.832 0.3 – d = 0.3 – 0.15076

d = 0.15076 m = 0.14924 m

Area of shear diagram:

A to C $\int v\,dx = (-2)(0.05) = 0.1$ kNm

C to E $\int v\,dx = (39.44)(0.1) = 3.944$ kNm

E to D $\int v\,dx = \frac{1}{2}(0.151)(39.44) = 2.98$ kNm

D to F $\int v\,dx = \frac{1}{2}(0.149)(-39.44) = -2.94$ kNm

F to B $\int v\,dx = (0.1)(-39.04) = 39.04$ kNm

Bending Moment:

$M_A = 0$ kNm

$M_C = 0 - 0.1 = -0.1$ kNm

$M_E = -0.1 \mp 3.944 = 3.84$ kNm

$M_D = 3.84 + 2.98 = 6.82$ kNm

$M_F = 6.82 - 2.94 = 3.9$ kNm

$M_B = 3.9 - 3.9 = 0$ kNm

Maximum $|M| = 6.82$ kNm

For shaft:

C = $\frac{1}{2}d_0 = \frac{1}{2}(20) = 10$ mm

I = $\frac{\pi}{4}(d_0{}^4) = \frac{\pi}{4}(10^4) = 7.854 \times 10^3$ mm^4

$$S = \frac{I}{C_0} = \frac{7.854 \times 10^3}{10} = 7.854 \text{ x } 10^{-4} \text{ m}^3$$

$$\sigma = \frac{M}{S} = \frac{6.82 \times 10^3}{7.854 \times 10^{-4}} = 8.683 \times 10^6 \text{ Pa}$$

$$= 8.683 \text{ MPa}$$

Figure 5.9 illustrated free body diagram for blade shaft where it have two fixed support, a single force and a uniform force. For a single force, 2 kN was acting on the blade shaft while a uniform force is 261.6 kN. From the information, the bending moment diagram was illustrated. Finally, the total stress loaded on the balde shaft is 8.683 MPa.

5.1.4 Discussion

From the calculation of the machine structure, there are two method was used to obtain the data which is by using simulation analysis (ANSYS) and theoretical calculation. In the simulation, only an adjuster and blade shaft was run the analysis where only these two parts need critical attention. While for the theoretical calculation, on blade shaft was calculated and illustrated in Free Body Diagram. From this two method, there is a different in term of final value between simulation analysis and theoretical calculation.

5.2 Product gained from machine calculation

5.2.1 Driven Pulley Calculation

In the driven pulley calculation, the objective is to calculate the suitable diameter of small pulley where it attached at petrol engine shaft. With a few

information given, the small pulley diameter can be calculate by using the Equation (1).

Where:

RPM, 1 = 3600 RPM

RPM, 2 = 4500 RPM

D1 = 100mm

$$\frac{rpm\ 1}{rpm\ 2} = \frac{D2}{D1} \tag{5.1}$$

$$\frac{3600}{4500} = \frac{D2}{100}$$

$$D2 = 80mm$$

When the RPM1 and RPM2 is 3600 RPM and 4500 RPM respectively, the diameter for large pulley is 100mm. From the calculation, it obtained the small pulley diameter is 80mm.

5.2.2 V-belt length calculation

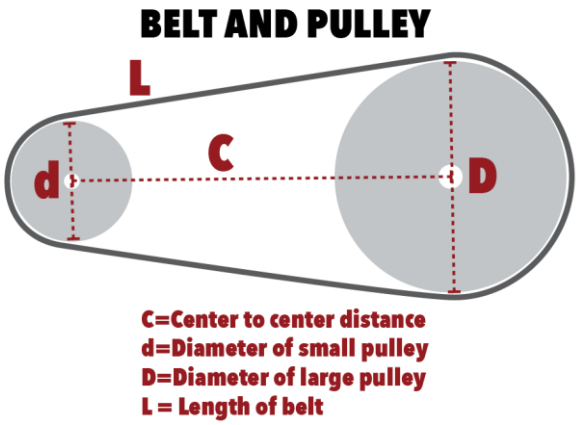


Figure 5.10: belt and pulley

The V-belt is a transmission mechanism where it transmit the power from small pulley to the large pulley via belt. To identify the suitable length for the V-belt, Equation(2) was used.

Where:

C = 593.286mm

D = 100mm

d = 80mm

$$belt\ length = \pi(D + d)(0.5) + (2C) + \left(\frac{(d - D)^2}{4C}\right) \quad (5.2)$$

$$belt\ length = \pi(100 + 80)(0.5) + (2(593.286)) + (\frac{(80 - 100)^2}{4(593.286)})$$

$$belt\ length = \pi(180)(0.5) + (1186.572) + (\frac{(-20)^2}{2373.144})$$

$$belt\ length = 1469.483892mm$$

$$\approx 57.874 \text{ inches}$$

5.2.3 Low speed blade rotation calculation

The machine was run at two condition which is high speed blade rotation and low speed blade rotation. The high speed blade rotation obtained from the machine is 4500 RPM where it ready mention at Equation (1). To calculate the low speed blade rotation, the Equation (1) is use by change the value of RPM 1 at 1400 RPM.

Where:

RPM, 1 = 1400 RPM

D1 = 100mm

D2 = 80mm

$$\frac{rpm\ 1}{rpm\ 2} = \frac{D2}{D1}$$

$$\frac{1400}{rpm\ 2} = \frac{80}{100}$$

rpm 2 = 1750 RPM

5.2.4 Coco peat

Coco peat is one the product produced by the machine where it obtained on form of powder. In this experiment, the machine was run in two condition which is high speed blade rotation and low speed blade rotation, 4500 RPM and 1750 RPM respectively. The 1kg of coconut fiber was used in this experiment to gain the data. Here, the quality of the coco peat after crushing process and weight of the coco peat can be measure when the speed of blade rotation was changed.

Figure 5.11: Coco crushed quality at 4500 RPM

Figure 5.12: Coco crushed quality at 4500 RPM

Table 5.5: Result of coco peat weight and coco peat crushed quality

Coconut fiber weight (kg)	Rotation speed of blade (RPM)	Coco peat weight (g)	Crushed quality
1	4500	185	Fine and better crushed quality. Less number of small fiber mix with coco peat
1	1750	134	Rough and good crushed quality. High number of small fiber mix with coco peat

The Table 5.5 shown the result of coco peat weight and coco peat crushed quality. From the result, 4500 RPM of blade rotation speed produced high number of coco peat weight which is 185g compare with 1750 RPM of blade rotation speed where only produced 134g of coco peat. The coco peat that crushed with blade rotation speed at 4500 RPM produced a fine and better crushed quality where the size of coco peat particle is small. At 1750 RPM blade rotation speed, it produced rough crushed quality of coco peat where coco peat particle size is larger compare with coco peat crushed at 4500 RPM. At a same time, the number of small fiber that mixed together with coco peat is higher. It because a small fiber not fully crushed during crushing process.

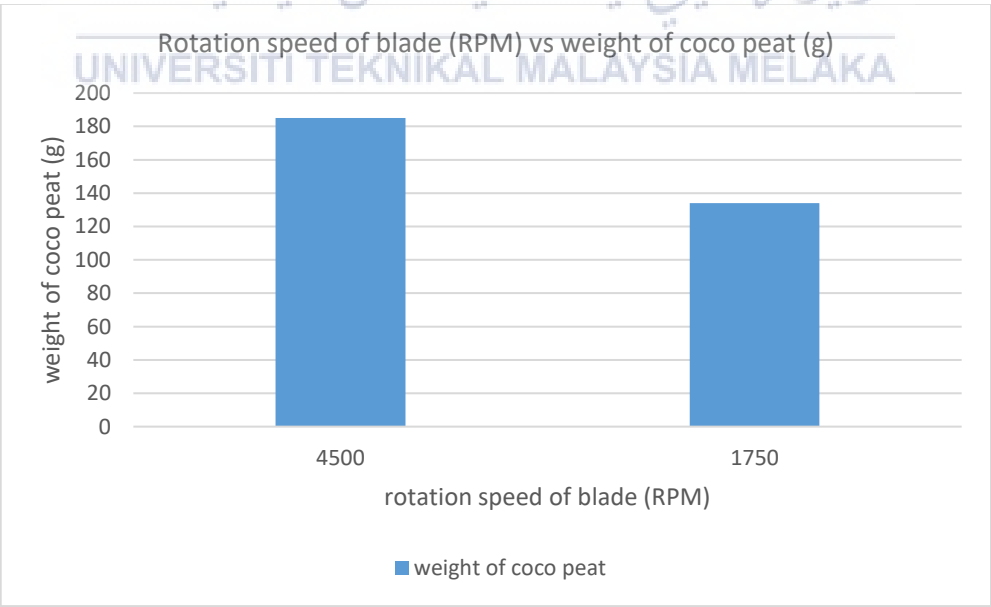


Figure 5.13: Graph of rotation speed of blade (RPM) vs weight of coco peat (g)

The Figure 5.13 above shown the graph of rotation speed of blade (RPM) against weight of coco peat (g). From the graph, 4500 RPM of blade speed rotation produced more coco peat compare with 1750 RPM where the of coco peat are 185g and 134g respectively.

5.2.5 Coco fiber

The fiber that produced after crushing process called as coco fiber. Same with coco peat process, coco fiber also run at two different speed of blade rotation which is 4500 RPM and 1750 RPM. From the 1kg of coco fiber feed into a machine, the quality of coco fiber and weight of coco fiber depend on the speed of blade rotation.

Figure 5.14: Coco fiber crushed quality at 4500 RPM

Figure 5.15: Coco fiber crushed quality at 4500 RPM

Table 5.6: Result of coco fiber weight and coco fiber crushed quality

Coconut fiber weight (kg)	Rotation speed of blade (RPM)	Coco fiber weight (g)	Crushed quality
1	4500	430	Fine and thin fiber produced. Better crushed quality where all coconut fiber fully crushed
1	1750	350	Rough and thick fiber produces. Good crushed quality but have a few coconut fiber not fully crushed

Table 5.6 shown the result of coco fiber weight and coco fiber crushed quality. The crushing process was run at two different speed which is 4500 RPM and 1750 RPM. At 4500 RPM, the coco fiber produced is 430g which is higher compared with speed at 1750 RPM where only produced 350g. The coco fiber quality crushed at 4500 RPM produced a fine and thin layer. It because all the coconut fiber was fully crushed during crushing process.

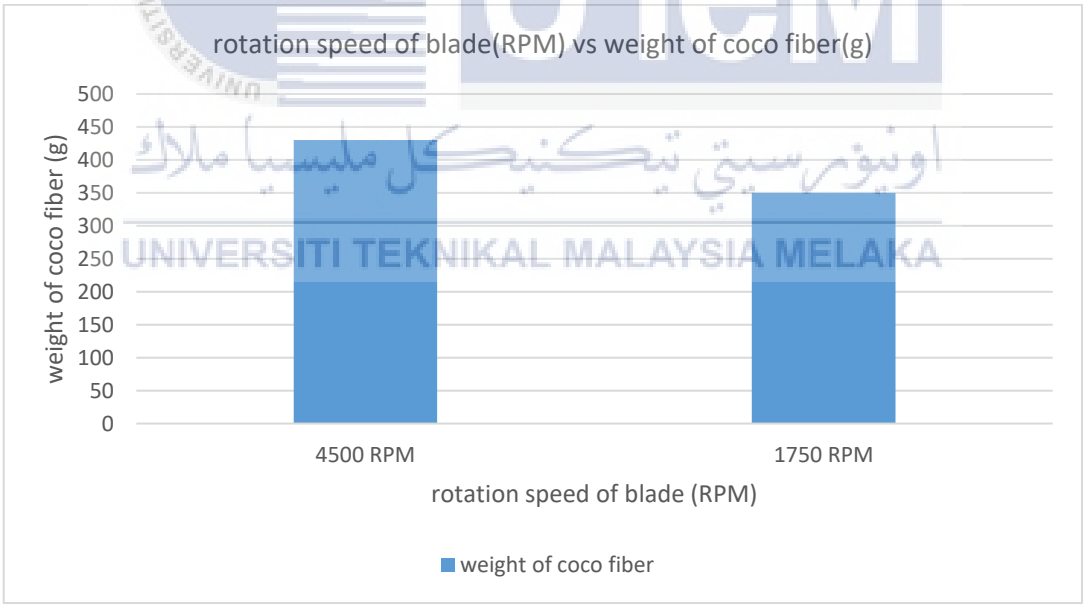


Figure 5.16: Graph of rotation speed of blade (RPM) vs weight of coco fiber (g)

The Figure 5.16 illustrate graph of rotation speed of blade (RPM) against weight of coco fiber. Coco fiber produced more when the rotation speed of blade higher which is 430g at 4500 RPM compared with 1750 RPM only produced 350g.

5.2.6 Discussion

Table 5.7: Comparison of coco peat weight and coco fiber weight with changes of blade rotation speed

Coconut fiber weight (kg)	Rotation speed of blade (RPM)	Coco peat weight (g)	Coco fiber weight (g)
1	4500	185	430
1	1750	134	350

Table 5.7 shown the comparison of coco peat weight and coco fiber weight when the rotation speed of blade. The machine was run in two variety of rotation speed which is 4500RPM for maximum speed and 1750 RPM for minimum speed. At the maximum speed, the machine crushed 185g of coco peat and 430g of coco fiber. While at 1750 RPM, the crushing process produced 134g of coco peat and 350g of coco fiber. The coco peat and coco fiber produced at 4500 RPM is more fine and thin compared with at 1750 RPM.

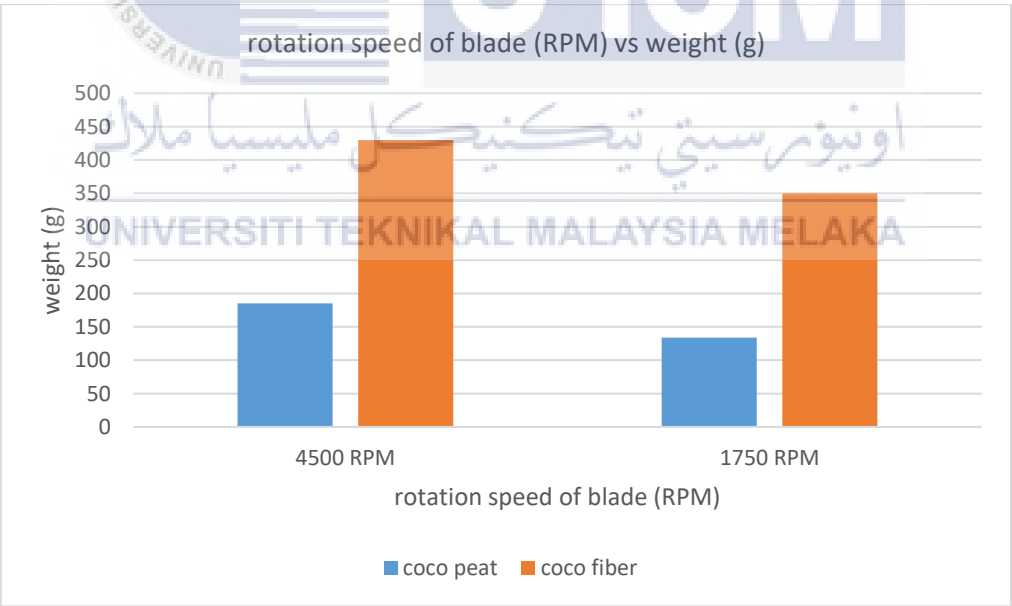


Figure 5.17: Graph of rotation speed of blade against weight

The Figure 5.17 illustrated the graph of rotation speed of blade against weight where the coco peat and coco fiber obtained higher when the rotation speed of blade is higher at 4500 RPM.

CHAPTER 6

CONCLUSION AND RECOMMENDATION

This project focused on design and fabrication of a mini coconut fiber crusher and screening machine in producing a coco fiber and coco peat from coconut fiber used as planting media. In this project the design of a mini coconut fiber crusher and screening machine started with a morphological chart where the idea of each part was illustrated on a piece of paper. From the morphological chart, the idea was combined to became a few concept generation of a mini coconut fiber crusher and screening machine. After completed concept generation stage, the design was evaluated by using a few methods to achieve a best design in designing the machine. Next, the best design was transform into a 3D drawing to virtualize the design by using CATIA.

After complete the design stage, it continued with fabrication stage where in this stage a lot of process needed in fabricate the machine. The most process used in fabricating process is welding and cutting process. An angle bar was used as a frame or structure of the machine where to reduce the machine weight at a same time remain the strength of the machine. The product that produced by the machine is a coco peat and coco fiber where it was crushed from the coconut fiber. This two main product were used in some industries especially for coco peat was used in fertigation agriculture. While the coco fiber was used in furniture industries, household and some other used.

During completing the fabrication of this machine, there is some problem was founded which is the height of the blade with hopper, dust of coco peat produced during crushing process and mixing of small coco fiber in coco peat drawer. For the future recommendation, the height of the blade with hopper must be change to ensure during inserting a coconut fiber, it not flying back through a hopper and maybe can add addition door to make the coconut fiber block if it flying back. For the problem of coco peat dust produced during crushing process, ensure there is no gap between the lid and upper body by add additional sealer or rubber to avoid the dust flying out. Lastly, to ensure the quality of coco peat, used a small wire mesh to ensure only a coco peat can pass through the gap and no small coco fiber mixed in coco peat.

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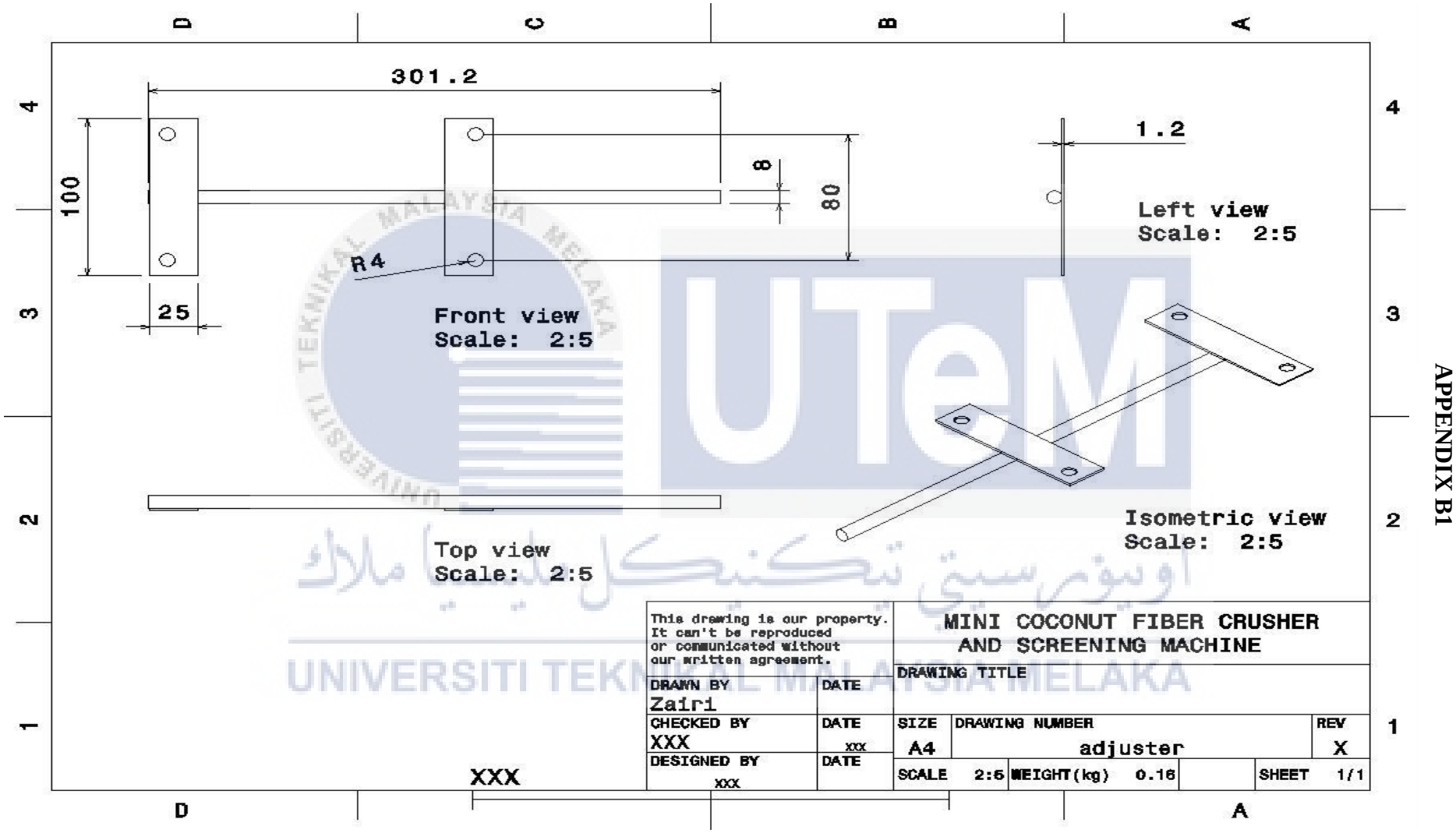
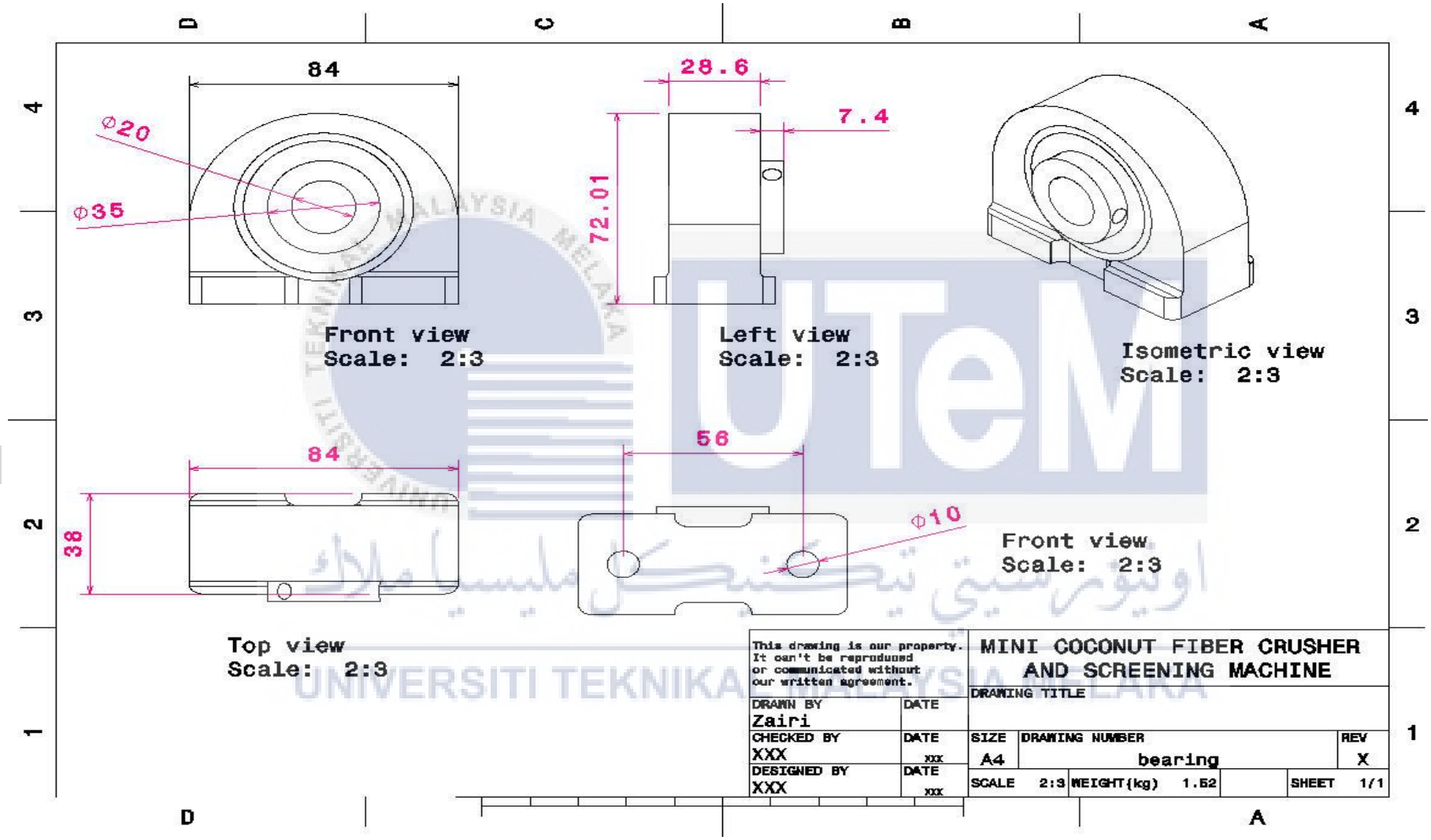
Activities	Week														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Brainstorming and select the title															
Meeting with supervisor															
Chapter 1:Identify introduction, problem statement, objectives and scope															
Chapter 2: Literature review															
Chapter 3: Methodology															
Reference and formatting															
Submission of general conduct form and logbook to supervisor															
Poster presentation															
Submission of PSM 1 reports to supervisor and examiners															

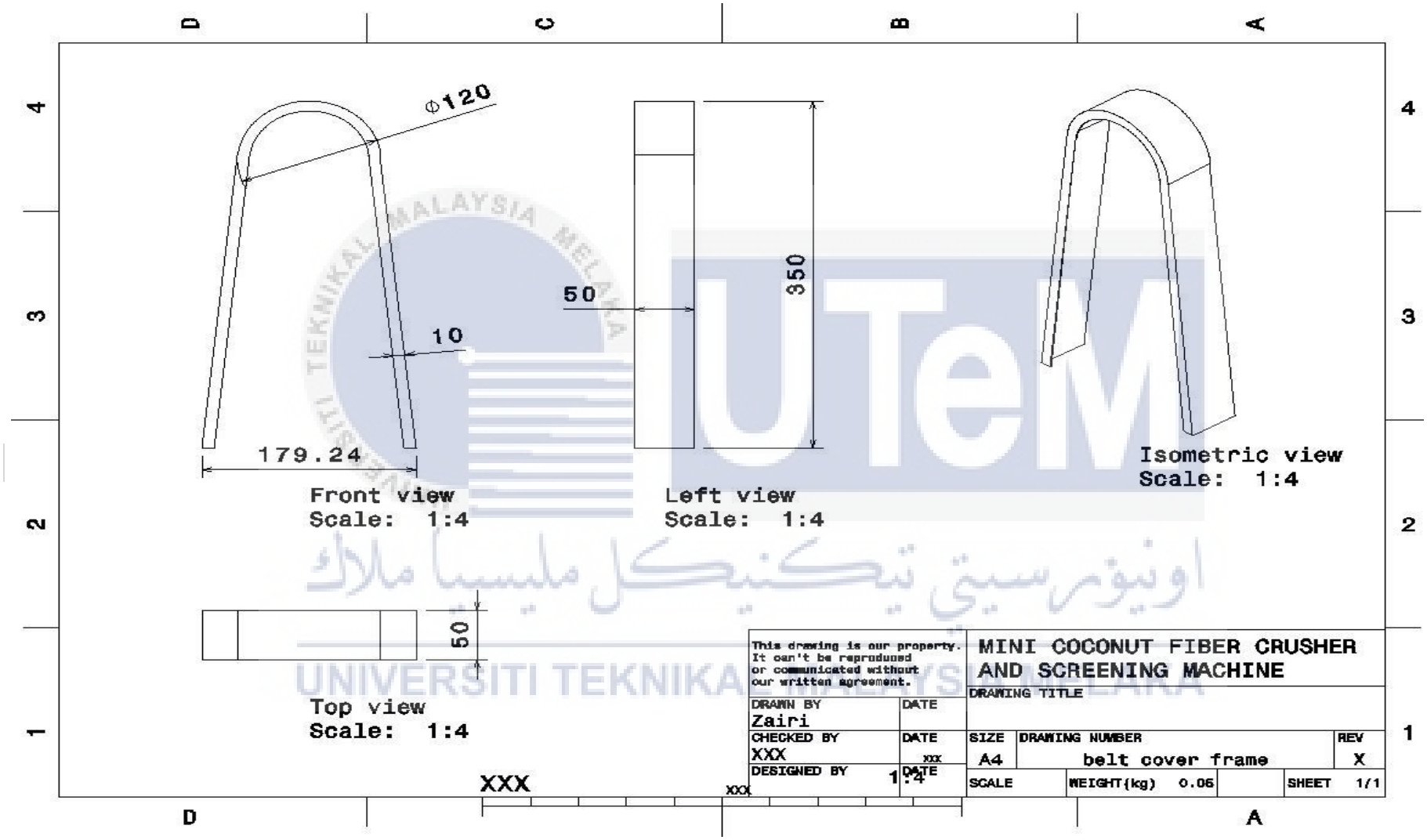
Activities	Week														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Briefing about PSM II															
Meeting with supervisor															
Making a calculation for material selection															
Material selection															
Fabrication process															
Chapter 4: Result analysis and discussion															
Chapter 5: Conclusions and Recommendations															
Reference and formatting															
Submission of general conduct form and logbook to supervisor															
Presentation PSM II															
Submission of reports to supervisor and examiners															

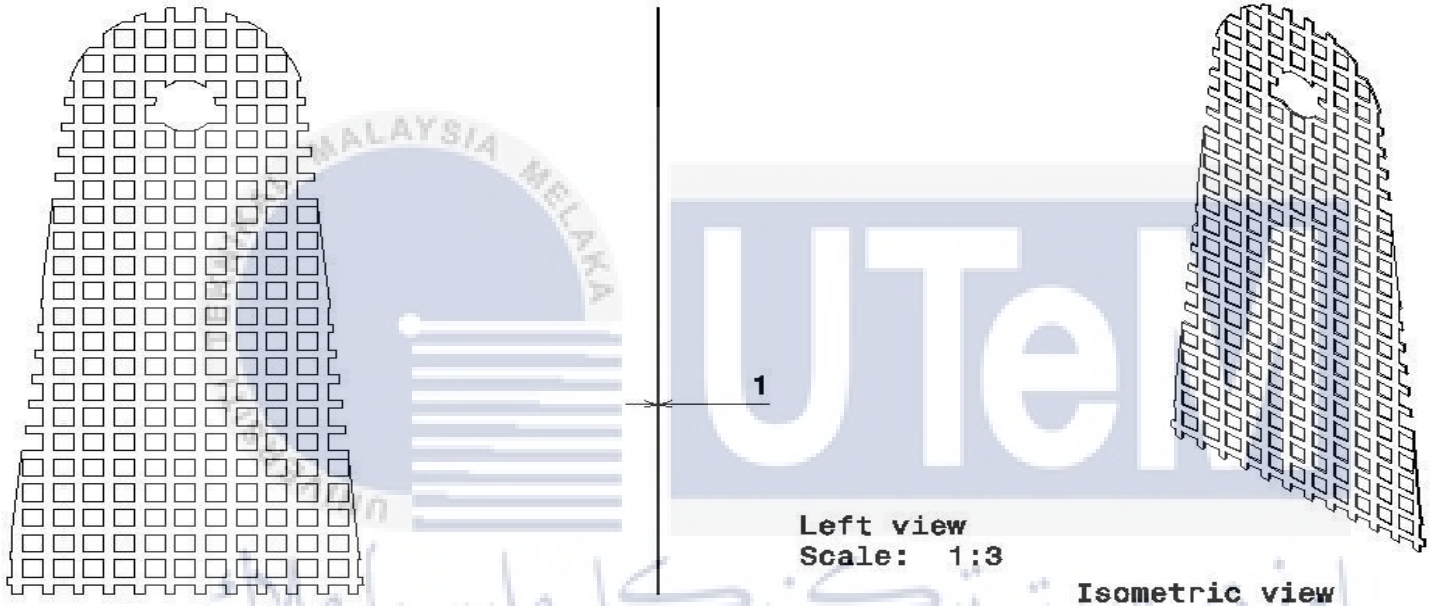


This drawing is our property. It can't be reproduced or communicated without our written agreement.		MINI COCONUT FIBER CRUSHER AND SCREENING MACHINE		
		DRAWING TITLE		
DRAWN BY: Zairi	DATE			
CHECKED BY: XXX	DATE: XXX	SIZE: A4	DRAWING NUMBER: adjuster	REV: X
DESIGNED BY: XXX	DATE	SCALE: 2:5	WEIGHT(kg): 0.16	SHEET: 1/1

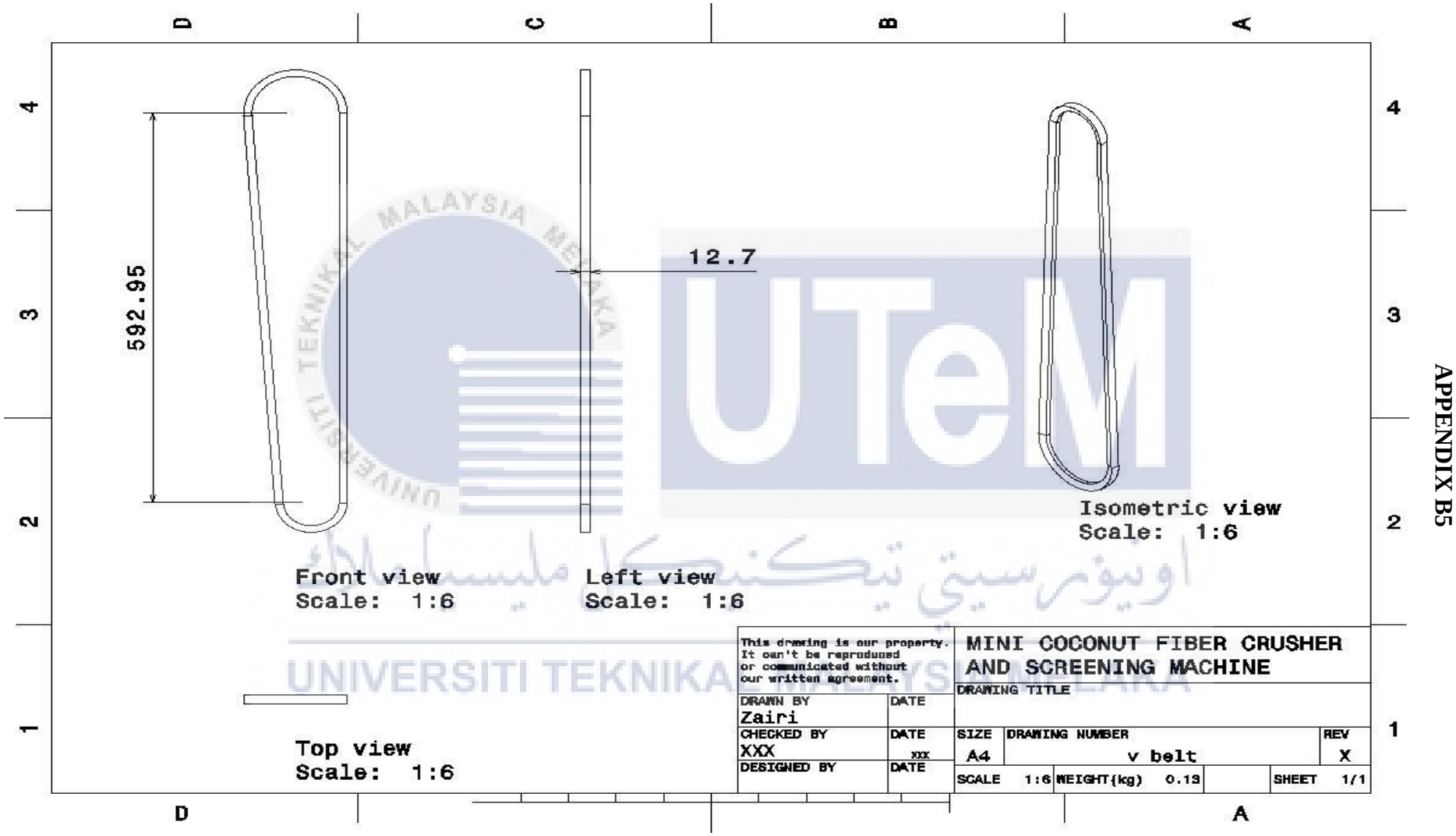


APPENDIX B2





DRAWN BY: Zairi	DATE	MINI COCONUT FIBER CRUSHER AND SCREENING MACHINE			
CHECKED BY: XXX	DATE: xx	DRAWING TITLE			
DESIGNED BY	DATE	SIZE: A4	DRAWING NUMBER: belt cover mesh		REV: X
		SCALE: 1:3	WEIGHT(kg): 0.21		SHEET: 1/1


592.95
12.7
Front view
Scale: 1:6
Left view
Scale: 1:6
Isometric view
Scale: 1:6
Top view
Scale: 1:6
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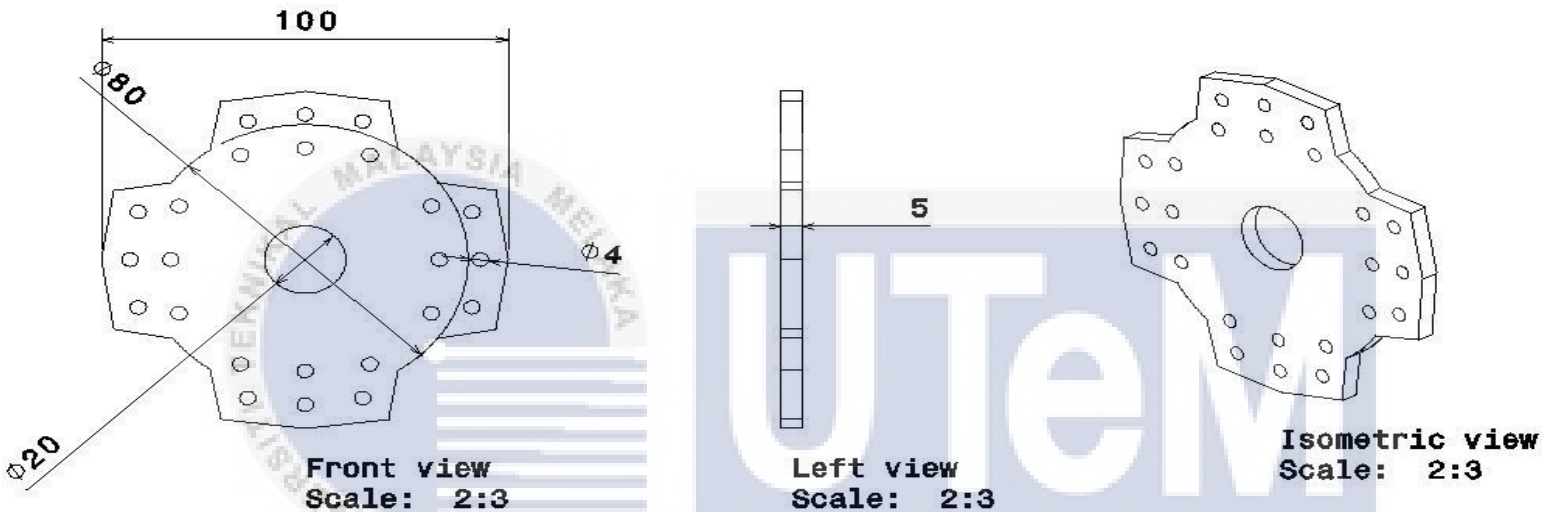
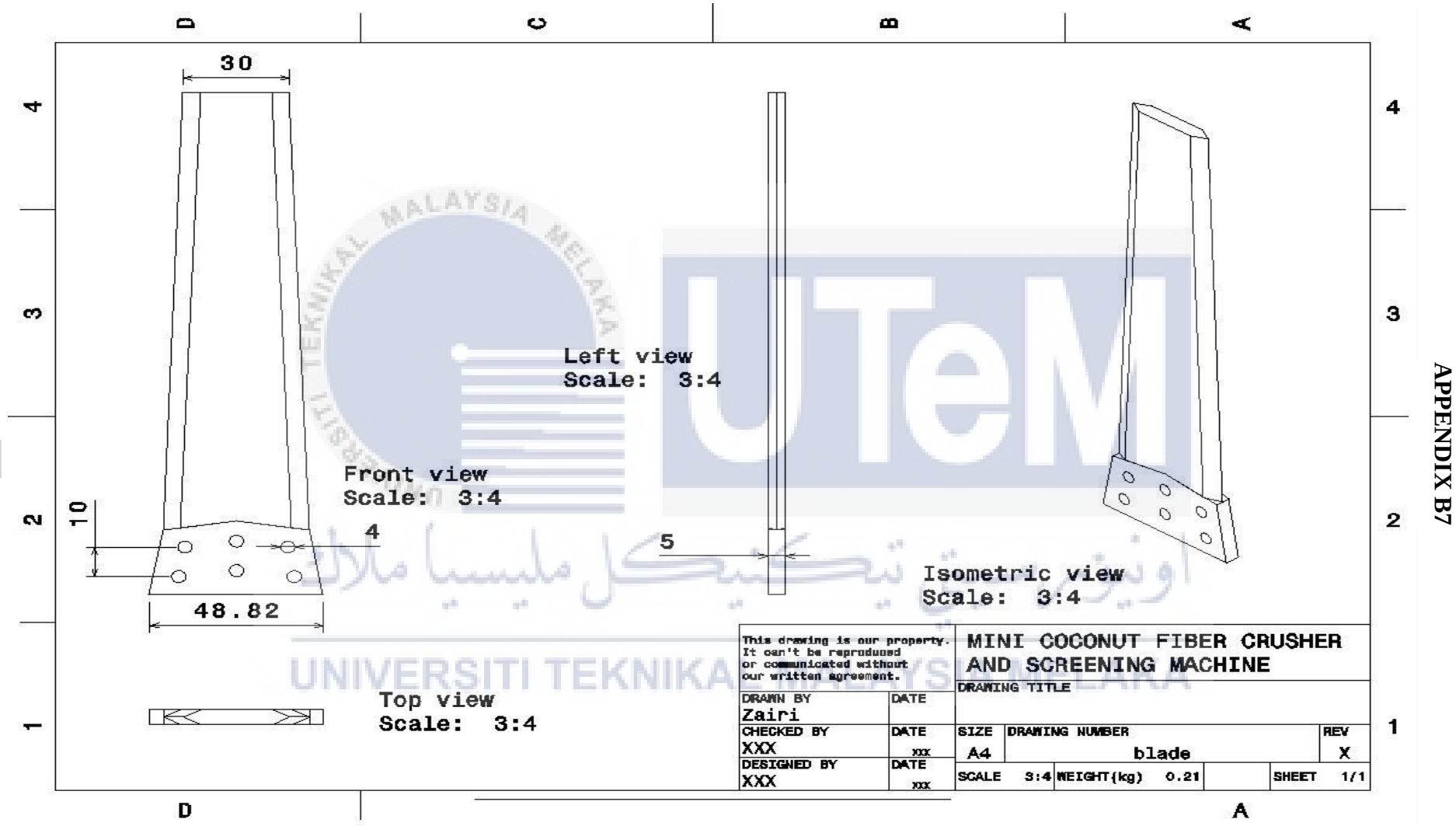
MINI COCONUT FIBER CRUSHER AND SCREENING MACHINE
DRAWING TITLE
DRAWN BY Zairi
DATE
CHECKED BY XXX
DATE xx
DESIGNED BY
DATE
SIZE A4
DRAWING NUMBER v belt
REV X
SCALE 1:6
WEIGHT(kg) 0.13
SHEET 1/1



MINI COCONUT FIBER CRUSHER AND SCREENING MACHINE					
DRAWING TITLE					
DRAWN BY: Zairi	DATE	SIZE: A4	DRAWING NUMBER: blade holder		REV: X
CHECKED BY: XXX	DATE: xxx				
DESIGNED BY: XXX	DATE: xxx	SCALE: 2:3	WEIGHT(kg): 0.26		SHEET: 1/1


30
10
4
48.82
Front view
Scale: 3:4
Left view
Scale: 3:4
5
Isometric view
Scale: 3:4
Top view
Scale: 3:4
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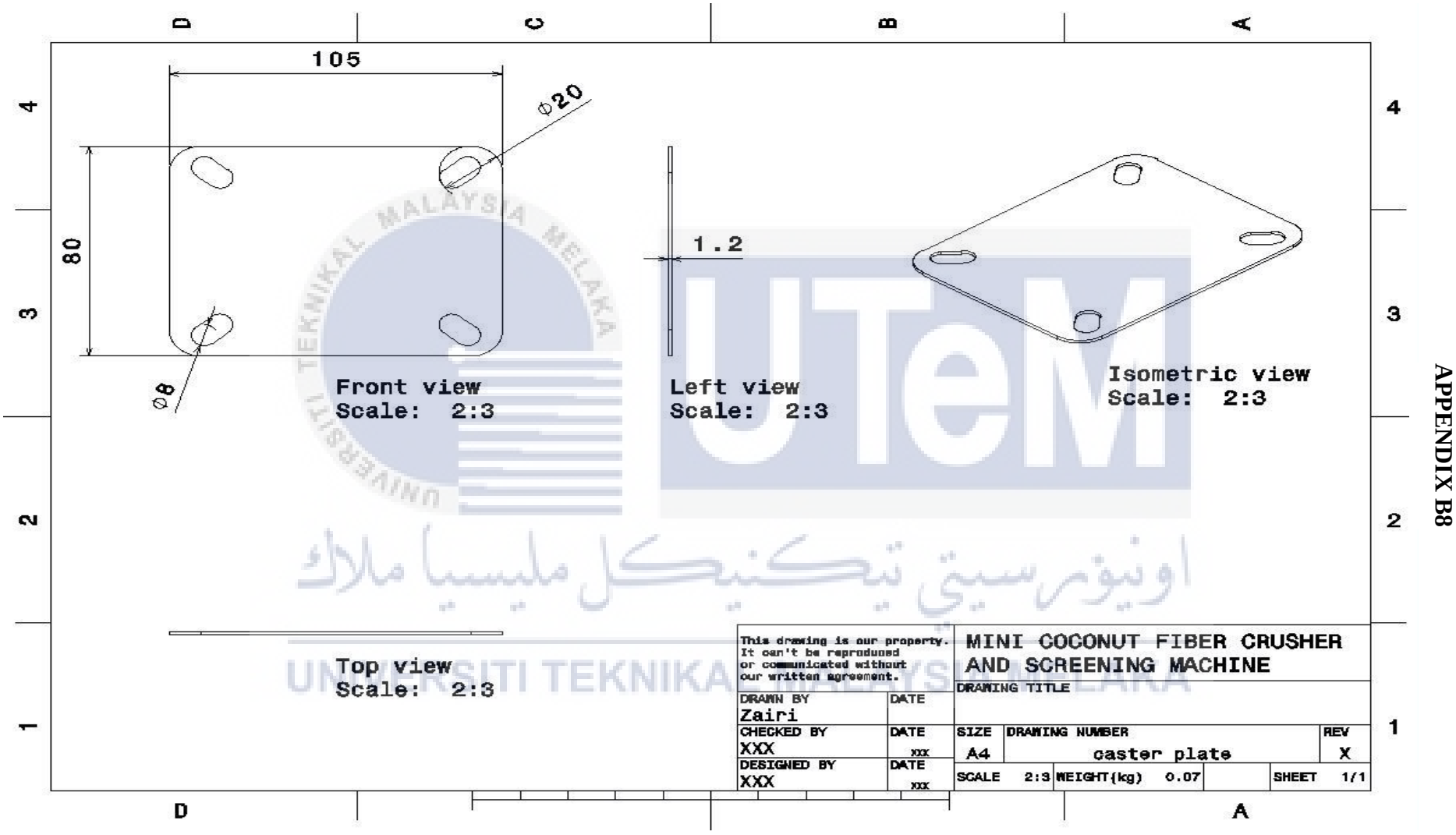
MINI COCONUT FIBER CRUSHER AND SCREENING MACHINE
DRAWING TITLE
DRAWN BY Zairi
DATE
CHECKED BY XXX
DATE xxx
DESIGNED BY XXX
DATE xxx
SIZE A4
DRAWING NUMBER blade
REV X
SCALE 3:4
WEIGHT(kg) 0.21
SHEET 1/1


105
Ø20
80
Ø8
Front view
Scale: 2:3
1.2
Left view
Scale: 2:3
Isometric view
Scale: 2:3
Top view
Scale: 2:3
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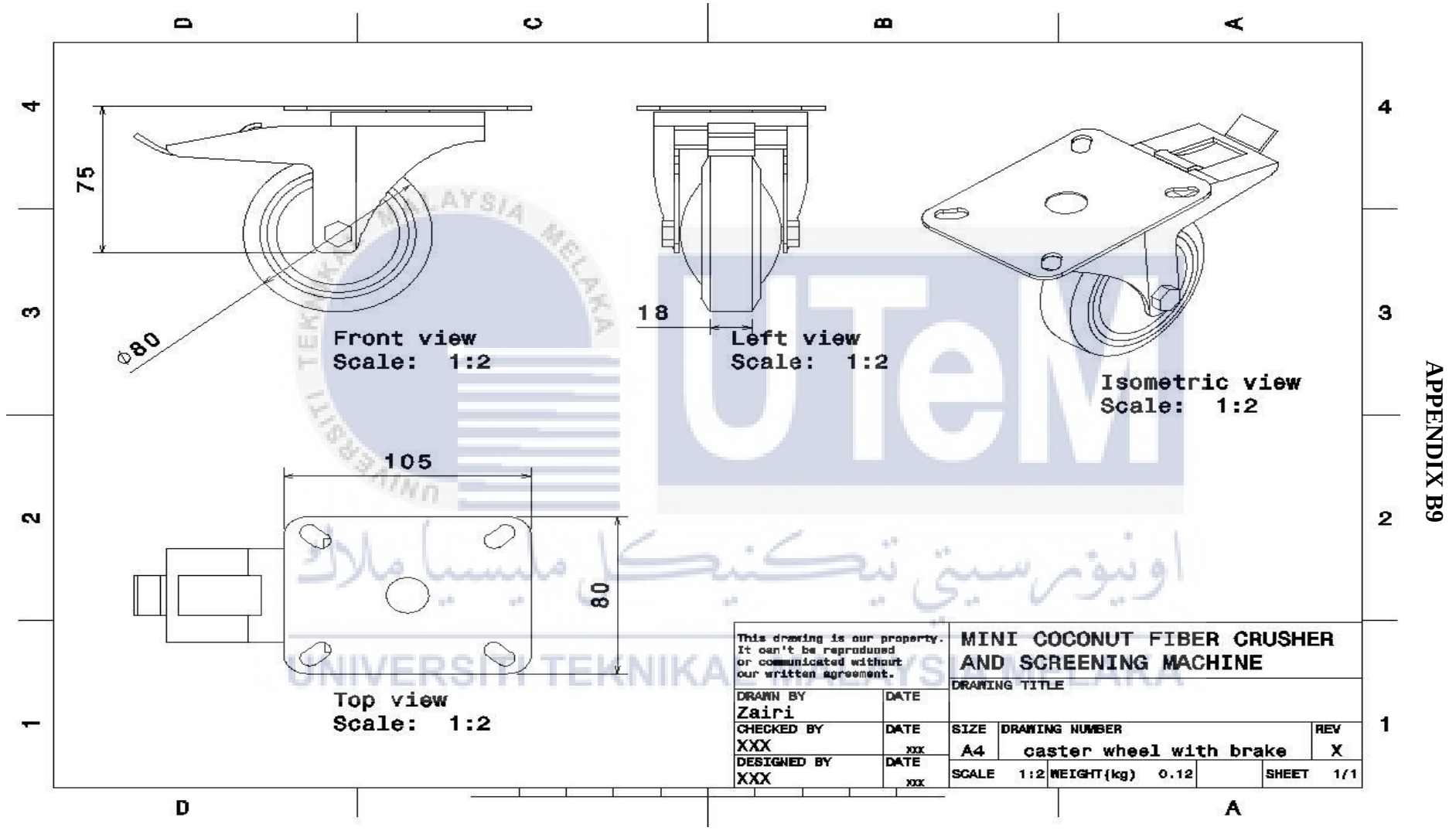
MINI COCONUT FIBER CRUSHER AND SCREENING MACHINE
DRAWING TITLE
DRAWN BY Zairi
DATE
CHECKED BY XXX
DATE xxx
DESIGNED BY XXX
DATE xxx
SIZE A4
DRAWING NUMBER caster plate
REV X
SCALE 2:3
WEIGHT(kg) 0.07
SHEET 1/1


75
Ø80
Front view
Scale: 1:2
18
Left view
Scale: 1:2
Isometric view
Scale: 1:2
105
80
Top view
Scale: 1:2
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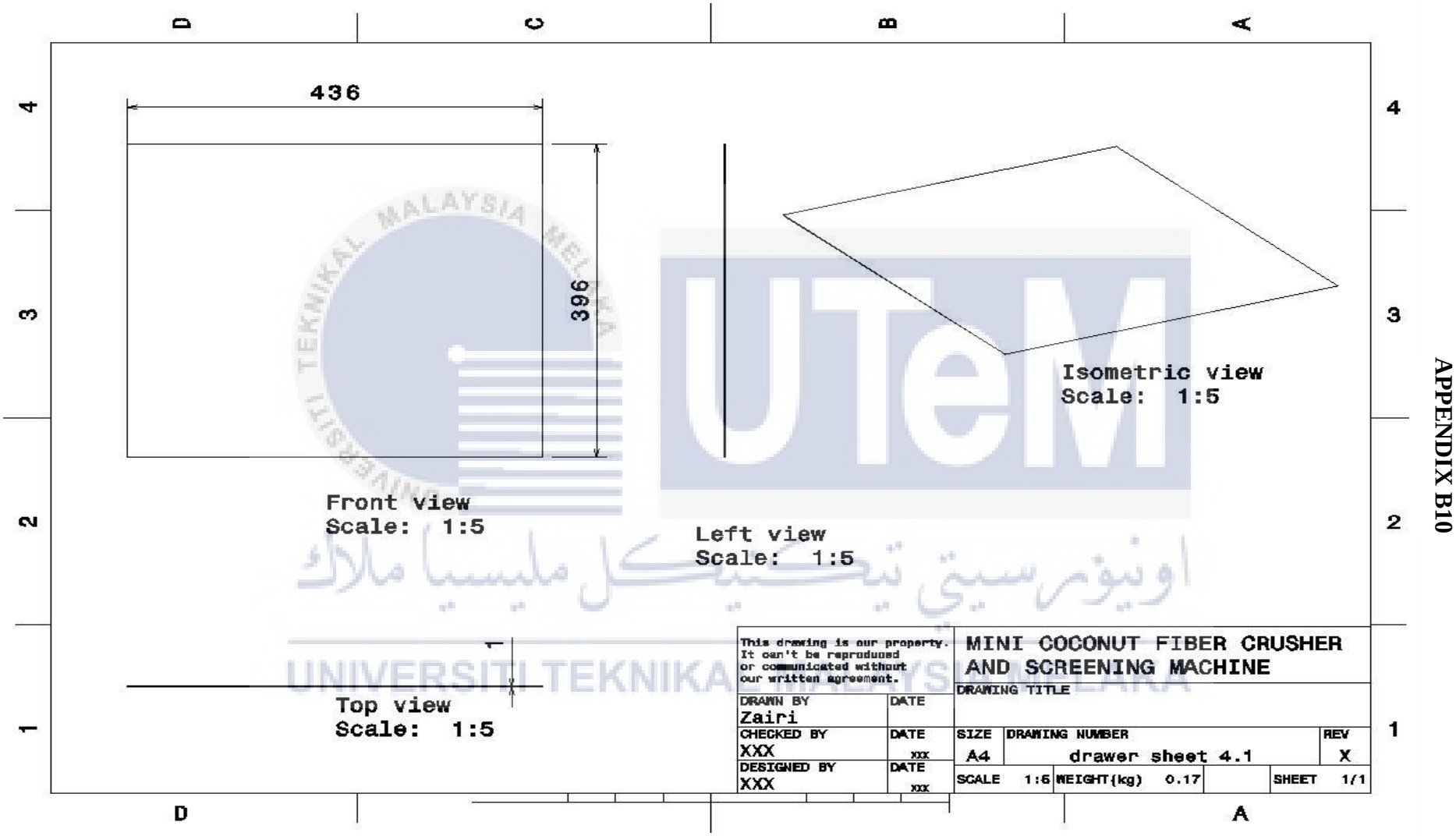
MINI COCONUT FIBER CRUSHER AND SCREENING MACHINE
DRAWING TITLE
DRAWN BY Zairi
DATE
CHECKED BY XXX
DATE xxx
DESIGNED BY XXX
DATE xxx
SIZE A4
DRAWING NUMBER caster wheel with brake
REV X
SCALE 1:2
WEIGHT(kg) 0.12
SHEET 1/1


436
396
Front view
Scale: 1:5
Left view
Scale: 1:5
Isometric view
Scale: 1:5
1
Top view
Scale: 1:5
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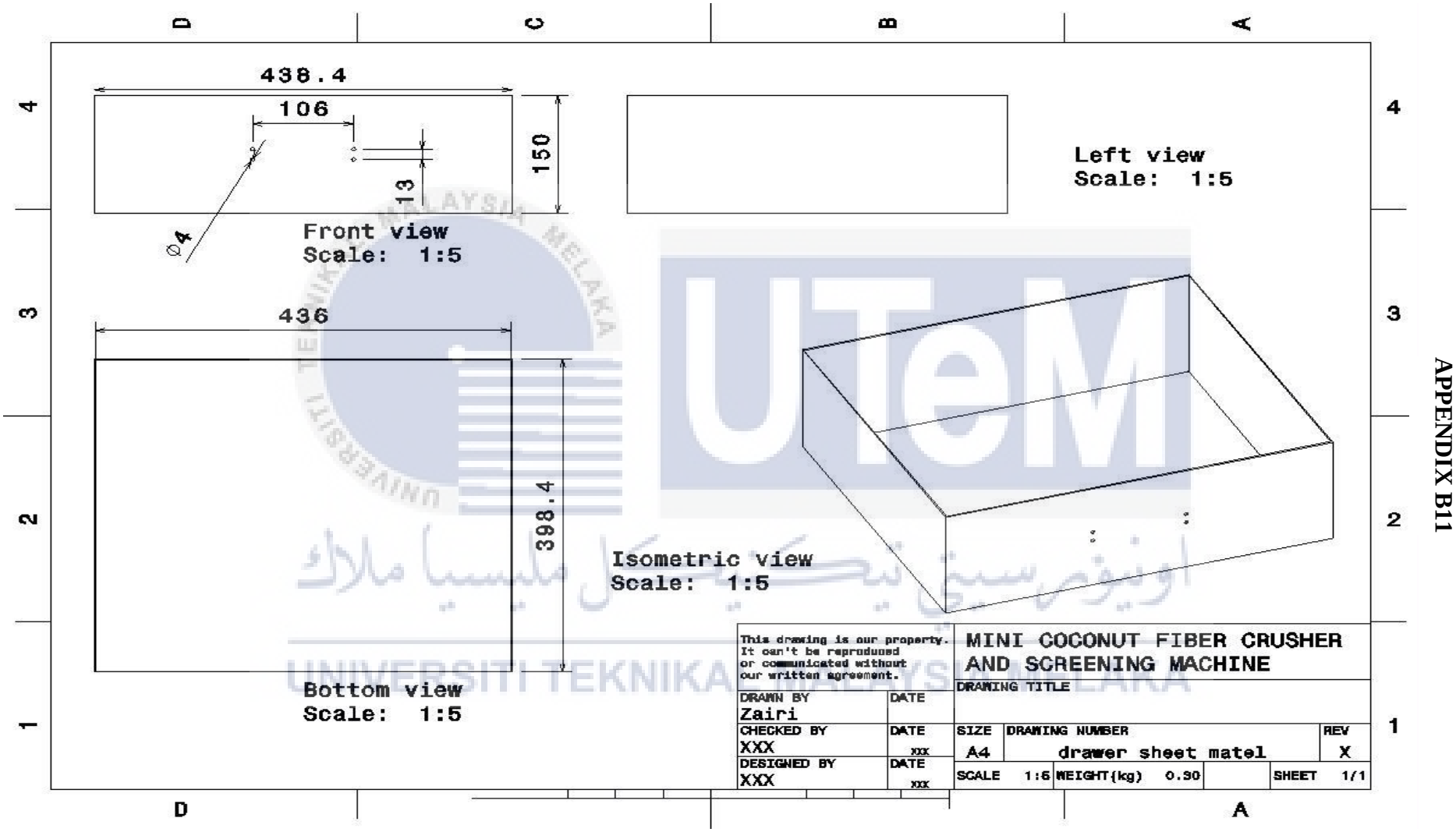
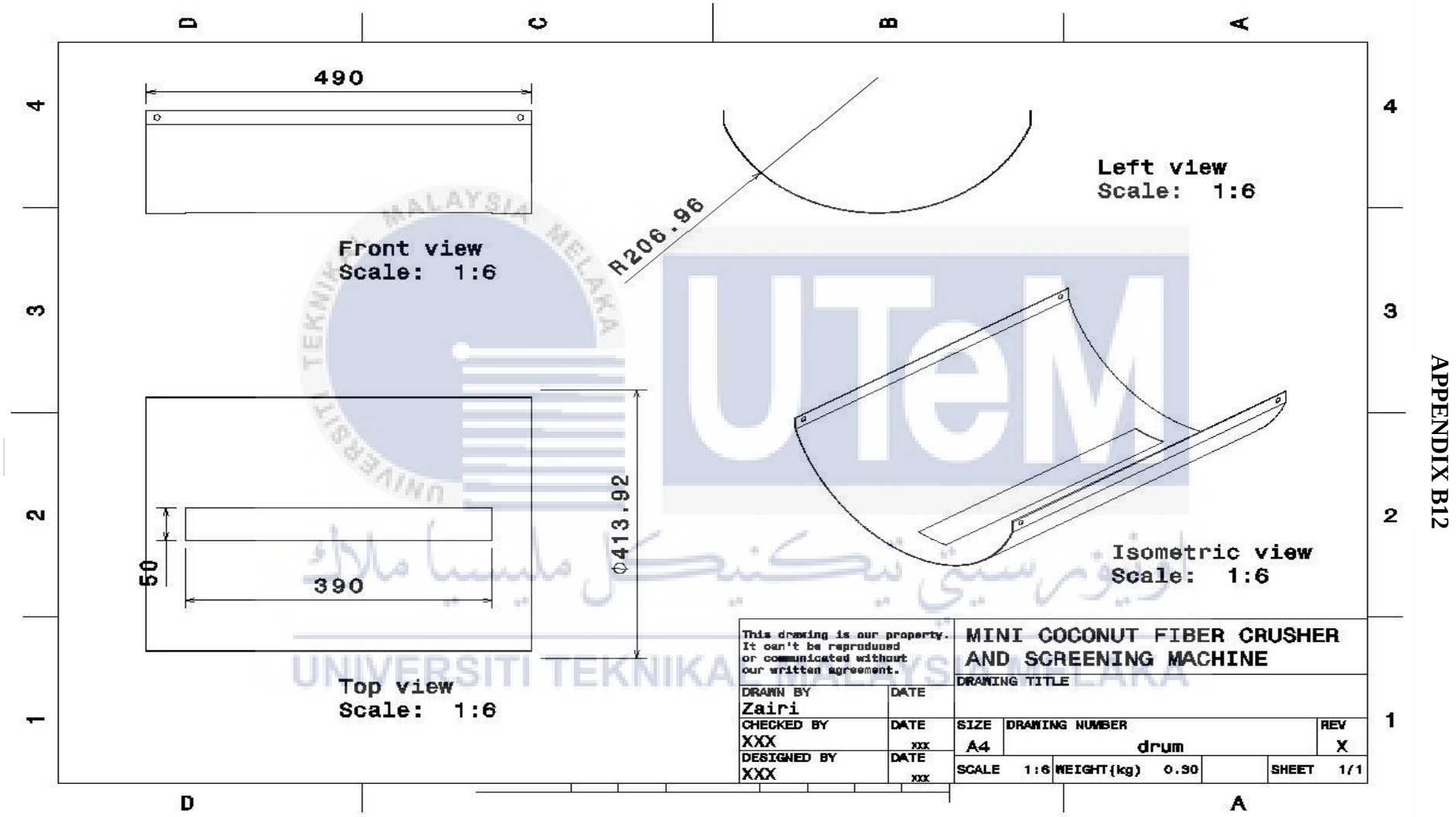
MINI COCONUT FIBER CRUSHER AND SCREENING MACHINE
DRAWING TITLE
DRAWN BY Zairi
DATE
CHECKED BY XXX
DATE xxx
DESIGNED BY XXX
DATE xxx
SIZE A4
DRAWING NUMBER drawer sheet 4.1
REV X
SCALE 1:6
WEIGHT(kg) 0.17
SHEET 1/1


438.4
106
13
150
Ø4
Front view
Scale: 1:5
Left view
Scale: 1:5
436
398.4
Bottom view
Scale: 1:5
Isometric view
Scale: 1:5
This drawing is our property. It can't be reproduced or communicated without our written agreement.
MINI COCONUT FIBER CRUSHER AND SCREENING MACHINE
DRAWING TITLE
DRAWN BY Zairi
DATE
CHECKED BY XXX
DATE xxx
DESIGNED BY XXX
DATE xxx
SIZE A4
DRAWING NUMBER drawer sheet matel
REV X
SCALE 1:6
WEIGHT(kg) 0.30
SHEET 1/1


490
Front view
Scale: 1:6
R206.96
Left view
Scale: 1:6
50
390
Φ413.92
Top view
Scale: 1:6
Isometric view
Scale: 1:6
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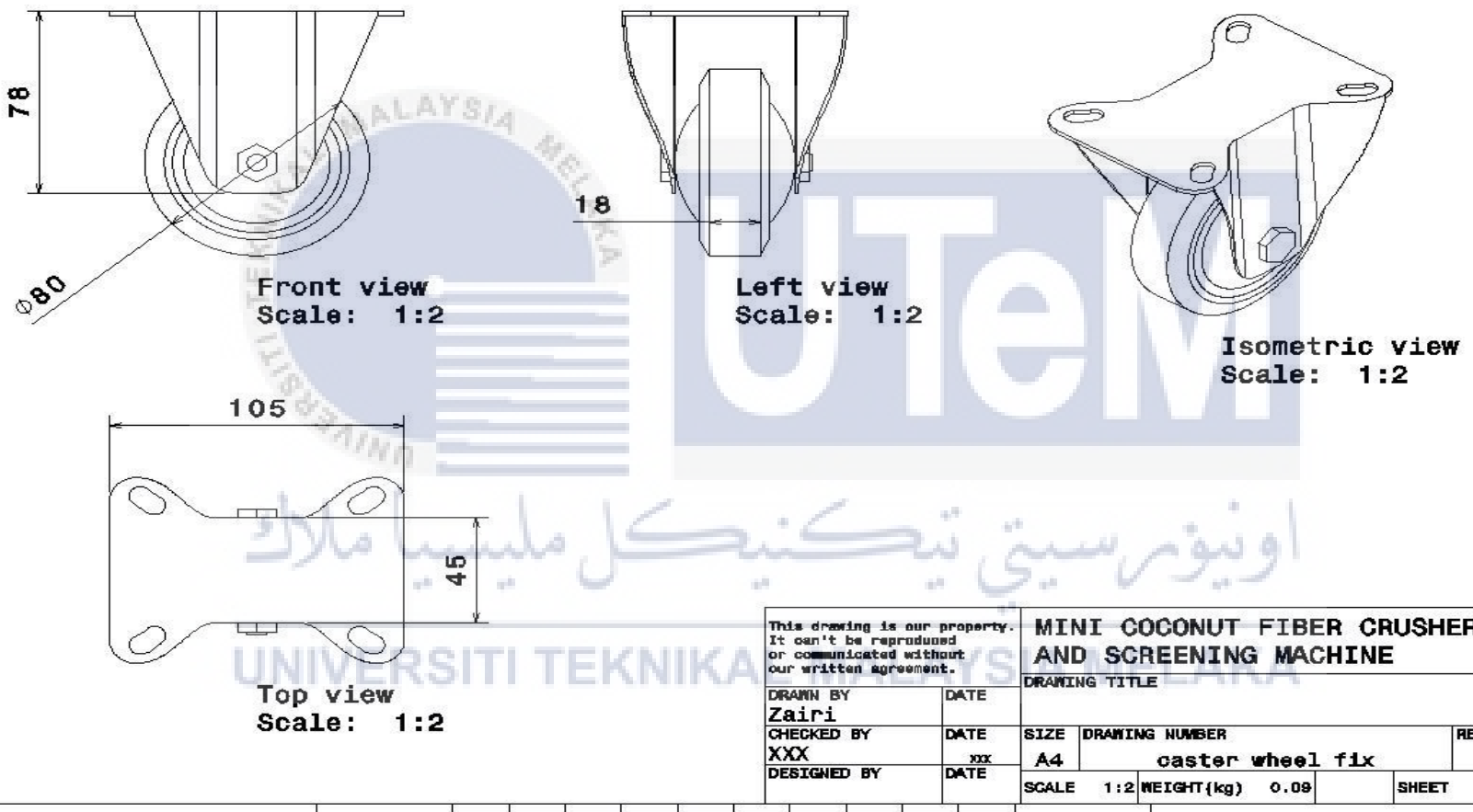
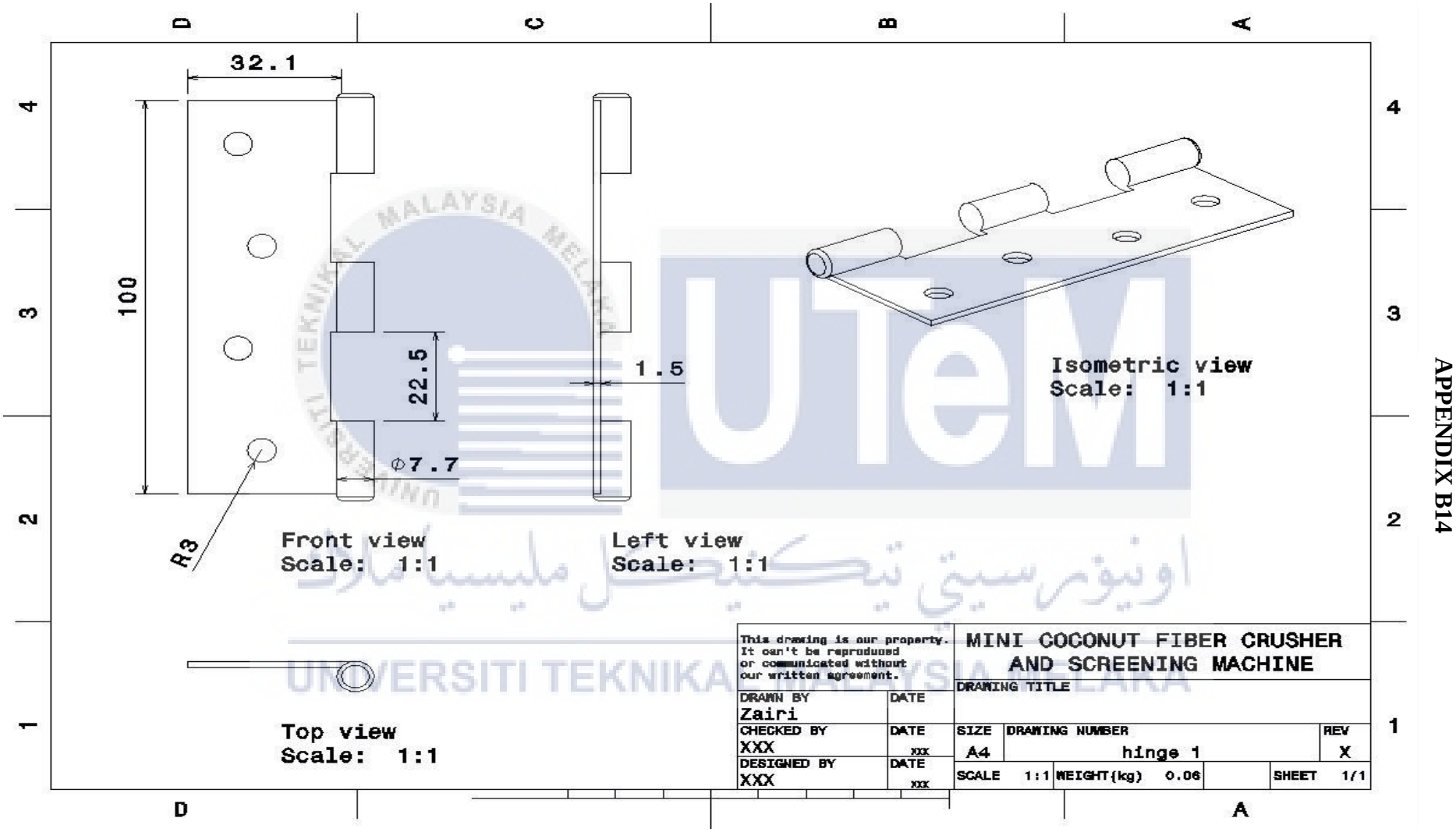
MINI COCONUT FIBER CRUSHER AND SCREENING MACHINE
DRAWING TITLE
DRAWN BY Zairi
DATE
CHECKED BY XXX
DATE xxx
DESIGNED BY XXX
DATE xxx
SIZE A4
DRAWING NUMBER drum
REV X
SCALE 1:6
WEIGHT(kg) 0.30
SHEET 1/1



APPENDIX B13


32.1
100
22.5
1.5
ϕ7.7
R3
Front view
Scale: 1:1
Left view
Scale: 1:1
Isometric view
Scale: 1:1
Top view
Scale: 1:1
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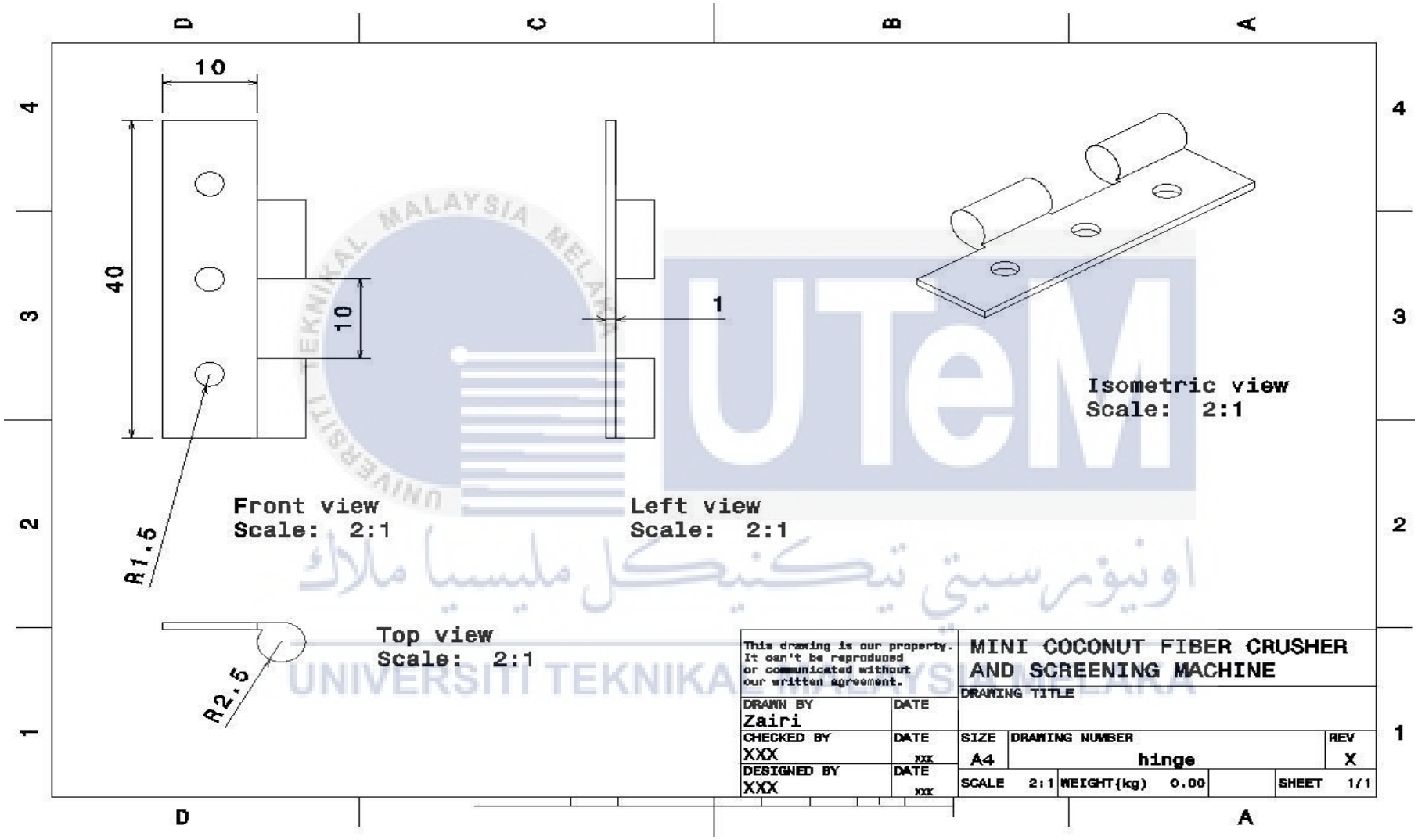
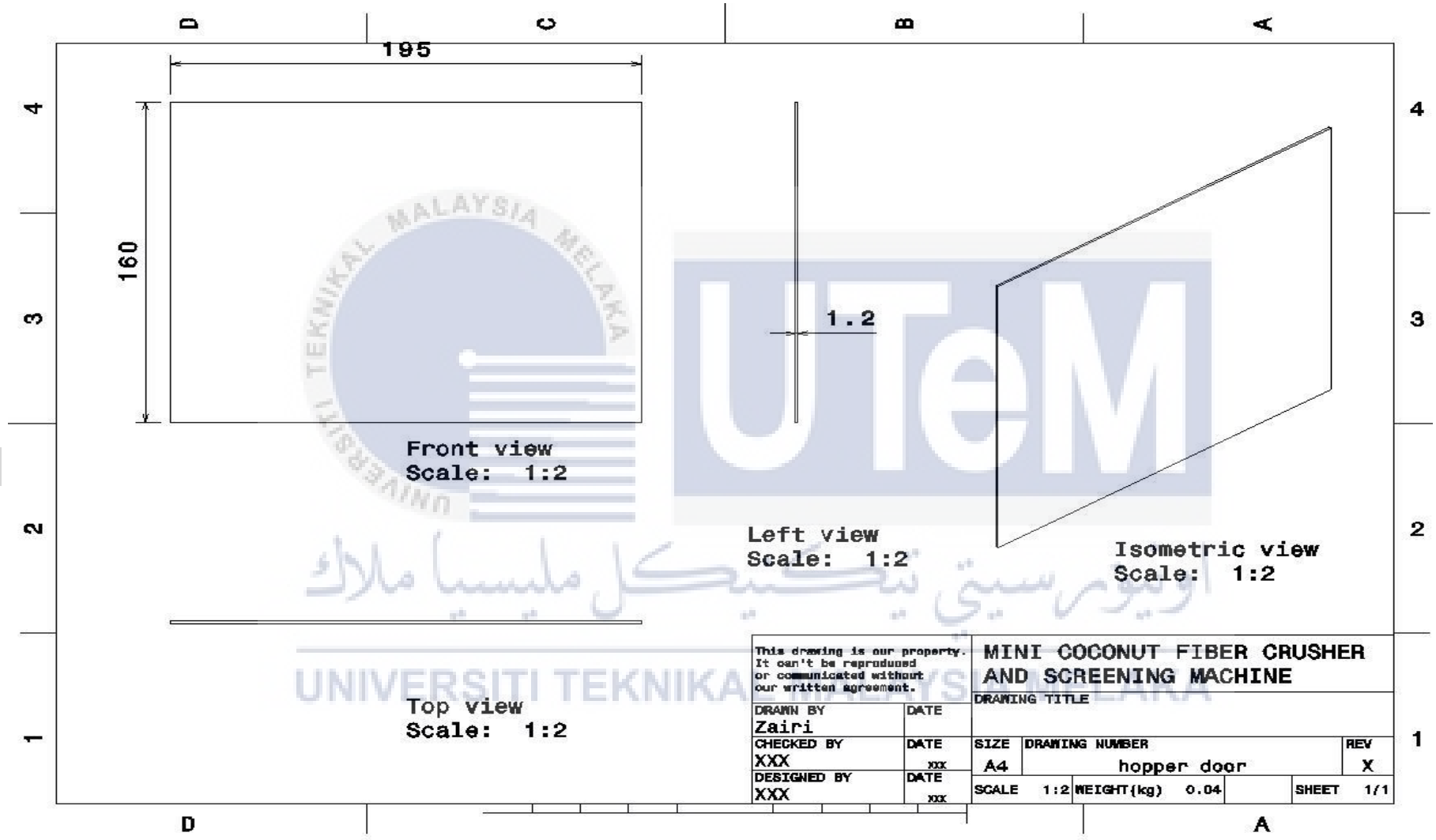
MINI COCONUT FIBER CRUSHER AND SCREENING MACHINE
DRAWING TITLE
DRAWN BY Zairi
DATE
CHECKED BY XXX
DATE xxx
DESIGNED BY XXX
DATE xxx
SIZE A4
DRAWING NUMBER hinge 1
REV X
SCALE 1:1
WEIGHT(kg) 0.06
SHEET 1/1



APPENDIX B15


195
160
1.2
Front view
Scale: 1:2
Left view
Scale: 1:2
Isometric view
Scale: 1:2
Top view
Scale: 1:2
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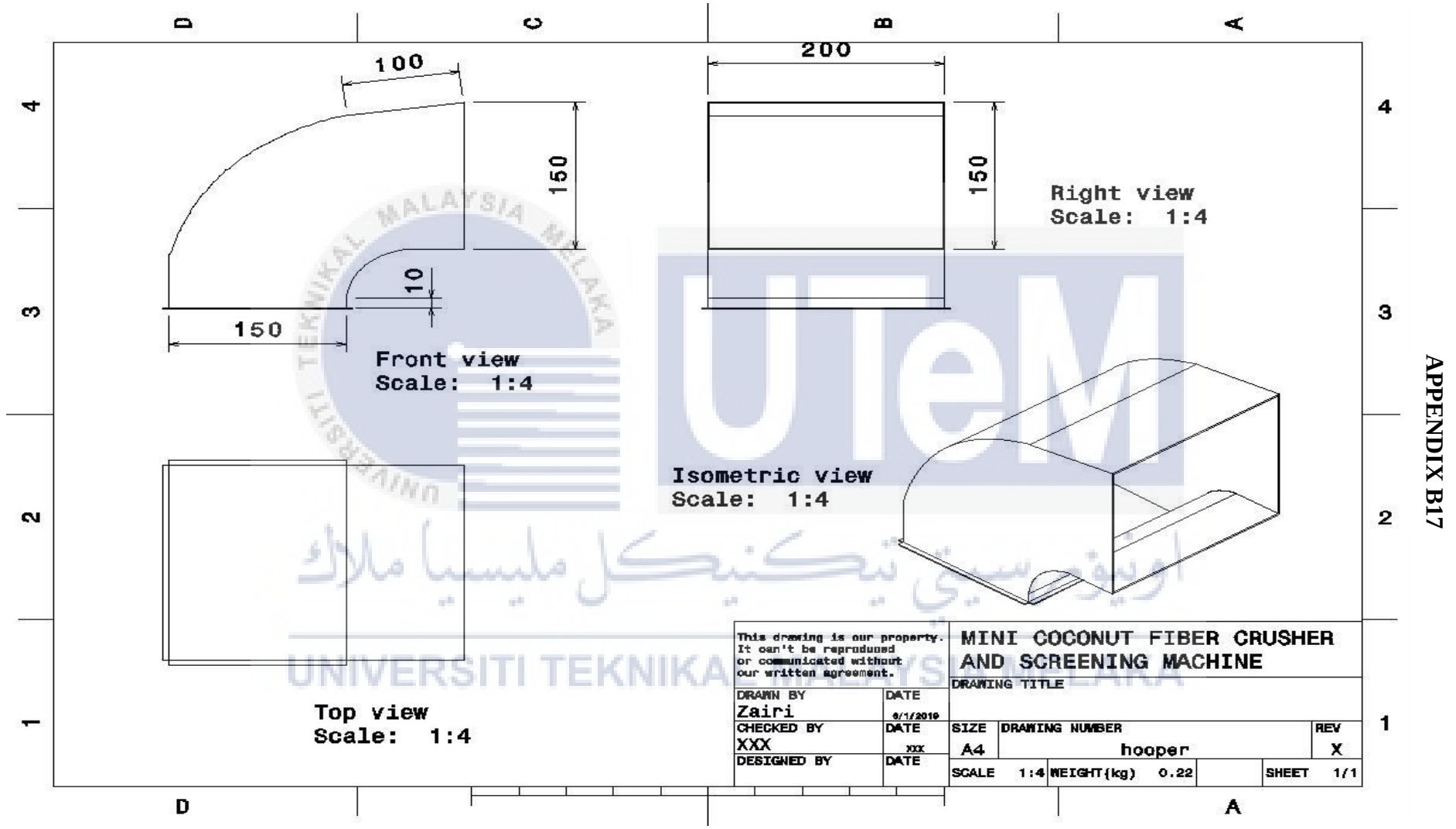
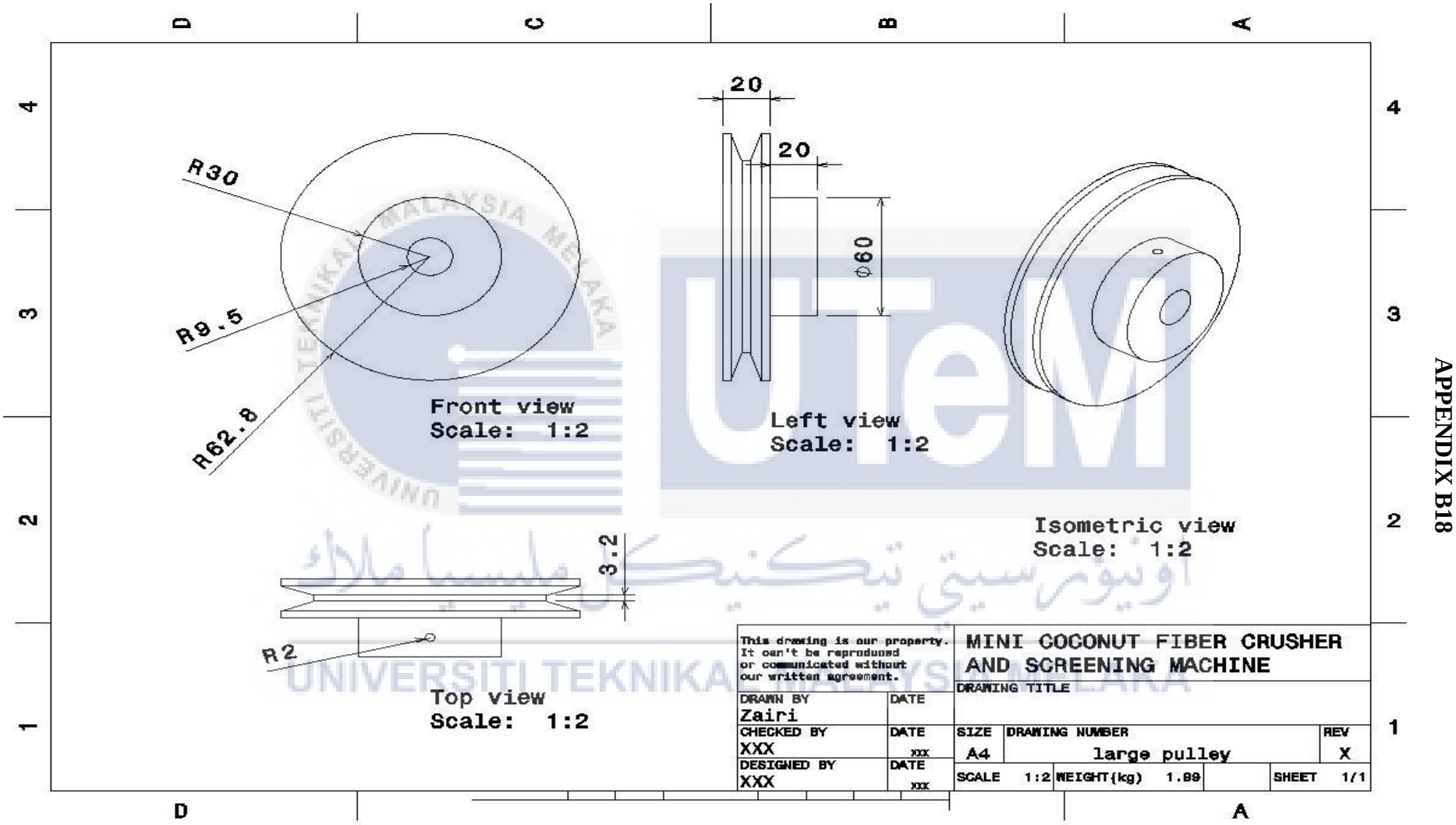
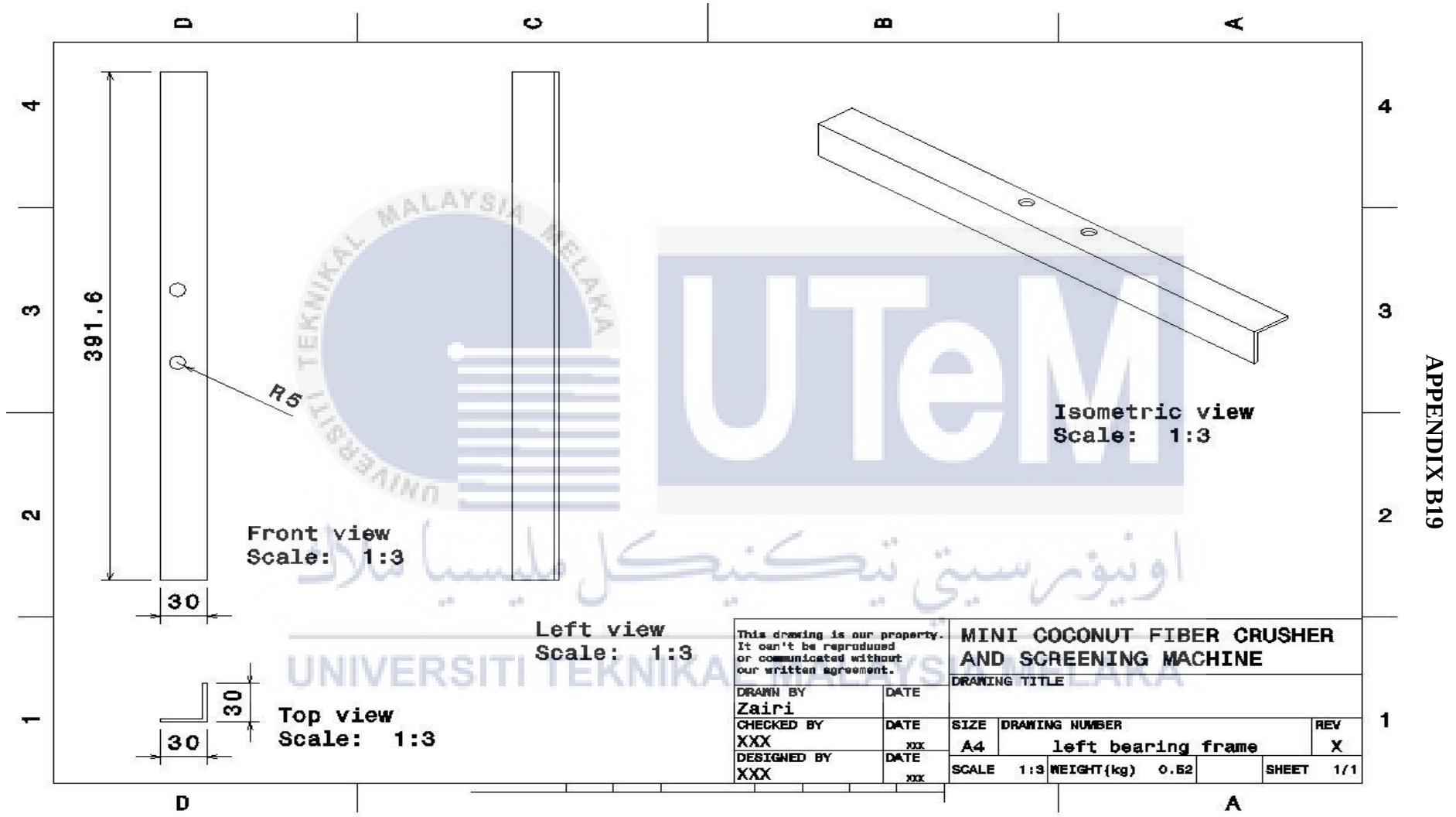
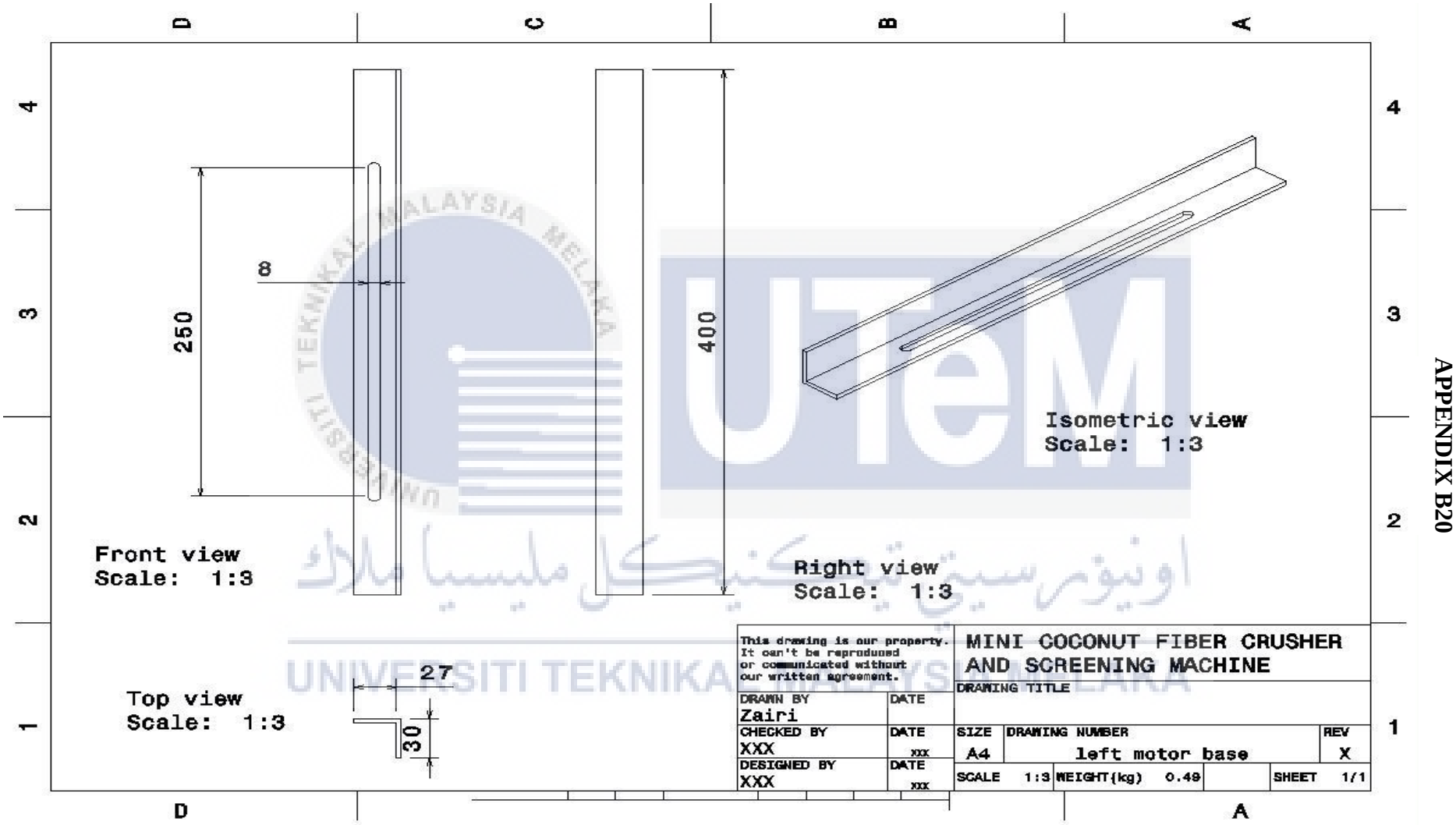
MINI COCONUT FIBER CRUSHER AND SCREENING MACHINE
DRAWING TITLE
DRAWN BY Zairi
DATE
CHECKED BY XXX
DATE xxx
DESIGNED BY XXX
DATE xxx
SIZE A4
DRAWING NUMBER hopper door
REV X
SCALE 1:2
WEIGHT(kg) 0.04
SHEET 1/1

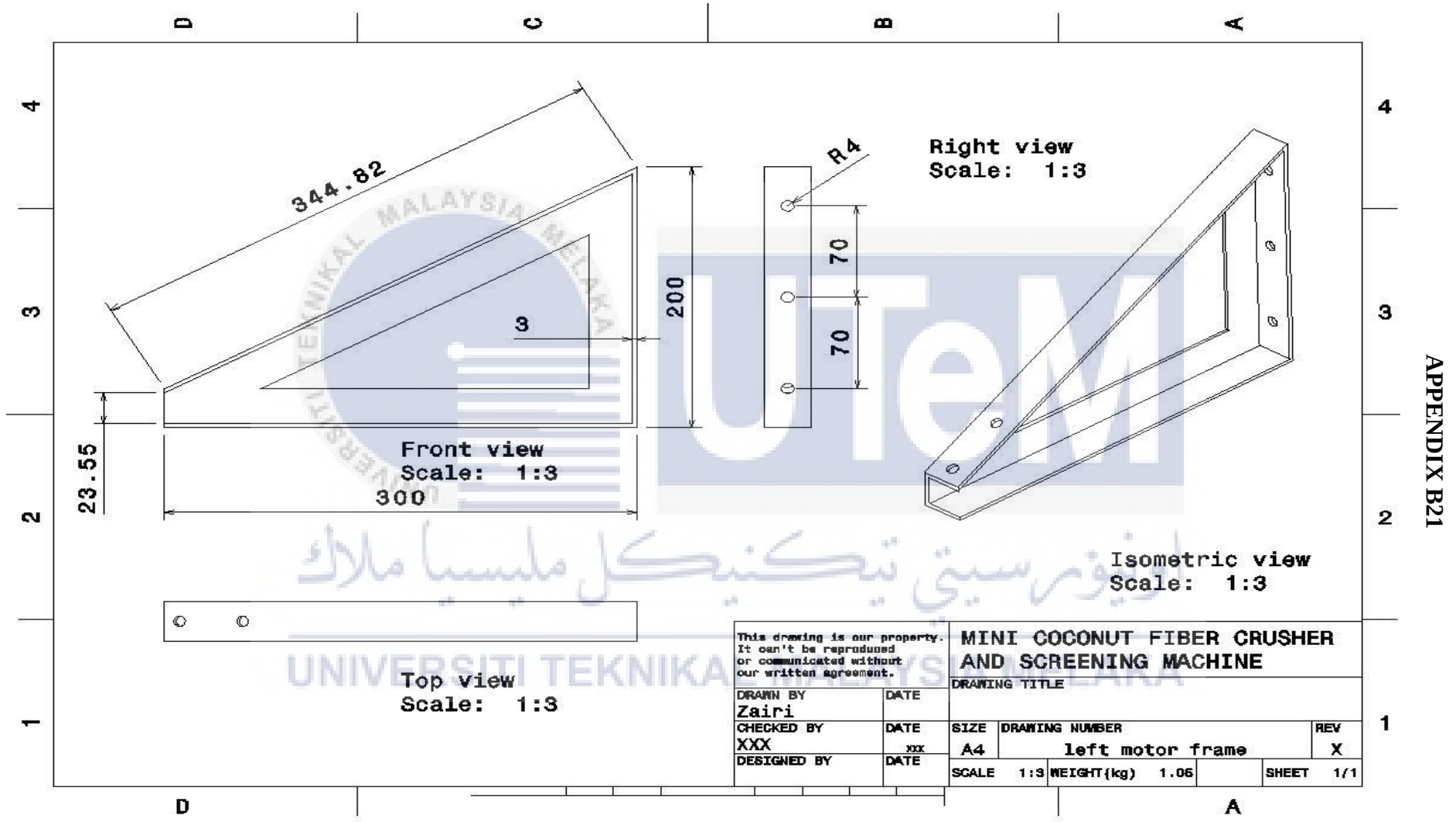

100
150
10
150
Front view
Scale: 1:4
200
150
Right view
Scale: 1:4
Isometric view
Scale: 1:4
Top view
Scale: 1:4
This drawing is our property. It can't be reproduced or communicated without our written agreement.
MINI COCONUT FIBER CRUSHER AND SCREENING MACHINE
DRAWING TITLE
DRAWN BY Zairi
DATE 9/1/2019
CHECKED BY XXX
DATE xxx
DESIGNED BY
DATE
SIZE A4
DRAWING NUMBER hooper
REV X
SCALE 1:4
WEIGHT(kg) 0.22
SHEET 1/1


R30
R9.5
R62.8
Front view
Scale: 1:2
20
20
ϕ60
Left view
Scale: 1:2
Isometric view
Scale: 1:2
3.2
R2
Top view
Scale: 1:2
This drawing is our property. It can't be reproduced or communicated without our written agreement.
DRAWN BY Zairi
DATE
CHECKED BY XXX
DATE xxx
DESIGNED BY XXX
DATE xxx
MINI COCONUT FIBER CRUSHER AND SCREENING MACHINE
DRAWING TITLE
SIZE A4
DRAWING NUMBER large pulley
REV X
SCALE 1:2
WEIGHT(kg) 1.89
SHEET 1/1



APPENDIX B19




344.82
200
3
R4
70
70
23.55
300
Front view
Scale: 1:3
Right view
Scale: 1:3
Isometric view
Scale: 1:3
Top view
Scale: 1:3
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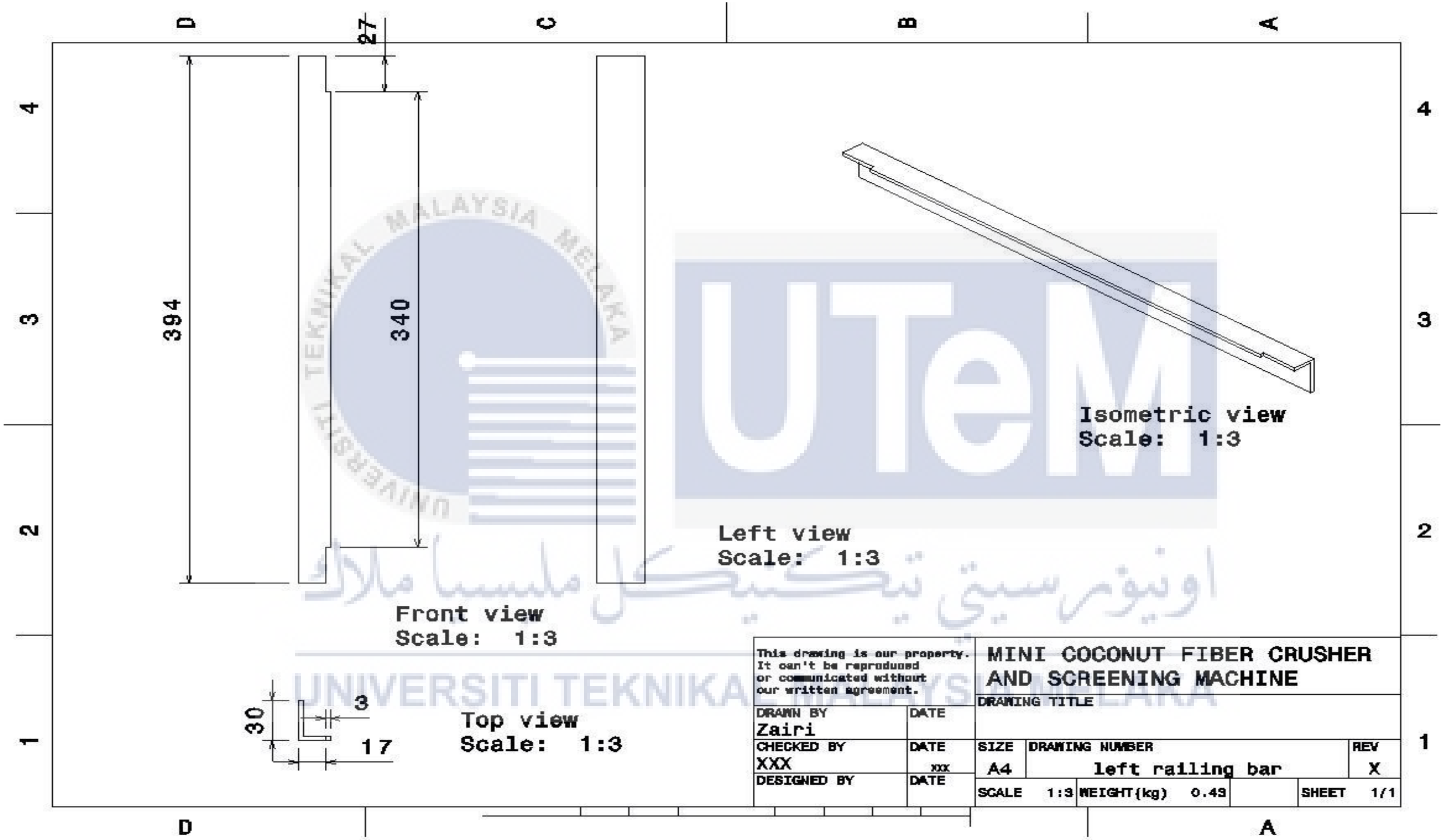
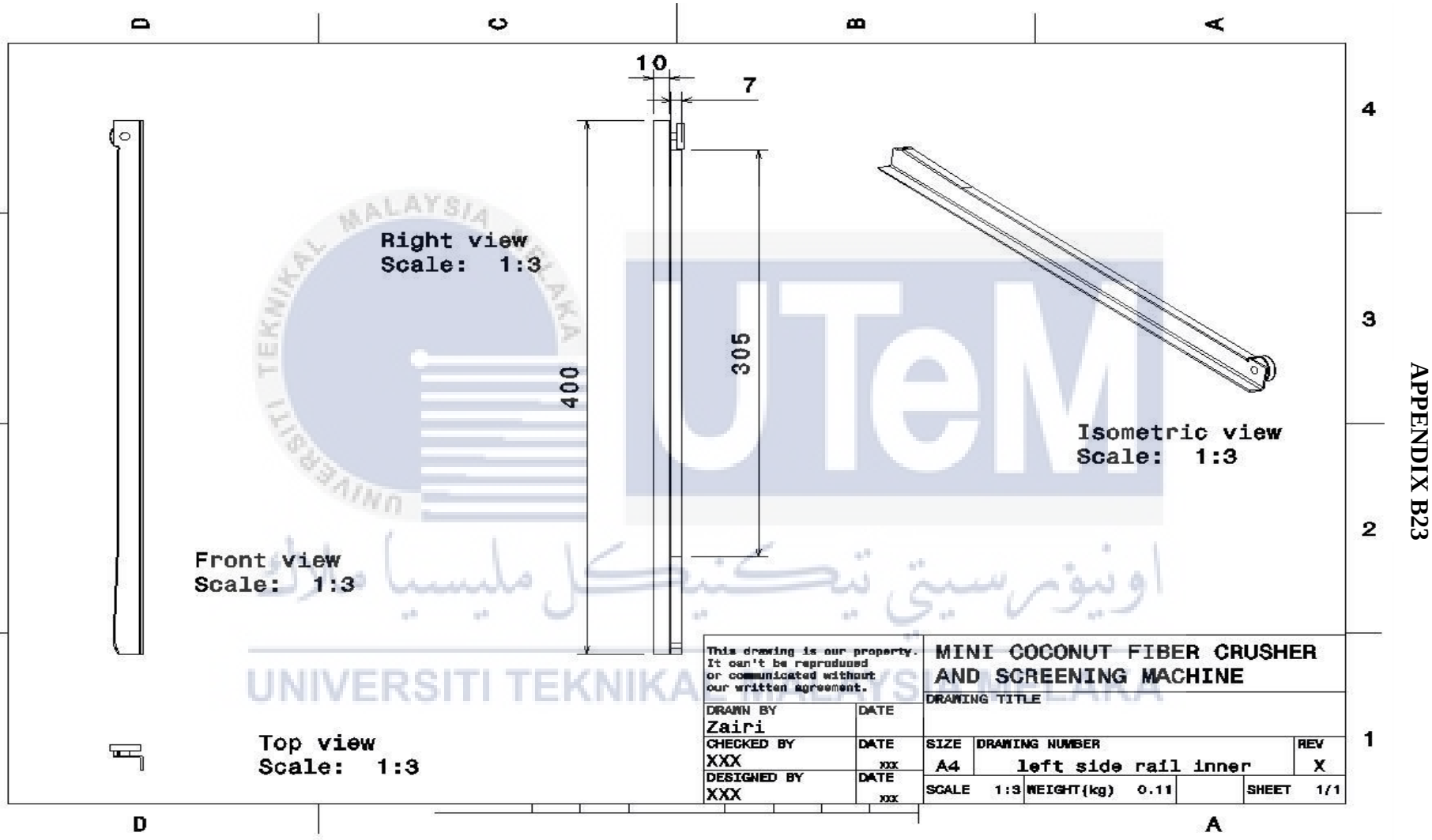
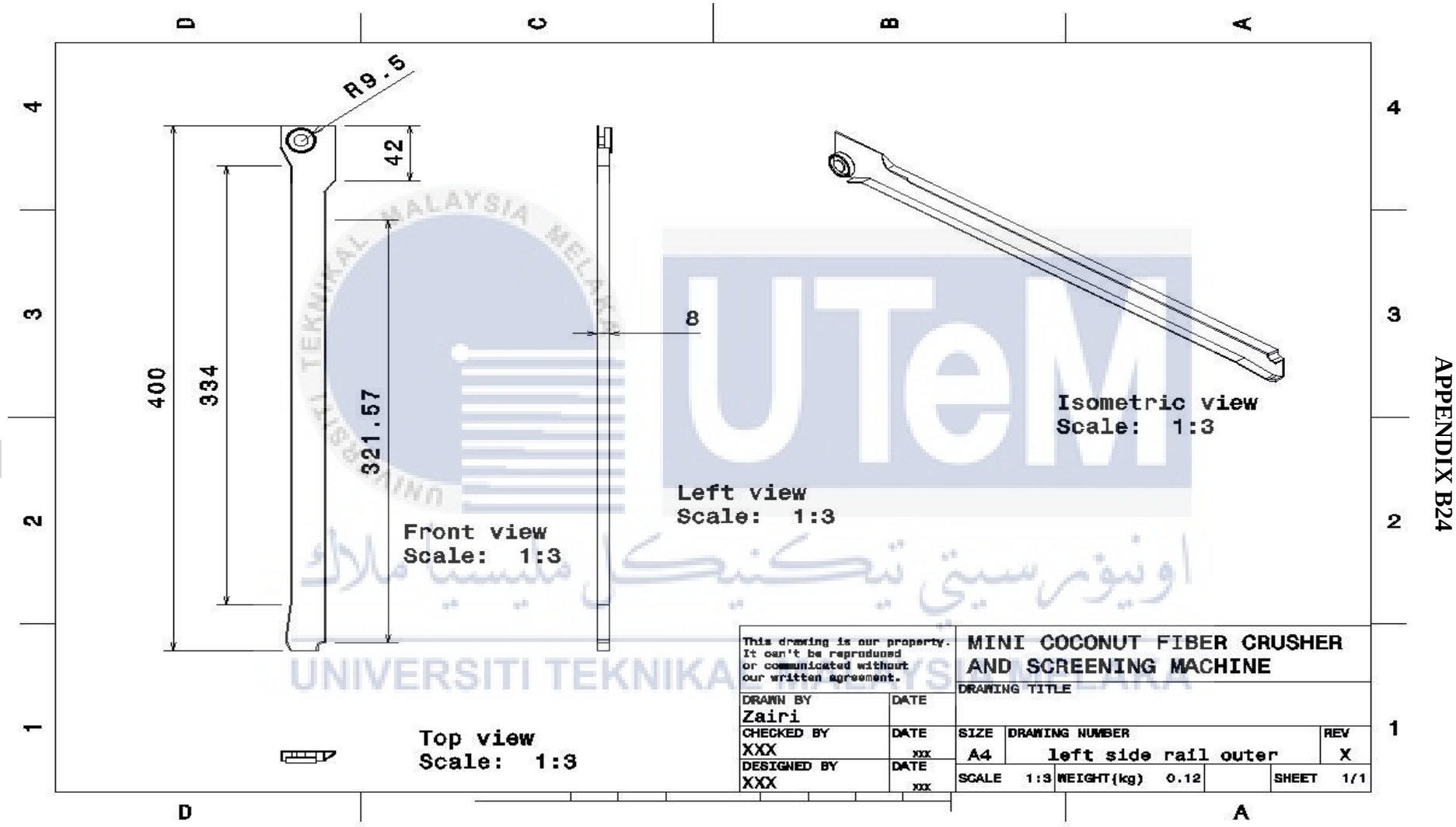
MINI COCONUT FIBER CRUSHER AND SCREENING MACHINE
DRAWING TITLE
DRAWN BY Zairi
DATE
CHECKED BY XXX
DATE xxx
DESIGNED BY
DATE
SIZE A4
DRAWING NUMBER left motor frame
REV X
SCALE 1:3
WEIGHT(kg) 1.06
SHEET 1/1

APPENDIX B22





DRAWN BY: Zairi	DATE	MINI COCONUT FIBER CRUSHER AND SCREENING MACHINE			
CHECKED BY: XXX	DATE: xxx	DRAWING TITLE	SIZE: A4	DRAWING NUMBER: left side rail inner	REV: X
DESIGNED BY: XXX	DATE: xxx	SCALE: 1:3	WEIGHT(kg): 0.11		SHEET: 1/1


R9.5
42
400
334
321.57
8
Front view
Scale: 1:3
Left view
Scale: 1:3
Isometric view
Scale: 1:3
Top view
Scale: 1:3
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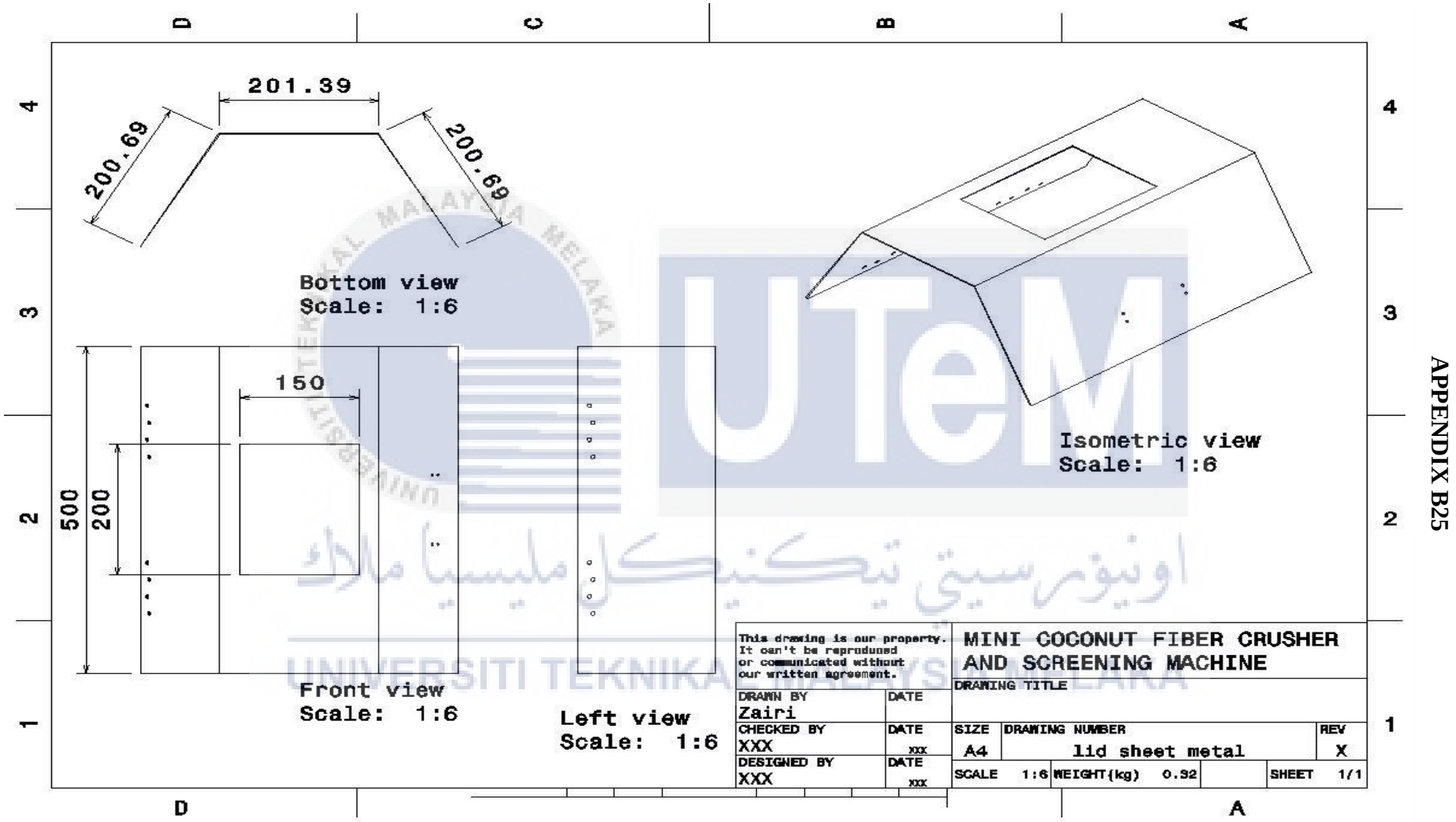
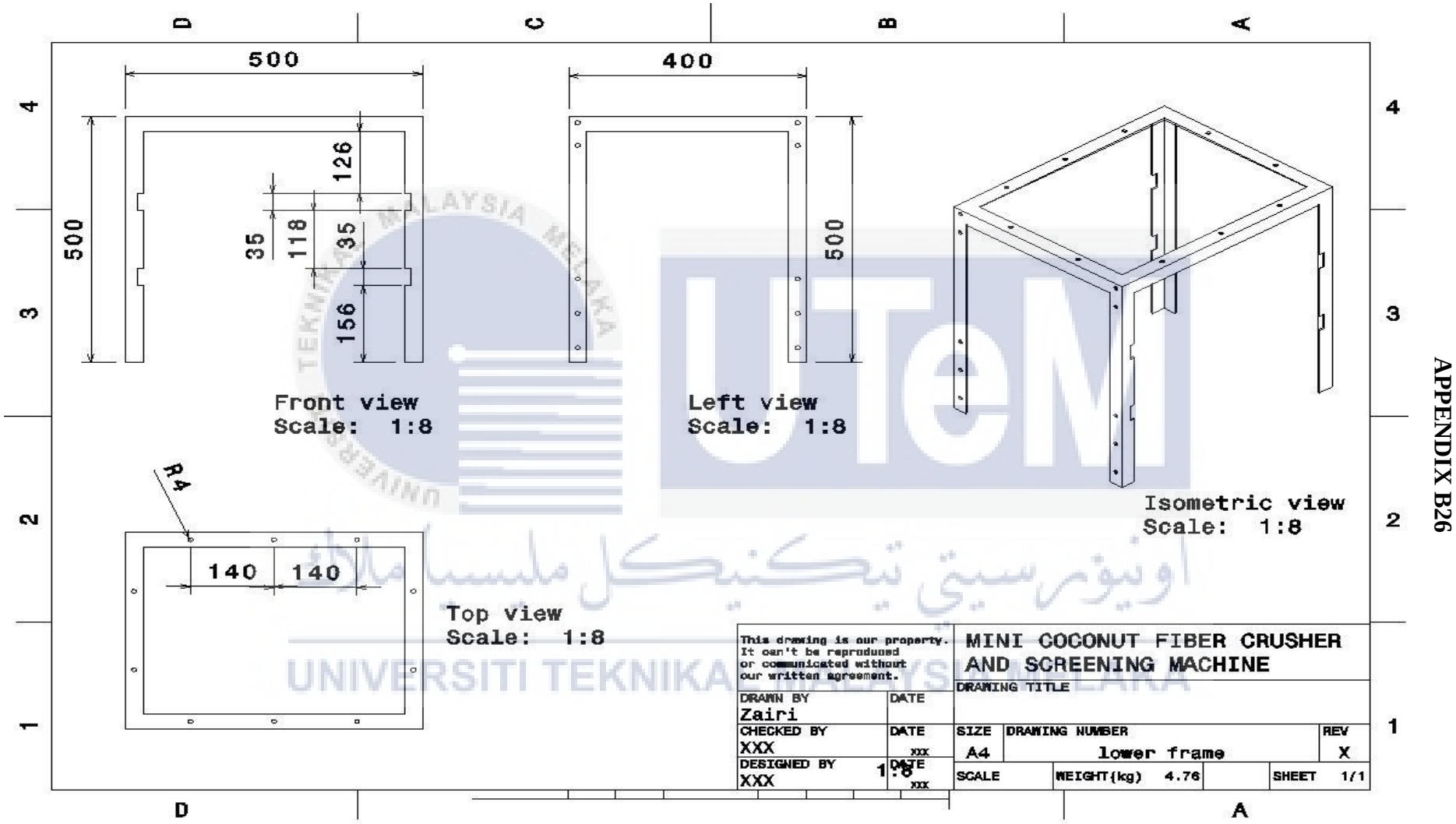
MINI COCONUT FIBER CRUSHER AND SCREENING MACHINE
DRAWING TITLE
DRAWN BY Zairi
DATE
CHECKED BY XXX
DATE xxx
DESIGNED BY XXX
DATE xxx
SIZE A4
DRAWING NUMBER left side rail outer
REV X
SCALE 1:3
WEIGHT(kg) 0.12
SHEET 1/1




D
C
B
A
500
400
500
126
35
118
35
156
500
Front view
Scale: 1:8
Left view
Scale: 1:8
Isometric view
Scale: 1:8
Ø4
140
140
Top view
Scale: 1:8
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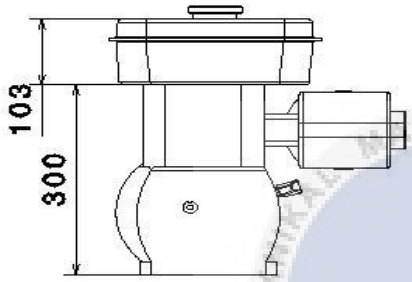
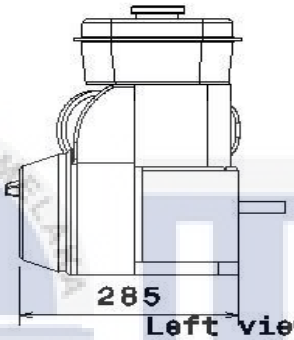
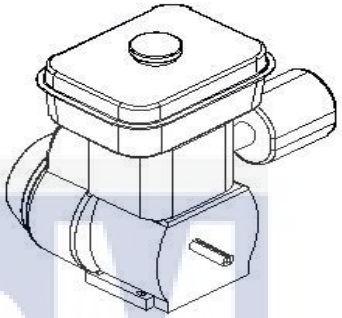
our written agreement.
MINI COCONUT FIBER CRUSHER
AND SCREENING MACHINE
DRAWN BY
Zairi
DATE
CHECKED BY
XXX
DATE
xxx
DESIGNED BY
XXX
DATE
xxx
DRAWING TITLE
SIZE
A4
DRAWING NUMBER
lower frame
REV
X
SCALE
1:8
WEIGHT(kg) 4.76
SHEET 1/1



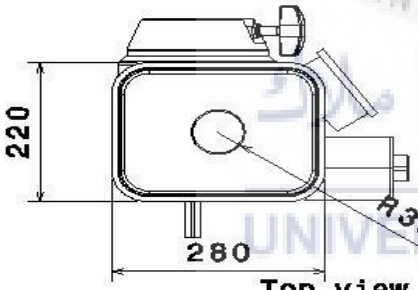
Front view
Scale: 1:8



Left view
Scale: 1:8

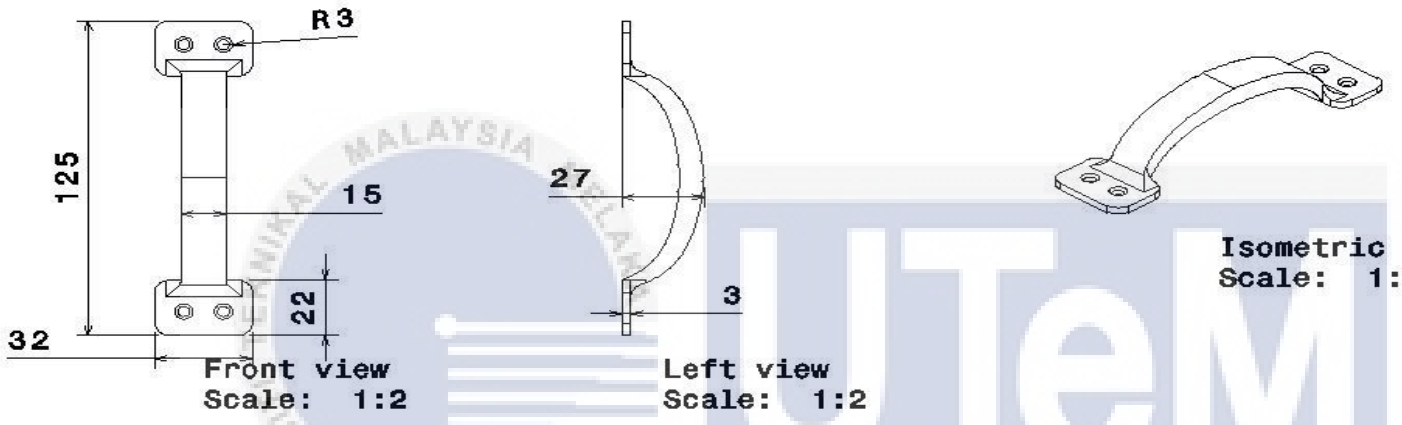


Isometric view
Scale: 1:8

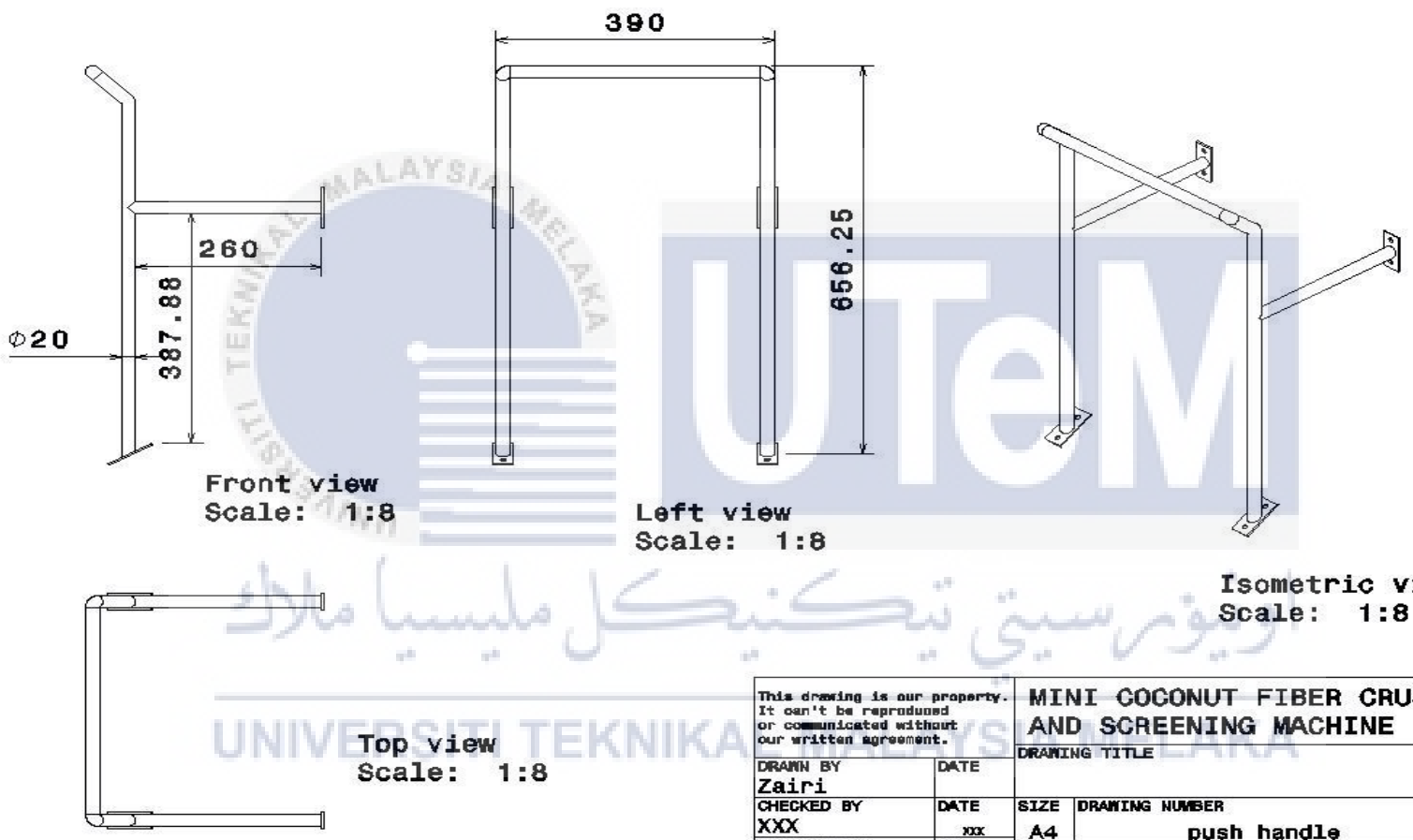


Top view
Scale: 1:8

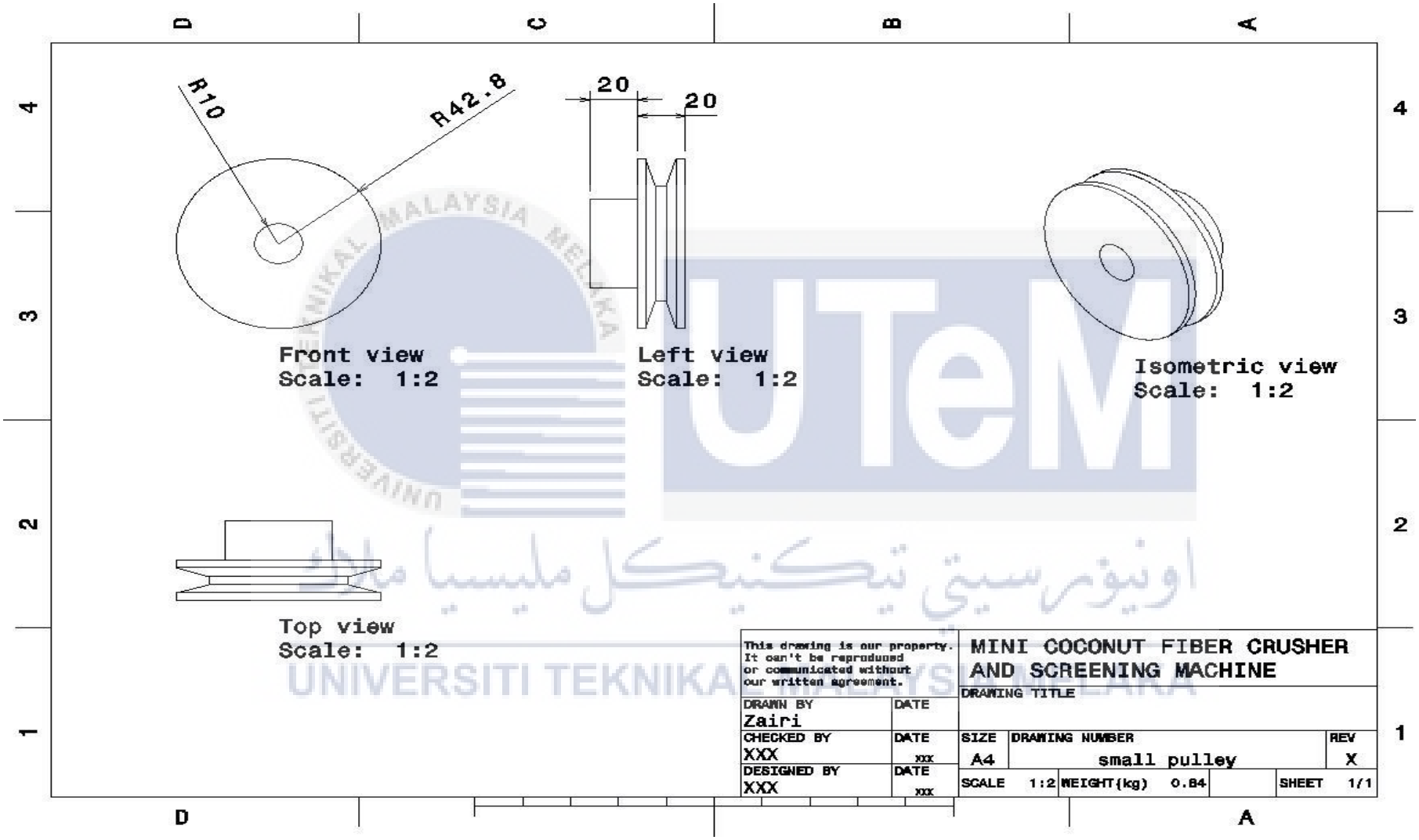
This drawing is our property. It can't be reproduced or communicated without our written agreement.		MINI COCONUT FIBER CRUSHER AND SCREENING MACHINE			
		DRAWING TITLE			
DRAWN BY: Zairi	DATE				
CHECKED BY: XXX	DATE: xxx	SIZE: A4	DRAWING NUMBER: petrol motor		REV: X
DESIGNED BY	DATE	SCALE: 1:8	WEIGHT(kg): 90.80		SHEET: 1/1



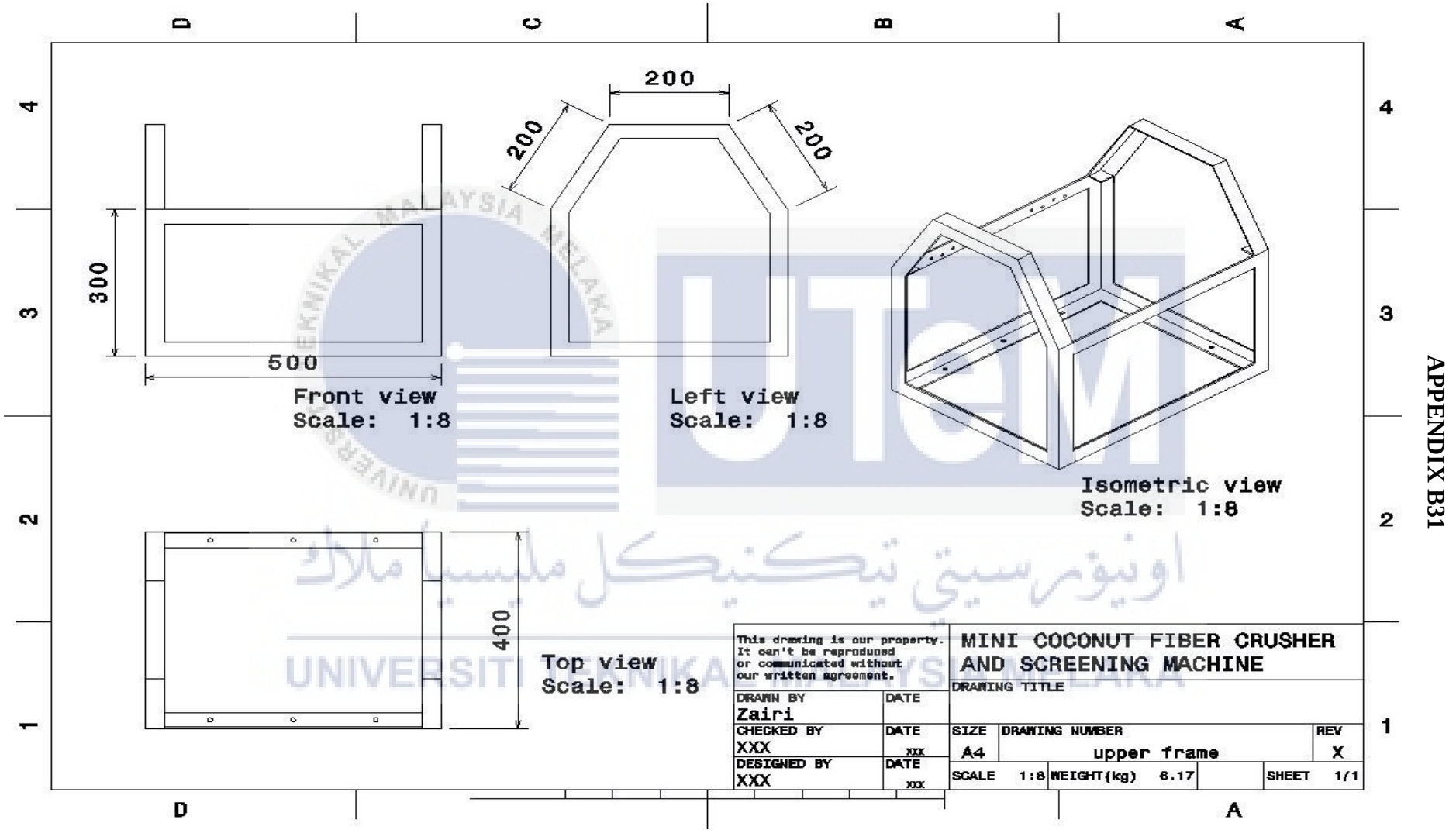
This drawing is our property. It can't be reproduced or communicated without our written agreement.		MINI COCONUT FIBER CRUSHER AND SCREENING MACHINE			
		DRAWING TITLE			
DRAWN BY Zairi	DATE				
CHECKED BY XXX	DATE xxx	SIZE A4	DRAWING NUMBER pull handle		REV X
DESIGNED BY XXX	DATE xxx	SCALE 1:2	WEIGHT(kg) 0.24		SHEET 1/1

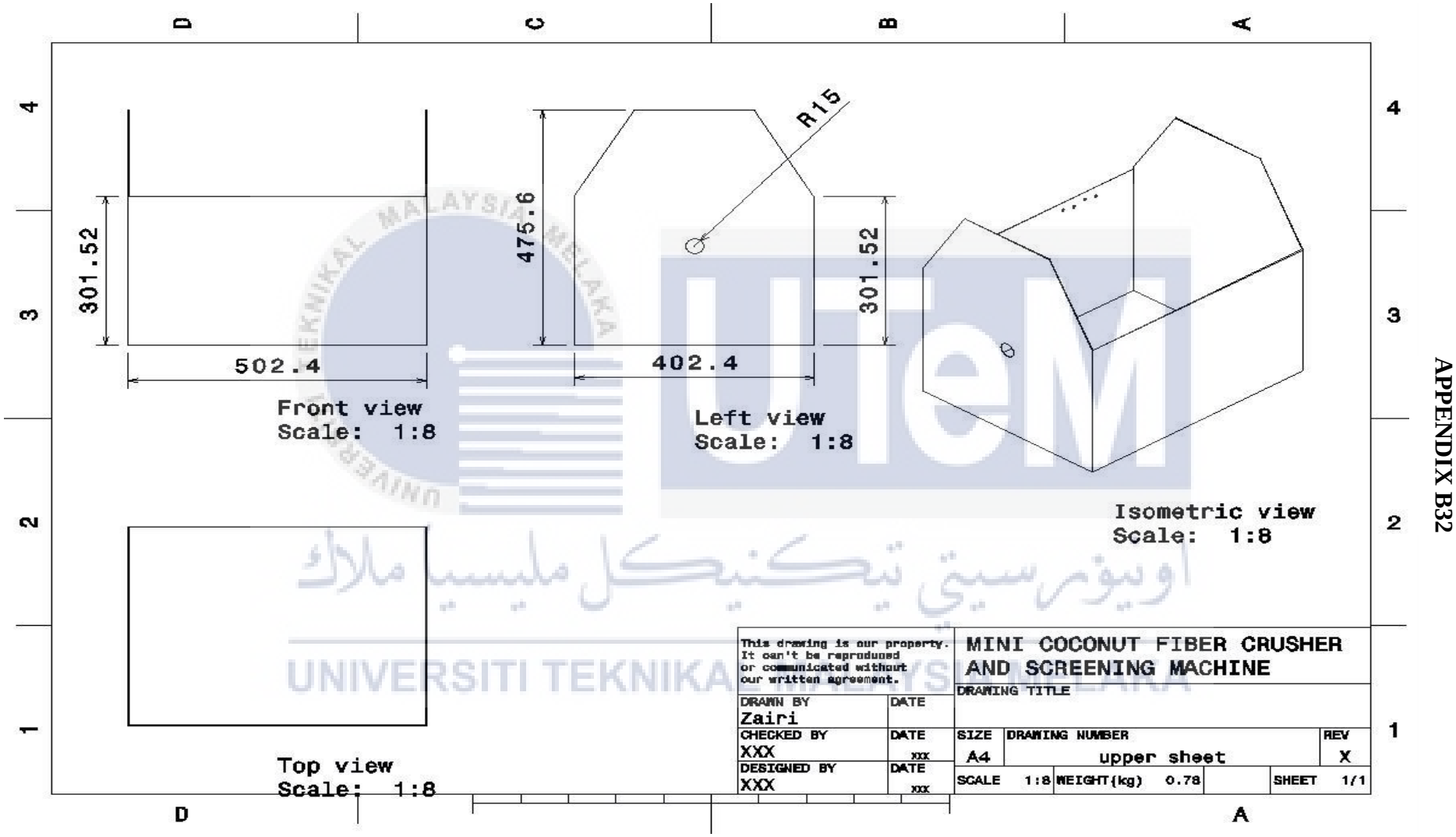


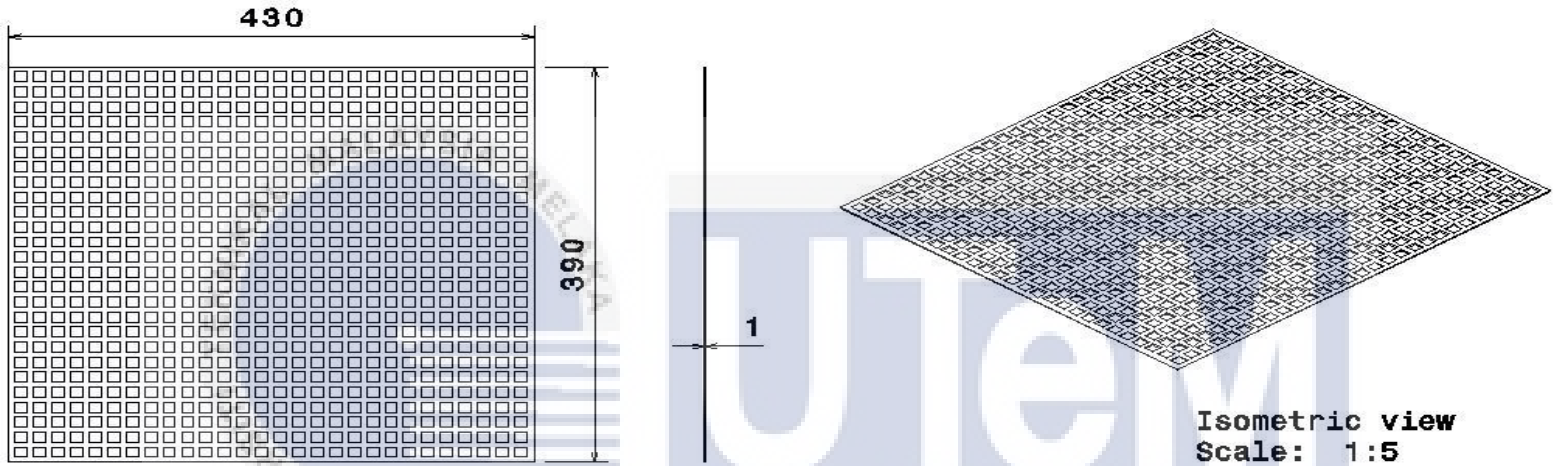
DRAWN BY: Zairi	DATE	MINI COCONUT FIBER CRUSHER AND SCREENING MACHINE			
CHECKED BY: XXX	DATE: xxx	DRAWING TITLE			
DESIGNED BY: XXX	DATE: xxx	SIZE: A4	DRAWING NUMBER: push handle		REV: X
		SCALE: 1:8	WEIGHT(kg): 0.72		SHEET: 1/1



APPENDIX B30


D
C
B
A
4
3
2
1
200
200
200
300
500
Front view
Scale: 1:8
Left view
Scale: 1:8
Isometric view
Scale: 1:8
400
Top view
Scale: 1:8
This drawing is our property. It can't be reproduced or communicated without our written agreement.
MINI COCONUT FIBER CRUSHER AND SCREENING MACHINE
DRAWING TITLE
DRAWN BY
Zairi
DATE
CHECKED BY
XXX
DATE
xxx
DESIGNED BY
XXX
DATE
xxx
SIZE
A4
DRAWING NUMBER
upper frame
REV
X
SCALE 1:8
WEIGHT(kg) 6.17
SHEET 1/1

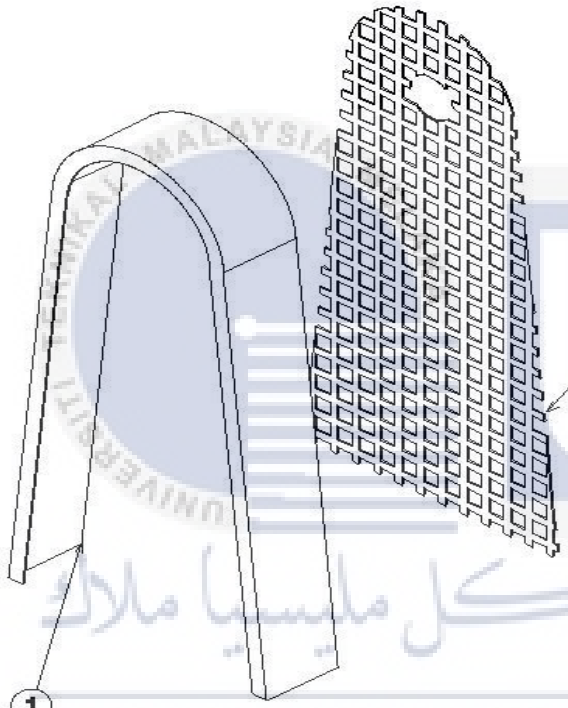




MINI COCONUT FIBER CRUSHER AND SCREENING MACHINE

DRAWING TITLE

DRAWN BY: Zairi	DATE	SIZE: A4	DRAWING NUMBER: wire mesh		REV: X
CHECKED BY: XXX	DATE: xxx				
DESIGNED BY	DATE	SCALE: 1:5	WEIGHT(kg): 0.09		SHEET: 1/1



Isometric view
Scale: 1:3

Bill of Material: belt cover

Number	Part Number	Quantity	Type
1	belt cover frame	1	Part
2	belt cover mesh	1	Part

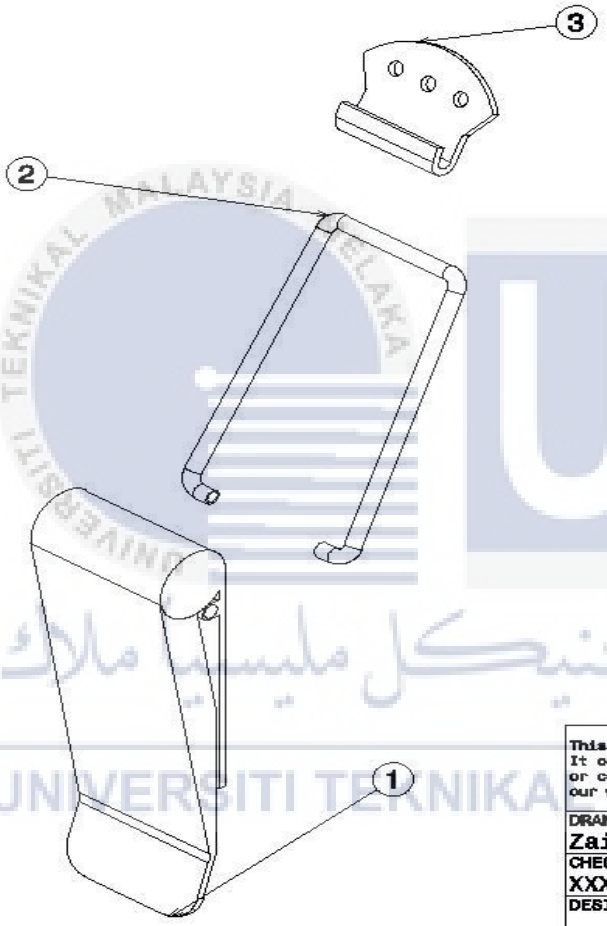
DRAWN BY	Zairi
DATE	
CHECKED BY	XXX
DATE	xxx
DESIGNED BY	XXX
DATE	xxx

MINI COCONUT FIBER CRUSHER AND SCREENING MACHINE

DRAWING TITLE: XXX

SIZE	DRAWING NUMBER	REV
A4	BELT COVER	X

SCALE 1:3 | WEIGHT(kg) XXX | SHEET 1/1



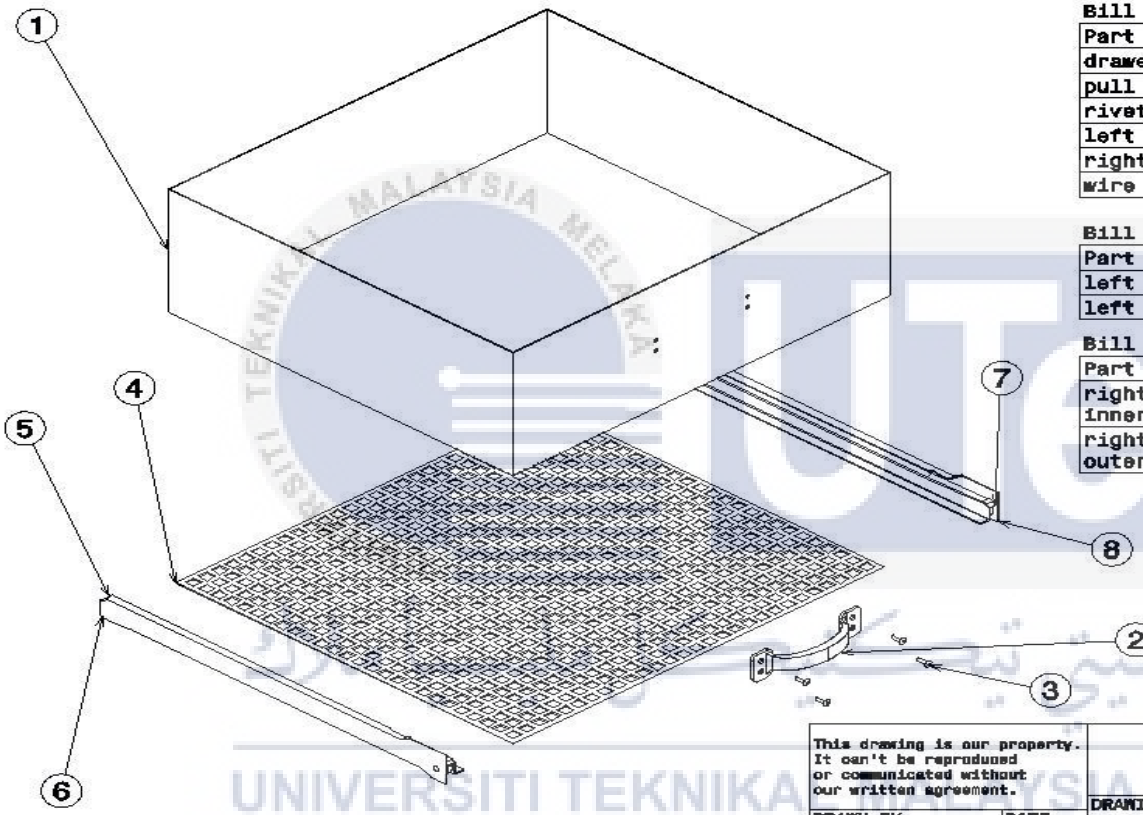
Bill of Material: bumper clip

Part Number	Number	Quantity
lower clip	1	1
middle clip	2	1
upper clip	3	1

Isometric view
Scale: 3:2

MINI COCONUT FIBER CRUSHER AND SCREENING MACHINE

DRAWN BY: Zairi	DATE	DRAWING TITLE			
CHECKED BY: XXX	DATE: xx	SIZE: A4	DRAWING NUMBER: bumper clip		REV: X
DESIGNED BY	DATE	SCALE: 3:2	WEIGHT(kg): 0.03		SHEET: 1/1



Isometric view
Scale: 1:5

Bill of Material: coco fiber drawer

Part Number	Quantity	Type
drawer sheet matel	1	Part
pull handle	1	Part
rivet	4	Part
left side rail	1	Assembly
right side rail	1	Assembly
wire mesh	1	Part

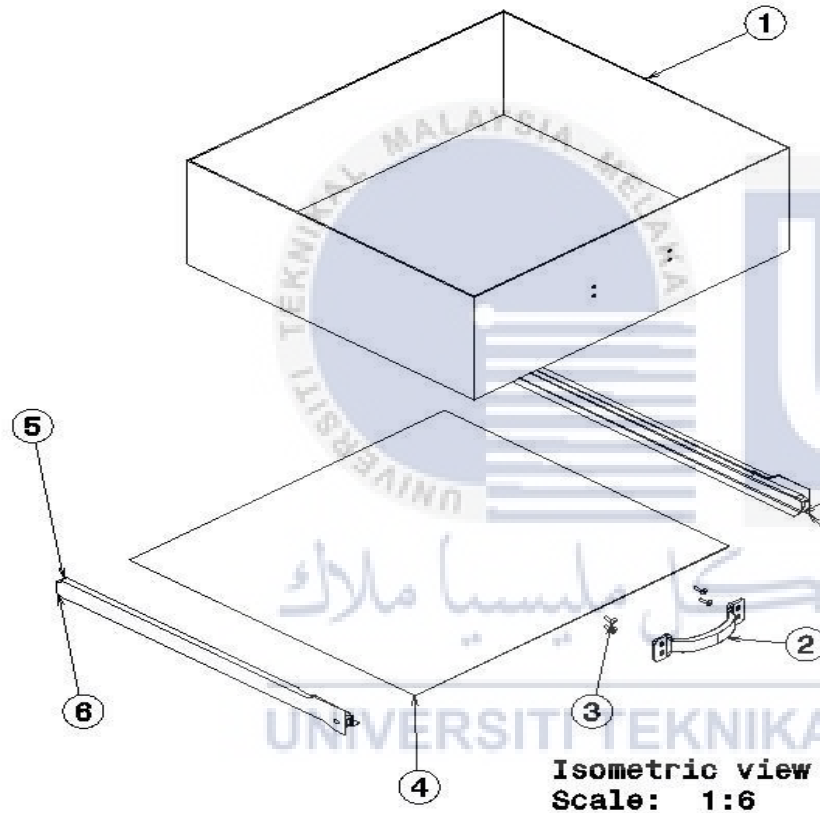
Bill of Material: left side rail

Part Number	Quantity	Type
left side rail inner	1	Part
left side rail outer	1	Part

Bill of Material: right side rail

Part Number	Quantity	Type
right side rail inner	1	Part
right side rail outer	1	Part

DRAWN BY: Zairi	DATE	DASSAULT SYSTEMES			
CHECKED BY: XXX	DATE: xxx	DRAWING TITLE			
DESIGNED BY: XXX	DATE: xxx	SIZE: A4	DRAWING NUMBER: coco fiber drawer		REV: X
		SCALE: 1:6	WEIGHT(kg): 1.09		SHEET: 1/1



Isometric view
Scale: 1:6

Bill of Material: coco peat drawer

Part Number	Quantity	Type
drawer sheet matel	1	Part
pull handle	1	Part
rivet	4	Part
left side rail	1	Assembly
right side rail	1	Assembly
drawer sheet 4.1	1	Part

Bill of Material: left side rail

Part Number	Quantity	Type
left side rail inner	1	Part
left side rail outer	1	Part

Bill of Material: right side rail

Part Number	Quantity	Type
right side rail inner	1	Part
right side rail outer	1	Part

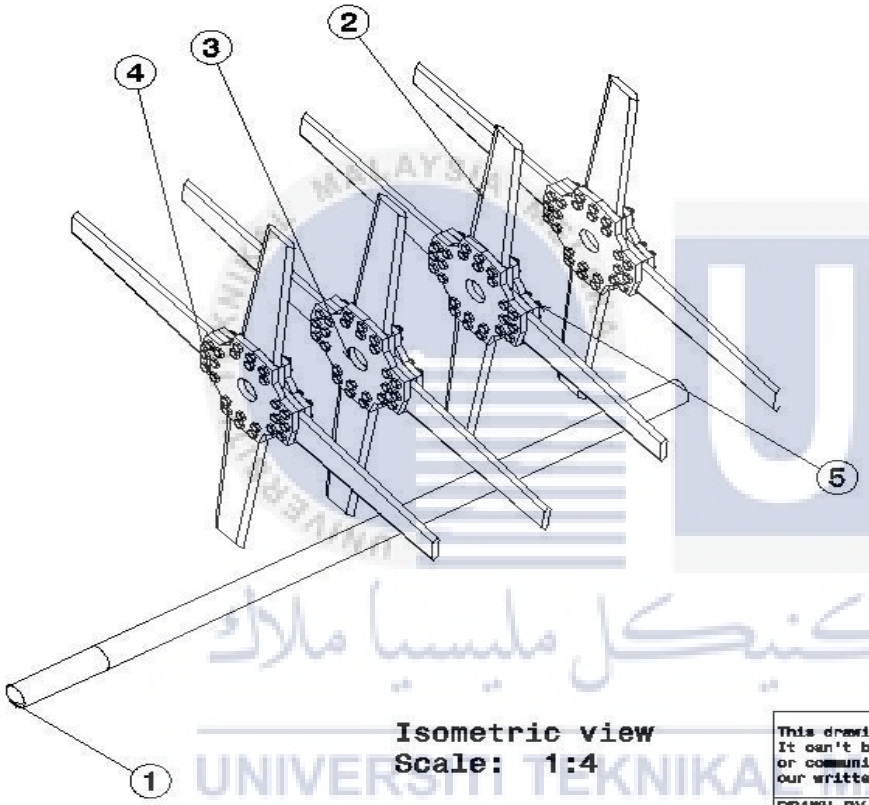
DRAWN BY: Zairi	DATE:
CHECKED BY: XXX	DATE: xxx
DESIGNED BY	DATE

MINI COCONUT FIBER CRUSHER AND SCREENING MACHINE

DRAWING TITLE: XXX

SIZE	DRAWING NUMBER	REV
A4	COCO PEAT DRAWER	X

SCALE 1:6 | WEIGHT(kg) XXX | SHEET 1/1



Isometric view
Scale: 1:4

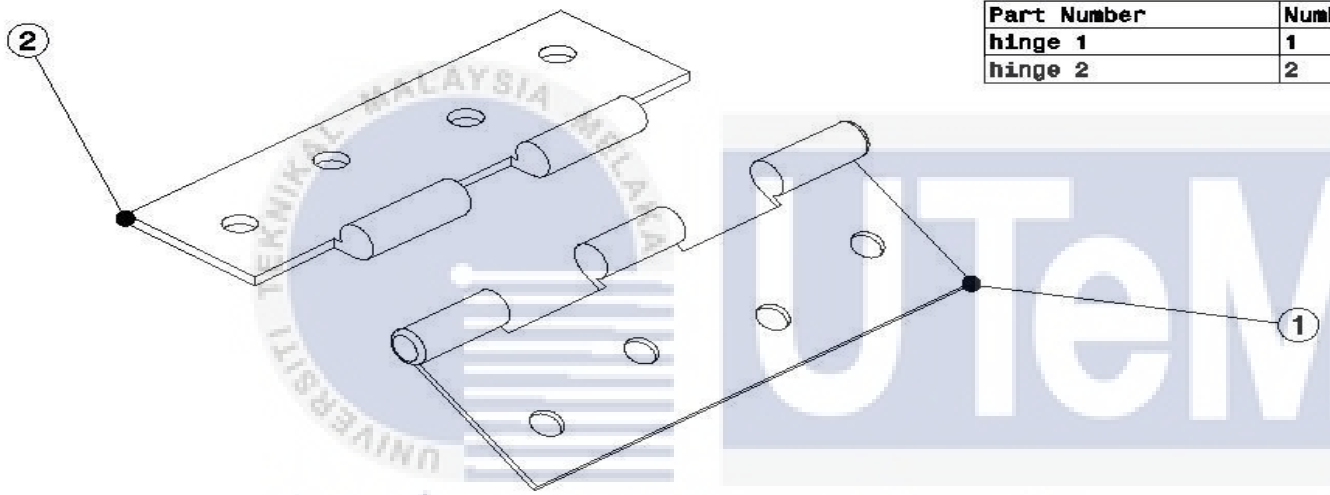
Bill of Material: full blade

Part Number	Number	Type	Quantity
shaft	1	Part	1
joint blade		Assembly	4

Bill of Material: joint blade

Part Number	Number	Type	Quantity
blade	2	Part	4
blade holder	3	Part	2
M4 bolt	4	Part	24
M4 nut	5	Part	24

DRAWN BY: Zairi	DATE	MINI COCONUT FIBER CRUSHER AND SCREENING MACHINE			
CHECKED BY: XXX	DATE: xxx	DRAWING TITLE	SIZE: A4	DRAWING NUMBER: full blade	REV: X
DESIGNED BY: XXX	DATE: xxx	SCALE: 1:4	WEIGHT(kg): 6.78		SHEET: 1/1



Bill of Material: hinge.1

Part Number	Number	Quantity
hinge 1	1	1
hinge 2	2	1

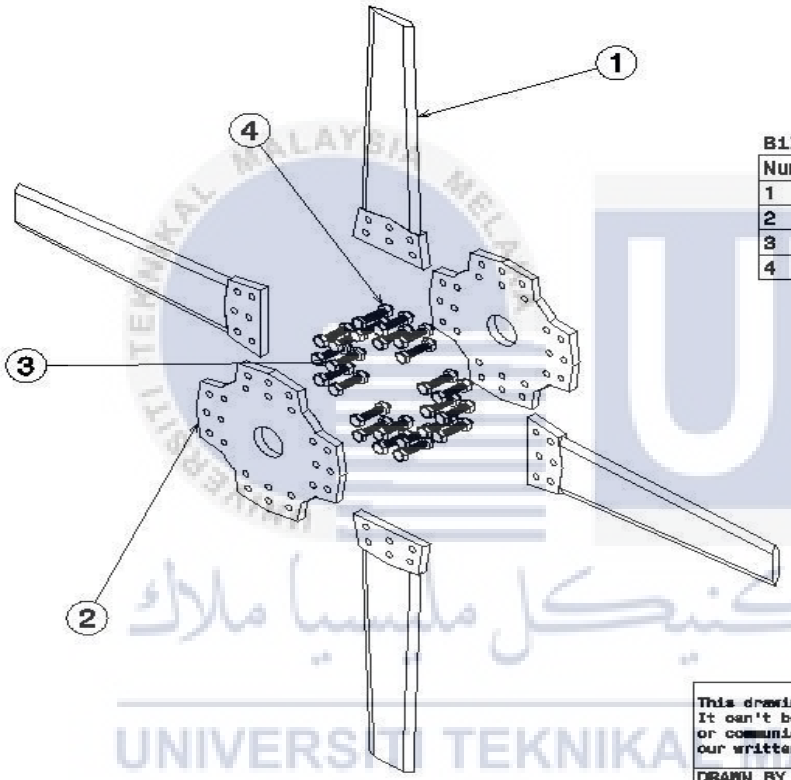
Isometric view
Scale: 1:1

MINI COCONUT FIBER CRUSHER AND SCREENING MACHINE

DRAWING TITLE

DRAWN BY: Zairi	DATE	SIZE: A4	DRAWING NUMBER: hinge.1		REV: X
CHECKED BY: XXX	DATE: xxx				
DESIGNED BY	DATE: xxx	SCALE: 1:1	WEIGHT(kg): 0.12		SHEET: 1/1

XXX



Bill of Material: joint blade

Number	Quantity	Part Number	Type
1	4	blade	Part
2	2	blade holder	Part
3	24	M4 bolt	Part
4	24	M4 nut	Part

Isometric view
Scale: 1:3

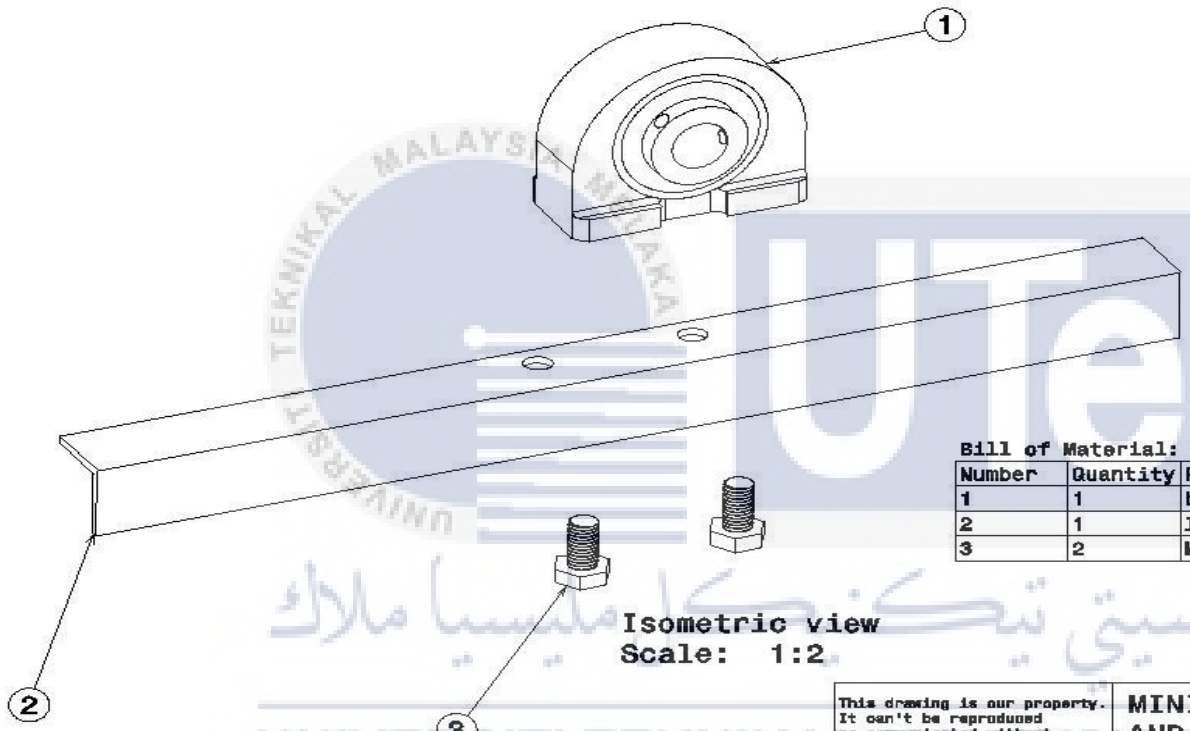
MINI COCONUT FIBER CRUSHER AND SCREENING MACHINE

DRAWING TITLE

DRAWN BY	DATE
Zairi	
CHECKED BY	DATE
XXX	xxx
DESIGNED BY	DATE
XXX	xxx

SIZE	DRAWING NUMBER	REV
A4	joint blade	X

SCALE	WEIGHT(kg)	SHEET
1:3	1.36	1/1



Isometric view
Scale: 1:2

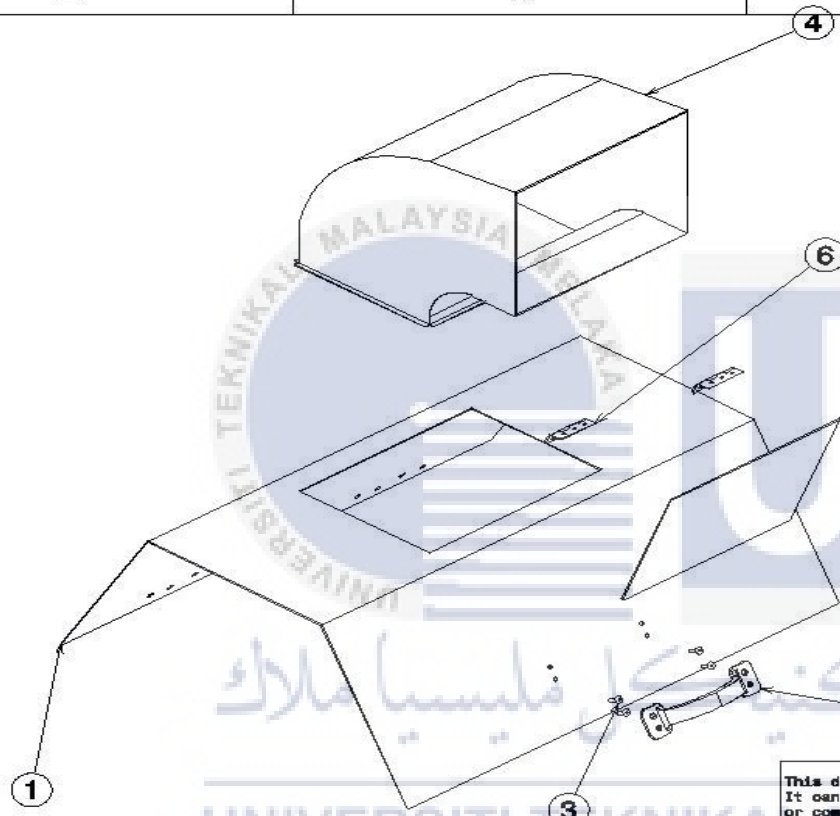
Bill of Material: left bearing

Number	Quantity	Part Number	Type
1	1	bearing	Part
2	1	left bearing frame	Part
3	2	M10 bolt	Part

MINI COCONUT FIBER CRUSHER AND SCREENING MACHINE

DRAWING TITLE

DRAWN BY: Zairi	DATE	SIZE: A4	DRAWING NUMBER: left bearing		REV: X
CHECKED BY: XXX	DATE: xx				
DESIGNED BY	DATE	SCALE: 1:2	WEIGHT(kg): 2.04		SHEET: 1/1



Isometric view
Scale: 1:5

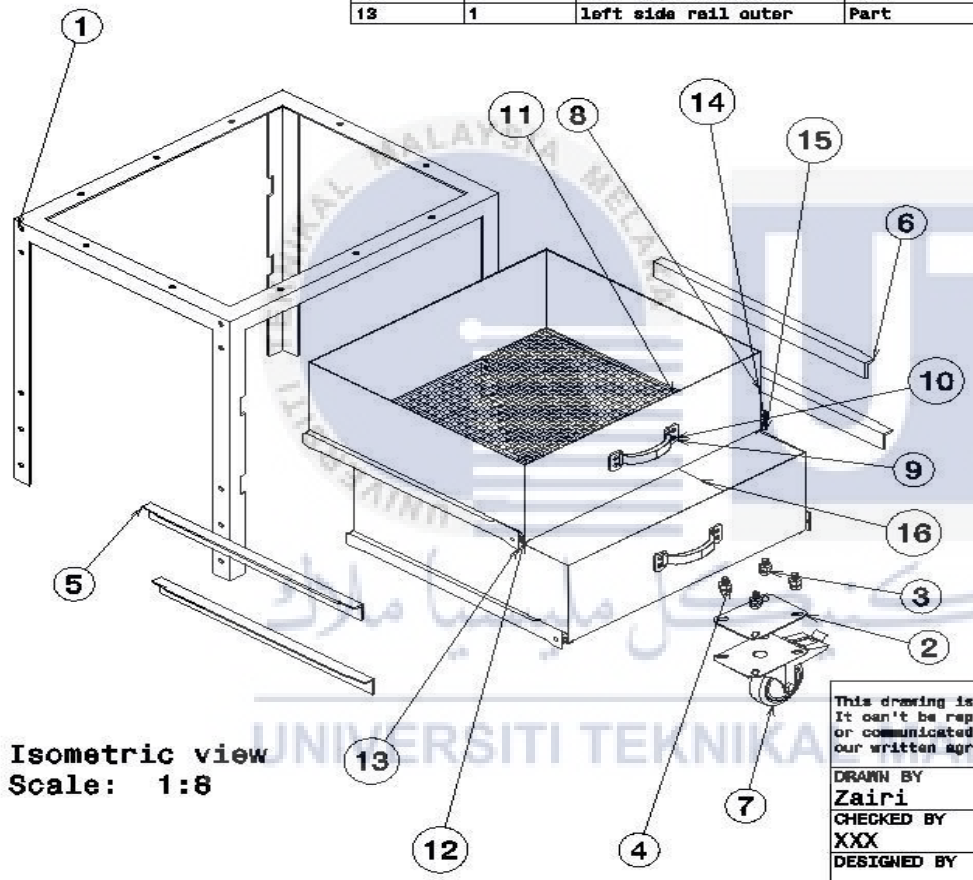
Bill of Material: lid

Number	Quantity	Part Number	Type
1	1	lid sheet metal	Part
2	1	pull handle	Part
3	4	rivet	Part
4	1	hooper	Part
	2	belt cover.1	Assembly
5	1	hopper door	Part

Bill of Material: belt cover.1

Number	Quantity	Part Number	Type
6	2	hinge	Part

DRAWN BY: Zairi	DATE	MINI COCONUT FIBER CRUSHER AND SCREENING MACHINE			
CHECKED BY: XXX	DATE: xxx	DRAWING TITLE	SIZE: A4	DRAWING NUMBER: lid	REV: X
DESIGNED BY: XXX	DATE: xxx	SCALE: 1:6	WEIGHT(kg): 0.82		SHEET: 1/1



Isometric view
Scale: 1:8

Bill of Material: left side rail

Number	Quantity	Part Number	Type
12	1	left side rail inner	Part
13	1	left side rail outer	Part

Bill of Material: lower

Number	Quantity	Part Number	Type
1	1	lower frame	Part
2	2	caster plate	Part
3	8	M8 bolt	Part
4	8	M8 nut	Part
5	2	left railing bar	Part
6	2	right railing bar	Part
	1	coco fiber drawer	Assembly
	1	coco peat drawer	Assembly
7	2	caster wheel with brake	Part

Bill of Material: coco fiber drawer

Number	Quantity	Part Number	Type
8	1	drawer sheet matel	Part
9	1	pull handle	Part
10	4	rivet	Part
	1	left side rail	Assembly
	1	right side rail	Assembly
11	1	wire mesh	Part

Bill of Material: coco peat drawer

Number	Quantity	Part Number	Type
8	1	drawer sheet matel	Part
9	1	pull handle	Part
10	4	rivet	Part
	1	left side rail	Assembly
	1	right side rail	Assembly
16	1	drawer sheet 4.1	Part

Bill of Material: right side rail

Number	Quantity	Part Number	Type
14	1	right side rail inner	Part
15	1	right side rail outer	Part

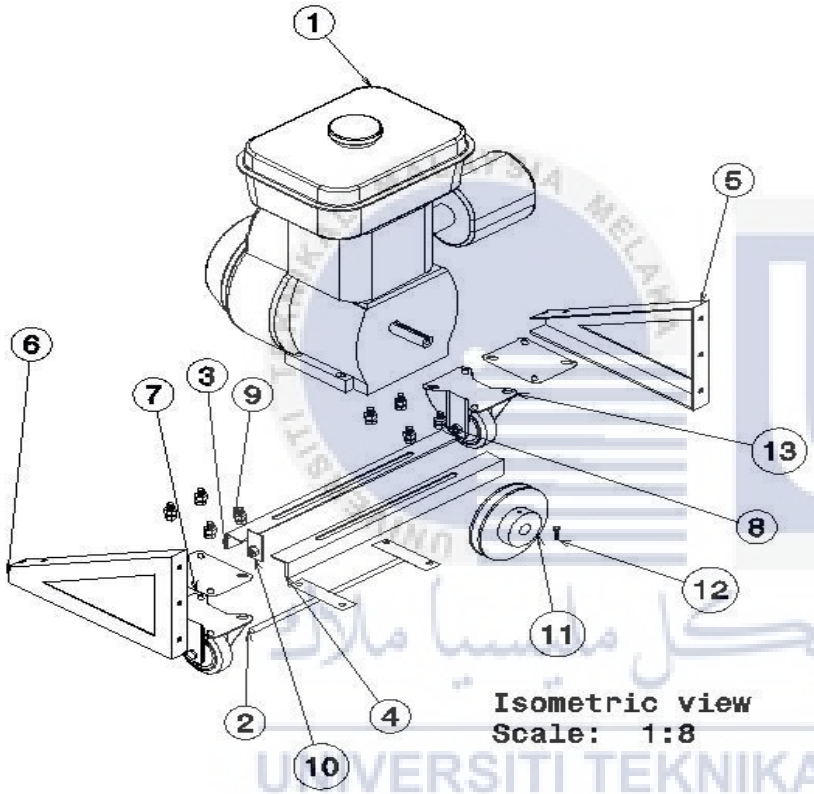
DRAWN BY	Zairi	DATE			
CHECKED BY	XXX	DATE	xxx		
DESIGNED BY		DATE			

MINI COCONUT FIBER CRUSHER AND SCREENING MACHINE

DRAWING TITLE

SIZE	DRAWING NUMBER	REV
A4	lower	X

SCALE	1:8	WEIGHT(kg)	9.18	SHEET	1/2



Isometric view
Scale: 1:8

Bill of Material: motor base

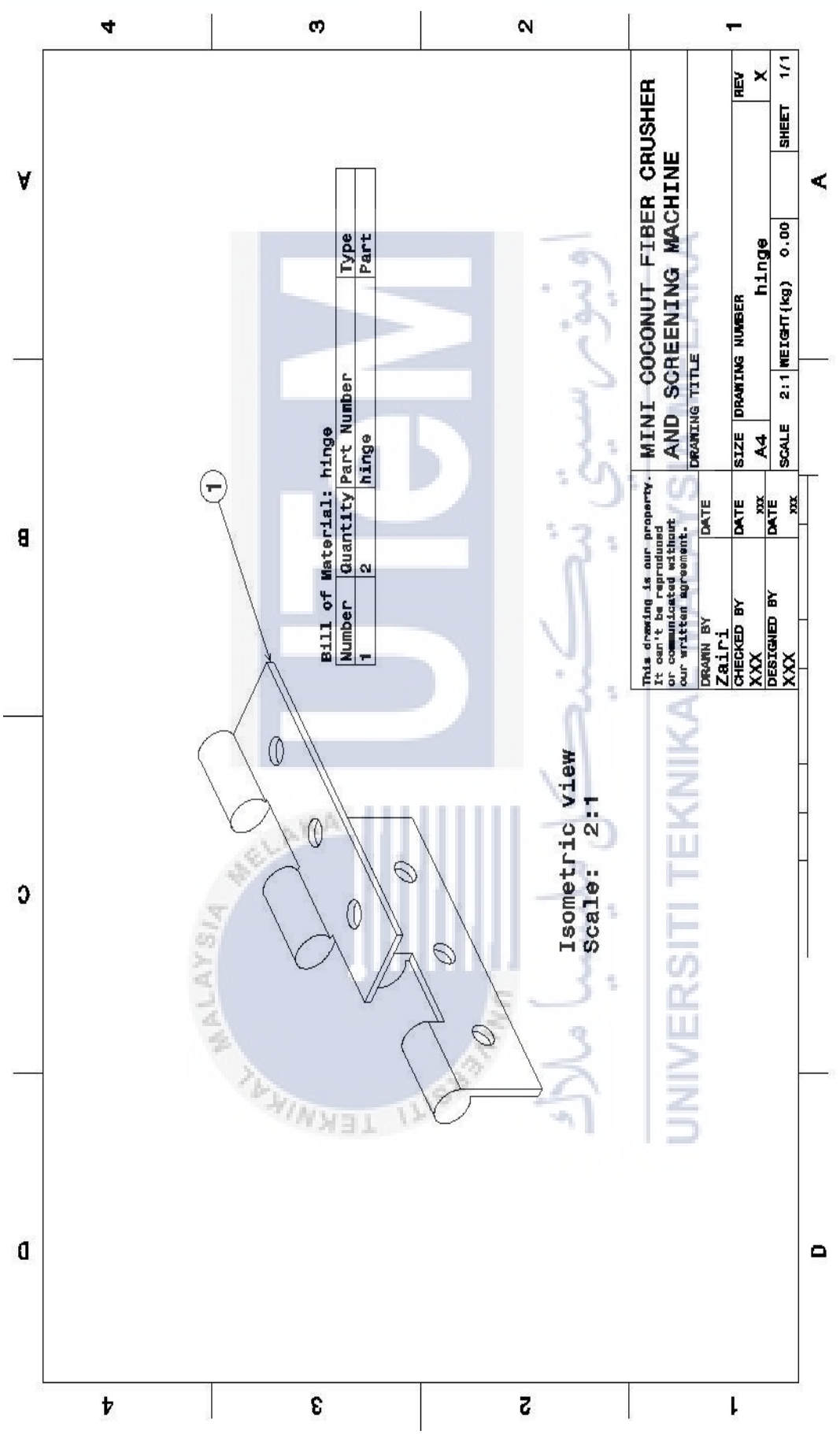
Number	Quantity	Part Number	Type
1	1	petrol motor	Part
2	1	adjuster	Part
3	1	left motor base	Part
4	1	right motor base	Part
5	1	left motor frame	Part
6	1	right motor frame	Part
7	2	caster plate	Part
8	8	M8 bolt	Part
9	9	M8 nut	Part
10	1	plate	Part
11	1	large pulley	Part
12	1	M4 bolt	Part
13	2	caster wheel fix	Part

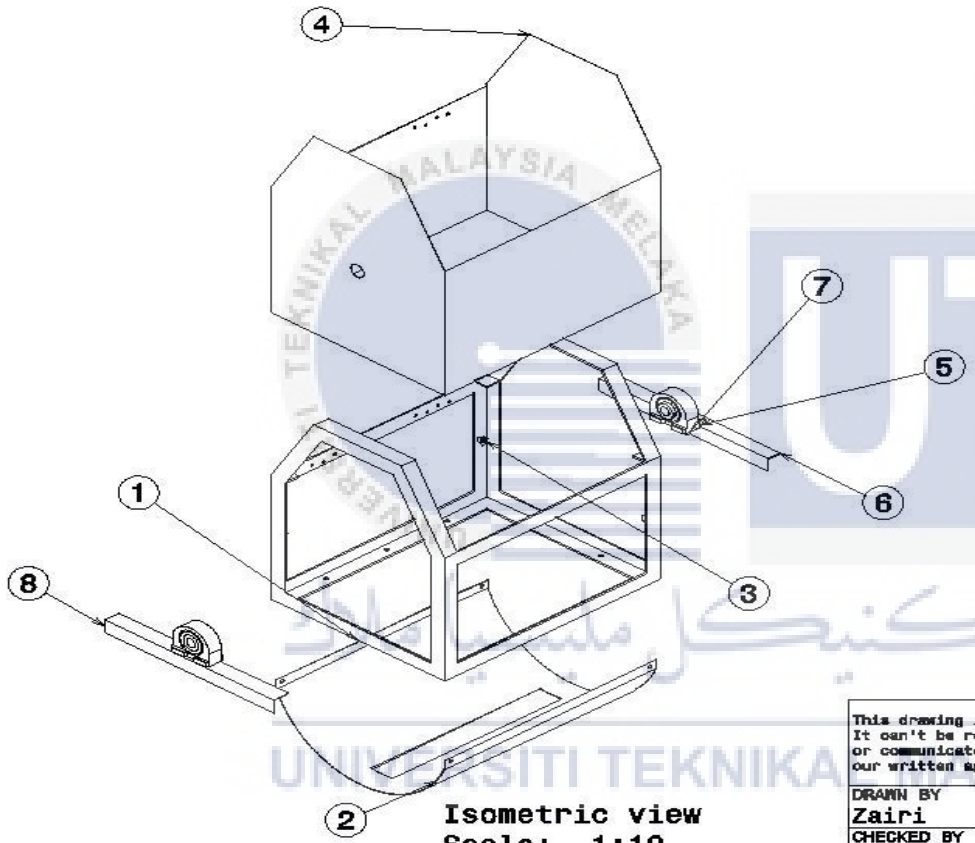
MINI COCONUT FIBER CRUSHER AND SCREENING MACHINE

DRAWING TITLE

DRAWN BY: Zairi	DATE	SIZE: A4	DRAWING NUMBER: motor base		REV: X
CHECKED BY: XXX	DATE: xx				
DESIGNED BY	DATE	SCALE: 1:8	WEIGHT(kg): 96.51		SHEET: 1/1

APPENDIX C12





Isometric view
Scale: 1:10

Bill of Material: upper

Number	Quantity	Part Number	Type
1	1	upper frame	Part
	1	left bearing	Assembly
	1	right bearing	Assembly
2	1	drum	Part
3	4	M8 nut	Part
4	1	upper sheet	Part

Bill of Material: left bearing

Number	Quantity	Part Number	Type
5	1	bearing	Part
6	1	left bearing frame	Part
7	2	M10 bolt	Part

Bill of Material: right bearing

Number	Quantity	Part Number	Type
5	1	bearing	Part
8	1	right bearing frame	Part
7	2	M10 bolt	Part

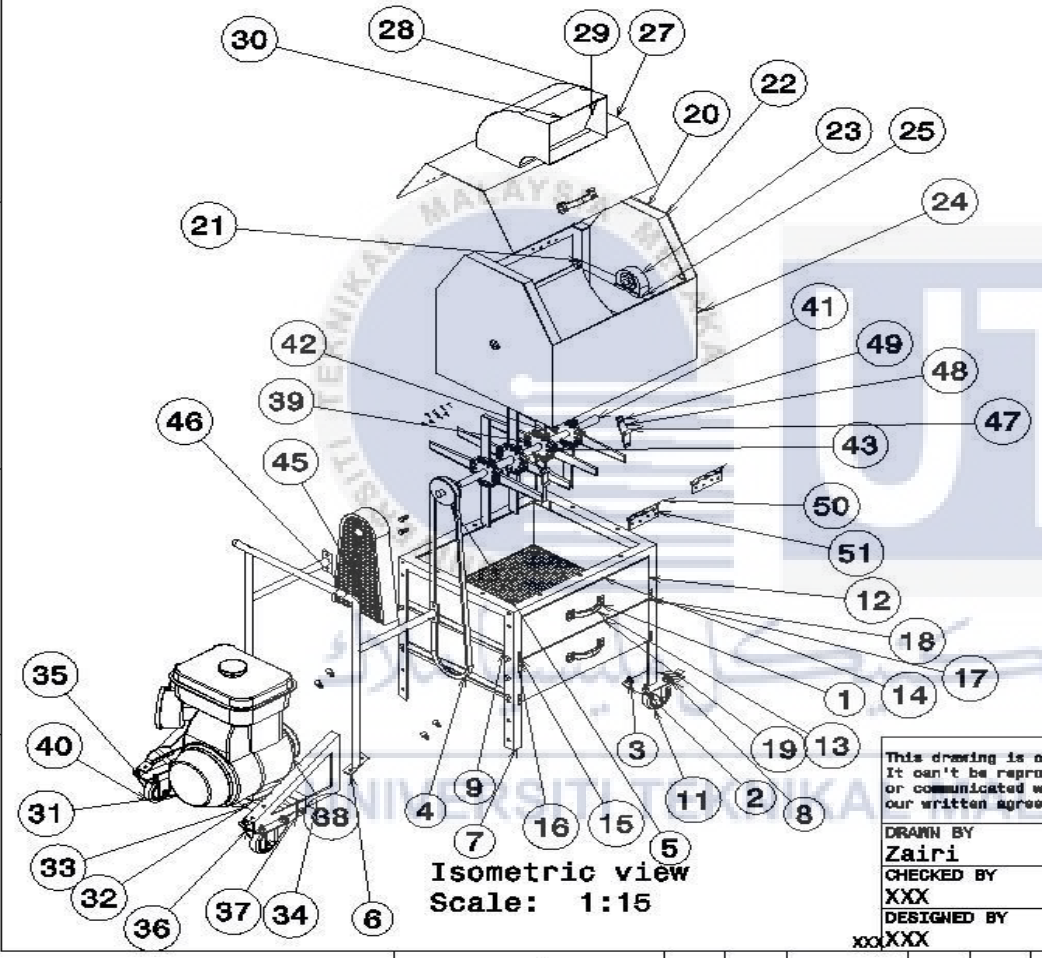
DRAWN BY	Zairi
DATE	
CHECKED BY	XXX
DATE	xxx
DESIGNED BY	XXX
DATE	xxx

MINI COCONUT FIBER CRUSHER AND SCREENING MACHINE

DRAWING TITLE

SIZE	DRAWING NUMBER	REV
A4	upper	X

SCALE	WEIGHT(kg)		SHEET
1:10	11.38		1/1



Bill of Material: Product1

Number	Quantity	Part Number	Type
	1	lower	Assembly
	1	upper	Assembly
	1	lid	Assembly
1	16	rivet	Part
2	14	M8 bolt	Part
3	6	M8 nut	Part
	1	motor base	Assembly
4	1	v belt	Part
5	1	small pulley	Part
	1	full blade	Assembly
	1	belt cover	Assembly
8	1	push handle	Part
	2	bumper clip	Assembly
	2	hinge.1	Assembly

Bill of Material: lower

Number	Quantity	Part Number	Type
7	1	lower frame	Part
6	2	caster plate	Part
2	8	M8 bolt	Part
3	6	M8 nut	Part
9	2	left railing bar	Part
10	2	right railing bar	Part

DRAWN BY	DATE	MINI COCONUT FIBER CRUSHER AND SCREENING MACHINE			
Zairi	6/2/2019	DRAWING TITLE			
CHECKED BY	DATE	SIZE	DRAWING NUMBER		REV
XXX	XXX	A4	FULL		X
DESIGNED BY	DATE	SCALE 1:15	WEIGHT(kg) 126.86		SHEET 1/1
XXXXXX					