

HYDRAULIC JACK ROLLER BENDER

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ABSTRAK

Mesin lenturan gulung adalah merupakan sejenis mesin yang dapat melenturkan bahan kerja iaitu kepingan logam menjadi bentuk bulat. Ia biasanya mempunyai tiga penggelek yang digunakan untuk melenturkan kepingan logam berkenaan. Lazimnya selepas proses melentur atau membengkokkan kepingan logam, bahan kerja tersebut kemudiannya perlu melalui proses pemotongan mengikut saiz panjang yang diperlukan. Di pasaran, mesin lenturan gulung kebiasaannya tidak didatangkan dengan konsep 2 dalam 1 iaitu mempunyai kemudahan melentur bahan kerja dan juga boleh memotong lebihan bahan kerja. Biasanya bahan kerja perlu melalui proses pemotongan secara berasingan dengan proses lenturan iaitu dengan menggunakan mesin pemotong. Di samping itu, mesin lenturan gulung di pasaran juga tidak mempunyai kemudahan membengkokkan bahan kerja pada sudut 90°. Oleh itu, projek '*Hydraulic Jack Roller Bender*' telah dibangunkan bagi menyelesaikan masalah-masalah berkenaan. Objektif projek ini adalah untuk mereka bentuk mesin lenturan gulung 2 dalam 1 yang dapat melenturkan bahan kerja, memotong dan membengkokkan bahan kerja sehingga sudut 90°. '*Hydraulic Jack Roller Bender*' ini adalah merupakan satu projek inovasi yang mensasarkan bagi kegunaan pekerja tapak binaan bangunan dan juga kontraktor pengubahsuaian. Keseluruhan fabrikasi mesin ini dilakukan di Hardtech Engineering Workshop, Kulim, Kedah. Bahan utama yang digunakan untuk mesin ini adalah keluli lembut. Hasil daripada pengujian operasi menunjukkan bahawa '*Hydraulic Jack Roller Bender*' ini dapat melenturkan kepingan logam menjadi bentuk bulat dan dapat memotong bahan kerja pada sudut 90° dan 45°. Selain itu, ia juga dapat membengkokkan bahan kerja pada sudut 90°. Secara kesimpulannya, pembangunan dan inovasi '*Hydraulic Jack Roller Bender*' ini telah berjaya mencapai objektif yang disasarkan.

CHAPTER 1

INTRODUCTION

1.1 Introduction

A bending machine is a machine that commonly used in industries and building construction to execute a bending work on the work piece. A bending machine is a type of machine tool. A machine tool is that usually discharge a bending, cutting, boring, grinding shearing and other type of deformation. A bending machine is forming a bend on metal sheet, metal pipe or a metal rod by an application that is called as a bending tool. There are various types of bending tools are used for different type bending works. A bending work is carried out by exert a pressure on a certain length of the work piece at a certain point. The applied force is known as the bending moment. The force of the bending moment regulated the degree of the deformation.

A roller bending machine is a type of bending machine that widely used in industries. A roller bending machine utilize a roller as a bending tool to bend the work piece. The roll bending work are one of the most not comparable method because there no sheet metal is been cut or removed. The sheet metal can be bent uniformly circular shape due to the arrangement of the rollers relative to each other.

In principle, there are two rollers at the lower and one roller at the upper. The lower roller that at the part which attached to the hydraulic jack is adjustable. The upper roller and the lower roller that at another side which are in static while the bending work is carry out. The lower roller that is adjustable, which is able to apply a force to the work piece, where the upper roller in pressed onto the work piece. Therefore, the deeper the work piece has been set

at the centre of the roller, the smaller the bending radius. The force applied on the work piece is contributed by the hydraulic jack. The greater the force been applied, the smaller the bending diameter. When rotating the upper roller there is a friction between the work piece and the roller. Due to the friction between the work piece and the roller, the work piece moves in advance. By adjusting the position of the lower roller which is adjustable, the desired bending angle can be achieved.

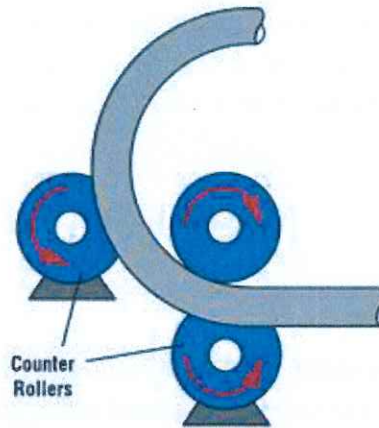


Figure 1.1 Block Figure of Roller Benderⁱ

1.2 Problem Background

The components in the roller bending machine is divided into two section which is the roller section and the hydraulic jack section. The roller section is containing rollers and bearings which is playing a role as a bending tool to bend the work piece. The bearings are used to give easy and convenient motion to the shaft which is the roller. The hydraulic jack section is containing a hydraulic bottle jack which is used to produce a force to bending works. The most common process which have been carried out after the work piece have been bend is a cutting process. The work piece has to be cut out from the machine according to the required length after bending. The existing roller bending machine which available in the market does not have a cutting facility to cut the excess work piece. The work piece to separately take out to carry out a cutting process. Besides that, the circular bending and the 90° angle bending are a common most bending works. The existing roller bending machine does not contain a 90° angle bending facilities to bend the work piece up to 90° angle.

To understand more about the problem that faced in the existing roller bending machine, an interview was arranged with Mr. Ravi, a renovation contractor at Kulim, Kedah. He has 20 year working experience in this field. From his experience in using the existing roller bending machine, the first problem he has to face is the existing roller bending machine

does not have cutter to cut the work piece while the bending was carried out. This issue cause to spend more time and effort to cut the work piece separately. The cutter machine also has to bring along to the cut the work piece. Otherwise, the second problem that he has to face while using an existing roller bending machine is it does not have a 90° angle bending facility to bend the work piece up to 90° angle. The most of the steel that he bent to do the housing renovation is a circular bend and 90° angle bend. He has manually bent the steel by using his hands to get an approximately 90° angle. He said that he always has to suffered while there is a 90° bending work because it has to be very accurate, if not means the assembly will tilted. Moreover, from his opinion to solve these problems is by adding a cutting and a 90° angle bending facilities on roller bending machine to make it more advance and user friendly.

1.3 Problem statement

Figure 1.3 is showing the existing roller bending machine which use to bend the work piece in a circular angle. The existing roller bending machine not able to cut the work piece, because it does not contain any cutting facilities. The work piece has to be take apart from the roller bending machine to carry out a cutting process. A cutting feature have to be added up on the roller bending machine to cut work piece while bending. Moreover, the most common metal sheet bend are circular bend and 90° angle bend. The existing roller bending only able to bend the work in a circular angle, not able to bend in 90° angle. A 90° angle bending feature have to been add up to the existing roller bending machine to bend the work piece up to 90° angle.



Figure 1.3 The existing roller bending machineⁱⁱ

1.4 Objective

The objective of this project is:

- i. To fabricate a 2 in 1 roller bending machine which can bend and cut the work piece.
- ii. To design a roller bending machine which able to bend the work piece up to 90^0 angle.

1.5 Scope of project

The scope for this project is:

1. This bending machine able to bend a pipe/metal sheet up to 5mm in required angular shape
2. The maximum force capacity of this bending machine is 2ton, because this machine is function with 2ton lift capacity hydraulic jack.
3. The estimated users of this hydraulic jack roller bender is the construction side workers and the renovation contractor.

1.6 The advantages in fabrication of the project

This project will produce a huge measure to the consumer at industries, especially construction industries. This project is an user friendly project, because it can reduce the human effort by using a hydraulic concept. This bending machine is producing the force to bend the work piece with hydraulic bottle jack, so that the consumers does not need to effort a lot force operating it. This project is good in mobility, so that the consumer able to use for any travelling works. It is because, the size and the mass of the hydraulic jack roller bender have been reduced to increase the mobility of the project. On the other hand, this bending machine is having very good stability due to the project was construct with a mild steel. The base part of the machine is wider than the top part, so that the machine is very stable. Moreover, this bending machine is a 2in1 concept machine which can bend and cut the work piece. By designing this project, the consumer able to safe their time usage due to carried to bending and cutting at the same time. Otherwise, this bending machine is able bend the work piece in circular and angular shape. This is due to the machine was designed with a roller bender and an angle bender. This bending machine is able bend the work piece up to 90° angle. Furthermore, this bending machine applies the right kind of simple force to bend the work piece ensuring that the work piece are not exposed to excessive manipulation or unnecessary damage.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

A roller bending machine is widely used in industries to carry out bending work. There are various type of bending machines are available in market. All type of bending machine have their own characteristic and specialty. A roller bending machine is essentially a forming machine tool with the main purpose being to assemble a bend on a work piece. This chapter will examine the types of roller bending machines that have been developed previously to execute operating mechanisms, design and manufacturing costs. A research was carried out by our team with a selecting a bending machine that almost similar to the criteria with our project.

2.2 Design of existing roller bending machine

Through the literature review that have been made, it is found that most of the designs of the manual roller bending machines is able to bend a metal sheet only, it is due to low bending capacity of the machine. The automatic roller bending machine have a high bending capacity, so that it able to bend metal pipe and rod too.

Product	Reference	Mechanism	Main material	Cost
Manual sheet bending machine	Wellon machinery	Manual	Cast iron	RM 930.00
G76 Metal bending machine	Mscdirect	Automatic	Cast iron	RM5,200.00
1/2"-4" Manual Hydraulic Bending Tool	Direct industry	Manual	Cast iron	RM1,400.00
Electrical Roller Bender	Hackaday	Automatic	Aluminium	RM2,600.00
3-roll plate bending machine	Direct industry	Manual	Cast iron	RM4,800.00
SAF - BS40M Roller bender	Quantum machinery group	Automatic	Cast iron	RM1,640.00

Table 2.1 Eagle table of product specifications

2.2.1 Manual sheet bending machine



Figure 2.1 Manual sheet bending machineⁱⁱⁱ

2.2.1.1 Introduction

A Manual sheet bending machine is a manual roller bending machine which use in a small scale bending works. This bending machine is most commonly used in a workshop. This bending machine has simple operating system which easier to operate by the users.

2.2.1.2 Specification

- i. Bend metal sheet only
- ii. Bend in a circular shape
- iii. Less bending capacity
- iv. Mobile
- v. More effort needed to operate
- vi. Less space consuming
- vii. Does not have a cutting facility
- viii. Does not have a 90° angle bending facility

2.2.2 G76 Metal bending machine

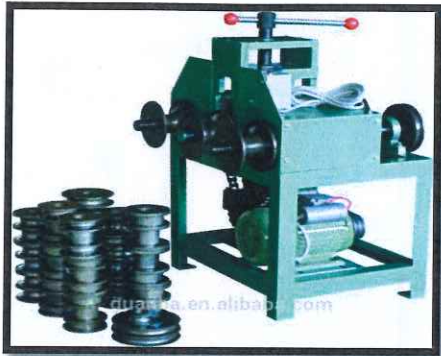


Figure 2.2 G76 Metal bending machine^{iv}

2.2.2.1 Introduction

A G76 bending machine is a automated roller bending machine which able to bend the metal sheet /rod/pipe in various diameter and thickness. This bending machine is widely used in the industries especially in a manufacturing section. Besides that, this is also used in a contractor workshop. This machine is a motor system based which used a sprocket and chain mechanism.

2.2.2.2 Specification

- i. Bend metal sheet/pipe/rod
- ii. Bend in a circular shape
- iii. High bending capacity
- iv. Immobile
- v. Less human effort needed to operate
- vi. Huge space consuming
- vii. Does not have cutting facility
- viii. Does not have 90° angle bending facility

2.2.3 1/2"-4" Manual Hydraulic Bending Tool



Figure 2.3 1/2"-4" Manual Hydraulic Bending Tool^v

2.2.3.1 Introduction

A 1/2"-4" Manual Hydraulic Bending Tool is manual roller bending machine which able to bend a metal sheet only due to the moderate bending capacity of the machine. This machine are 3 rollers bending machine with a hydraulic jack as a force supplier. This bending machine is small scale bending work machine which usually used in a workshop.

2.2.3.2 Specification

- 1) Bend metal sheet only
- 2) Bend in a circular shape
- 3) Moderate bending capacity
- 4) Mobile
- 5) Less human effort needed
- 6) Less space consuming
- 7) Does not have a cutting facility
- 8) Does not have 90° angle bending facility

2.2.4 Electrical Roller Bender



Figure 2.4 Electrical Roller Bender^{vi}

2.2.4.1 Introduction

An Electrical Roller Bender is a automated roller bending machine with a motor system based which used a sprocket and chain mechanism. This machine was used for the small scale bending works due to the low bending capacity of the machine. This machine is mostly used at the small workshops.

2.2.4.2 Specifications

- i. Bend metal sheet/pipe
- ii. Bend in a circular shape
- iii. Low bending capacity
- iv. Immobile
- v. Less effort needed to operate
- vi. Less space consuming
- vii. Does not have a cutting facility
- viii. Does not have 90° angle bending facility

2.2.5 3-roll plate bending machine

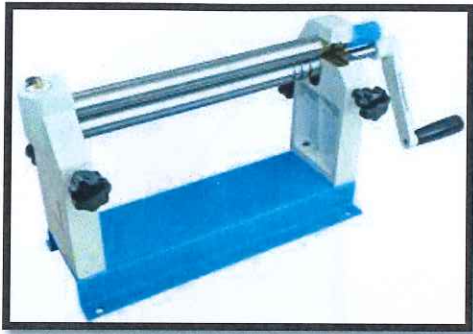


Figure 2.5 3-roll plate bending machine^{vii}

2.2.5.1 Introduction

A 3-roll plate bending machine is a manual roller bending machine which able to bend metal sheet only. This bending machine is usually used in industries for a hand forming sheet metal part.

2.2.5.2 Specifications

- 1) Bend metal sheet only
- 2) Bend in a circular shape
- 3) Moderate bending capacity
- 4) Immobile
- 5) More effort needed to operate
- 6) Less space consuming
- 7) Does not have a cutting facility
- 8) Does not have 90° angle bending facility

2.2.6 SAF - BS40M Roller bender

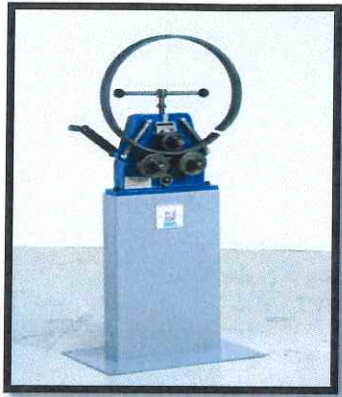


Figure 2.6 SAF - BS40M Roller bender^{viii}

2.2.6.1 Introduction

A SAF-BS40M Roller bender is an automated roller bending machine which able bend a metal/rod/pipe in circular shape. This machine is mostly used at the industries or workshops to carry out a heavy duty bending works. Due to the high bending capacity, this machine able carry out a heavy duty bending works. The bending of this machine is very precision and accurate.

2.2.6.2 Specifications

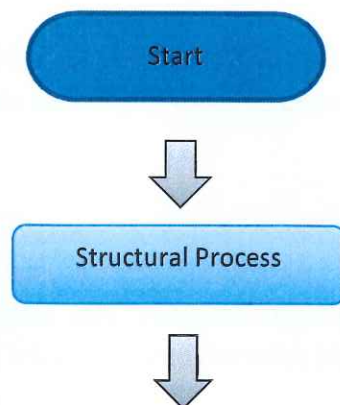
- i. Bend metal sheet/rod/pipe
- ii. Bend in a circular shape
- iii. Moderate bending capacity
- iv. Immobile
- v. Less effort needed to operate
- vi. Less space consuming
- vii. Does not have a cutting facility
- viii. Does not have 90° angle bending facility

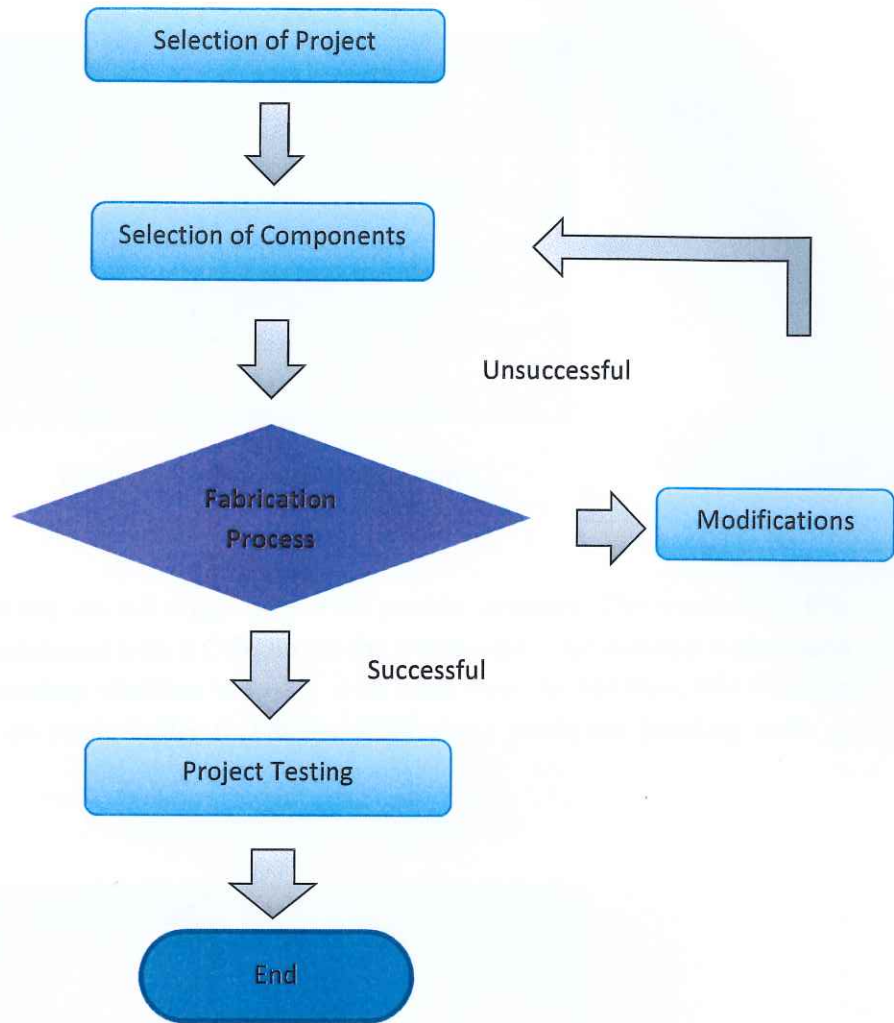
CHAPTER 3

METODOLOGY

3.1 Introduction

This chapter is mainly focus on the designing and fabrication process of the Hydraulic Jack Roller Bender. This chapter contains the theory of hydraulic jack functions, the concept selection and design of hydraulic jack, technical drawing, selection of material and the selection of components. The flowchart below showing the design and fabrication process of Hydraulic Jack Roller Bender.





3.2 Selection of Concept and Structure of Project

In an initial stage, there are three suggestion of potential project structure. The figures 3.2, 3.3 and 3.4 is shows the isometric drawing of those three structures.

Figure 3.2 is showing the structure of roller bending machine. This machine is was constructed with aluminium plates for the framework. The applications in this bending machine are fully with a stainless steel material. This bending machine is containing a hydraulic jack which is produce a force to bend the work piece.

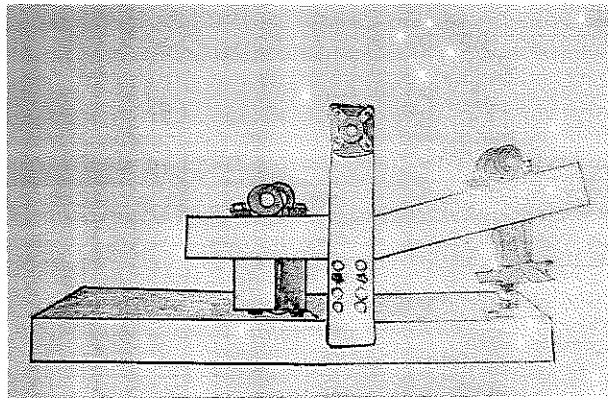


Figure 3.2. Structural suggestion 1

The figure 3.3 is shows the second suggestion of the project structure. The structure of this bending machine was constructed with a C-beam for the framework. The material which used for applications of this bending machine are fully with mild steel. In addition, this bending machine added on with an angle cutter to cut the work piece while the bending work is carried out.

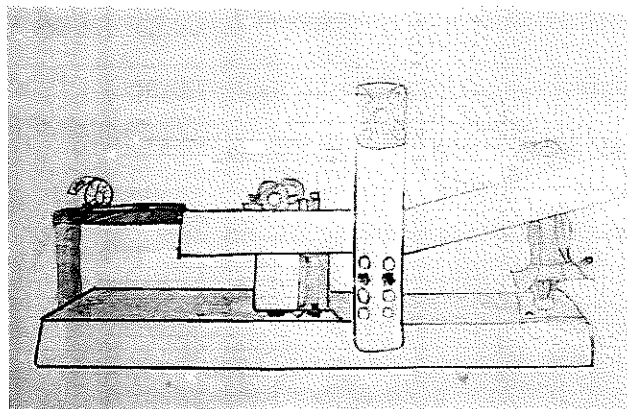


Figure 3.3. Structural Suggestion 2

Figure 3.4 shows the third suggestion of the project structure. The structure of this bending machine is constructed with a C-beam. The material which use for application of this bending machine are mild steel. This roller bending machine are also having a angle cutter which is able cut the work piece while the bending work is carry out. In addition, the roller bending machine having a 90° angle bender which able to bend the work piece up to 90° angle.

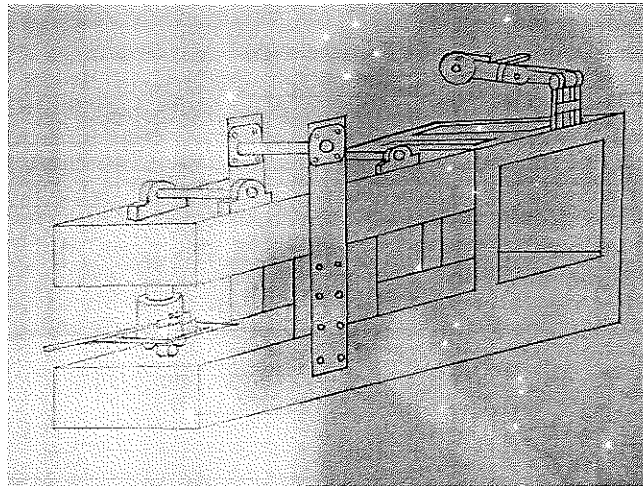


Figure 3.4. Structural suggestion 3

Table 3.1 is defining the summary of the comparison between the all 3 structural suggestion.

Table 3.1. The summary of structural suggestion

Suggestion	Characteristic & Advantages	Disadvantages
Suggestion 1	a. Components material (Stainless steel)	a. Structural material (soft metal) b. Weak structure
Suggestion 2	a. Having a angle cutter b. Structural material (hard metal)	a. Weak structure
Suggestion 3	a. Having a angle cutter b. Having a 90° angle bender c. Structural material (hard metal)	a. Space consuming

The best structure will select by using a matric rating method. There are 6 criteria that need to be considered for selecting the best project structural. Table 3.2 define the rating of project structural selection.

Table 3.2. Matric comparison between the structures

No.	Criteria	Idea 1	Idea 2	Idea 3
1	Integrity	5	5	5
2	Bending efficient	3	4	5
3	Material cost	4	4	4
4	Save energy consumption	2	3	5
5	Commercial structure	3	4	5
6	Mobility	5	4	3
	TOTAL	22	24	27

Scale	Represent
1	Very unsatisfied
2	Unsatisfied
3	Moderate
4	Satisfied
5	Very satisfied

3.3 Technical Drawing

3.3.1 Bill of Material

Column 1	Column 2	Column 3
1	BASE PART	1
2	TOP PART	1
3	FRONT ROLLER	1
4	BACK ROLLER	1
5	CENTER ROLLER SHAFT	1
6	SIDE ROLLER SHAFT	1
7	SIDE PLUNGER	1
8	PEDESTAL BEARING	4
9	FLANGE BEARING	2
10	STEERING	1
11	HYDRAULIC BOTTLE JACK	1
12	ANGLE CUTTER BASE PART	1
13	ANGLE CUTTER STAND	1
14	ANGLE CUTTER HOLDER	1
15	WORK PIECE CLAMP	1
16	HAND CUTTER	1
17	SEPARABLE BENDER	1

DATE: _____

DRAWN BY: _____

CHECKED BY: _____

APPROVED BY: _____

SCALE: _____

PROJECT: _____

REV: _____

DATE: _____

BY: _____

FOR: _____

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Figure 3.6 shows a 3D structural drawing with an isometric, top, front and side views of the project. Through the top view of the project can be seen the measurements for the thickness and length of each section. The overall size of the project and the width can be known also through the side view of the project and the front view shows the total length of the project. From the front view, the total length of project is 1100mm. The width of the project is 200mm and the height is 440mm.

