UNIVERSITI MALAYSIA PAHANG

BORANG PENGESAHAN STATUS TESIS ◆

JUDUL: MOTORCYCLE JACK

SESI PENGAJIAN: 2009/2010

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MOTORCYCLE JACK

MOHD FADHLI BIN CHE ISMAIL

UNIVERSITI MALAYSIA PAHANG

MOTORCYCLE JACK

MOHD FADHLI BIN CHE ISMAIL

A report submitted in partial fulfilment of the requirements for the award of the degree of Diploma of Mechanical Engineering

Faculty of Mechanical Engineering
UNIVERSITI MALAYSIA PAHANG

NOVEMBER 2009

SUPERVISOR'S DECLARATION

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

Signature:
Name of Supervisor: NGUI WAI KENG
Position: TUTOR
Date: 23 NOVEMBER 2009

STUDENT'S DECLARATION

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

Signature:
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ID Number: MB07064
Date: 23 NOVEMBER 2009

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ABSTRACT

These reports present about develop and make the motorcycle jack. This motorcycle jack is developing to ease for make maintenance toward motorcycle such as change engine oil, change tire and fork oil change and other. For make a motorcycle jack, it has many process included such as measuring process, cutting process, joining process, drilling process and painting process. This motorcycle made by adjusting and upgrades the motorcycle jacks that already have in market. This project also required analysis to ensure the strength and safety of the product meet the user need. To be confirm that the motorcycle jack safe and can be used, a stress analysis have be done to study about maximum stress. By using mild steel, it can be producing following the characteristic and specification.

ABSTRAK

Laporan ini membentangkan tentang projek untuk membuat motosikal jek. Motosikal jek ini dibuat untuk memudahkan kerja – kerja penyelenggaraan kecil terhadap motosikal seperti menukar minyak enjin, menukar tayar dan sebagainya. Untuk membuat motosikal jek ini, terdapat beberapa proses – proses yang terlibat seperti proses pengukuran, proses pemotongan, proses penyambungan, proses menebuk lubang dan proses mengecat. Motosikal jek ini dibuat dengan mengubah suai dan membaik pulih motosikal jek yang sudah berada dipasaran. Projek ini juga memerlukan analisis bagi memastikan kekuatan produk dan memastikan keselamatan pengguna dipenuhi sebetulnya. Untuk memastikan motosikal jek ini selamat dan dapat digunakan, satu analisis tentang tegasan telah dibuat untuk mengkaji berkenaan tegasan maksimum yang dapat ditampung. Dengan mengunakan besi lembut, motosikal jek ini dapat dihasilkan mengikuti kehendak dan memenuhi ciri – ciri yang dikaji.

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σ	True stress, local stress (MPa)
Ø	Diameter (mm)
$\boldsymbol{\sigma}_{cal}$	Local calculate stress (MPa)
$\boldsymbol{\sigma}_{y}$	Local maximum stress (MPa)
%	Percent of value
A	Area of material (mm^2)
F	Force (N)
r	Radius of circle (mm)
N	Newton
kg	Kilogram
mm	Millimeter
kN	Kilo Newton
MPa	Mega Pascal

LIST OF ABBREVIATIONS

UMP	University Malaysia PAHANG
CAD	Computer Added Design
SMAW	Shielded Metal Arc Welding
MMA	Manual Metal Arc
CO_2	Carbon Dioxide
GMAW	Gas Metal Arc Welding
MIG	Metal Inert Gas
DC	Direct Current
EP	Electrode Positive
NC	Numerical Control
CNC	Computerized Numerical Control
PDS	Product Design Specification
BOM	Bill Of Material

CHAPTER 1

INTRODUCTION

This chapter will explain and contains about the project objective, problem statement, project scope, and the organization of the thesis.

1.1 OBJECTIVE PROJECT

Basically, this thesis would be done for fulfill the following:

i. To fabricate the motorcycle jack.

ii. To design the motorcycle jack.

1.2 PROBLEM STATEMENT

Many people had no idea how hard it would be to perform the most basic maintenance tasks on a motorcycle without centre stand. Easy projects like an engine oil or fork oil change, a chain lube, tire change or even cleaning the wheels are more difficult or, in some cases, nearly impossible without extra lifts, stands or jacks.

However, some of the motorcycles are come with centre stand. But not all have sufficient strength in order to manually locate the motorcycle using this centre stand.

1.3 SCOPE OF PROJECT

The scope of this project are :

i. This motocycle jack produce for motorcycle Yamaha RX-Z.

ii. Can accommodate and handle load below 150 kg.

iii. To design the suitable motorcycle jack using Auto CAD.

iv. It focus to develop and fabricate with using engineering method such as welding, drilling and other.

1.4 ORGANIZATION OF THE THESIS

This thesis have contains five chapter at overall. At Chapter 1 explain about the objective of project, problem statement of project and scope of this project. Beside that, at Chapter 2 will cover and explain about the type of motorcycle jack have exist in market, it also explain the specification of motorcycle Yamaha RX-Z, and history of the fabrication process. Chapter 3 will explain about the design of product, bill of material, and all of fabrication process well done in this project. At Chapter 4 will discuss about the analysis product such as cost analysis and stress analysis was carried out. And the last chapter will cover mainly about the conclusion of the project, it also have recommendation to improvement the product in the future.

1.5 CONCLUSION

In this chapter, we have clear objective and scope for develop project based on problem statement, beside that we can start a project and go the next step.

CHAPTER 2

LITERATURE REVIEW

This chapter will cover and explain about the research of the project and explain about the type of mechanical and hydraulic jack at market and method used. Beside that, specification of Yamaha RX-Z motorcycle aslo included here.

2.1 MOTORCYCLE JACK

A motorcycle jack includes a frame having front and rear cross shafts rotatable supported thereon. Pairs of front and rear legs are secured to opposite ends of the respective front and rear cross shafts for rotation in unison with the shafts. A linkage mechanism interconnects the front and rear shafts for rotation in unison, but in opposite directions so that the frame is raised in response to pivotal movement of the front and rear legs toward one another and is lowered in response to pivotal movement of the front and rear legs away from one another. A power unit is provided for rotating their legs relative to the frame. The cross shafts are preferably formed of a resilient material so that the free left legs tend to spread slightly further apart than the interconnected right legs, thereby tilting the motorcycle slightly to the left for placement onto its kickstand when the jack is lowered.

A mechanical jack is a device which lifts heavy equipment. The most common form is a car jack, floor jack or garage jack which lifts vehicles so that maintenance can be performed. Car jacks usually use mechanical advantage to allow a human to lift a vehicle by manual force alone. More powerful jacks use hydraulic power to provide more lift over greater distances. Mechanical jacks are usually rated for a maximum lifting capacity. The jack shown at the right is made for a modern vehicle and the notch fits into a hard point on a unit body. Earlier versions have a platform to lift on the vehicles' frame or axle. Figure 2.1 shown the basic mechanical jack and Figure 2.2 shown a double mechanical jack.

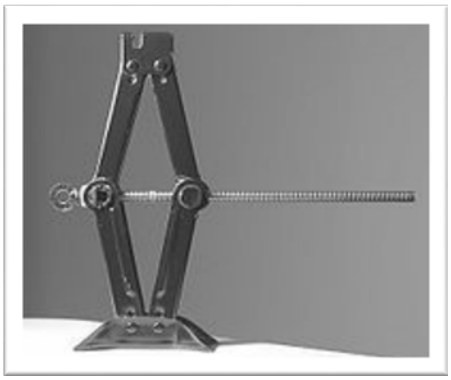


Figure 2.1: Mechanical Jack

Source: Wikipedia (2009)

Figure 2.2: Double Mechanical Jack

Source: Wikipedia (2009)

2.2 TYPE OF MOTORCYCLE JACK

2.2.1 Swingarm Motorcycle Jack

Featured on the swing arm stands shown in Figure 2.4 are rubber pads that rest on the swing arm and spool attachments for attaching to bikes with spools for even more stability. Included reversible rubber mounts adjust to fit almost any size swing arm. The rubber mounts also prevent swing arm scratches. The rubber swing arm mounts and spool attachments can be switched out in a flash with a spin of the adjustment knob. Heavy duty 1.5 inch tubing and dual 3 inch wheels on each side provide maximum stability for your motorcycle. The stands have a slightly raised

handle to keep from pinching your hands between the floor and handle when raising or lowering your bike. Use the motorcycle swing arm stand to service your sport bike or dirt bike, or to keep from getting flat spots on your rear tire. The motorcycle stand only weighs 10LBS and can adjust to fit widths from 8 inch to 13.5 inch which will accommodate almost any dirt bike or sport bike. Figure 2.3 shown how to use the motorcycle swing arm stand.

Figure 2.3: Using Motorcycle stand

Source : eHardware2u (2008)

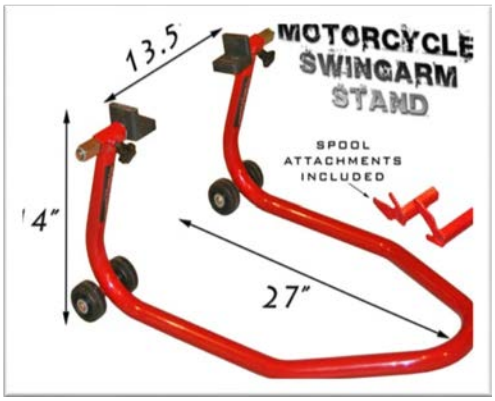


Figure 2.4: Motorcycle Swingarm stand

Source : eHardware2u (2008)

2.2.2 Bottle Jack

Bottle jacks as shown in Figure 2.5 are hydraulic jacks that are placed in a horizontal position. These jacks push against a lever, which lifts the main lift arm. Bottle jacks have a longer handle than most hydraulic jacks, however, and it is possible to get more lift per stroke with the increased leverage they provide when compared to regular models of jacks. Mechanics and construction workers building or repairing home foundations prefer to use bottle jacks.

Bottle jacks are versatile because their horizontal position makes it possible to place them in tight spots and provides good leverage. In recent years, bottle jacks have proven useful in search and rescue missions following earthquake damage. As a result, bottle jacks are standard equipment in firehouses and for search and rescue

teams. This life-saving purpose is a use manufacturers had not expected from bottle jacks.

Bottle jacks are also used for lifting, spreading, bending, pushing, pressing, or straightening requirements. Newer bottle jacks have undergone some slight design changes, including chromed pump pistons and rams to provide for added rust resistance. The base and cylinders of bottle jacks are electrically welded for strength, and all models are capable of working in upright, angled, or horizontal positions.

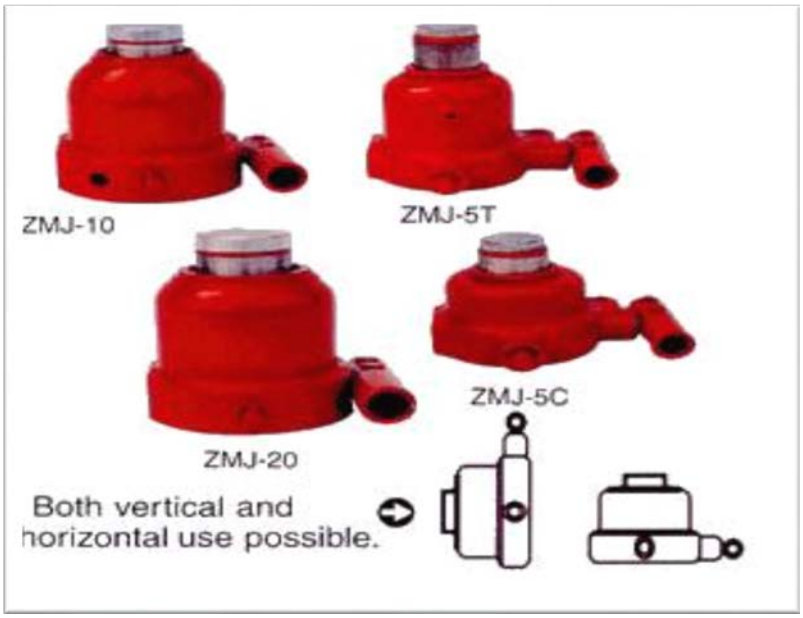


Figure 2.5: Zinko Mini Bottle Jack

Source : Hydraulic Jacks Home Page (2009)

2.2.3 Motorcycle Jack Stand

Motorcycle jack stand usually use as a suport stand for the motorcycle and car after it has jack which other divice. Figure 2.6 shown that ratchet jack stand refer with many specification in the market. It can make a jack safety during a process jack up a motorcycle or other. Figure 2.7 below shown the specification for ratchet jack stand

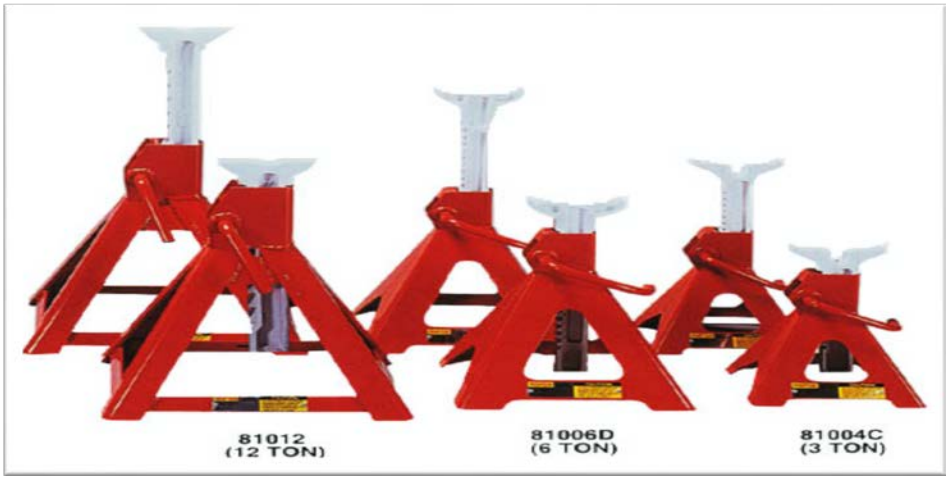


Figure 2.6: Ratchet Style Jack Stand

Source : Hydraulic Jacks Home Page(2009)

TONS	LOW HEIGHT	MAX HEIGHT	HHT. INTER-VALS	BASE	MODEL	LBS. PAIR
3	12"	17 1/2"	9/16"	7 1/2" by 7 7/8"	81004C	19
6	16 1/4"	24 7/8"	5/8"	10 1/16" by 11 1/16"	81006D	30
12	19 5/8"	29 3/8"	1 1/4"	13" by 15"	81012	86

Figure 2.7: Specification of Ratchet Jack Stand

Source : Hydraulic Jacks Home Page (2009)

2.3 MOTORCYCLE SPECIFICATION

Yamaha RX-Z 135 shown in Figure 2.8 is a 2-stroke naked bike manufactured by Yamaha Motor Corporation. Debuted in 1987, the RX-Z is very popular in Malaysia and Singapore and enjoys one of the longest current motorcycle product life in both countries, especially in Malaysia due to the absence of other street bike competitors to date. In 2004, the model was face lifted and a catalytic converter was installed. **Appendix B** has shown the detail specification of Yamaha RX-Z motorcycle.

Figure 2.8: Motorcycle Yamaha RX-Z

2.4 WELDING MACHINE

Welding is a fabrication or sculptural process shown in Figure 2.9 that joins materials, usually metals or thermoplastics, by causing coalescence. This is often done by melting the work pieces and adding a filler material to form a pool of molten material the weld pool that cools to become a strong joint, with pressure sometimes used in conjunction with heat, or by itself, to produce the weld. This is in contrast with soldering and brazing, which involve melting a lower-melting-point material between the work pieces to form a bond between them, without melting the work pieces.

Figure 2.9: Welding Process

Source : Wikipedia (2009)

2.4.1 Process Of Arc Welding

One of the most common types of arc welding is Shielded Metal Arc Welding (SMAW), which is also known as Manual Metal Arc Welding (MMA) or stick welding. Electric current is used to strike an arc between the base material and consumable electrode rod, which is made of steel and is covered with a flux that protects the weld area from oxidation and contamination by producing Carbon Dioxide (CO_2) gas during the welding process. The electrode core itself acts as filler material, making separate filler unnecessary.

The process is versatile and can be performed with relatively inexpensive equipment, making it well suited to shop jobs and field work. An operator can become reasonably proficient with a modest amount of training and can achieve mastery with experience. Weld times are rather slow, since the consumable electrodes must be frequently replaced and because slag, the residue from the flux, must be chipped away after welding. Furthermore, the process is generally limited to welding ferrous materials, though special electrodes have made possible the welding of cast iron, nickel, aluminum, copper, and other metals. Inexperienced operators may find it difficult to make good out-of-position welds with this process.

2.4.2 Process Of MIG Welding

Gas Metal Arc Welding (GMAW), also known as Metal Inert Gas or (MIG) welding, is a semi-automatic or automatic process that uses a continuous wire feed as an electrode and an inert or semi-inert gas mixture to protect the weld from contamination. As with SMAW, reasonable operator proficiency can be achieved with modest training. Since the electrode is continuous, welding speeds are greater for GMAW than for SMAW. Also, the smaller arc size compared to the shielded metal arc welding process makes it easier to make out-of-position welds e.g. overhead joints, as would be welded underneath a structure.

The MIG process show in Figure 2.10 uses a Direct Current (DC) power source, with the Electrode Positive (EP). By using a positive electrode, the oxide layer is efficiently removed from the aluminum surface, which is essential for avoiding lack of fusion and oxide inclusions. The metal is transferred from the filler wire to the weld bead by magnetic forces as small droplets, spray transfer. This gives a deep penetration capability of the process and makes it possible to weld in all positions. It is important for the quality of the weld that the spray transfer is obtained.

There are two different MIG welding processes, conventional MIG and pulsed MIG. Conventional MIG uses a constant voltage DC power source. Since the spray transfer is limited to a certain range of arc current, the conventional MIG process has a lower limit of arc current or heat input. This also limits the application of conventional MIG to weld material thicknesses above 4 mm. Below 6 mm it is recommended that backing is used to control the weld bead. Pulsed MIG uses a DC power source with superimposed periodic pulses of high current. During the low current level the arc is maintained without metal transfer. During the high current pulses the metal is transferred in the spray mode. In this way pulsed MIG is possible to operate with lower average current and heat input compared to conventional MIG. This makes it possible to weld thinner sections and weld much easily in difficult welding positions.

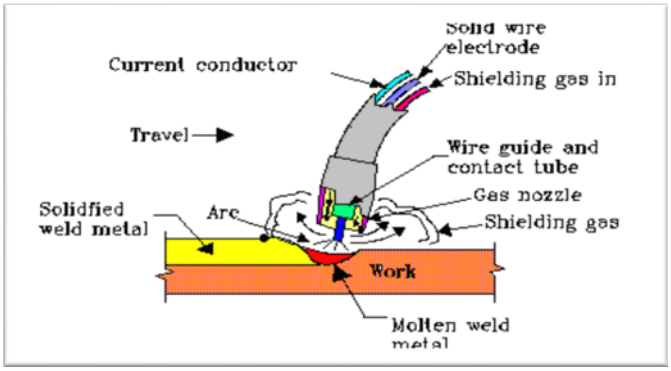


Figure 2.10: MIG Welding Process

Source: WeldingEngineer.com (2009)

There are some advantages and disadvantages in using MIG welding. The advantages of MIG welding is a all position capability, higher deposition rates than SMAW, less operator skill required, long welds can be made without starts and stops and last advantage is minimal post weld cleaning is required

The disadvantages of MIG welding is a costs money of consumable, such as tips and nozzles, is not worth a dang on paint, rust, or dirty surfaces and lastly no good for thick steel because it does not get the proper penetration

2.5 DRILLING MACHINE

Drill Press

A drill press shown in Figure 2.11 also known as pedestal drill, pillar drill, or bench drill is a fixed style of drill that may be mounted on a stand or bolted to the floor or workbench. A drill press consists of a base, column or pillar, table, spindle or quill, and drill head, usually driven by an induction motor. The head has a set of handles usually 3 radiating from a central hub that, when turned, move the spindle and chuck vertically, parallel to the axis of the column. The table can be adjusted vertically and is generally moved by a rack and pinion; however, some older models

rely on the operator to lift and reclamp the table in position. The table may also be offset from the spindle's axis and in some cases rotated to a position perpendicular to the column. The size of a drill press is typically measured in terms of swing. Swing is defined as twice the throat distance, which is the distance from the center of the spindle to the closest edge of the pillar.

Speed change is achieved by manually moving a belt across a stepped pulley arrangement. Some drill presses add a third stepped pulley to increase the speed range. Modern drill presses can, however, use a variable-speed motor in conjunction with the stepped-pulley system. Some machine shop tool room drill presses are equipped with a continuously variable transmission, giving a wide speed range, as well as the ability to change speed while the machine is running.

Figure 2.11: Upright drill press

Source: Basic Type of Drilling (2001)

2.6 GRINDING MACHINE

The grinding machine shown in Figure 2.12 consists of a power driven grinding wheel spinning at the required speed which is determined by the wheel's diameter and manufacturer's rating, usually by a formula and a bed with a fixture to guide and hold the work-piece. The grinding head can be controlled to travel across a fixed work piece or the work piece can be moved whilst the grind head stays in a fixed position. Very fine control of the grinding head or tables position is possible using a vernier calibrated hand wheel, or using the features of Numerical Control (NC) or Computerized Numerical Control (CNC).

Grinding machines remove material from the work piece by abrasion, which can generate substantial amounts of heat; they therefore incorporate a coolant to cool the work piece so that it does not overheat and go outside its tolerance. The coolant also benefits the machinist as the heat generated may cause burns in some cases. In very high-precision grinding machines most cylindrical and surface grinders the final grinding stages are usually set up so that they remove about 200nm less than 1/100000 in per pass - this generates so little heat that even with no coolant, the temperature rise is negligible.

Figure 2.12: Grinder Machine

2.7 STRESS ANALYSIS

For the simple case of a body axially loaded, e.g., a prismatic bar subjected to tension or compression by a force passing through its centroid, the stress (σ), or intensity of the distribution of internal forces, can be obtained by dividing the total tensile or compressive force F by the cross-sectional area A where it is acting upon. In this case the stress σ is represented by a scalar called engineering stress or nominal stress that represents an average stress σ_{avg} over the area, meaning that the stress in the cross section is uniformly distributed.

CHAPTER 3

METHODOLOGY

In this chapter, it will explain about the process that involved during the fabrication process and selection process. Besides that, it also will explain about the design and that had been chosen to be as the final idea to be producing or fabricate. All the fabrication process in this project is going to be explained in details.

3.1 PROJECT FLOW CHART

Flow chart in **Appendix C** shown flow the project starts objective the project. This is a first step for the project flow because to find the main objective for this project design. The objective is very important in every work or to make a project. It will help the person know the main point to make it success for the project or work. So, the main of objective for my project is to make the motorcycle jack that can be more safety to the user and more stable.

After choose the best objective for the project, it continue with literature review and research about the title. This consist a review of the concept of motorcycle jack, system motorcycle jack and type of motorcycle jack. These tasks have been done through research on the internet, books and others sources.

After identify the objective the project, it continues with identify the scope of the project because this scope can help me to male of the product in this project. First of all, the first scope for this project is make a literature review. Selection this scope because it is important to gathered data about motorcycle jack in entire aspect like type, material and shape. For the next scope is a sketch and design. This scope is purpose to sketch the product before it can be fabricate. Then it will fabricate the product following the drawing or sketching. For final is a testing and evolution.

Next, it will continue with the problem identification. It because want to know about the problem that still have in current product and this step can help to create a different type of the product. It also helps to find a main problem from this project.

After all the parts needed had been gathered, the project proceeds to next step that is fabrication process. The finished drawing and sketching is used as a reference by following the measurement and the type of materials needed. The fabrication process that involved is cutting, welding, and others. If all the parts had been processed, the parts are joined together to produce full-scaled motorcycle jack.

Then it go the testing and evaluation process. The motorcycle jack will be test to see if it full fills the requirement such as safety, and strength. During the testing, if problem occur, the motorcycle jack will step back to the previous process, where the error is fixed. The motorcycle jack is expected to have an error that may cause the part to be re-designed and re-fabricate again.

After all the parts had been joined together, here comes the last phase of process that is data discussion. In data discussion, the draft report and all the related articles are gathered and hand over to the supervisor for error checking. The finish product will be compared with the report to make sure that there is no mistake on both project and report.

After the product and the report had been approved by the supervisor, the report is rearranged and prints out to submit at the supervisor, the project coordinator and Faculty of Mechanical Engineering.

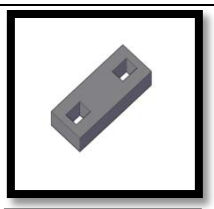
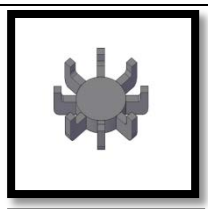
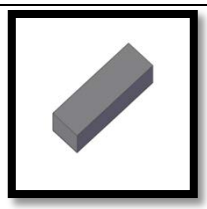
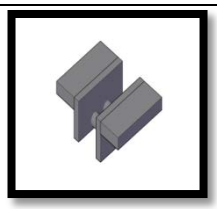
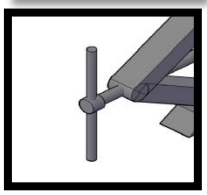
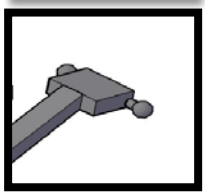
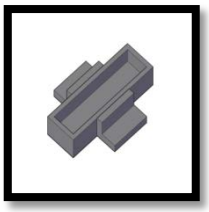
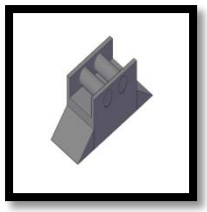
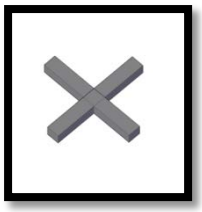
3.2 CONCEPT GENERATION

3.2.1 Concept Generation Process

Concept generation is one of a process involve to develop a new design with other specification. It will compare with different idea to make a concept.

For this project , the concept generation only develop only 3 part such as top of product, method to use and base of product. Table 3.1 shown the concept generation.

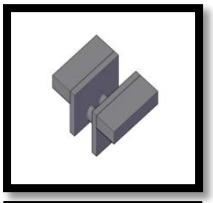
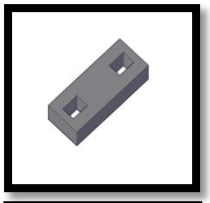
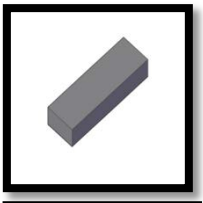
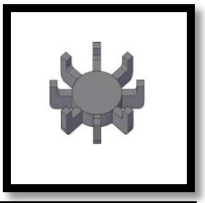
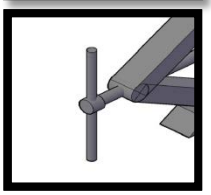
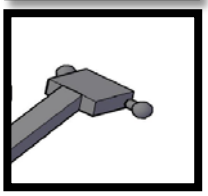
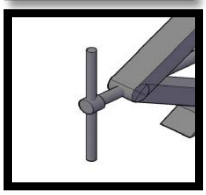
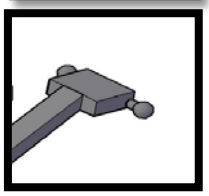
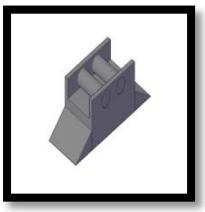
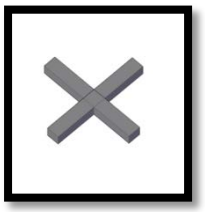
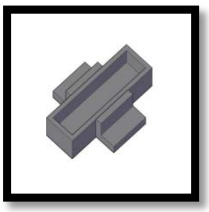
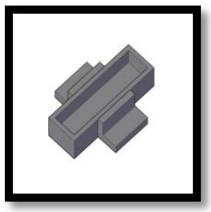
Table 3.1: Concept Generation

	1	2	3	4
Top				
Method				
Base				

3.2.2 Concept Combination

After the generation process , it going to the concept combination. At this part, it combine part generate to get one concept. Table 3.2 shown the concept combination process.

Table 3.2: Concept Combination

	Concept A	**Concept B**	**Concept C**	**Concept D**
Top				
Method				
Base				

Concept A can up the motorcycle with the different height. Beside that, with a small base and it not stable to height condition. Easy to keep and bring anywhere. Need more energy or force to lift the motorcycle.

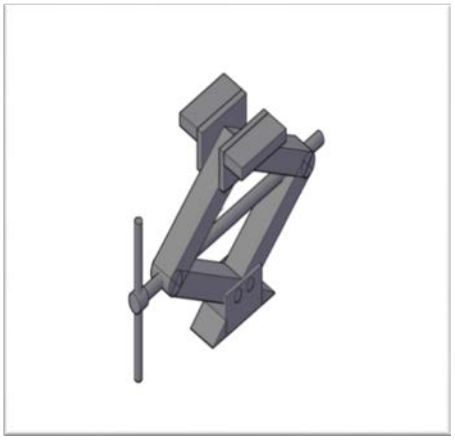


Figure 3.2: Concept A

Concept B have a adjustable clamp at the top side. Beside that, it also have a lock at a base and with a stable base. Can lift the motorcycle with quickly. But it only lift a motorcycle at limit height.

Figure 3.3: Concept B

Concept C use a screw method. It will take many time to up the motorcycle. The top part of the product is very small and it easy to slip. Easy to keep and bring anywhere. It not stable because no support and clamp at top side.

Figure 3.4: Concept C

Concept D have a lock at base and can press up the motorcycle with limit height. Beside that, it so hard to find a center of motorcycle with many hook at top part. It very heavy because many material used.

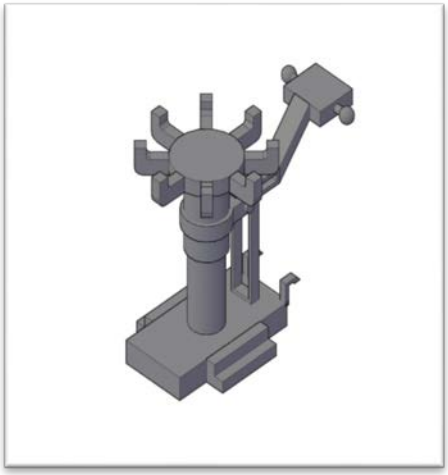


Figure 3.5: Concept D

3.3 CONCEPT SELECTION

For the concept selection, it will compare the criteria with the every product to get a best poduct to develop as a project. And then, choose the best concept. Table 3.3 shown the concept selection criteria.

Objective tree, it is a some of criteria have will refer to do the project. It must refer these criteria to make a design and concept. **Appendix D** shown the objective tree in project.

Table 3.3: Concept Selection Criteria

Selection Criteria		**Concepts**			
	Datum	**A**	**B**	**C**	**D**
Less work done	0.1	0.04	0.08	0.05	0.08
Quick and save time	0.15	0.08	0.11	0.08	0.12
Can keep and bring anywhere	0.1	0.07	0.06	0.07	0.04
Stability	0.25	0.14	0.23	0.17	0.19
Using rubber at sharp shape	0.1	0.04	0.05	0.00	0.04
Have a extra lock	0.05	0.00	0.02	0.00	0.02
Manufacture and equipment	0.1	0.05	0.05	0.05	0.05
Material	0.15	0.10	0.08	0.11	0.06
Net Score	1.0	0.52	0.68	0.53	0.60
Rank		4	**1**	3	2
Develop			**Yes**		

3.4 FINAL CONCEPT

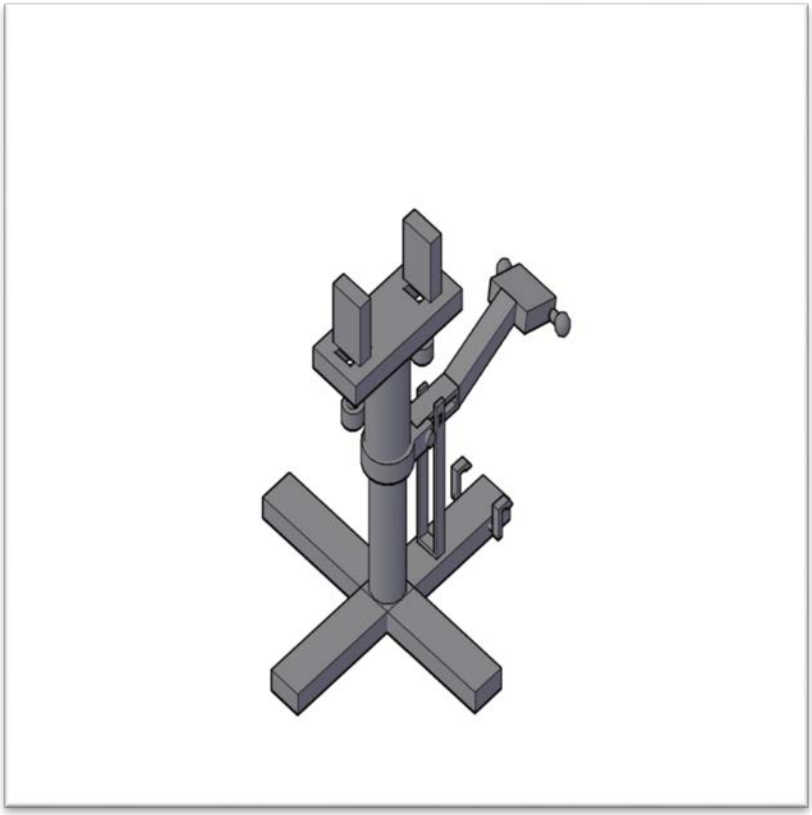


Figure 3.6: Final Concept Design

Study of the concept selection in Table 3.3 shows that concept B score the highest value compare another concept in different creteria such as less work done, quick and save time, can keep and bring anywhere, stability, using rubber at sharp shape, have a extra lock, manufacture and equipment, material. Therefore, concept B is the best concept to be produce.

3.5 PRODUCT DESIGN SPECIFICATION (PDS)

Product title

i. Motorcycle Jack.

Introduction

i. Motorcycle was important in live. Everyday people must use it to go anywhere and must care it as good as can. The motorcycle jack make easy to all perform maintenance like tire change, engine oil and other.

Purpose

i. To easy an improvement way to make a basic maintenance at motorcycle.

New or special features

i. Stronger and less susceptible to cracking on dropping.

ii. Easier and quicker to push or press the stand.

iii. Easier to change the location product.

iv. Moveable rod with screw.

v. High resistance to decay.

Competition

i. Will compete against standard motorcycle jack or motorcycle stand produced by local manufacture.

Intended market

i. Will sell direct to largest producers of distributor furniture and also to the market-market such as Giant, Tesco and Jusco. Approximately 5 million motorcycle jack sold each year in Malaysia.

Need for product

i. User survey has shown customer interest in new features 65 % of people surveyed expressed willingness to pay a bit more for an improve product.

Relationship to existing products line

i. For this product, it is combining with other product such as double stand and jack. The function for it will get in one product for the motorcycle jack

Market demand

i. Current Malaysia market is about 27 million units annually.

Price

i. Selling motorcycle jack refer to cost analysis in bulk lots. The manufacturing cost should be no more than RM 20 per unit.

Functional performance

i. Allows for easy to store it.

ii. Easy change location as needed.

iii. Simple product for daily use.

Physical requirements

i. Every surface for this product is smooth and flat.

ii. Have an only two colours in market, varnish and black.

iii. Only use quality material for the product.

Service environment

i. Must immune water for avoid decay.

ii. No chemical reaction for product.

Life-cycle issue

i. Footrest must not fail for 200 cycles when push and press. The mild steel can cycle like molten to produce steel again.

Human factors

i. No sharp corners or edges to cause cutting.

ii. Rounded edges give more safety to user.

iii. All corners and part is fillet to avoid bad happen.

Corporate constraints

i. Must be in market within 6 months.

ii. Manufacturing will be contracted to suppliers.

3.6 BILL OF MATERIAL

This project use a many material with a different shape and size. Beside that, Bill of Material (BOM) also explain a quantity and type of material. Table 3.4 shown the bill of material of this product.

Table 3.4: Bill Of Material

Bill	Type	Size(mm)	Quantity
1	Rectangular Steel	220 x 50 x 20	1
2	Rod Steel(hollow)	120 (Ø 40)	1
3	Rod Steel (hollow)	190 (Ø 20)	1
4	Rectangular Steel	350 x 50 x 20	1
5	Rod Steel(hollow)	50 (Ø 15)	2
6	Rectangular Steel	150 x 50 x 20	3
7	Rectangular Steel	120 x 30 x 20	3
8	Screw and Nut	Ø 12	5
9	Screw	Ø 14	1

3.7 FABRICATION PROCESS

In order to make the design come to reality, fabrication process needs to be done first. The fabrication process starts from dimensioning the raw material until it is finish as a desired product.

The fabrication process was started with measuring the material into the required dimension. All the measuring and marking process is done by using steel ruler, measuring tape, and vernier height calliper as shown in Figure 3.7.

Figure 3.7: Use Vernier Height Caliper

Then, after several quantities of material had been marked, the next step is to cut the material into its desired length. This process is done using the bend saw, hand saw as shown in Figure 3.8 and vertical saw. Then after finish all of material to use, we use the file and file it at the chip the material to get a precise dimension and also to safety. We also use the table clamp to clamp the material during the cutting process for easy work

Figure 3.8: Cut the Hollow Rod Steel

Properly attach the masonry drill bit to the press or table drill. Mark with either a pencil or ink-marker pen the spot where the hole is to be made. Place the drill bit's end exactly on this mark, and while keeping the bit on this mark. Put the drill bit into the pilot-dimple as show in Figure 3.9 and start the deep drilling process by slowly queering the press or table drill trigger on-and-off to continually vary the constant rotation of the bit while simultaneously pushing and pulling, immediately remove the drill bit from the hole. Promptly squirt water on the drill bit to cool it and water into the hole to force flush out resulting debris. Repeat until the hole is finally drilled deep enough to satisfaction, or is completely cut through to the other side if that is the desired result.

Figure 3.9: Make a Hole Using Table Drill

The process welding as shown in Figure 3.10 is versatile and can be performed with relatively inexpensive equipment, making it well suited to shop jobs and field work. An operator can become reasonably proficient with a modest amount of training and can achieve mastery with experience. Weld times are rather slow, since the consumable electrodes must be frequently replaced and because slag, the residue from the flux, must be chipped away after welding. Furthermore, the process is generally limited to welding ferrous materials, though special electrodes have made possible the welding of cast iron, nickel, aluminum, copper, and other metals. Inexperienced operators may find it difficult to make good out-of-position welds with this process

Figure 3.10: Joining part with arc welding

After finished welding, the entire welded places were then grinded to make sure that the entire joint surface was smooth from any spatters or sharp edge. During the process grinding as shown in Figure 3.11, the careless of wearing an ear plug will cause high risky damage to ears. Hand gloves and goggles are also need to give attention.

It to remove the chip or debris after process joining. Any rough surface cause by welding spark were grind to give smooth and safe surface.

Figure 3.11: Using Hand Grinder

After do the finishing, and for get a good product, use the sand paper for smooth the surface of material. And then wash a product to reduce or clear all of dirt. After that, the product can paint as shown in Figure 3.12 and Figure 3.13 the product using metal paint have from mechanical lab. After all the process had been done, come the last part that is tightening the bolt and nut at all joins.

Figure 3.12: Paint the project

Figure 3.13: Use the brush paint

CHAPTER 4

RESULTS AND DISCUSSION

In this chapter will discuss mainly about the analysis of this project was been carried out. This chapter also will explain about the stress analysis and the cost analysis.

4.1 FINAL RESULT PROJECT

As a result, the motorcycle jack have been produced according to the specification. Figure 4.1 shown the final fabricated product.

Figure 4.1: Final Fabricated Motorcycle Jack

4.2 HOW TO USE

i. Firstly, put the motorcycle jack at under chassis of motorcycle. Put it at centre place.

Figure 4.2: Motorcycle Jack

ii. After put the motorcycle jack under motorcycle jack, move a support rod as shown in Figure 4.3 to clamp the swing arm motorcycle. And then, tight it using a alen key.

Figure 4.3: Support Rod

iii. After clamp a motorcycle, press or push the foot rest with leg as shown in Figure 4.4 . It can up the motorcycle quickly.

Figure 4.4: Motorcycle Jack After Press

iv. Finally, after the center rod move up and jack a motorcycle, pull the lock as shown in Figure 4.5 at base to avoid it will back.

Figure 4.5: Motorcycle Jack Lock

4.3 COST ANALYSIS

After finish fabricated the product, it must do a cost analysis for get a price per unit and get a profit. Table 4.1 shown the price every material used.

Table 4.1: The price of the material use at product.

Bill	Type	Size(mm)	Price
1	Rectangular Steel	800 x 50 x 20	RM 12
2	Rod Steel(hollow)	120 (Ø 40)	RM 1.20
3	Rod Steel (hollow)	190 (Ø 20)	RM 2.50
4	Rod Steel(hollow)	50 (Ø 15)	RM 0.50
5	Screw and Nut	Ø 12 and 14	RM 1.20
6	Rectangular Steel	320 x 30 x 20	RM 0.80
TOTAL PRICE			**RM 18.20**

Price of the mild steel is RM 18.20 that includes 800 mm x 50 mm x 20 mm rectangular steel 1 unit, 320 mm x 30 mm x 20mm rectangular steel 1 unit, 120 mm with diameter (Ø) 40 mm rod steel hollow 1 unit, 190 mm with diameter (Ø) 20 mm rod steel hollow 1 unit, 50 mm with diameter (Ø) 15 mm rod steel hollow 1 unit. Other items are screw 6 unit and nut 1 unit.

Assume that labour cost is RM 3.00 per unit and equiment cost is RM 1.50 per unit. Total material cost of for rectangular steel, rod steel hollow, screw and nut is RM 18.20. If the profit is 27%,it get the RM 6.13 per unit selling and the total estimate price of the product is RM 28.83 per unit.

4.4 STRESS ANALYSIS

$$\sigma = \frac{F}{A} \tag{4.1}$$

Where :

$\boldsymbol{F}$ *is the normal force*

$\boldsymbol{A}$ *is the section area*

$\boldsymbol{\sigma}$ *is the bending stress*

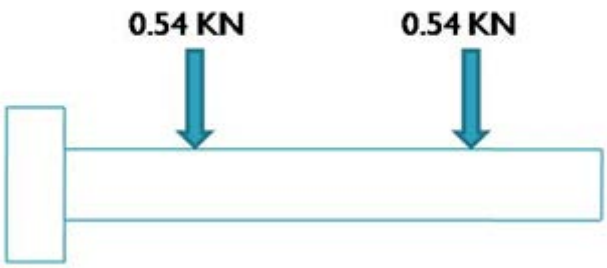


Figure 4.6: Free Body Diagram for screw

The analysis will done at critical point such as at the screw joint

Where weight of Motorcycle Yamaha $RX - Z$ *shown in Appendix B is* $110kg$

$$F = 110kg \times 9.81N$$

$$= 1079.1N \ @ \ 1.08kN$$

$$A = \pi r^2 \tag{4.2}$$

Using a screw with diameter 12 as shown in Table 3.4, the value of radius to calculate can assume:

$$r = 6mm$$

$$A = \pi(6)^2$$

$$= 113.09mm$$

$$\boldsymbol{\sigma}_{\text{Cal}} = \frac{F}{A}$$

$$= \frac{1079.1N}{113.09mm}$$

$$\boldsymbol{\sigma}_{\text{Cal}} = 9.54Mpa$$

Based on the Figure 4.7, the value maximum of the yield stress for mild steel is $\boldsymbol{\sigma}_{\text{y}} = 250MPa$. After make a stress calculation at critical point, it get the value $\boldsymbol{\sigma}_{\text{Cal}} = 9.54MPa$. So the of the $\boldsymbol{\sigma}_{\text{y}}$ is higher than value $\boldsymbol{\sigma}_{\text{cal}}$ and it can accommodate the motorcycle.

Based on scope of project, it will accommodate and handle load below 150 kg. For a safety user, test stress analysis will do at higher than 150kg. Assume a load is 160 kg.

$$F = 160kg \times 9.81N$$

$$= 1569.6N \text{ @ } 1.57kN$$

$$r = 6mm$$

$$A = \pi(6)^2$$

$$= 113.09mm$$

$$\boldsymbol{\sigma}_{\text{Cal}} = \frac{F}{A}$$

$$= \frac{1569.6N}{113.09mm}$$

$$\boldsymbol{\sigma}_{\text{Cal}} = 13.87MPa$$

Based on the Figure 4.7, the value maximum of the yield stress for mild steel is $\boldsymbol{\sigma}_{\text{y}} = 250MPa$. After make a stress calculation at critical point, it get the value $\boldsymbol{\sigma}_{\text{Cal}} = 13.87MPa$. So the of the $\boldsymbol{\sigma}_{\text{y}}$ is higher than value $\boldsymbol{\sigma}_{\text{cal}}$ and it can accommodate the motorcycle.

All of properties calculation about the stress analysis will refer in Figure 4.7. It only refers to material steel (mild).

Typical properties of some common engineering materials

Material	*Unit Weigh, w* (kN/m^3)	*Modulus of Elasticity, E* (GPa)	*Shear Modulus G* (GPa)	*Yield Stress* σ_y (MPa)	*Ultimate Stress* σ_{ult} (MPa)	*Poisson's ratio* μ
Steel (Mild)	77	200	79	250	400	0.27
Steel (High carbon)	77	200	79	345	450	0.27
Cast iron	72.3	103	41	–	700(c) 200(t)	0.25
Copper	80.6	117	41	245	345	0.33
Aluminium alloy	27	70	40	300	450	0.33
Brass	82.5	103	40	100	270	0.35
Concrete	22	14	–	0	30(c)	0.1
Timber	6	11	–	–	50(c)	–

Figure 4.7: Properties of Material

Source: Mechanics of Material, McGraw-Hill (2007)

CHAPTER 5

CONCLUSION AND RECOMMENDATION

In this chapter will discuss mainly about the conclusion of the project, concluding all the process that involved. Besides that this chapter also contains recommendation for improvement about the project in the future.

5.1 CONCLUSION

As a conclusion, the objective of this project is to design and fabricate the motorcycle jack have been achieved. This product cheaper than the product that exist in the market. Because the product used less material and cheap compare the other motorcycle jack.

5.1 RECOMMENDATION

The following recommendations can be making based on:

Change the centre rod to the adjustable one. We suggest or recommendation a centre rod at motorcycle jack will have a adjustable rod for get a many function at next time.

All materials should be lightweight and hardy. For all material will use a lightweight and hardy to easy for user bring and keep any where he want.

The rod must be water proof to prevent rod surface become rusty. We also recommendation use a material water proof to avoid it become rusty and decay. It as other safety because it is very important to hold a high load given.

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APPENDICES A

GANTT CHART PROJECT

ID	TASK		WEEK													
			1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Title selection, scope and objective	Plan														
		Actual														
2	Literature review	Plan														
		Actual														
3	Identify problem	Plan														
		Actual														
4	Design concept	Plan														
		Actual														
5	Selection concept	Plan														
		Actual														
6	Collecting data and information	Plan														
		Actual														
7	Preparing mid presentation	Plan														
		Actual														
8	Mid presentation	Plan														
		Actual														
9	Fabrication	Plan														
		Actual														
11	Preparing final presentation	Plan														
		Actual														
12	Making report	Plan														
		Actual														
13	Final presentation	Plan														
		Actual														
14	Correction and submit final report	Plan														
		Actual														

GANTT CHART

APPENDICES B

MOTORCYCLE RX-Z SPECIFICATION

SPESIFIKASI TEKNIKAL

ENJIN

Jenis	2 pusingan, silinder tunggal
Kapasiti	133cc
Lubang & lejang	56.0mm x 54.0mm
Nisbah Mampatan	7.0:1
Kuasa Maksimum	20 ps@8500 rpm DIN
Tork Maksimum	1.85 kgfm@7500 rpm DIN
Sistem Pelinciran	Autolube
Karburetor	VM26SS x 1
Sistem Penyalaan	CDI
Sistem Penghidup	Enjut
Kapasiti Tangki Bahan Api	13.0 liter
Kapasiti Tangki Enjin Minyak	1.2 liter
Transmisi	6-kelajuan

CASIS

Panjang Seluruh	1990mm
Lebar Seluruh	725mm
Tinggi Seluruh	1160mm
Tinggi Tempat Duduk	770mm
Tapak Roda	1300mm
Kelegaan Dari Tanah	175mm
Berat Kering	106kg
Lampu Depan	12V 35W/30W

SUSPENSI

Depan	Cabang Teleskopik
Belakang	Lengan Ayun

BREK

Depan	Brek Cakera Tunggal
Belakang	Brek Gelondong

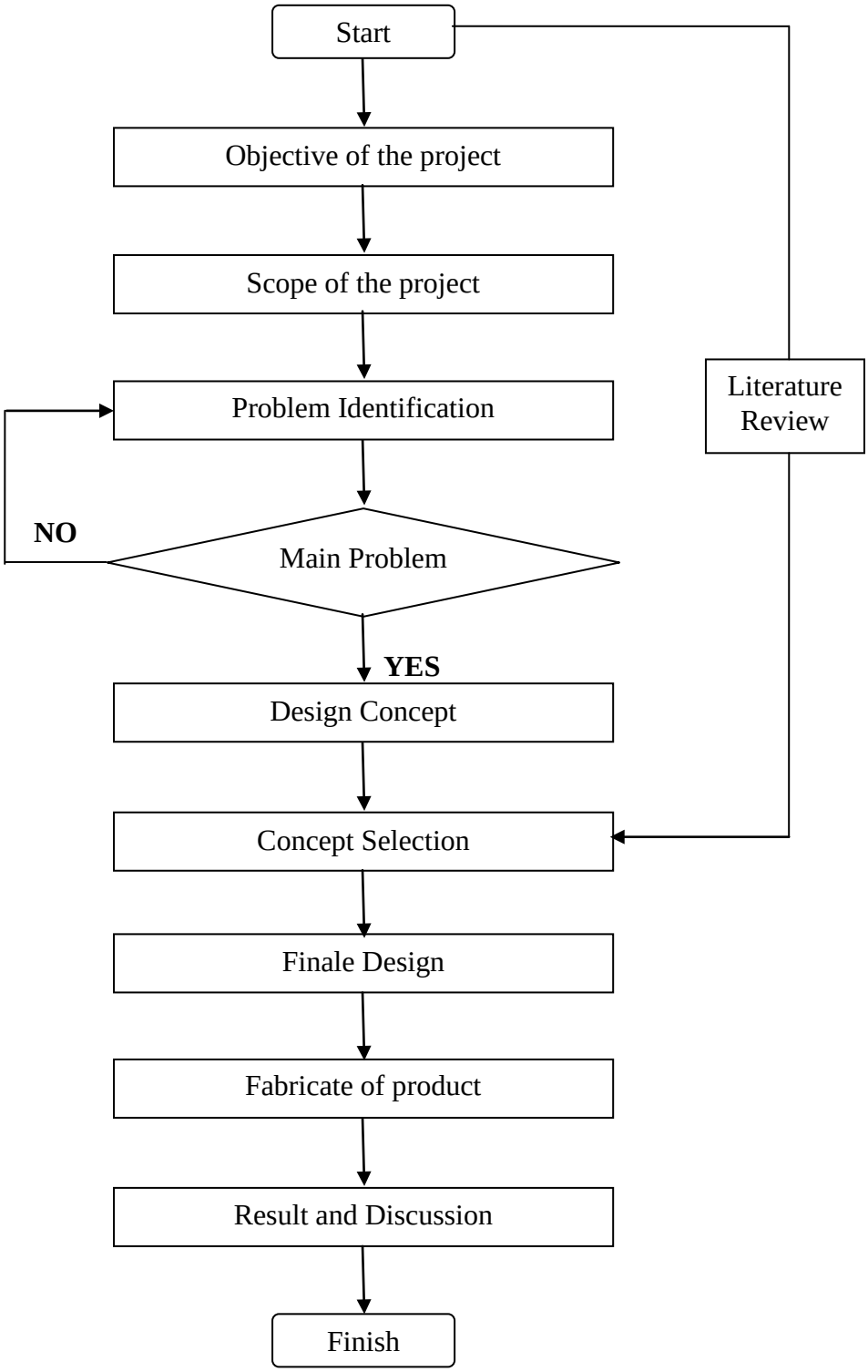
TAYAR

Depan	89/90-18 45H
Belakang	90/90-18 51H

PYHSICAL SPECIFICATION MOTORCYCLE RX-Z

APPENDICES C

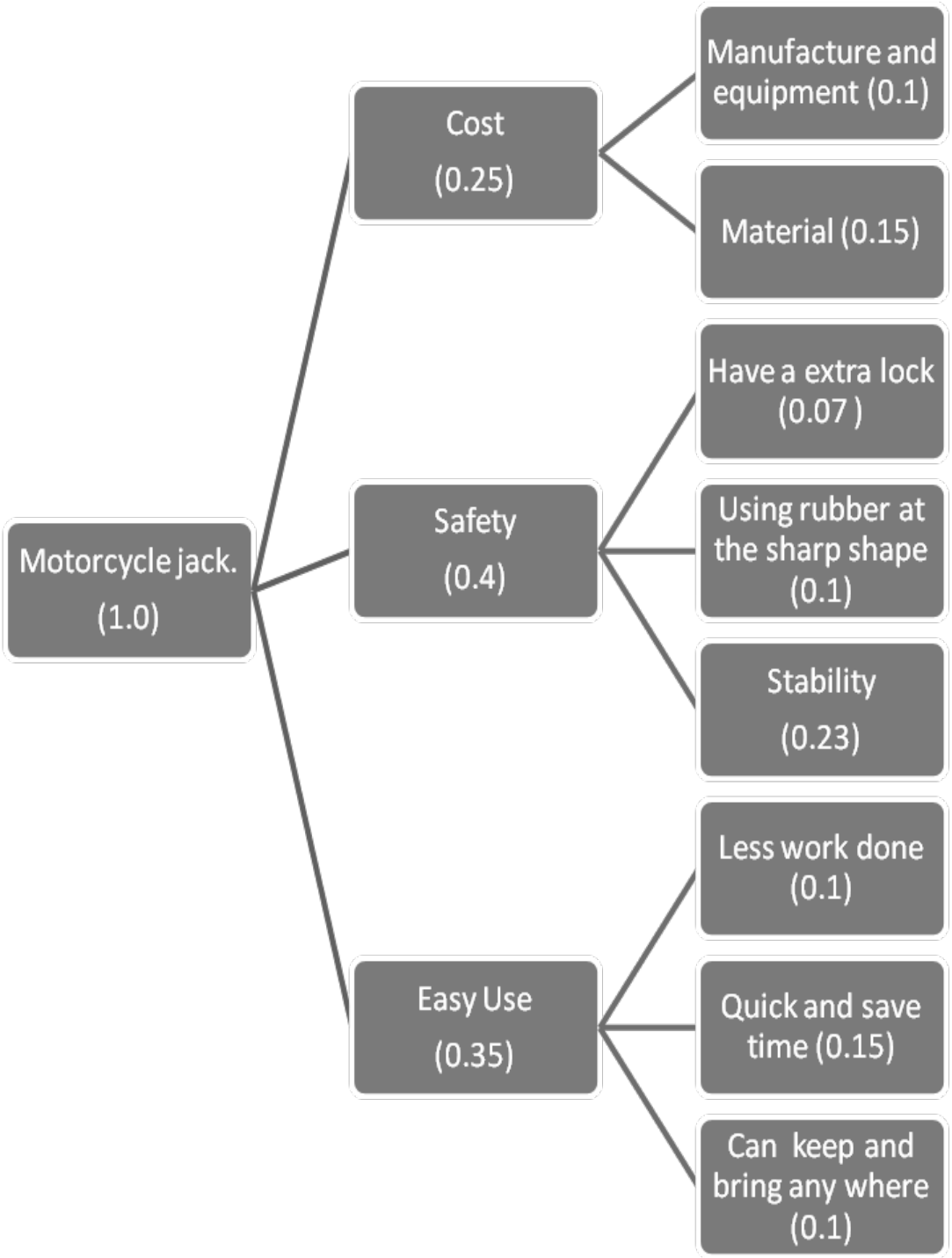
FLOW CHART PROJECT



FLOW CHART PROJECT

APPENDICES D

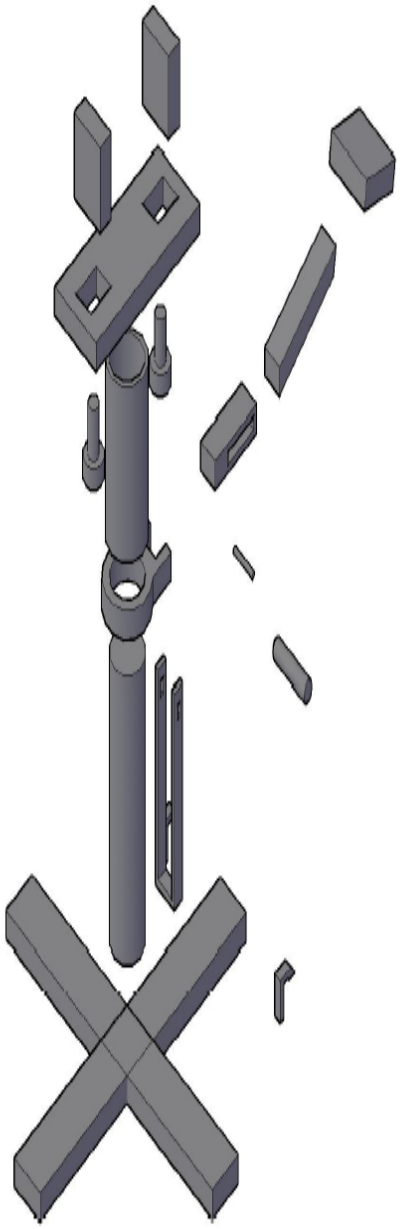
OBJECTTIVE TREE PROJETC



OBJECTIVE TREE PROJECT

APPENDICES E

ASSEMBLY DRAWING



ASSEMBLY DRAWING