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DESIGN AND DEVELOPMENT OF MOTORCYCLE ROTATED STAND

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A project report submitted in fulfillment of the requirements for the degree of Bachelor Manufacturing Engineering Technology with Honours



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2023

DECLARATION

I declare that this thesis entitled "Design and Development of Motorcycle Rotated Stand" is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.



APPROVAL

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor of Manufacturing Engineering Technology with Honours.

Signature : Supervisor Name Ts. Diversitie and Bing American Mohamed 11 January 2023 Date : TEKNIKAL MALAYSIA MELAKA UNIVERSITI

DEDICATION

This report is dedicated to my parents in particular, for their endless love, support, and encouragement. And to my lecturer Ts. Dr. Kamarul Bin Amir Mohamed has guided me along the way to finish this project. Thank you for all your support, and give me strength until this project is finished.



ABSTRACT

This project describes a motorcycle stand to design a space-saving and multifunctional product based on basic service to maintenance the motorcycle for users. Every motorcycle has its own way to handle and how to stand if the user wants to place and park. However, there must be the exertion of force and energy when handling motorcycles, especially for types of motorcycles with mass of 300kg and above. Besides that, the characteristics of the motorcycle are very big and it is utilized more space to park in a certain place. Due to that, the main purpose of this thesis is to study the characteristics of motorcycle stands and maintenance for motorcycles. Then, the thesis is also about to analyze the level strength of the structure motorcycle stand using Solidworks software. In addition, to design a functional stand for lifting and rotating a motorcycle with a maximum weight of 300kg. In this study to produce a new motorcycle rotated stand, at least three phases must be completed in the development of this project. The three phases are the study, design, and development phases. This project was started with a questionnaire survey that involved 123 respondents. This questionnaire survey is carried out to figure out the customers' requirements. Furthermore, the data collected will be utilized to improve or develop a new motorcycle stand design that would meet the expectations of customers and a morphological chart has been used to complete this project. Thus, the motorcycle rotated stand will be created based on customer requirements and stability to use for lifting and rotating. Concept designs have been created and the most appropriate concept is chosen using the Pugh matrix, House of Quality (HOQ) and Solidworks software was used to design the 3D CAD drawing of the selected concept. The Design for the motocycle rotated stand is sketching 4. It is because sketching 4 is more safety, efficiency, stability and it is easy to store. The rotated motorcycle stand must have these criteria according to the objective of this project. The material selection has been selected by analysis in Solidworks simulation to assess the motorcycle stand's safety, durability, and structural integrity, to optimize the satisfaction of users with their everyday usage, to determine the material behaviour and deformation in a few aspects. The main concerns in this project were the displacements, factor of safety, strains, and stresses of motorcycle stand designs subject to internal and external loads. A project feature was developed to perform weakness point of the product, in order to confirm that the designed product is stable enough to use. The results showed that the designed motorcycle stand is stable to use.

ABSTRAK

Projek ini adalah mengenai pendirian motosikal yang direka bentuk untuk produk yang menjimatkan ruang dan pelbagai fungsi berdasarkan perkhidmatan asas untuk penyelenggaraan motosikal kepada pengguna. Setiap motosikal mempunyai keistimewaan tersendiri untuk dikendalikan dan cara berdiri sekiranya pengguna ingin meletakkan kenderaan. Namun, pengguna mesti menggunakan tenaga yang banyak untuk mengendalikan motosikal terutamanya bagi motosikal yang berjisim sebanyak 300kg dan ke atas. Selain itu, ciri-ciri motosikal tersebut sangat besar dan menggunakan lebuh banyak ruang untuk disimpan. Oleh itu, tujuan utama tesis ini adalah untuk mengkaji ciri-ciri pendirian motosikal dan penyelenggaraan motosikal. Di samping itu, tesis ini juga menganalisiskan tahap kekuatan struktur pada pendirian motosikal dengan menggunakan Solidworks. Selain itu, tujuan thesis ini untuk mereka bentuk pendirian berfungsi untuk mengangkat dan mengalihkan motosikal yang mempunyai berat maksimumnya 300kg. Pelaksanaan pendirian motosikal dalam kajian ini, mempunyai tiga fasa yang perlu dilaksankan. Tiga fasa tersebut ialah fasa kajian, reka bentuk dan pembangunan. Projek ini dimulakan dengan tinjauan soal selidik yang melibatkan 123 orang responden. Tinjauan soal selidik ini dijalankan untuk mengetahui keperluan pengguna yang memggunakan motorsikal. Justera, data yang dikumpulkan akan digunakan untuk menambahbaik dan mereka bentuk "Motorcycle Rotated Stand" yang akan memenuhi jangkaan pelanggan dan carta morfologi dalam projek ini. Oleh itu, "Motorcycle Rotated Stand" akan dibuat berdasarkan keperluan pelanggan dan kestabilan untuk digunakan untuk mengangkat dan dialihkan. Reka bentuk konsep telah dibuat dan konsep yang paling sesuai dipilih dengan menggunakan "Pugh matrix", "House of Quality (HOQ)" dan Solidworks yang digunakan untuk mereka bentuk lukisan CAD 3D bagi konsep yang dipilih. Reka bentuk yang telah dipilih untuk "Motorcycle Rotated Stand" ini ialah lakaran 4. Dalam kajian "House of Quality (HOQ)", lakaran 4 lebih selamat, cekap, stabil dan mudah disimpan. "Motorcycle Rotated Stand" mestilah mempunyai kriteria ini untuk memenuhi objektif projek ini. Pemilihan bahan telah dipilih melalui analisis dalam simulasi Solidworks untuk menilai keselamatan, ketahanan, dan integriti struktur pendirian motosikal, untuk mengoptimumkan kepuasan pengguna dengan penggunaan harian mereka. Kebimbangan utama dalam projek ini ialah sesaran, faktor keselamatan, strain, dan tegasan reka bentuk pendirian motosikal tertakluk kepada beban dalaman dan luaran. Projek yang telah dibangunkan untuk melaksanakan titik kelemahan produk, untuk mengesahkan bahawa produk yang direka bentuk adalah stabil untuk digunakan. Hasil kajian menunjukkan bahawa pendirian motosikal yang direka adalah stabil untuk digunakan.

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AALAYSIA

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LIST OF SYMBOLS AND ABBREVIATIONS

D,d	-	Diameter
Etc	-	Editable text configurations
CC	-	Cubid Capacity
ACU	-	Auto-Cycle Union
Kg	-	Kilogram
HP	-	Horsepower
KTM	-	Kronreif, Trunkenpolz, Mattighofen
HSS	-	High strength steel
UFG	- 14	Ultrafine grained
ARB	A. A	Accumulative roll-bonding
FEA	No.	Finite element analysis
F	F	Force
Ν	"Pop	Newton
Lb	- "11	Pounds (in weight)
	ملاك	اونيۆم سيتي تيڪنيڪل مليسيا

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CHAPTER 1

INTRODUCTION

1.1 Background Research

Motorcycles are the fastest-growing segment of the global automobile industry, representing the majority of fleets in many low and middle nations and motorcycles are the fastest-growing trends in the global automobile industry, accounting for the majority of fleets in many low- and middle-income nations (Dimitrios, 2017). There are many different sorts of motorcycles, depending on how they are used, the designer's purpose, or a mix of the two. Cruiser, sport, touring, standard, dual-purpose, and dirt bikes are the six primary categories. Sport touring motorcycles are often classified as a seventh category.

Every motorcycle has its own special to handle and how to stand if the user wants to place and park. Every motorcycle must have one stand. The one stand is always used as a temporary park. The side-stand on superbikes positions the bike in a slanting position, limiting users' capability to do maintenance. The kickstand should be retracted by kicking it up with the left foot and allowing it to tuck behind the motorcycle's underbody. Besides, the motorcycle also has a double stand or known as a center stand. Besides that, doublestand which is common on considerably lighter lower CC motorcycles is rarely encountered on superbikes with a dry weight of moreover 100 kg. This double-stand serves as a temporary stand that elevates the motorcycle to a vertical standing position, allowing for easy maintenance work on a regular or ad-hoc basis (Rashid et al., 2012). Motorcycle studies have recently sparked a lot of interest in the scientific community (Syahmi et al., 2022). A paddock stand is used on superbike motorbikes to support the motorcycle in an upright and stable posture, which can be used for a variety of tasks such as washing, tire change, and general maintenance (Pratik Patole, 2015). So, the paddock stand serves an important purpose and can be found in most garages. It's not difficult to use a paddock stand. All that is required is to align the paddock stand's holding mounts with the extension bolts on the rear wheel and support the wheel on it. Then simply push the handle frame lower, wedging the bike upwards until the frame contacts the ground and supports it. It's a lock mode in which the bike will be supported on the stand and will not move till you pull the frame upwards again. As a result, they are extremely safe to use.

While using a paddock for a superbikes motorcycle, the motorcycle will be stable and can use to maintain the motorcycle. It also provides solid stability to the motorcycle. However, if the user motorcycle does not use the paddock stand, it has limitations that can occur motorcycle damage and fall. Moreover, the paddock stand has a lot of space to store. It can occupy space for the user to store such as in the garage. Next, one stand motorcycle can also easy to fall upside down the motorcycle which is parking for a long period. This is because, factors of environment, maintenance, and the placement of motorcycles are affected the stability of the motorcycles.

1.2 Problem Statement

People nowadays prefers riding a motorcycle to driving a car. This is because motorcycles also have lower operational costs and fuel consumption than passenger cars, contribute less to traffic congestion and provide the personal freedom that public transportation does not (Cox & Mutel, 2018). However, users must use a lot of force and energy for handling motorcycles, especially for types of motorcycles with 100 kg and above. Besides that, the characteristics of the motorcycle are very big and it is use more space to store. If the motorcycle has to park and handle, the space also should be big and have a lot of space to use. Besides that, motorcycles like 100kg and above do not have a double stand. So, it is difficult to park and maintenance. So, paddock stands are commonly used by superbike owners to temporarily hold their motorcycle in an upright posture, allowing them to do either daily or ad-hoc maintenance (Syahmi et al., 2022). Unfortunately, usage of the paddock in the current market is not effective and the rear wheel of the motorcycle and front are not orderly. In addition, the paddock can lifting at rear wheel of the motorcycle only.

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1.3 Research Objective

The main aim of this research is to propose a systematic and effective methodology to design and develop a motorcycle rotated stand with reasonable accuracy. Specifically, the objectives are as follows:

- To study the characteristics of the motorcycle stands and services to maintenance for motorcycles.
- ii) To analyze the level strength of the motorcycle stand using Solidworks software.
- iii) To design a functional stand for lifting and rotating a motorcycle with a maximum weight of 300kg.

1.4 Scope of Research

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The scope of this research are as follows:

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- This project focuses on the motorcycle which does not have a double stand and type of service the motorcycle.
- ii) The main focus of this project is to design and create functional tools for lifting and can rotate the motorcycle.
- iii) Handling motorcycle which is weight of moreover 100 kg to 400 kg in the small space.

1.5 Report Outline

This study proposal has been divided into 5 main chapters. Each chapter consists of the project background, literature review, methodology, result, and project summary. Chapter 1 introduces the project background, problem statement, research objective, research scope, report outline, and summary. This chapter is very important to tell the background and direction of this project.

Chapter 2 cover the literature study on about type of motorcycle, the history of the motorcycle, the space that the motorcycle use, and the service or maintenance for the motorcycle. This chapter describes the history, and analysis of the structure of the material, basics, principles, and existing products that have to handle the motorcycle.

Chapter 3 explain the flow chart of a detailed project implementation process that is carried out for the whole process of the methodology and project scheme (Gantt Chart). This chapter describes from the beginning until the end. There has three-phase for this project which are Phase I (Study), Phase II (Design of Product), and Phase III (Development and Fabrication).

Chapter 4 presents the results and analysis of the development of the motorcycle rotated stand, along with the results step by step. The data the result collected from the survey by questionnaire and analyzed in Solidwork.

Chapter 5 concludes the improvement of the final result collected from the survey. The improvement is based on the customer requirement. This chapter also will conclude with the study objective and suggestions for the future studies.

1.6 Summary

This chapter presents an overview of the project's background and objectives. To limit the scope of this planning approach, the issue statement and study scope are also provided. The literature review and the material required to complete the overall analysis are covered in the following chapters.



CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter covers the study's literature review, which is important to the study's scope. Journals, theses, case studies, technical documents, books, reports, and other electronic media sources are also used in the research. Each source was selected depending on how well it fit the study's objectives. All of these sources must be related to customer satisfaction, and they were chosen because they were similar to the study's scope.

This project focusing on the development of motorcycle rotated stands for superbike users in Malaysia.

2.2 History of Motorcycles

Since steam engines and bicycles were invented in the 19th century, experts soon understood that combining these two technologies could greatly improve public transportation. The initial motorcycle was nothing more than a bicycle that had been fitted with a motor, hence the moniker "motor bicycle." In the Parisian exhibition, Werner used the term "motorcycle" as a brand name to present his notion. Since then, the term motorcycle has been used so frequently for these types of vehicles that exclusive usage of the term is no longer conceivable, and the phrase has been designated as a public domain. Any motorized vehicle with two inline wheels is referred to as a "motorcycle." The conservation of angular momentum concept underpins its motion stability (Dimitrios, 2017).



Figure 2.1 Steam engines and bicycles in the 19th century (Two MotionTM, 2021)

Louis Guillaume Perreaux, a French engineer, invented the first motorcycle. On March 16, 1869, Perreaux received a patent for his innovation. Vélocipede à Grande Vitesse, his motorcycle, was powered by a steam engine.



Figure 2.2 The first motorcycle by Louis Guillaume Perreaux (Dimitrios, 2017)

In 1885, two well-known German inventors, Gottlieb Daimlerr and Wilhelm Maybach created the first internal combustion engine motorcycle. The two inventors were also in charge of building the first electric vehicles.



Figure 2.3 Internal combustion engine motorcycle by Daimler (Dimitrios, 2017)

Hildebrand & Wolfmüller developed the first production motorcycles, which used a steam engine until researchers collaborated with Alois Wolfmüller and developed a twocylinder, four-stroke engine in 1894.



Figure 2.4 First motorcycle in 1894 (Dimitrios, 2017)

Motorcycle engineers are involved continuously since the earliest motorcycles, which were nothing more than more advanced bicycles with motors, with businesses experimenting and providing new designs in Europe and the United States. The leading motorcycle producers were in the United States, the United Kingdom, Germany, and Italy until the 1960s, when Japanese Industries made their big debut in the motorcycle industry with game-changing innovations. Table 2.1 below shows the timeline history of motorcycles from early 1885 until 1955 years.

Years	Description
1867 - 1868	- Ernest Michaux fitted a small steam engine to a bicycle in a factory that belongs to his father in 1867.
	- In 1868, Sylvester H. Roper introduced his steam-powered twin-cylinder bicycle.
1885	 Gottlieb Daimler and Wilhelm Maybach created the first petroleum-powered motorcycle as the first true motorcycle. They also tested a new engine on a wooden bicycle and named it Reitwagen which is meant as a riding car.
UNIV	 ERSITI TEKNIKAL MALAYSIA MELAKA In 1894, the Hildebrand & Wolfmüller was the first motorbike to be produced. This motorousle had a 1 480cc interpole
1892 - 1898	combustion engine that only produced 2.5 horsepower (1.9kW) to support its 50kg overall weight.
	 In 1898, the oldest motorcycle manufacturer which is the 7th Cycle and Automobile Exhibition produced the first Peugeot Motorcycle with a Dion-Bouton engine.

Table 2.1 Timeline History of Motorcycle (Two MotionTM, 2021)

	- In 1901, Bob Walker Smith and Jules Gotiet designed Royal Enfield motorcycles which had a 15hp Minerva engine.
	- Indian motorcycles were already sold in 1902, and they won an endurance race from Boston to New York.
1900– 1909	 In 1902, Triumph motorcycles were manufactured by Schulte and it is powered by the Minerva engine which is produced 2.2hp
A REALL TERMINE	 In 1903, Harley Davidson, produced by William S. Harley and Arthur Davidson and Husqvarna is one of the world's oldest motorcycle manufacturers. In 1907, the Isle of Man TT race was produced by Auto-Cycle Union (ACU)
UNIV 1910 - 1919	 - In 1912, Sunbeam motorcycles by Harry Stevens - Nonetheless, his motorcycles were dubbed the Rolls-Royce
	 of motorcycles, and they cost a lot of money. Benelli motorcycles as known as Velomotore which has a
1920 – 1929	98cc two-stroke engine and Guzzi motorcycles manufactured by Emanuele Vittorio Parodi, Giorgio Parodi, and his friend Carlo Guzzi in 1921

	 In 1923, the BMW company produced car engines given for other motorcycles. The first motorcycle is R32 which is use an M2B33 engine. It is 494cc flat – twin.
	- In 1928, DKW motorcycles become the largest produced motorcycles and engines in the world.
1930 – 1939	 BMW was the first motorcycle manufacturer to introduce hydraulically damped telescopic forks, which were first seen on the R12 and R17 models in 1935 - In 1936, the Jewish Simson and family left Simson & Co and the Simson and family left Simson & Co and the Simson and family left Simson & Co and the Simson and family left Simson & Co and the Simson and family left Simson & Co and the Simson and family left Simson & Co and the Simson & C
L LUBBRIN	they cooperate with other factories to form BSW to produce the first motorcycle called BSW98.
UNIVI	- The MV98 was the initial model, and it was called "Vespa," ERSIT but the name had already been taken. ELAKA
1940 – 1948	 Ducati motorcycles were produced in 1947. In the same year, Honda started to produce a 2-stroke 50cc auxiliary bicycle engine by Soichiro Honda
	- In 1948, Beta Motors released the Cervo 48, as their first motorcycle.

 In 1951, R100 was first motorcycle by Hans Trunkenpolz. KTM motorcycle is Kraftahrzeuge Trunkenpolz Mattinghofen and changed to Kronreif Trunkenpolz Mattinghofen after Ernst Kronreif has joined the firm.
 1950 - 1955
 In 1955, Tehuelche motorcycles were manufactured with 50cc and 75cc then, 4700 machines were produced. In the same year, Genichi Kawakami is Yamaha Motor Co., Ltd founded who is the first president and first designed the YA-1.



2.3 Type of Motorcycles

Motorcycles come in a variety of shapes and sizes, with the primary difference being the vehicle's intended usage. This factor has an impact on vehicle geometry, engine specifications, riding posture, and target group. The weight of a motorcycle can vary greatly depending on the model. The average weights of each different type of motorcycle are listed below in Table 2.2.

Motorcycle Type	Range weight, Kg
Moped MALAYSIA	73 - 82
Dirt Bike	45 - 113
Scooter	91 - 136
نيكل مليسيا ملاك Scrambler	اويوم سيخ نيڪ 181 - 227 MALAYSIA MELAKA
Adventure Bike	227 - 294
Cruiser	181 - 318
Chopper	295 - 327
Bagger	318 - 385
Touring	363 - 454

Table 2.2 Range Weight of Motorcycle (Brennan Valeski, 2019)

2.3.1 Standard

The standard motorcycle has a straightforward design and can be used for a variety of applications. It comes in sizes ranging from 125cc to 1,000cc and can be customized with luggage, a tank bag, and a different seat, making it an excellent first and all-around motorcycle. It usually doesn't come with a large front fairing, if one exists at all. Because it isn't too forward-leaning or rearward-reclining, the ergonomics are quite neutral. Seat height is normally in the shorter to middle range, and practically everyone can sit comfortably. For example, the motorcycle Yamaha SR400. (Michael Padway, 2021)

In 2021, Simon Hancocks published a web page that described YAMAHA as officially stating that the SR400 will be phased out of production, and the Iwata factory is honored the model with a limited-edition Final Edition.



Figure 2.5 The motorcycle Yamaha SR400 (Simon Hancocks, 2021)

2.3.2 Naked Bike

The Naked Bike, also known as a standard roadster, is the most basic bike ever seen. Naked bikes have a personality that is quite similar to that of sports bikes, but there are significant differences in terms of aesthetics and usefulness. The fairings (wing-shaped coverings on the bike's body) are removed on naked bikes to reveal the bike's machinery. It only needs minor bodywork, and external repairs and replacements are inexpensive! Because of their rugged appearance, flatter handbags, and tuned engines, these motorbikes are popular as street bikers. The engine capacity can range from 250 to 1000cc (Keerthi, 2022).

The research study by Wade Thiel found that the best-naked motorcycles are the 2022 Honda Grom, 2022 Yamaha MT-03, and 2022 KTM 390 Duke. Firstly, the Grom is a straightforward device. The bike is powered by a single-cylinder, air-cooled, 124.9cc four-stroke engine that produces roughly 10 horsepower. The engine is linked to a four-speed transmission, and the bike is possibly the most entertaining thing to whip about on and perform wheelies on. Then, the Yamaha MT-03 was released in North America in the second half of 2020. Based on sales data, it has earned a place among the best and a nice example is the KTM 390 Duke. It's sharp and speedy, and the bike's condition will be excellent while riding. A 373cc single-cylinder four-stroke engine is mated to a six-speed transmission on the motorbike. The engine produces around 43 horsepower, and the bike is capable of handling any winding road or concrete jungle. Figure 2.6 shows the motorcycle KTM 390 Duke.



Figure 2.6 Example of Naked Bike (Keerthi, 2022)

2.3.3 Touring Motorcycle

Touring motorcycles are surprisingly comfortable and more convenient making them ideal for cross-country travel. It is made for riding and traveling in all types of weather, with high-capacity engines and everything can make a trip more comfortable, such as aerodynamic protectors, bags, windshields, ergonomic seats, and touring suspension (Dimitrios, 2017). The expansion of storage space to prepare for long drives is the primary reason. Touring bikes also include additional side fairing to reduce aerodynamic drag on roads. The engine sizes are also large enough to maintain respectable speeds for long periods. The engine capacity can range from 250cc to 700cc or more.

For example, Nzili Sam found that the 10 Best Touring Motorcycles Can Buy In 2021 such as Indian Chalengger, BMW R1250RT, Harley-Davidson Road King, and KTM 1290 Super Duke GT. All the following are the highly recommended touring bikes in 2021 based on consumption, comfort, power, speed, safety, and prices considered at the motorcycle requirement.



Figure 2.7 Example of touring and grand touring motorcycle (KTM 1290 Super Duke GT) (Nzilili Sam, 2021)
2.3.4 Dirt Bike

Dirt bikes are designed to be used on natural surfaces such as dirt, mud, and rocks (Lee Sullivan hill, 2004). They are made of lightweight, hard polymers and make aesthetic compromises, such as headlamps, to reduce curb weight. (Kelly KOzakowski, 2021) The seating posture is elevated to provide the rider with a better view of the road. These off-roading motorcycles have more suspension travel, and higher torque, and are not intended for use on paved roads. The CC range can be anywhere from 150 to 700 or higher.

Mark Lindemann identifies that dirt bikes are excellent motorcycles for learning only. The dirt bike has high–quality suspension that is designed to handle tough terrain and typically requires a foot which is 30 cm of suspension travel to do it properly. Other than that, the dirt bike is easy to handle which is a recreational dirt motorcycle that lacks the high-performance components seen on motocross bikes, for most casual riders, this is better and cheaper than another motorcycle. Their wider powerbands make them more forgiving than racing bikes, which demand extreme precision. Lastly, the dirt bikes also have powerful tires which are designed for full off-roading and require tires that can claw into the ground for grip.



Figure 2.8 Dirt Bike (Kelly KOzakowski, 2021)

2.3.5 Café Racer

A Cafe Racer motorbike is a modified motorcycle based on an existing model or one created from the ground up to replicate the design and feel. The idea is to make the bike lighter by reducing it to its core essentials, resulting in improved handling and a sportier appearance. Modifications are typically in the shape of a café racer seat, sometimes known as a bum stopper. The race seat from which it draws its design reference keeps the rider from sliding backward during heavy acceleration (Joeri, 2015).

In 1984, Nash, A., and Keerthi stated that the Café Racers also are high-speed bikes with a reputation for agility and power. The feature of Café Racers is very little bodywork and a low comfort factor. It is a light motorcycle with low-mounted, narrow handlebars known as "Clip-on." The handlebars on standard motorcycles are frequently replaced to create café racer bikes. The engine capacity can be as high as 900cc (Nash, 1984).



Figure 2.9 Café Racers (Joeri, 2015)

2.3.6 Motocross

Motocross bikes are sometimes mistaken for Enduro motorcycles. The bikes are designed to compete in outdoor events with rugged terrain, sharp turns, and jumps. They are designed for off-road surfaces and feature strongly built suspensions. Supercross riders also participate in indoor facilities that are specifically designed for these events. For example, Kawasaki and Honda are two of the most well-known manufacturers of Motocross bikes.



Figure 2.10 Example of Motorcross (Mat Boyd, 2016)

2.3.7 Chopper

The Chopper is the most famous motorcycle in American history. It first appeared in the late 1950s as a symbol of rugged masculinity and has since been used in various television programs, films, and ads. In 2021 Benjamin Smith concluded that Motorcycle riders in California in the late 1950s began to experiment with their machines in ways they had never done before. The chopper, a custom motorbike with significantly modified steering angles and expanded dimensions, was one of the most extreme types to emerge. This motorcycle's extreme styling, which includes modified steering angles and longer forks, makes it an attractive sight. It is made from a chopped-up original motorcycle. The long front ends that extend like forks are the most iconic features and are also paired with a rake and hardtail frame angle that's been enhanced.

The Chopper is also responsible for the creation of the Harley Davidson, possibly the most famous motorcycle of all time. The motorcycle, which originated with the eponymous business, became an iconic sight in the 1960s and has since become a symbol of the touring American male.



Figure 2.11 Chopper Bike (Benjamin Smith, 2021)

2.4 Services of Motorcycles

The main reason for the usage of rotated motorcycle stands is for service. Other than use for parking, the vehicle service is a collection of maintenance operations performed at a predetermined period or after the vehicle has traveled a specified distance. The vehicle manufacturer specifies the service intervals in a service schedule, and some newer vehicles electronically show the next service required date on the instrument panel.

Motorcycle maintenance schedules vary depending on the year, consider making, model of the motorcycle, driving circumstances, and driver behavior. Based on impact characteristics such as extreme hot or cold climate conditions steep, dusty, or roads the number of trips and distance driven every trip per day, the engineer recommends the socalled extreme or ideal service schedule. Figure 2.12 shows an example of a service for superbikes that needs support when the mechanic is doing the service. The service is to change the coolant. Figure 2.12 shows an example of a service for superbikes that needs support when the mechanic is doing the service is to change the coolant. The efficient cooling system determines the engine's consistent performance and overall life. Manufacturers all around the world rely on a "Liquid Cooling System" for superior engine cooling.

While Figure 2.13 is an example of a service for superbikes that do not need support, It is to change the spark plug. The spark plug is an important part of your motorcycle's ignition system. A spark is created when voltage is injected into the plug from its base, jumping from a center electrode to a grounded electrode. The other services are in the Table 2.3.



Figure 2.12 Example Service for Superbikes Need to Support. (John Milbank, 2020)



Figure 2.13 Example Service for Superbikes Do Not Need to Support. (Startrescue.co.uk, 2019)

Table 2.3 shows the maintenance for the Ducati 999 Superbike (Dana Hooshmand., 2021). The services can be classified and listed in accordance with how well they fit the motorcycle parts that need to be supported.

Type of service	Front wheel	Rear Wheel		
Change engine oil and oil filter	\checkmark	\checkmark		
Check/ clean engine oil intake filter	✓	✓		
Check/ adjust valve clearances	\checkmark	\checkmark		
Check/ Replace timing belts		✓		
Change spark plugs	\checkmark	\checkmark		
Change coolant	✓	✓		
Change fuel filter	✓	\checkmark		
Check throttle body sync and idling	✓	✓		
Change air filter		×		
Check air pressure tyre		~		
Check engine oil pressure		· · · · · · · · · · · · · · · · · · ·		
Change clutch and brake fluid	سىتى تىكنىك	 اونيوس 		
Check clutch and brake controls	VIKAL MALAYSIA N	IELAKA		
Check steering bearing play	✓	\checkmark		
Clean fuel tank	\checkmark	1		
Perform general lubrication and greasing		~		
Check torque of safety – critical points of the vehicle		\checkmark		
Perform general testing	✓	\checkmark		

Table 2.3 The maintenance for the Ducati 999 Superbike(Dana Hooshmand., 2021)

As a result, the rear wheel is always used for superbike maintenance. So, the main purpose of lifting the motorcycle while servicing is the back wheel of the motorcycle. In conclusion, the comprehensive motorcycle service will guarantee that any mechanical or electrical issues are addressed before the motorcycle is used, which will impair the motorcycle's safe operation. Regular servicing can not only extend the life of a motorcycle (Saleh, 2016), but it will also make it more efficient and enjoyable to ride when all of its components are in good working order.

2.5 Type of High Jack Lifter

Similar to car maintenance, lifting a motorcycle off the ground is necessary for motorcycle repairs. The motorcycle jack is necessary for that function. A motorcycle lift enables adjustment to any position during the repair. A motorcycle jack would be able to change the motorcycle's height and position while working on it, unlike other options that keep the motorcycle static during the operation. The list of high jack lifter for motorcycle is shown in Table 2.4.









As the summary indicates, the Stark 65124 Center Lift Motorcycle Scissor Jack is suitable to lift the motorcycle. It has a decent weight capacity and is easy to operate. Moreover, the type of lifting mechanism is a scissor and comes with two detachable rubber saddle adapters as a base. It is also a lightweight and reasonably portable motorcycle jack.

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2.6 Material of Product

The product of the material is important in design and fabrication. From the researcher, the motorcycle stands is a quite simple especially structures. The main objective of structural analysis and design is to create a structure that can withstand all applied loads for the duration of its intended life. As a result of multicriteria optimization of structure characteristics, mass, product manufacturing, and service costs, as well as ecological compatibility with the natural environment, materials engineers participate in product design processes, and materials manufacturers face requirements (Dobrzański, 2011). Furthermore, materials' ability to transport load will be harmed if they corrode or deteriorate.

2.6.1 Mechanical Properties of Materials

Mechanical properties are those that affect a material's mechanical strength and ability to be molded into a required shape. Some common mechanical properties have significant applications in the aerospace and automobile industries. These properties are important to a material's ability to withstand mechanical forces and loads, and they are measured in terms of the material's behavior when subjected to a force. Mechanical characteristics can be determined to provide design data to engineers or as a check on raw material quality (Murugan, 2017).

The ability of a material to resist externally applied forces without breaking or yielding is referred to as material strength. The utmost stress a material can bear before becoming destructive is referred to as its ultimate strength (D) (Murugan, 2020). It refers to a material's ability to resist bending, breaking, shattering, or deforming when subjected to external forces.

Strong material iscanustain significant forces without breaking or deforming. Some materials have varied strengths depending on the type of stress they are subjected to. Such as concrete which has impressive strength but low tensile strength. There are a few aspects to be considered while selecting the material trial properties of a motor stand.

2.6.1.1 Strength Strentgh and Stress-Strain

Simple stress is known as the ratio of the applied force divided by the resisting area. Normal stress, shear stress, and bearing stress are three types of simple stress. When a force is applied perpendicular to the material's cross-sectional area, normal stress arises. The stress tensor is commonly used to represent a stress state at a material point (Lou et al., 2020).

Figure 2.15 shows the stress and strain relationship. The material's ductility and yield strength are described by the stress and strain curve acquired during tensile testing (Xu et al., 2019). Tensile testing is a destructive test method that determines the metallic material's tensile strength, yield strength, and ductility. It determines the amount of force required to break a composite or plastic specimen, as well as how far the specimen stretches or elongates to reach that breaking point. According to David Roylance, the stress-strain curve is a crucial graphical representation of a material's mechanical properties.





Figure 2.15 Relationship Stress and Strain Curve (Murugan, 2020)



Figure 2.16 Necking in a tensile specimen (Kaufman & Rooy, 2021)

2.6.1.2 Ductility

Ductility is known as able to be deformed without losing toughness. During cyclic deformations, ductile structures are often capable of dissipating considerable amounts of energy. The ductile materials should be strong and plastic. Such as gold, mild steel, copper, aluminium, nickel, zinc, and tin. The most ductile is gold. Ductility is usually measured by the percentage of elongation and reduction in area. The following is a simple ductility test:

UNIVERSITI TEKNIKAL MALAYSIA MELAKA Ductility = 100 x (Lf - Lo)/Lo (2.1)

Where;

L_f: Final length of specimen,

L_o: Origin length of the specimen.

The ability of a material to stretch under tensile load and keep its distorted shape when the load is removed is known as ductility. The material would yield and deform if subjected to a shock load. Ductile material can be shaped without losing its strength. All materials that are created by drawing, such as drawing into wire form which is must be ductile.

The creation of strain incompatibility-driven microcracks with a size similar to the grain size limits ductility, which is determined by grain size. However, when particle size drops, microstructure nonuniformity and a reduction in initiation hardness limit ductility improvement. The fracture is cleavage-like, although it is preceded by plastic deformation. When the general tensile yielding behavior and the near-tip local plasticity recorded at the commencement of crack are compared, the inverse link between ductility toughness is explained (Kim, 1998).

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In 2002, N. Tsuji et al. stated that The strength and ductility of ultrafine-grained (UFG) aluminum and steel were first systematically elucidated throughout a large range of grain sizes, from 200 nm to 10 lm. Both materials have mechanical characteristics that were very close. Even in submicrometer grain sizes, the strength roughly maintains the Hall–Petch relationship. However, the dislocation substructures inside the UFGs, as well as the elongated grain morphology, are present in the as accumulative roll-bonding (ARB) treated specimens and the specimens annealed at lower temperatures. This indicates that grain refinement strengthening, as well as strain hardening and texture strengthening, may alter the strength of these specimens.

However, as demonstrated in Figures 2.17 and 2.18, grains larger than 1 lm are almost equiaxed and free of dislocations. The next studies should go into the Hall–Petch parameters in-depth, such as the slope which is known as k (Tsuji et al., 2002).



Figure 2.17: TEM microstructures of the 1100 aluminum annealed for 1.8 ks at (a) 373 K, (b) 423 K, (c) 473 K, (d) 498 K, (e) 523 K, and (f) 573 K after 6 cycles of ARB (e ¼ 4:8) at 473 K. Observed from TD (Tsuji et al., 2002).



Figure 2.18 TEM microstructures of the IF steel annealed for 1.8 ks at (a) 673 K, (b) 773 K, (c) 873 K, (d) 898 K, (e) 923 K, and (f) 973 K after 5 cycles of ARB (e ¼ 4:0) at 773 K. Observed from TD (Tsuji et al., 2002).

2.6.1.3 Hardness

Hardness is one of the most main characteristic characteristics of materials, and it has played an important part in the evolution of civilization since it has allowed for the creation of increasingly sophisticated gadgets and machines. Quantitative hardness scales and related measuring methods, on the other hand, were first proposed in the last century or so. Brinell is credited with inventing the first modern method for determining the hardness of metals (Leyi et al., 2011), which involved employing a hard steel ball as an indenter (Zhang et al., 2011). In early studies by D. Tabor, the ratio of the indentation load to the surface or anticipated area of residual indents is commonly used to calculate the hardness value.



Figure 2.19 Schematic figure of a Brinell-hardness tester (Gyurkó & Nemes, 2018).

Based on an analysis of the dimension of indentation, a relationship between hardness and strength has been established. Cheng Y.-T et al, analyzed that the ratio of hardness to yield strength was related to yield strength, young's modulus, Poisson's ratio, work-hardening exponent, and indenter half angle. In Table 2.3, the strength, hardness, and ratio of hardness to strength in Cu and Cu-Zn alloys with different pretreatment are listed

as follows.

	σ (MPa)		$H_V(MPa)$	H_V/σ		
	σ_y	$\sigma_{\rm U7S}$		H_V/σ_y	H_V/σ_{UTS}	
Annealed Cu	80.71	223.43	545.86	6.76	2.44	
Cold rolled Cu	250.03	271.28	925.81	3.70	3.41	
Cu ECAP-1p	344.67	350.85	1194.18	3.46	3.40	
Cu ECAP-2p	381.20	391.50	1253.34	3.29	3.20	
Cu ECAP-3p	387.67	398.54	1263.19	3.26	3.17	
Cu ECAP-4p	402.27	415.02	1329.86	3.31	3.20	
Cu10%Zn ECAP-1p	375.87	389.97	1421.58	3.78	3.65	
Cu10%Zn ECAP-2p	478.00	498.45	1565.72	3.28	3.14	
Cu10%Zn ECAP-3p	531.70	546.43	1644.73	3.09	3.01	
Cu10%Zn ECAP-4p	539.60	569.13	1691.32	3.13	2.97	
Cu10%Zn HPT-1t	735.67	803.44	2046.80	2.78	2.55	
Cu10%Zn HPT-5t	708.88	831.62	2105.72	2.97	2.53	
Cu10%Zn HPT-10t	675.75	821.04	2130.74	3.15	2.60	
Annealed Cu32%Zn 3/4	63.59	257.64	522.73	8.22	2.03	
Cold rolled Cu32%Zn	374.35	422.86	1458.44	3.90	3.45	
Cu32%Zn ECAP-1p	517.80	551.73	1847.54	3.57	3.35	
Cu32%Zn ECAP-2p	648.90	685.27	2038.63	3.14	2.97	
Cu32%Zn ECAP-3p	703,03	749.39	2038.31	2.90	2.72	
Cu32%Zn ECAP-4p	734.63	768.27	2224.11	3.03	2.89	
Cu32%Zn HPT-1t	918.31	1009.25	2415.99	2,63	2.39	
Cu32%Zn HPT-5t	894.75	1035.44	2469.13	2.76	2.38	
Cu32%Zn HPT-10t	968.76	1083.82	2500.69	2.58	2.31	

Table 2.5 Table of strength, hardness, and the ratio of hardness to strength in Cu and Cu-Zn alloys with different pretreatment (Zhang et al., 2011).

2.6.1.4 Toughness

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Toughness refers to a material's capacity to absorb energy and deform plastically without cracking. Toughness is a quality that indicates a material's resistance to fracture in the presence of a crack. The Charpy or Izod tests are commonly used to determine toughness. The impact test assesses toughness in the presence of imperfections such as notches or fractures that concentrate stress in weak places. The amount of effort required to distort one cubic inch of metal until it fractures is known as toughness.



Figure 2.20 Charpy test (Ashter, 2014)

High-strength steel is designed to have the best combination of physical and mechanical qualities, such as strength, ductility, and toughness. High-strength steel (HSS) is made to achieve the best possible combination of physical and mechanical qualities, such as strength, ductility, and toughness. This is because the lightweight weight of HSS components may result in a reduction in overall weight and energy usage. Moreover, because of the chemical composition and production process, the mechanical properties of HSS differ from those of normal strength steel, and they are worth researching (Tong et al., 2018).

2.6.2 Material Selection

The materials used in the construction of the motorcycle stand, particularly the materials used for the coating, as well as the material strength itself, are now being given great consideration to ensure that the stand's functionality, stability, and performance are met. Moreover, the frame should be highly durable and its weight should be light enough to move about freely while still meeting the maximum weight limit. Then, designers and engineers must consider a wide range of considerations when selecting materials.

Mechanical and electrical qualities, as well as corrosion resistance and surface finish, are all considerations to consider (Holloway, 1998). According to Rashid et al. paddock stands are need required to fulfill criteria:

- Functionality Indicating the items that need to be adjusted and the objective that they are supposed to achieve.
- Stability For evaluating aspects including a product's shelf life, ideal storage settings, retest period, and overall quality assurance for customers.
- iii) Maintainability To easily repair with separation of the parts.
- iv) Safety To safeguard customers, producers must take steps to ensure that all products are safe.
- v) Easy to handle To verify that the paddock stand is simple to use, test it on persons who are unfamiliar with it.

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2.6.3 Material Analysis

A variety of materials are used to construct a long-lasting paddock stand. A paddock stand can be made entirely of one material or have a design that includes several materials for the frame and handle holder. A good choice of material for a paddock stand will give users enough stability and optimize their comfort while using it. Each material has its unique properties for dealing with various conditions. Table 2.6 shows some of the materials to produce most of the frames.

Material	Characteristics						
	Durable, Strongest, and Hardness						
	Resistant to corrosion						
	• the ratio of ultimate strength to yield strength is						
Stainless Steel	greater than for carbon steel						
	• Material used for cookware, industrial equipment, and						
	construction in railway train (S. A. Main, 1935).						
	• 100% steel atom						
AL B	The properties of pure steel are hardness, toughness,						
EKUL	tensile strength, yield strength, elongation, fatigue						
Pure Steel	strength, corrosion, plasticity, malleability, and creep.						
1. E. S.	• It's used to make oil tankers, and it's the most						
ملاك	extensively utilized material for building the world's						
UNIVI	infrastructure and industries. ERSITI TEKNIKAL MALAYSIA MELAKA						
	• Combining iron and carbon with other alloys.						
	• alloy steel was created to increase the quality of steel.						
	• Has a Cr content of greater than 12%. Chromium						
Alloy Steel	creates a passive oxide film on the surface of these						
	alloys, making them corrosion resistant in a variety of						
	chemical conditions (Morales, 2012).						
	has a density around						
Aluminium	• Has a heat conductivity that is around three times that						
	of steel.						

Table 2.6 Type of Material for Frame (Tom Roth, 2021)

	• It is one of the lightest engineering metals.
	• high corrosion resistance.
	• Type of low carbon steel
	• High tensile strength and impact strength
Mild Steel	• Good ductility and weldability
	• high ductility and less toughness (Srivastava et al
	2021)

The motorbike stand is made of a variety of materials. Steel is used in the majority of them. However, many of the most popular motorbike stands are made of mild steel. Mild steel is a grade of carbon steel, which are metals that primarily contain carbon and iron. Carbon enhances the properties of pure iron, and the resulting mechanical and chemical properties vary depending on the carbon content. There are the following advantages to mild steel:

i) Strength to weight ratio UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Mild steel is one of the lightweight metals that can be used in a variety of items. This is because the carbon content in these metals is the main influencing factor for their overall weight.

ii) Ideal mechanical properties

Mild steel may be less hard than its counterparts with its lower carbon content. But, this allows them to offer improved malleability, as they are less brittle and less likely to fracture under pressure. Moreover, mild steel still offer higher tensile strength and higher impact resistance than carbon steels. Additionally, they are magnetic due to their ferrite content.

iii) Favorable chemical properties

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More chromium is added to mild steel to increase hardness and corrosion resistance. This is the best solution for uses where metal can withstand oxidation brought on by exposure to air and water. Another alloying component that affects mild steel similarly is copper, which is frequently utilised in the production of items like pipes and tubes.

iv) Weldable

The weldability of mild steel products is one of their main benefits. This is due to the steel used in their construction, which allows electric currents to easily pass through mild steel without damaging the metal's surface. Other kinds of steel, such as stainless steel, have this problem. While welding these materials may need specialized methods, mild steel can be treated using methods that are far more basic and less expensive. Because of this, working with it during fabrication is simple.

2.7 Structural Analysis

The process of calculating and identifying the effects of loads and internal forces on a structure, building, or object is known as structural analysis. Structural analysis is very significant for structural engineers since it ensures that they fully comprehend load courses and the effects of those loads on their engineering design. It enables engineers or designers to confirm that a piece of equipment or construction is safe to operate under the anticipated loads. Structural analysis can be done during design, testing, or after the building has been built, and it will usually take into consideration the materials used, the structure's geometry, and the applied loads.

In the Journal of Applied Engineering Design and Simulation, Syahmi et al. suggested that when jacking down the superbike, the end of the handlebar was curved to provide the operator some room to grab the handlebar and avoid fingers being clamped or damaged. When the RhiNO v2.0 paddock stand successfully elevates the motorcycle into an upright position, this is the key position for the stand's operation. In Figure 2.21, this is when the motorcycle's complete weight is evenly distributed on the stand.

On the bending part of the expanded handlebar, a knurling pattern was incorporated as a grip to provide a solid grip and avoid being slippery when handling lubricant works on the superbike which is shown in Figure 2.22.



Figure 2.21 Free body diagram of critical position during operation of RhiNO v2.0 (Syahmi et al., 2022).



Figure 2.22 Structural and Design Detail on RhiNO v2.0 (Syahmi et al., 2022).

2.7.1 Finite Element Model and Analysis

Finite element methods are commonly applied to calculate stresses and strains in complex mechanical systems. Finite element analysis (FEA) are computer-based stress analysis methods that are employed when the forms, quantities, or types of materials, or the loading history are too difficult for analytical methods to handle. Furthermore, the motorcycle rotated stand is a use of space established for the convenience of the user, it is important to ensure that the motorcycle rotated stand is strong and durable, as well as to optimize users' pleasure during daily use. Engineers are frequently left to their instincts during the design phase of a project, with no analytical tool to back up their assertions. As a result, a range of testing could be used as a tool to reduce the risk of product damage and ensure product quality.

Jacob Fish employs Finite Element Analysis (FEA) as a numerical method to address complicated structural issues using computers and technology. Syahmi et al use FEA on the model to make sure it's highly durable and can support the weight of the motorcycle. As illustrated in Figure 2.23, it was allocated as clamped at the lever surface, where the stand would rest once the motorcycle was lifted, with a 250 kg weight or 2500 N of force applied on both ends of the support.



Figure 2.23 Boundary condition and an acting load of the finite element model (Syahmi et al., 2022)

The FEA simulation analysis consists of the deformation, von Mises stress, and translational displacement caused by the structure of the stand. Figure 2.24(a) shows the deformation of the stand as a result of the load. However, the FEA found that there is very little distortion. The von Mises stress acting on the stand is depicted in Figure 2.24(b). The red area depicts the maximum von Mises stress of 30 MPa, which will have a significant impact on the RhiNO v2.0 due to the load pressing on it. When the load is applied to the stand, Figure 2.24(c) displays the translational displacement findings, with the red region representing the maximum translational displacement of 0.984 mm.



Figure 2.24 Result in FEA in CATIA V5R20 (a) Deformation of the RhiNO v2.0, (b) von Mises stress acting on the RhiNO v2.0, and (c) Translational displacement on the RhiNO v2.0 (Syahmi et al., 2022)

In 2017 L. Venugopal et al. published Optimum Design and Performance Analysis on a Rail Wheel Assembly of Rail Mounted Storage CUM Resting Fixture in which they described that for persons involved in engineering design, a finite element method is a great tool. From their finding which is observations for Railway Wheel Assembly Design, they found a maximum deflection of wheel 0.97mm which is Figure 2.25, and the maximum von mises stress detected on the axle shaft is 137 Mpa which is shown in the Figure 2.26.



Figure 2.25 The Maximum Deflection of the Wheel is 0.97mm (Venugopal & Kumar, 2017).



Figure 2.26 The Maximum Von Mises Stress Detected On The Axle Shaft (Venugopal & Kumar, 2017).

From the finding, FEA also can be demonstrated in Solidworks simulation. Solidworks also can view the results using a variety of color plots, graphs, animations, and reports. Solidwork simulation can perform stress, the factor of safety, or deformation analysis of components without setting up loads and boundary conditions. The motorcycle rotated stand should have a good structure and can be more stable to lift and move the motorcycle. The procedure that should be required to test for a motorcycle rotated stand:

- i) Horizontal static load test.
- ii) Vertical static load tests on the body frame
- iii) Body frame impact test
 iv) Arm holder static load test
 v) Clamping single-arm motorcycle load test
 vi) Clamping single-arm impact test.
- vii) Wheel impact test.
- viii) Wheel load test

2.8 Summary

In summary, all the previous research for this Chapter 2 have been shows in the Table 2.7.

	Table 2.7 Summary of Chapter 2								
No.	Year	Author(s)	Name Product	Tittle	Material	Usage	Characteristics		
1.	2013	John Clays	Redline Center stand	Center Stand Lift for Sport	U	Jack to support the exhaust header and	• 12 adaptor pins are being used, as well as a CNC-cut		
		5	سيا ملا	Bikes	کنید	raise the front of the bike, Stand is	wooden pin holder.		
		U	NIVERSI	TI TEKN	IIKAL M	adjustable in width to fit all-sport bikes	• Allows front and rear LAKA suspension work by lifting		
							from the swing arm pivot holeDifficult to set up.		

Table 2.7 Summary of Chapter 2



3.	2013	John Clays	Front and Rear Stand	Center Stand Lift for Sport	-	Allow using all parts of the bike	 Uses a variety of lifting techniques such as pin,
			A MALAY	Bikes			spool, and rubber shelves.
		1	7	E.			• Need more than one stands to
		TEK.		S.			carry the bike
			od aning	-			• All models do not fit the same pin
4.	2012	H. Rashid,	Paddock stand	Design of a	Mild Steel	Mechanical platform	The support can be adjusted
		A.H.		superbike		that elevates the	to various widths depending
		Abdullah,	NIVERSI	paddock	IKAL M	motorcycle into a	LAKA the model of the
		M.H. Mohd		stand using		vertical position.	superbike.
		Noh, A.H.					

		Abdul		cad and cae				
		Hamid and		tools			•	The back tire is lifted by the
		N.M.						stand, allowing it to turn
		Zainal						freely.
		Zamai	MALAY	IA de				
		Abidin	S.	10			•	A single user may simply
		100	1	E				
		LE P	•	2			V.	operate.
							1	
5.	2022	Wan	RhiNO v2.0	Development	Aluminium	Use it to temporarily	•	The breadth can be adjusted
		Muhammad	YAINO .	of RhiNO	Alloy 6061	support the motorcycle		up to 210 mm.
		Syahmi	611	v2.0: An		superbike in an upright		
		Wan Fauzi,	سا ملاد	Enhanced		posture, allowing them	يبوز	Has the extended handlebar
		Helmi	NIVERSI	Single User	IKAL M	to maintain work.	LA	There are no detachable
		Rashid,		Paddock				elements in a single
		Muhammad		Stand				cionicito in a single
								structure.



CHAPTER 3

METHODOLOGY

3.1 Introduction

The process for implementing this project will be explained in detail in this chapter. To produce a new motorcycle rotated stand, at least three phases must be completed in the development of this project. The three phases consist of the study phase, design phase, and development phase. The process in these may revert but will follow the designed rules. The product must first pass all processes to achieve the final result. The further detail will describe in Section 3.2. The detail of the timing of this project will show in Appendix A.

3.2 Planning of The Study

First and most importantly, the study's problem statement and objectives were determined based on the research conducted. Figure 3.1 shows the framework for the study flow chart in greater detail. In this project, the literature review is the second main reference source, and it is fully supported by data generated through analysis. The study is being debated and analyzed to evaluate whether or not the research topic is clear. To complete this project, three ways are highlighted in this chapter study research, design, and analysis, as well as fabrication.



Figure 3.1 Framework of Study
3.3 Phase I: Study and Research

Phase I is about the study phase of journal papers, conference papers, books, articles, magazines, and newspapers as tools and references for this project. To complete this project, five main topics need to apply which are the existing product, problem statement, project phase, proposal the design, and lastly, the construction of the questionnaire have been made.



Figure 3.2 Framework of Product Development in Phase I

3.3.1 Existing Product

This is the first step to starting the design and developing the project. The existing product can be referenced to study and research the product that exists in the market. There are many existing products from the research such as dynamoto movable motorcycle stands, DIY motorcycle turntables, and Acebikers u-turn motor mover motorcycle dolly. Then, we are required to identify the main goal or objective for the product. Besides, the target consumer and respondents required in performing the study survey also need to consider before collecting the product sample. Moreover, the product sample can be founded by using internet sources, observation, customer feedback, and others. Competitive research would give good ideas for new products to sell as well as how to plan and implement market strategies.

3.3.2 **Project Limitation**

The project limitation can be identified by feedback and satisfaction from the customer. In general, a problem statement will outline the negative points of the current situation and explain why this matters. Moreover, the problem statement can help in contextualizing and understanding the significance of the research problem.

3.3.3 Propose Design

After the study and problem statement has been identified. The product needs to be seen in more detail to identify the whole component consist in the motorcycle stand, especially the combination between the rotating stand and paddock. Usually, three or more drawings to propose with guidelines and feedback from customers. The sketches will be used in future procedures like questionnaires and Morphological Charts. As a result, sketching will remain an important part of the design and development process. After the drawing is finished, the comparison should make in the questionnaire.

3.3.4 Construct Qustionnaire UNIVERSITI TEKNIKAL MALAYSIA MELAKA

The purpose of this questionnaire is to collect the best design that customers decide on their opinion. This questionnaire is conducted for students and citizens who are familiar with handling motorcycles especially in workshop. The questionnaire should have the main point about the research and study being. The questionnaire consists of two sections. The first part is to collect the background data of the respondents. While the second parts are questions related to general information about the design of motorcycle stands. The last part of the questionnaire will provide questions that relate to the design of a motorcycle.

3.4 Phase II: Design

This phase will explain the things that need to be done after the phase I completed. This phase focuses more on the selection and production of the design of a motorcycle rotated stand after conducting research in phase I.



Figure 3.3 Framework of Product Development in Phase II

3.4.1 Distribute Questionnaire

The survey questions will be distributed at random and should be answered honestly by the respondents to make sure that the decision selected is the best option. There will be no limit on the number of people who can respond to this survey. In addition, the questionnaires are based on a variety of existing motorcycle rotated stands on the market. Then, the questionnaire survey was carried out in March 2022 using an online Google form, as shown in the diagram.

Design Survey for Motorcycle Rotated
Stand
Hi and Assalamualaikum, I am Nor Azureen Binti Saleh a third year student from Faculty of Mechanical Engineering & Manufacturing Technology (FTKMP) at Universiti Teknikal Malaysia Melaka (UTeM).
I am assigned to analyze and collect the data for my Bachelor Degree Project that supervised by Ts.Dr. Kamarul bin Amir Mohamed, for my project which is DESIGN AND DEVELOPMENT OF MOTORCYCLE ROTATED STAND.
The purpose of my project are : 1. To design a functional stand for lifting and rotating a motorcycle with a weight of 100ka
 To develop a new functional stand for the motorcycle to rotate based on the design that had been made.
Please read the question carefully and choose the best answer provided. All information from respondent will be kept confidential and used for academic purposes only.
Finally this survey form is important for the project research improvement and documentation.
اونيوبرسيتي تيڪنيڪل مليسيا ملائ
UNIVERSITI TEKNIKAL MALAYSIA MELAKA Figure 3.4 Survey Design

3.4.2 Data Analysis

In this step, the chosen product needs to identify based on the data collected. When the data in the questionnaire survey is complete, the data should be gathered and will analyze to identify the element that is most preferred to attach with the product that has to improve.

3.4.3 Design Sketching

This section is about sketching the new design. The new design is from the opinion of all the respondents that have answered the questionnaire survey. After the sketch, the next process is material selection.

3.4.4 Material Selection

To get the finalized characters of the design, the material selection is a systematic and rapid method for engineers to eliminate inappropriate materials and find the one or a limited number of materials that are the most suited. For material selection, the morphological chart is the best method to select and may help the team establish a wide range of prospective design solutions for a product by conducting a systematic investigation of the shape or configuration that a product or machine could take. Moreover, this section aims to capture the required product functionality and investigate alternative methods and combinations to do it. Below shown the morphological chart that has been constructed.



Figure 3.5 Example of Morphological Chart

3.4.5 3D Modelling

In this section, 3D modeling is used to create a three-dimensional digital representation of any item or surface. After completing the survey procedure and material selection to obtain the design of the motorcycle rotated stand and other components, 3D modeling has been created in Solidwork software. All designs will see clearly and accurately by Solidwork software.

3.4.6 Analysis and Simulation

The final process in phase II will be simulation and analysis, which will be done with SolidWorks software. The motorcycle rotated stand will be put to the test in this step by applying force to it. The goal of this test is to determine the stand's ability to handle the load placed on it. For example, analysis of stress and strain of the structure of the motorcycle. This process is very important because it will find solutions to common problems and make informed decisions about which action to take next.

3.5 Phase III: Develop Phase UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Phase III will explain the main of how to complete the project and study. This phase needs to follow to develop and create the real design in this study and research.



Figure 3.6 Framework of Product Development in Phase III

3.5.1 Cutting

In this step, the sheet metal will be cut with the metal cutting machine because Metal cutting machining is one of the most used methods for shaping a product or component in the manufacturing industry. Moreover, one of the most efficient methods for cutting sheet metal is laser cutting. Then, it is can be used to cut a variety of materials, like steel and aluminum sheets, as well as three-dimensional bodies as profiles and tubes. It is a very economical efficiency so, due to high material utilization.

3.5.2 Welding

Next, welding is the next process used for the fabrication method in which two or more parts are merged by heat, pressure, or both, resulting in a join as the parts cool. Moreover, it can also use a shielding gas to prevent contamination or oxidation of the melted and filled metals.

3.5.3 Assembly

The rear of the motorcycle stand is combined with the front stand. Use hook to UNIVERSITITEKNIKAL MALAYSIA MELAKA combine it.

3.5.4 Finishing

Last but not least, finishing for the motorcycle rotated stand that should use are coating and spray painting. Then, the stand holder will additional by using polymer or rubber to prevent the stand from fell and damage. The goal of the finishing process is to change the surface of a manufactured object to achieve a specific attribute.

3.6 Summary

In summary, all the preparation for the design and development of the motorcycle rotated stand is done. The progress of this project is ready to advance to the development phase. The development phase will start with generating the design of the product until transferring tall the design to Solidworks, material selection for the product, and fabricating the product.



CHAPTER 4

RESULTS AND ANALYSIS

4.1 Introduction

This chapter presents the results and analysis of the development of the Motorcycle Rotated Stand. This survey was designed for data collection and results in interpretation which concentrates on the study and research. Furthermore, the data collected will be utilized to improve or develop a new motorcycle stand design that would meet the expectations of customers. The developed questionnaires were then distributed to the respondent, examined, and manipulated using several tools such as Excel to depict the statistical information required.

4.2 User Requirement Preliminary Survey

In the beginning, this project was started with a questionnaire survey that involved 123 respondents. This questionnaire survey is carried out to figure out the customers' requirements. The respondents must choose which design is better for them. For details of the questionnaire, one can refer to Appendix C. This questionnaire survey was executed in May 2021 through an online Google form. Questionnaire two is divided into three sections, one is demography information and product attributes. The second section is the rating preference.

4.3 Analysis of Questionnaire

The preliminary survey is divided into two parts. Part A is the respondent's background. Part B is about the design part by part of the Motorcycle Rotated Stand.

4.3.1 Part A: Respondent Background

This part is about the gender of respondents, age, and the ownership of a motorcycle for every participant who had to answer the survey.

4.3.1.1 Gender

Based on the result of the survey, was conducted through the Google online form. The period of the survey to distribution is three weeks and data collection started in May. The total participant of this survey is 123 respondents. Here will use descriptive statistics to explain the result of the survey. Figure 4.1 shows the result gender. There are 61% (75/123 respondents) of the respondents are male whereas a female is % (48/123 respondents).



Figure 4.1 The analysis of the gender of the respondent in percentage.

Based on the descriptive statistics shown in Figure 4.2, the result of the survey shows that there is it shows that there is 8% (9/123 respondents) of respondents below 18 years old. There is 55% (68/123) of the respondent are 19 to 25 years old, 30% (37/123) of the respondent are 26 to 30 years old and only 7% (9/123) of the respondent are 30 years old and above. The most of respondents age are between 19 to 25 years old.



Figure 4.2 The analysis of the age of respondents in percentage.

4.3.1.3 Ownership Motorcycle

The question helps us to easily set the target market based on the ownership motorcycle of the respondents. The total number of respondents was 123. Based on Figure 4.3, most of the respondents have motorcycles. It is about 77% (95/123) of respondents have motorcycles and 23% (28/123) of respondents do not have a motorcycle.



Figure 4.3 The analysis of the ownership of motorcycles in percentage.

4.3.2 Part B: Design Part by Part of Motorcycle Rotated Stand

Part B is about the design that respondents and user motorcycle give feedback on which is the best design and fulfills the motorcycle rotated stand requirement.

4.3.2.1 Body Frame UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Based on Figure 4.4, most respondents choose Design 1, which had 50 respondents.

14

22 respondents choose Design 2. For Design 3 there were 3 respondents only chosen, and

for Design 4 in 6 respondents. Lastly, 42 respondents chose the design for Design 5.



Figure 4.4 The analysis of body frame design.

4.3.2.2 Wheel

Based on Figure 4.5, most respondents choose Feature 6, which has 57 respondents.

For Features 1 and 2, there were 5 respondents and 33 respondents. For Feature 3, 6 respondents, and the respondent that have chosen Feature 4 were 20 respondents. Lastly, there were 2 respondents only which were chosen Feature 5.



Figure 4.5 The analysis of wheel feature.

4.3.2.3 Stand Holder

Based on Figure 4.6, most respondents choose Design 1, which had 38 respondents.

31 respondents choose Design 2, 22 respondents choose Design 6, 12 respondents choose

Design 4, 11 respondents choose Design 3 and 9 respondents choose Design 5.



Figure 4.6 The analysis of stand holder design.

4.3.2.4 Clamping Single Arm on Motorcycle

Based on Figure 4.7, most respondents choose Feature 4, which had 73 respondents. 31 respondents choose Feature 2, 10 respondents choose Feature 3 and 9 respondents choose Feature 1.



4.4 Design and Development of Motorcycle Rotated Stand

4.4.1 Morphological Chart

Table 4.1 shows the morphological chart for this project. The main focus of this analysis is on the basic needs in consideration of the limitations of the motorcycle rotated stand design and their respective functions.

The components for this project analysis are classified as body frame, wheel, stand design holder, and clamping single arm as shown in rows. There are mainly 6 developed options for each of the components as shown in columns, where three designs will be involved in the idea selection. The selection is aimed to fit well with the function, which could consume minimum space and also maintain the motorcycle rotated stand properties required.

The concept idea generated from the selections helps to develop the motorcycle rotated stand functions easier, and also maintains the product stability in the next stage. The selected ideas will be the design guideline for the design generation in Chapter 4.3.2.

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1.00

Table 4.1 Morphological Chart



4.4.2 Concept Sketches

There are a total of four designs developed as referred to in the morphological chart in Chapter 4.4.1. The Sketching 1, Sketching 2, Sketching 3 and Sketching 4 are these four design ideas. In addition, the selection from the morphological chart will combine with new idea to complete the functional motorcycle rotated stand.

The first sketch in Figure 4.8 has a back stand and front stand. The back stand such as paddock can clamping the back wheel of motorcycle. Then, the back stand and front stand will be attached with the hook.



Figure 4.8 Sketching 1

Next, the tyre base and paddock are included in the second sketch in Figure 4.9. The tyre base will be added four wheel and will carry the weight of rear wheel of motorcycle. Moreover, this sketching has a stand side base of motorcycle.



UNIVERSITI TEFigure 4.9 Sketching 2'SIA MELAKA

Then, Figure 4.10 shows the third drawing, which is adjustable stand. The stand is based on measure by length of the motorcycle. It is use screw and nut which is commonly practise to fasten machine and structural components. This stand can lift the motorcycle with a handle pump. In addition, this stand has a side stand for motorcycle stick.



Figure 4.10 Sketching 3

Lastly, the Figure 4.11 below show that the fourth drawing. This drawing included with the roll for rear wheel of motorcycle and the platform to place the high lift motorcycle jack. The function of roll is easy to turn the rear wheel of motorcycle around. It is use for user can check air pressure tyre easily. Then, the function for the platform is to place and can lift at center of the motorcycle.



4.4.3 Pugh Matrix

The final design for the ideas generated in Chapter 4.4.2 is chosen using the Pugh matrix. A tool for analysis that produces an ideal concept is the Pugh Matrix. The score is weighted with a "+" for improvement over baseline, a "0" for parity with baseline, and a "-" for not preferable to baseline. According to the design requirements, the ratings are weighted. The baseline for the matrix's set of criteria is Sketching 2.

Criteria	Baseline/ Datum	Sketching 1	Sketching 3	Sketching 4
Safety	4 0	-	+	+
Efficiency	0	+	-	-
Stability 📕	0	-	+	+
Affordable	0	+		-
Easy to store	0	+	+	+
Lifespan	lo QC	i Si	in the said	+
Removeable piece	0	* + *	20 V -	+
UNITOTAL	I TEKNIK	AL MALAYS	SIA MELAK	5
RANK		2	3	1

Table 4.2 Pugh Matrix

The final selection of the design that have selected is Sketching 4. The Sketching 4 is more safety, efficiency, stability and it is easy to store. The rotated motorcycle stand must have these criteria according to the objective of this project.

4.4.4 House Of Quality (HOQ)

In this section, using a planning matrix, the Quality Function Deployment (QFD) and House of Quality (HOQ) methodologies help define client requirements and translate design specifications or product control characteristics. In other words, adopting QFD makes it possible to map consumer needs and technical how-tos, which enhances our grasp of design linkages.



Figure 4.12 House of Quality

The Figure 4.12 show the House of Quality (HOQ), it show the technical need and prioritise the rotated motorcycle stand have a good structure which is score 176 from 8 that technical requirement to develop and fabricate. Then, the priority for customer requirement is an efficiency and stability. Moreover, Efficiency is the ability to achieve something or get a desired outcome without wasting resources, time, money, energy, or effort. In a broader

sense, it is the capacity to carry out tasks effectively, efficiently, and without wasting time. Lastly, the stability of the rotated motorcycle stand canr effers to how structure, objects, colours, textures, and space are distributed visually. These components should be balanced to create a design that feels stable, as if the design were a scale.

4.4.5 Engineering Drawing

This topic covers technical drawings of the final design as well as 3D modelling using Solidworks. According to the design sketching, the Sketching 4 is chosen as the final design since, among the three design concepts, it had the highest rank in the Pugh Matrix illustrated in Table 4.2. The detailed design idea sketches are therefore included in Appendix D and Appendix E. 4.4.5.1 3D Modelling a) Assembly Sketching 4 UNIVE

Figure 4.13 Assembly Sketching 4

b) Frame of Sketching 4



4.5 Analysis and Simulation for Structure

This project uses mild steel as its material and the simulation for the motorcycle rotated stand uses static analysis. There are two types of frames that have been chosen. Figures 4.15 and 4.16 show the design frame with different numbers of rods. To determine which structure is stronger, both frames will be tested with the same load. The thickness of the two rods varies.



Figure 4.16 Frame with 13 Rod

There are several important factors that must be analyzed, such as stress, displacement, load, and factor of safety (FOS). This study's goal is to make sure the stand is strong enough to handle loads and other external factors. The load is set to 2942N for all analyses, it is around 300 kg equally across the top frame. On the six locations above the frame, which serves as the frame's wheel, are the fixtures. Following that, Table 4.3 summarises the outcome analysis for a frame with 9 rods which is middle of frame that has shown in Figure 4.15

Thickness. mm	Weight , kg	Stress, N/m ²	Yield strength,	Strain	Displacement , mm	Factory of safety
1	20.75	45.15	$2.500 e^{+08}$	9.852 e ⁻¹¹	0.2003	20
2	25.73	39.93	$2.500 e^{+08}$	8.110 e ⁻¹¹	0.1745	21
3	30.50	36.95 💆	$2.500 e^{+08}$	7.180 e ⁻¹¹	0.1606	21

Table 4.3 Summarizes result analysis for Frame with 9 middle rods.

That frame has nine middle rods, and the load is set to 2942N for all middle rods. However, the best result that has been analysed is a frame with 13 middle rods and a thickness of 2 mm. The result will show in the Figure 4.17, 4.18, 4.19 and 4.20.



Figure 4.17 Stress Analysis

The Figure 4.17 shows the stress plot for Frame with 13 middle rods. The maximum stress appears to be at 2.853 N/m^2 , which means that it was below the yield strength of

 $2.500 \ge 10^8 \text{ N/m}^2$. This illustrate that the material won't crack or fracture. According to the counter displayed in green, the area without support is where the majority of the stress is concentrated. As the stress value is not very high, this has few effects.



Then, Figure 4.18 shows that the maximum of displacement plot for the frame. The result of the displacement is 0.1372mm. The maximum displacement occurs in the middle of the frame, although it only slightly deforms it and does not have a significant impact.



Figure 4.19 Strain Analysis

According to Figure 4.19, the strain contour for the frame has a lower average result, meaning that the majority of the model will have no strain and that the maximum strain is only 5.961 $\times 10^{-12}$. The frame will have minimal distortion meanwhile.



Figure 4.20 Factor of Safety Analysis

Finally, Figure 4.20 displays the frame safety factor. The model is classified as safe to use because the value is 27, and the safety value factor is more than 1. When it achieves the intended load at about 300 kg, it won't break and cause harm. Through this simulation, it was possible to determine that the frame would be stable and capable of supporting a load of 300 kg.

Other than that, Table 4.4 summarizes the results for all of the frames with 13 middle rods which is with different thickness of frame. From that, thickness with 2mm is more stable and will be the use as the frame for motorcycle rotated stand. Moreover, the weight for the frame is 45.82kg.

Thickness.	Weight,	Stress,	Yield	Strain	Displacement,	Factory
mm	kg	N/m ²	strength,		mm	of Safety
1	38.38	3.158	$2.500 e^{+08}$	$6.006 e^{-12}$	0.1518	26
2	45.82	2.853	$2.500e^{+08}$	5.961e ⁻¹²	0.1372	27
3	52.93	2.651	$2.500e^{+08}$	$5.368 e^{-12}$	0.1311	27

Table 4.4 Summarizes result analysis for Frame with 13 middle rods.

4.6 Weakness Point / Critical Point

The discussion of the results begins with the weakness point which is to determine the analyzes information and the weaknesses of preliminary products to further the development of a product.

First of all, our findings revealed that the critical point that have happen is base for wheel and frame which is has joint together between side of frame and wheel. Figure 4.21 presents the base wheel of the frame. The wheel is capable of supporting the weight of the motorcycle. The Figure 4.22, 4.23, 4.24 and 4.25 show that the level strength of the base wheel in Solidworks.



Figure 4.21 Base Wheel of Frame

The Figure 4.22 shows the result stress analysis for the base Design 4. From the result analysis, maximum stress for base of the Design 4 is $1.523 \times 10^8 \text{ N/m}^2$. However, the yield strength is 2.5×10^8 . This shows that the material will not fail and fracture. The located stress of the base is side and the centre of the base is the contour plotted in green.



Figure 4.22 Stress Analysis for Base Design 4

The displacement plot in Figure 4.23 shows that the maximum displacement is 7.226×10^{-4} mm. However, this little affect the base wheel and will just slightly move a

little.



Figure 4.23 Displacement Analysis for Base Design 4

The strain contour from Figure 4.24 shows that the resulted strain value is quite high and the maximum strain is 4.208×10^{-4} . This indicates that the base will have a quite low rate of deformation.



Figure 4.24 Strain Analysis for Base Design 4

In the Figure 4.25, the minimum factor of safety value obtained for chair body is 1.6. The model is considered safe to use as the factor of safety value is more than 1. It will not fail when it reaches the designed load. Through this simulation, it could be concluded that base wheel will be safe and able to withstand load upon 300kg.



Figure 4.25 Factor of Safety Analysis for Base Design 4

Other than that, the wheel that have use in this project is wheel trolley which is shows in Figure 4.26. the wheel has PU rubber that covered the wheel. The dimension of the wheel is about 3 inch which is 75mm. The thickness of the wheel is 32mm. Moreover, the weight that can carry the load is 105kg per wheel.



4.7 **Project Features**

To demonstrate the overall product of Design 4, the project will be developed at a 1:1 scale. Figure 4.27 shows the feature of Design 4 by isometric view. The frame made from the fully mild steel. It has 11 rods and the length of the frame is 2300mm and the rods divide equally.



Figure 4.27 Feature of Design 4 by Isometric View Figure 4.28 illustrates the feature of Design 4 by side view. The motorcycle place at along the frame. The front tyre place at the wheel chock which is shown in Figure 4.29. The wheel chock is a tool that can stop the motorcycle from moving.



Figure 4.28 Feature of Design 4 by Side View 87



Figure 4.29 Close up of Design 4 by Front View

Other than that, the Figure 4.30 shows the platform to place High Jack Lifter. The material for the platform is also made from mild steel. The platform can adjust based on the centre of the motorcycle. It is to place the High Jack Lifter if a consumer wants to lift up the motorcycle.



Figure 4.30 Platform to Place High Jack Lifter

Lastly, the Figure 3.1 shown the roller to rotate the rear wheel. The roller is roller conveyor that can remove and place at the hole side of the frame. The length of the roller is 300mm and it need add some plate to make it centre.


4.8 **Project Costing**

According to Table 4.5, the project budget is attached. From Table 4.5, it could be seen that the total cost for this project is RM 586.50.

No.	Item / Description	Single price (RM)	Quantity	Total Amount (RM)	Remarks		
1.	Wheel chock	256	1	256	-		
2.	Rectangular hollow mild steel (50x20x2) mm	12/ft	JTe	12	Rod for Frame		
3.	Rectangular hollow mild steel (50x30x2) mm	نيكل ه EKNIKAL	ېتي تيڪ MAL ² AYSI	وييومرسي A MELAKA	Frame		
4.	Wheel 3inch	20	6	120	-		
5.	Roller conveyor	35	2	70	Roller at Frame		
6.	Metal Plate Mild Steel (1x1.1.5)ft	17.90/ft	2	35.80	Platform		

Table 4.5 Project Costing for Design 4 Г

7.	Rectangle Internal Rubber Cap	1.70	4	6.80	Finishing
8.	Samurai 29 Flat Black Standard Spray	17.90	1	17.90	Finishing
		Т	TOTAL (RM)	568.50	-



4.9 Summary

In this chapter, product sizing for this project is based on the preliminary finding. Design and development of the motorcycle rotated stand is done through a survey Google Form online, morphological chart, and concept sketch. Google Form online was distributed and 123 respondents that have participated. The morphological chart was created from the data collected from Google Form online. Three concept sketches are applied from the morphological chart. Mock up sizing is done through 3D CAD model by using Solidworks software to further understand the approximate scale on the product size and analysis by Solidworks which is can know the stress, strain, displacement and factor of safety is done as guideline in designing a stable motorcycle stand. The results showed that the designed



CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

Overall, based on the survey and analysis that were conducted, it can be said that all of the research's goals were met. As refereed to the first objective, research the characteristics of the motorcycle stands and services to maintenance for motorcycles as discussed in Chapter 2.2, 2.3, 2.4, 2.5 and 3.3 respectively.

The second objective focused on the level strength of structure for development of motorcycle stand concepts based on the defined target users and product market in Chapter 2.5. Next, Chapter 2.6 have been discussed about the material of product to determine the material for the motorcycle rotated stand. Besides that, the parameters to decide the product material and final design is discussed based on the Chapter 3.3 and this objective will be the entire project outcome. In Chapter 4.4, the final design motorcycle rotated stand have been develop by morphological chart, Pugh matrix and House of Quality (HOQ). Then, 3D modelling have been construct and analysis for the final design also in Solidworks. The result structure of the frame can determine the structure were stable to carry out the weight of the motorcycle which is 300kg.

Finally, the motorcycle rotated stand requires based on the result analysis and simulation for structure which is in Chapter 3.4. The design phase of the motorcycle rotated stand are cutting process, welding process, assembly part by part and lastly, finishing the product by paint. After the features and development of motorcycle stand, the testing is

conduct at base of wheel and wheel of the frame to determine the critical point of the final design.

5.2 Recommendation

AALAYSIA

The following suggestions are made to help future research be of higher quality:

- Increase the range of possible materials for the motorcycle rotated stand. such as changing the type of material for the frame from mild steel to another material. From that, research can study the different material of the frame about material durability.
- ii) The adjustable frame should be universal for all types of motorcycles. It is because the motorcycle rotated stand only can use for the motorcycle which is 2200mm length of motorcycle.
- iii) Further research on the features of the frame and compare the new feature in the market. UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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APPENDICES

		WEEK													
BIL.	ACIVITALATSIA		2	3	4	5	6	7	8	9	10	11	12	13	14
1	Title Selection														
2	PSM planning	1													
	Project mind map	7													
	Flow chart	12													
3	Chapter 1	1													
	Objective	-							0			1			
	Problem statement														
	Scope 1														
4	Chapter 3					/			-						
	Draft				-				-						
	Methodology														
	Gantt chart														
5	Chapter 2	1	1			1		- 11							
	Literature review		-	-		_	-					1.1			
	Summary	1	-		~~~			4.1	2	-	\sim	400	2.		
6	Questionnaire	0			1.0				10		-	10.0			
	Distribute														
	Analyzed data	E La	Th H	12.0	1	1.1.0	1.7	1.10	NI A	1.0	-	A 1.	CA.		
7	Design UNIVERSIII	Er	^r LA1	N/-	1	MA	(Lat	112	STA	. IVI	EL	Ar	A		
	Propose the design														
	3D model														
8	Submission														
	e-logbook														
	Draft Report														
	Report														
	Slide presentation														

APPENDIX A Gannt Chart PSM 1

APPENDIX B Gannt Chart PSM 2

	ACTIVITY	WEEK													
BIL.		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Chapter 4														
	Sketch Design														
	HOQ / QFD														
	Final Design	200													
2	Material Selection	X		_											
	Analyze Material		1												
	Pugh Method		7												
3	3D Model							17	-			1			
	Build 3D Model														
4	Simulation		-						_			1.1			
	Analyzed data														
5	Fabrication Product		-		-	1				100					
	Cutting														
	Welding														
	Assembly		1 1	e		1									
	Finishing		16	_	5.1	6	_		144			٠			
6	Chapter 5	1			-0-0			10	2		11	20	21		
	Concluison							10	~			1.11			
	Recommendation								-						
7		TE	KA	IIK	A L	NA	A L	AV	Q1/	N	FI	AL	(A)		
	e-logbook						- L has		017	1.14	l las la		1.1		
	Draft Report														
	Report														
	Prototype														

APPENDIX C Google Form Survey



PART A
Respondent Background
Gender *
O Female
O Male
Age *
○ 18 & below
0 19-25
0 26-30 ALAYSIA
O 30 & above
Do you have a motorcycle? *
اونيومرسيتي تيڪنيڪل مليسيا ملاكر No
UNIVERSITI TEKNIKAL MALAYSIA MELAKA
Back Next Clear form



UNIVERSITI TEKNIKAL MALAYSIA MELAKA



Which is the best feature of wheel? *



Which is the best stand design holder? *





Which is the best feature of clamping single arm on motorcycle? *





APPENDIX D Detail Design for Assembly Sketching 4



APPENDIX E Detail Design for Frame of Sketching 4