(An Autonomous Institute Affiliated to Savitribai Phule Pune University)

A Project Report on

Design Analysis and Optimization Of Universal Paddock Stand

Submitted by,

Riddhesh Gandre	(Exam Seat No. B229013)
Rohan Kotkar	(Exam Seat No. B229029)
Nishant Dhakne	(Exam Seat No. B229052)
Luv Sharma	(Exam Seat No. B229054)

Guided by,

Prof. Dilip Panchal

A Report submitted to MIT Academy of Engineering, Alandi(D), Pune, An Autonomous Institute Affiliated to Savitribai Phule Pune University in partial fulfillment of the requirements of

BACHELOR OF TECHNOLOGY in

Mechanical Engineering

School of Mechanical and Civil Engineering

MIT Academy of Engineering

(An Autonomous Institute Affiliated to Savitribai Phule Pune University)

Alandi (D), Pune – 412105

(2022–2023)

(An Autonomous Institute Affiliated to Savitribai Phule Pune University)

CERTIFICATE

It is hereby certified that the work which is being presented in the BTECH Project Report entitled **"Design Analysis and Optimization Of Universal Paddock Stand"**, in partial fulfillment of the requirements for the award of the Bachelor of Technology in Mechanical Engineeringand submitted to the **School of Mechanical and Civil Engineering** of **MIT Academy of Engineering, Alandi(D), Pune, Affiliated to Savitribai Phule Pune University (SPPU), Pune**, is an authentic record of work carried out during Academic Year **2022–2023**, under the supervision of **Prof. Dilip Panchal**, **School of Mechanical and Civil Engineering**

Riddhesh Gandre	**(Exam Seat No. B229013)**
Rohan Kotkar	**(Exam Seat No. B229029)**
Nishant Dhakne	**(Exam Seat No. B229052)**
Luv Sharma	**(Exam Seat No. B229054)**

Prof. Dilip Panchal	**Prof. Ashwin Chandore**	**Dr. Prafull Hatte**
Project Advisor	**Project Coordinator**	**Dean**

Director/Dy. Director(AR) **External Examiner**

DECLARATION

We the undersigned solemnly declare that the project report is based on our own work carried out during the course of our study under the supervision of **Prof. Dilip Panchal**.

We assert the statements made and conclusions drawn are an outcome of our project work. We further certify that

1. The work contained in the report is original and has been done by us under the general supervision of our supervisor.
2. The work has not been submitted to any other Institution for any other degree/diploma/certificate in this Institute/University or any other Institute/University of India or abroad.
3. We have followed the guidelines provided by the Institute in writing the report.
4. Whenever we have used materials (data, theoretical analysis, and text) from other sources, we have given due credit to them in the text of the report and giving their details in the references.

Riddhesh Gandre	**(Exam Seat No. B229013)**
Rohan Kotkar	**(Exam Seat No. B229029)**
Nishant Dhakne	**(Exam Seat No. B229052)**
Luv Sharma	**(Exam Seat No. B229054)**

Abstract

Paddock stand is regularly used with the operation of the bike servicing process. Various types of paddock stand models and features are available in the market currently. Lifting each type of supersport alone utilizing the available design of the paddock stand might be impracticable and inconvenient for users. To get over this restriction, a brand-new superbike paddock stand design that could be managed by one person was envisioned. However, selection of significant product is differed from individual precedence factors similar as price, safety, and also workplace constrain.

Improper selection of paddock stand will produce inconvenience for users, especially in handling the movement of two- wheelers while they're being repaired and repositioned. Through the use of Solidworks designing software, it's suitable to give flexible movement and promising safety features. The primary goal of this design research was to create a superbike paddock stand that would be easier for one person to use and more useful.

A paddock stand is simply a metal contrivance that keeps a motorbike steady while it is stationary. Contrast it with your motorcycle's side-stand or center-stand since a paddock stand allows us to keep one or both wheels in the air. Even with a central stand, this is conceivable. Only one motorbike wheel may remain in the air while employing a centre stand, though. The motorbike will continue to oscillate backward and forth if it is not secured in place.

Acknowledgment

Write your acknowledgement here We would like to express our special thanks of gratitude to our guide Prof. Dilip Panchal sir , who gave us the golden opportunity to do this conceptual major project and also for their constant encouragement and valuable guidance during completion of this project work. We wish to express our profound gratitude towards respected School Dean Prof. Prafulla Hatte sir for his continuous encouragement .

We would be failing in our duty if we do not thank all the other staff and faculty members for their experienced advice and evergreen co-operation. We want to express our gratitude towards our respected project advisor/guide Prof Dilip Panchal Sir for his constant encouragement and valuable guidance during the completion of this project work.

We would be failing in our duty if we do not thank all the other staff and faculty members for their experienced advice and evergreen co-operation.

students

1. Riddesh Gandre
2. Rohan Kotkar
3. Nishant Dhakne
4. Luv Sharma

Contents

List of Figures

List of Tables

Chapter 1

Introduction

1.1 Background

A motorcycle center-stand is primarily designed for maintenance tasks, not for regular bike parking. It enables chain maintenance or the removal of one or both wheels by lifting one (or both) wheels off the ground. On most current bikes, the back wheel is elevated by default. You may eliminate the "parking brake" effect of engaging the gears to assist stop the bike from moving forward by raising the back wheel. The parking space is meant to be utilised on the side-stand. When compared to a centre stand, it is far more stable laterally. A bike is significantly harder to side-tip off of the comparatively wide footing of a center-stand than it is to high side (push over to the right) off the left side, side-stand. As long as the bike doesn't slide forward, it is perfectly stable to the left against the stand's broad leg. This is the reason why placing your bike on the middle stand is NEVER advised when riding a boat over choppy seas.

Those who own a motorbike with a centre stand are fortunate. Unfortunately, many motorbike models from manufacturers lack this useful part. This could be done to reduce weight, because the centre stand might obstruct other parts, such the exhaust system, or just for practical reasons. Every motorbike, whether it has a stand or not, has to be jacked up sometimes, for example, to reduce the weight on the tyres when putting them in winter storage and to position the motorcycle in an upright posture. Or if chain upkeep, servicing, and repairs are required. After that, we'll demonstrate how to raise your machine off the ground even if it lacks a centre support.

Figure 1.1: Existing model of Paddock Stand

Companies provides a variety of paddock stands that make it possible to lift the motorbike steadily. Finding a stand that is appropriate for the car in terms of form, lifting ability, and your needs is the first step.

Depending on where they are linked to the motorbike, there are three main types:

either on the front wheel, the centre, or the back wheel.

1.2 Project Idea

After carrying out a research on paddock stands, we discovered that all superbikes require various types of stands because the dimensions of the bikes vary from manufacturer to manufacturer. In addition, these stands are used by mechanics to perform other tasks like changing oil, repairing engines, fixing tyre problems, and other tasks, so in order to make things easier for both the user and the mechanic, we came up with the following concept.

We decide that regardless of the size of the superbikes, we will develop a paddock stand that can be used with every type of superbike now on the market. Therefore, when creating the paddock system, we choose the superbikes with the lowest and highest possible dimensions.

1.3 Motivation

To begin with, utilising a paddock stand entails having one or both wheels free. The rear wheel may be easily turned if you put the motorbike into neutral. This is useful if we want to oil and clean the chain on your motorcycle. The paddock stand makes sure that the motorbike is upright and not swaying to one side, even if we are working on a component of it that doesn't require you to move the wheel.When draining the oil from a motorbike engine, this is quite useful. The oil won't drain out completely if you empty it when the motorcycle is in a side-stand. In this situation, it is challenging to activate the centre stand since you must set up a pan nearby to catch the oil. In addition, the majority of expensive motorcycles lack a centre stand.

Furthermore, a paddock stand will guarantee that our motorcycle doesn't budge from its position while we're disassembling the engine. If this occurs, the motorbike may be in danger. Additionally, there is a potential that you might lose a little component even if nothing mechanically goes wrong. Race bikes are designed to be lightweight and do not have any form of stand. Instead, they support themselves always upright using paddock stands. The usage of paddock stands is beneficial when using tyre warmers. These coverings, which can only be used with a paddock stand, were created specifically to warm up race tyres.

Additionally, there are several paddock stands for the various bikes since their chassises or dimensions vary. Therefore, it would be preferable if only one stand could be used for all varieties of super motorcycles, and that stand had to be adjustable for the size of the bike.

Chapter 2

Literature Review

Fabrication of Automatic Centre Stand for Motorcycles, the idea proposed in this project is to pull the stand by the use of a linear actuator. This linear actuator will provide enough force to pull the stand and also be able to lift the two-wheeler off the ground. The Actuator will be arranged in a horizontal manner and can be easily bolted to the chassis or the leg guard on the fixed end and to the stand from its moving side i.e., barrel. The actuator will be driven by a DC battery.[1]

Design and Development of a Superbike Paddock Stand, this paper focused on designing a paddock stand with prioritized product features grounded on a case study problem by the operation of 3D CAD tool software. The improved paddock stand was produced and its mobility function was validated with real superbikes and a variety of motorcycles. thus, it satisfied the company's conditions as it was practical for use by a single user with space constraints. For coming product development, the sharp edges can be cut, andthis will bear multiple analyses such as stress analysis, distortion analysis, and transitional displacement test analysis. either, it's recommended to study the operation of lightweight material in the development of the paddock stand.[2]

Development of RhiNO v2.0 : An Enhanced Single User Paddock Stand, This paper reports the structural and functional analysis inthe development of an enhanced single user paddock stand named RhiNO v2.0. The enhanced and optimized design of the single user superbike paddock stand was fabricated based on the CAD modelling and tested using a real motorcycle, Kawasaki Ninja ZX10R 2009. This Product RhiNO v2.0 proved that this product can be operated easily by a single user, hence reducing risk of LBP and MSD.[3]

The "Automatic Side- Stage Retrieval System" was to be created using the same operating system as bikes. As all bikes used totransfer the power from engine to rear wheel by application of chain drive, sprocket rotates and side stand retrieves automatically as the designarrangement is kept between chain drive.[4]

Automatic motor- bike stand slider, By application of mechanical and electronic arrangement automatically retracting side stand was made. Micro-controller, speed sensor, dc motor were used. Speed sensor will detect the gyration of wheel and will send it to the micro-controller and DC motor will get actuated. Which helps to disengage stand from road. A bike stand is used to park the vehicle easily without any effort for a single user. This retracting side stand is constructed to reduce the risk of accidents. The position of this side stand is behind the bottom bracket and can be bolted on anchoring the chain stays.[5]

Design of motorcycle double stand, Currently there are very less methods which can be used for lifting the bikes for maintenance. Very less options are available in terms of single stand which can support a sport bike on its own. For a double stand the strength is most important as bike may feel unstable movement when we apply the center stand. The motive of this project was to design a stand which can support a sports bike, this stand was to be made by doing some modifications in existing stand. The major focus of the project was to take ease of use for the user into consideration as many a times because of very high load of sports bike safety becomes concern.[6]

When computer technologies are used to examine the design, optimising freshly produced items makes the product much better and more dependable. The same is true with a recently created superbike paddock platform, which was initially created to help motorcyclists pull up their motorcycles on their own for maintenance purposes. The efficiency of this newly created superbike paddock stand has already been proven, but it was discovered to be very heavy and size was bulky, which might result in overdesign and increased production costs. Design optimization is required as a prospective product that may enter the superbike user market in order to fulfil consumer needs, whichare what always drive the market for a specific new product.[7]

Chapter 3

Problem Definition and Scope

3.1 Problem statement

Design Analysis and Optimization Of Universal Paddock stand.

3.2 Scope

1. Universal Paddock Stand can be used for all the bikes irrespective of the dimensions and can be used to carry out the small work in case of engines.

2. The mechanic person do not need extra space as it is easy to carry from one point to another point.

3.3 Goals and Objectives

1. To modify existing bike stand (paddock stand).

2. To make compact design for making it easy to transport and easy to carry.

3. To minimize the dependencies on showroom service center.

4. To compare the results among studied ANSYS software.

3.4 Software Requirements

Dassault Systèmes' SolidWorks is a computer-aided design (CAD) and computer-aided engineering (CAE) solution for solid modelling. SOLIDWORKS is used from start to finish to create mechatronic systems. The programme is first used for project management, planning, visual ideation, modelling, feasibility analysis, and prototyping. The design and construction of mechanical, electrical, and software components are subsequently done using the programme. The software may also be used for administration, including cloud services, analytics, device management, and data automation.

Engineers in the fields of mechanical, electrical, and electronics utilise SOLIDWORKS software to create a cohesive design. All engineers should be able to respond to changes in design requirements thanks to the suite of tools.

Chapter 4

CAD Model

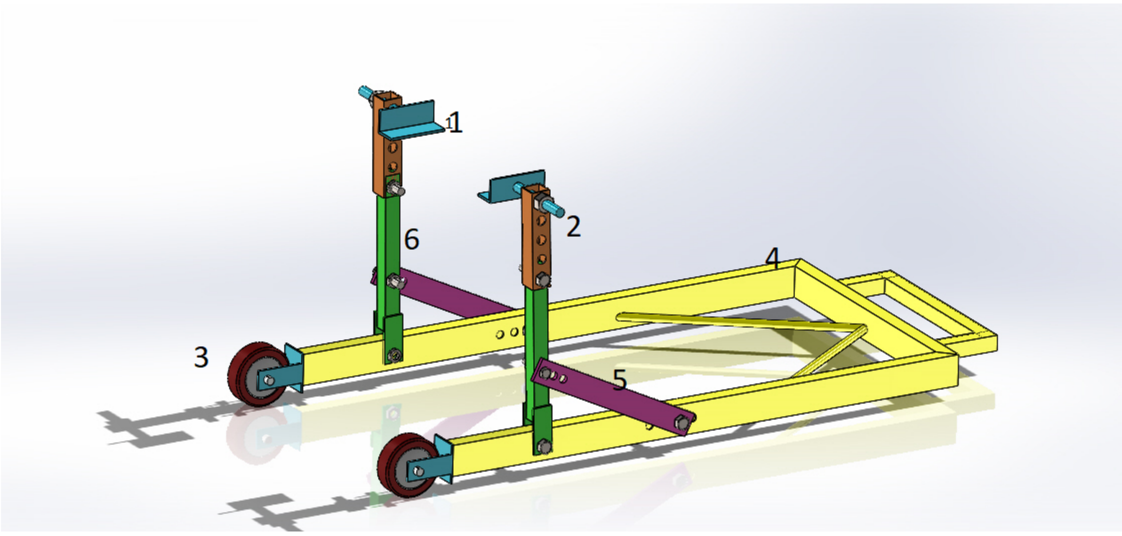

Figure 4.1: CAD Model of Paddock Stand

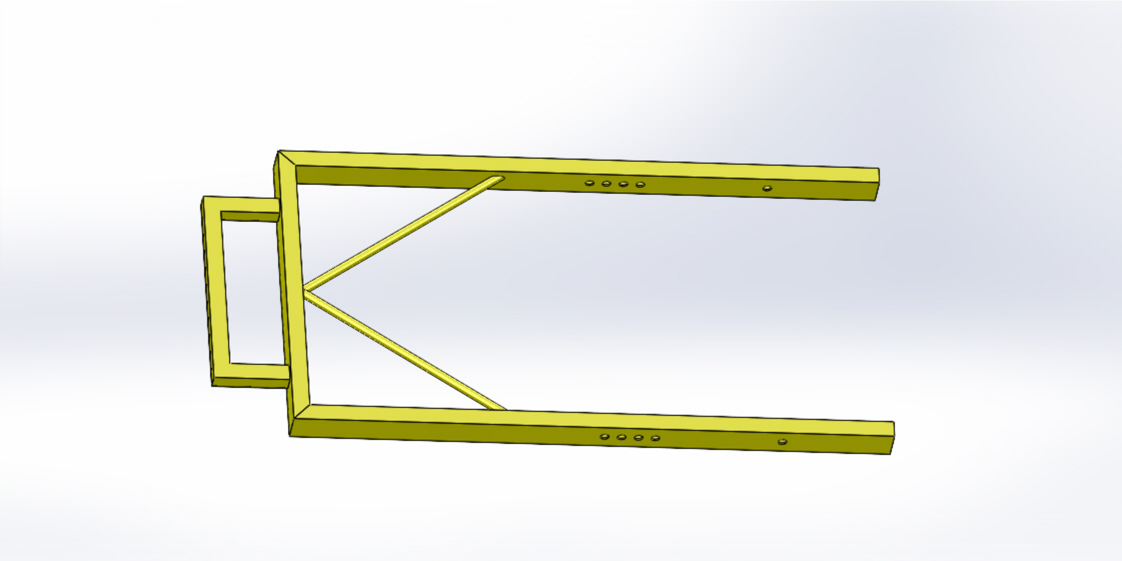

Figure 4.2: Main frame of Paddock Stand

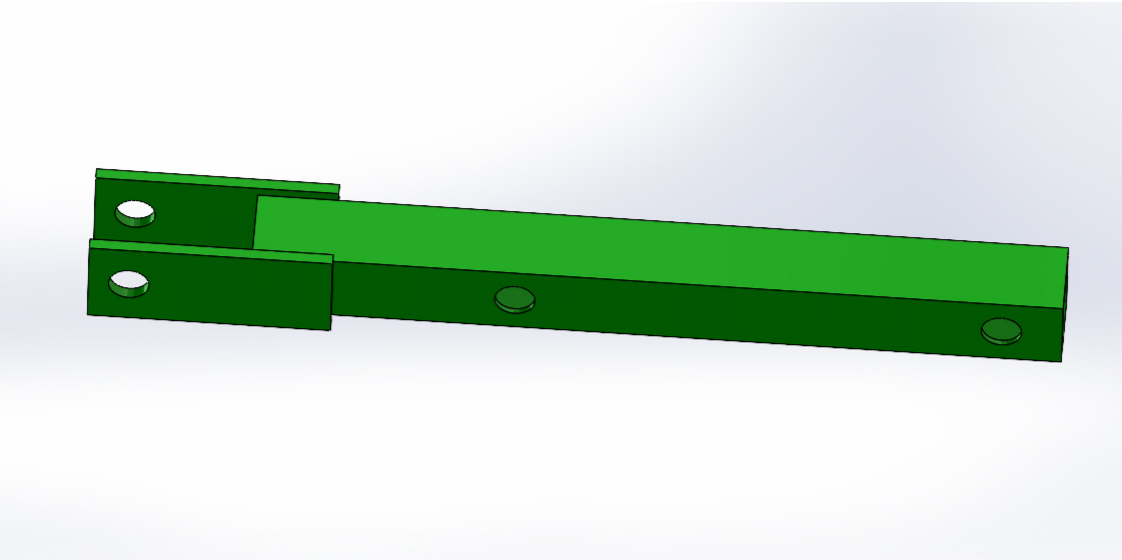

Figure 4.3: Limbs

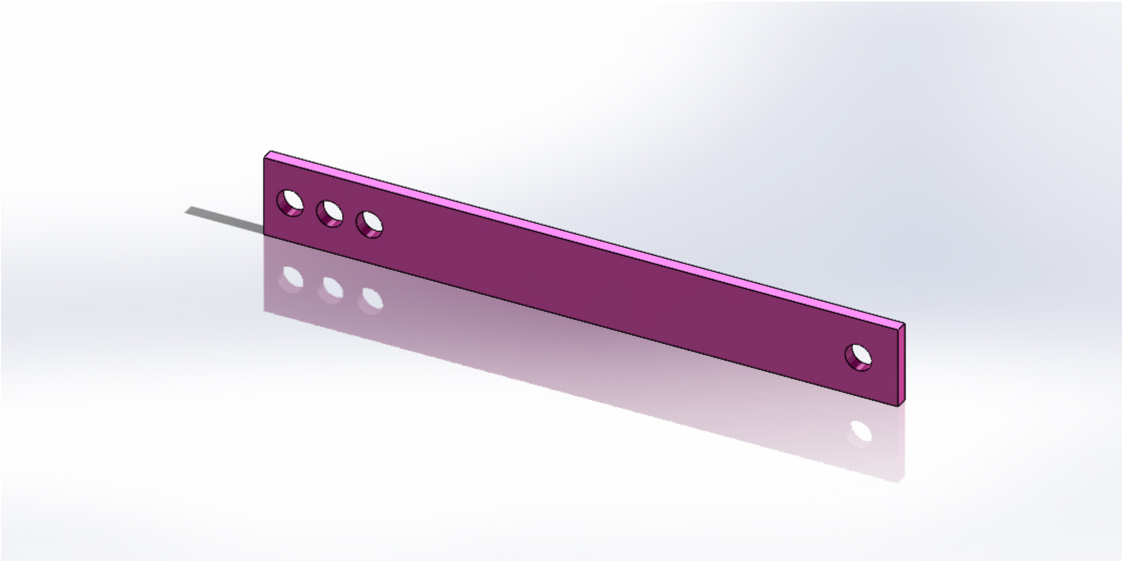

Figure 4.4: Recliners

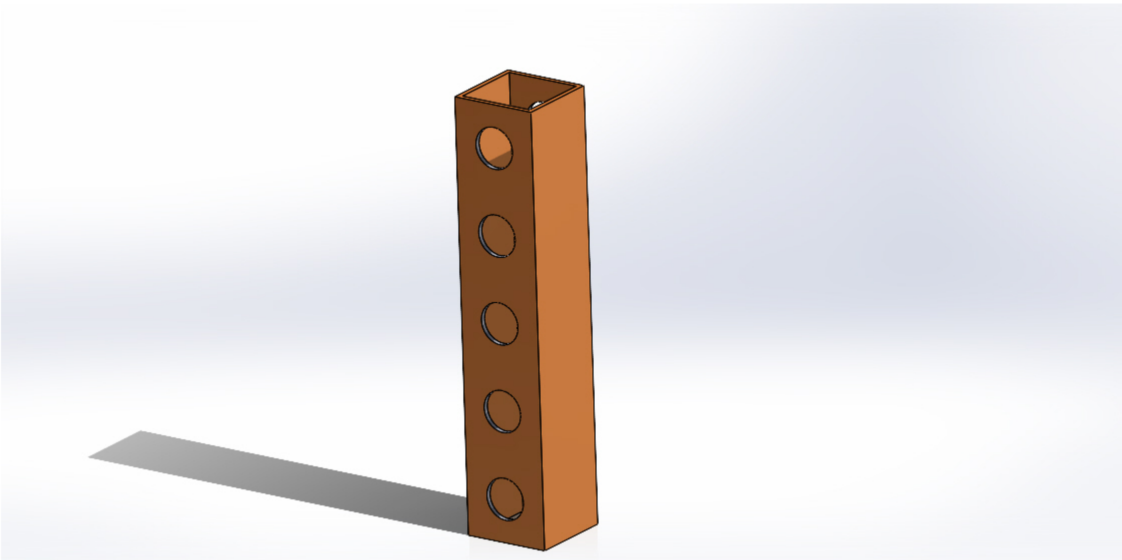

Figure 4.5: Rising Brackets

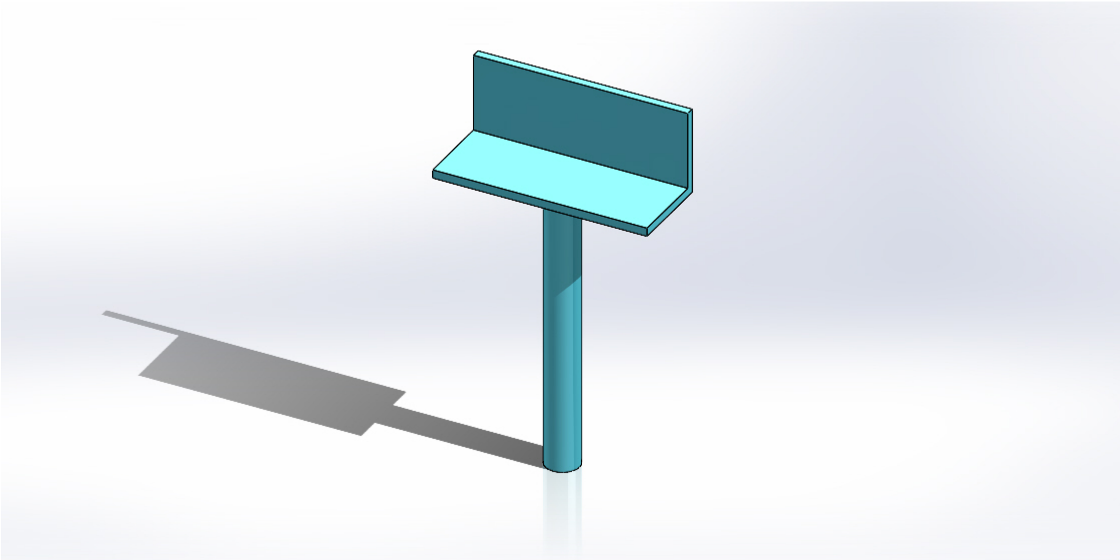

Figure 4.6: Hinges

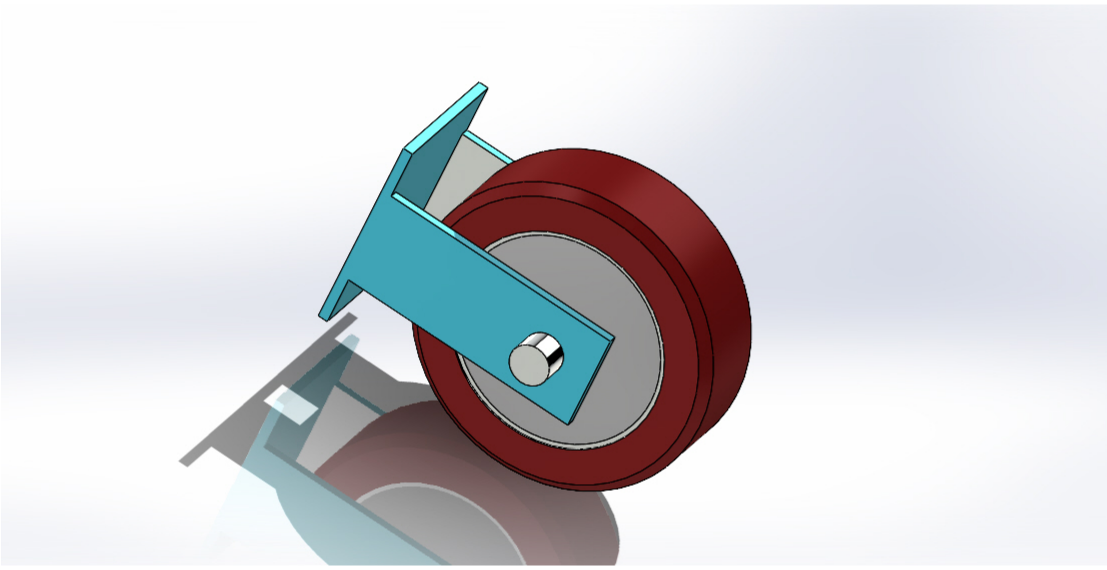

Figure 4.7: Wheels

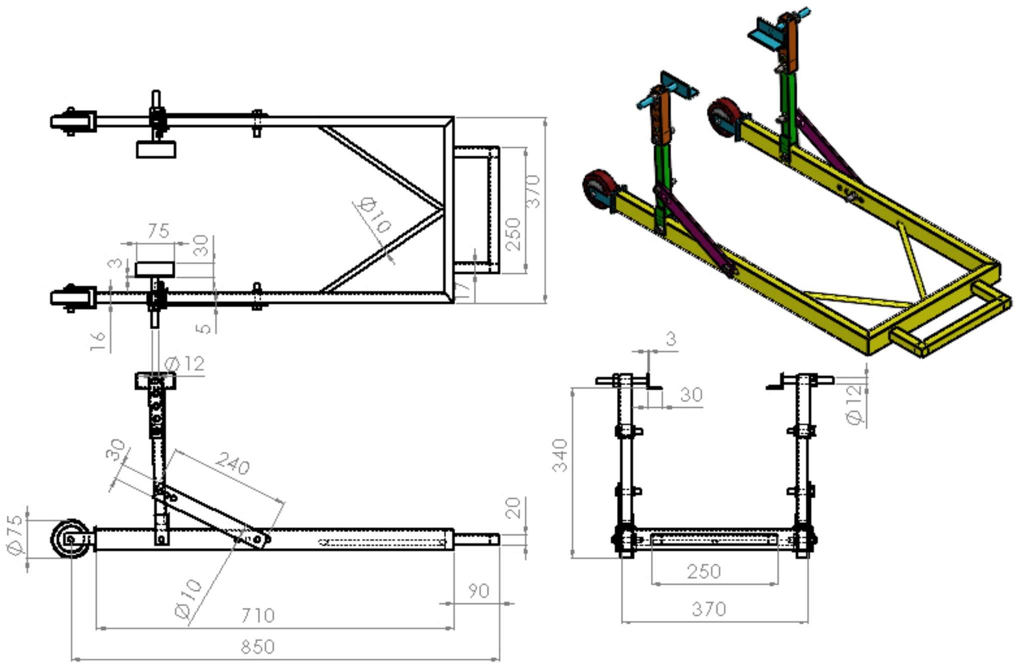

Figure 4.8: Drafting of the Paddock Stand

Chapter 5

Methodology

5.1 Introduction

It begins with determining the needs for a stand that just has one user. Before being chosen, ideas and concepts were developed utilising the Pugh decision matrix selection process.

Before being modelled in a 3D CAD model using Solidworks software, the superbike paddock stand underwent detailed design work. Calculations and analysis using finite element analysis were then performed using CAE software on the 3D CAD model to analyse the maximum stresses operating on the new design. A prototype was created for testing using a real superbike to ensure that the new design won't fail with the strain pressing against it.

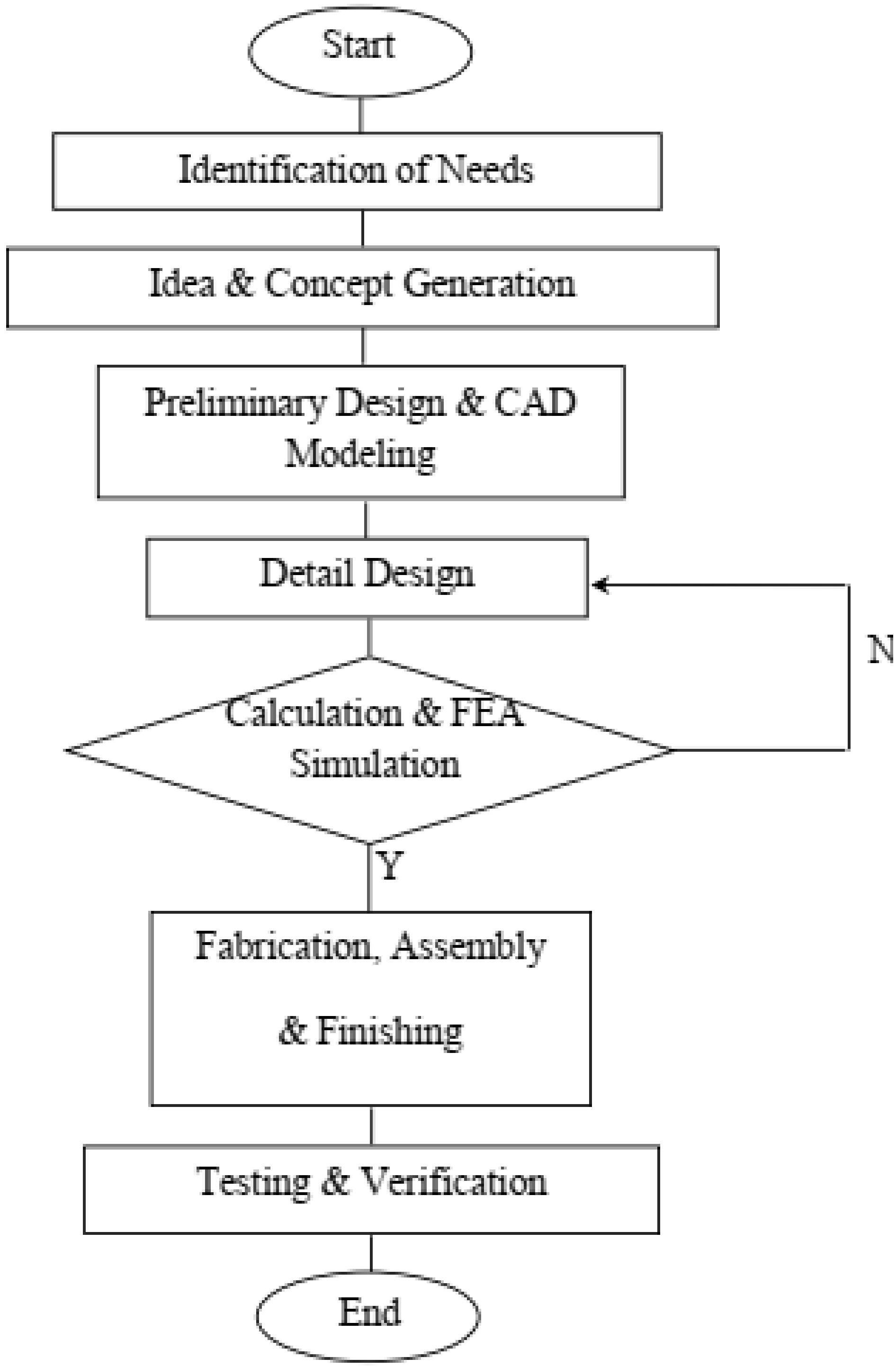

Figure 5.1: Methodology Flowchart

Chapter 6

Implementation

6.1 Material required parameters

1. Mechanical properties : Young's modulus, yield strength, and the Poisson ratio are some of the mechanical properties that lead you to select a suitable material for a particular application. Most of the time you can obtain the required mechanical property values from mechanical design calculations or from the FEA packages.

2. Physical Properties : The properties like density, boiling point, melting point, and freezing points are called the physical properties of material. But, unlike mechanical properties, the physical properties values of a material are not obtained from the design calculation, but need to be decided based upon atmospheric conditions.

3. Electrical Properties : For designing electromechanical or electrical systems, various electrical properties like resistivity, permeability, conductivity, etc. will influence your engineering material selection process. For example, for the windings of a motor, copper or aluminium would need to be selected.

4. Manufacturability : The raw material you have selected for your design needs to shape up as per your design requirements, and here manufacturability comes into picture. Rather than a material selection factor, the manufacturability can be termed a bottleneck. For example, you need a part to be made by casting and you then select stainless steel, which is probably not the best selection.

5. Cost : Cost is the most important factor for every part of any business and nothing different in the case of material selection. For example, you can afford to use costly lightweight composites for aerospace applications, but not for automotive applications.

6.2 Material Selection

Low carbon content (0.05percent to 0.2percentC) plain carbon steel (cast iron), such as 080M15, 150M19, 220M07, AISI 1006, AISI 1009, and AISI 1020. Since these steels cannot be successfully heat treated, heat impacted zones in welding are often not a concern. Batches without "tramp" components like chromium are ductile and have good forming characteristics because they show no evidence of work hardening. Vanadium and molybdenum levels as low as 0.05percent and chromium as low as 0.1percent, however, can have a significant impact on hardenability.

MATERIAL PROPERTIES	
Name:	**Plain Carbon Steel**
Model type:	**Linear Elastic Isotropic**
Default failure criterion:	**Max von Mises Stress**
Yield strength:	**2.20594e+08 N/m^2**
Tensile strength:	**3.99826e+08 N/m^2**
Elastic modulus:	**2.1e+11 N/m^2**
Poisson's ratio:	**0.28**
Mass density:	**7,800 kg/m^3**
Shear modulus:	**7.9e+10 N/m^2**
Thermal expansion coefficient:	**1.3e-05 /Kelvin**

Figure 6.1: Properties of Material

6.3 Applied Loads

Force applied by the rear axel of the bike is distributed equally on both ends of the Stand.

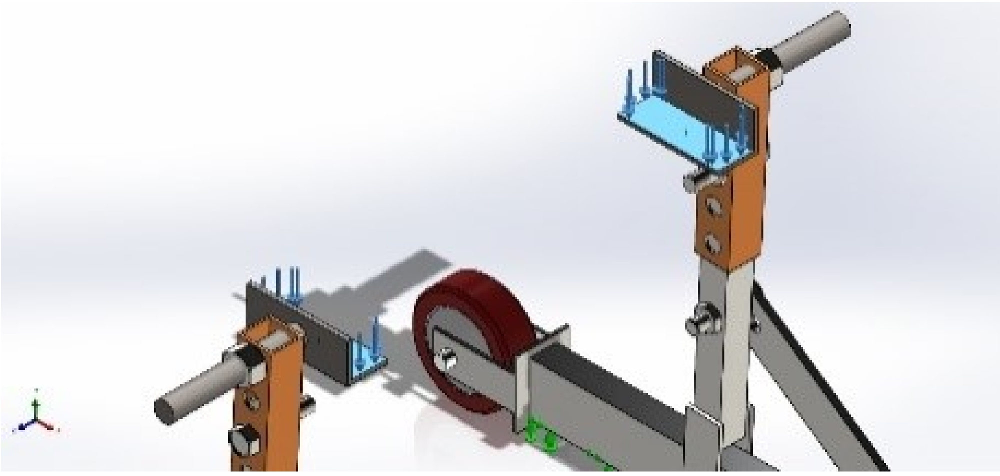

Figure 6.2: Force applied Geometry

Table 6.1: Resultant Reaction Forces

Selection Set	Units	Sum X	Sum Y	Sum Z	Resultants
EntireModel	N	-4.00543e-05	1300	0.000114441	1300

Table 6.2: Resultant Reaction Moments

Selection Set	Units	Sum X	Sum Y	Sum Z	Resultants
EntireModel	N-m	0	0	0	0

Table 6.3: Free Body Forces

Selection Set	Units	Sum X	Sum Y	Sum Z	Resultants
EntireModel	N	795.9	-368.065	-84.0477	880.904

Table 6.4: Free Body Moments

Selection Set	Units	Sum X	Sum Y	Sum Z	Resultants
$EntireModel$	N-m	0	0	0	1e-33

At equilibrium the the paddock stand is lying on the ground without any distributing force acting on it.

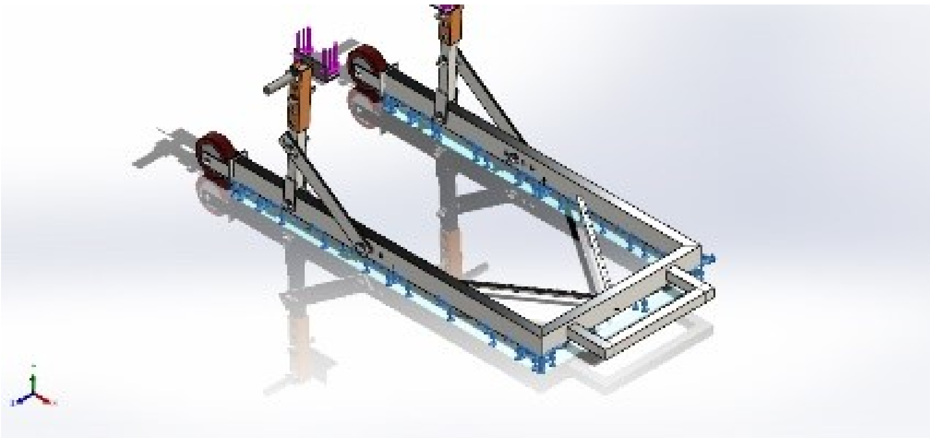

Figure 6.3: Fixed Type Geometry

Table 6.5: Reaction Forces

Components	X	Y	Z	Resultant
$Reactionforce(N)$	-4.00543e-05	1300	0.000114441	1300
$ReactionMoment(N-m)$	0	0	0	0

Chapter 7

Result Analysis/Performance Evaluation

7.1 Stress Analysis

For civil, mechanical, and aerospace engineers involved in the design of structures of various sizes, such as tunnels, bridges, and dams, aircraft and rocket bodies, mechanical parts, and even plastic cutlery and staples, stress analysis is a key duty. Stress analysis is also employed in the maintenance of such structures as well as in the investigation of structural breakdowns.

Engineering's field of stress-strain analysis, often known as stress analysis, employs a variety of techniques to identify the stresses and strains that pressures on materials and structures cause. In continuum mechanics, strain is the measure of the material's deformation, whereas stress is a physical term that expresses the internal forces that adjacent particles of a continuous material exert on one another.

Stress is simply the amount of resistance a body offers against deformation per unit of its area. Stress (S = F/A, where S is the stress, F is the internal resisting force, and A is the cross-sectional area) is the ratio of force to area. After doing a stress study in the software, we discovered that the smallest stress applied to the body at that specific spot is 2.97N/m2, and the maximum stress is 13.05N/m2.

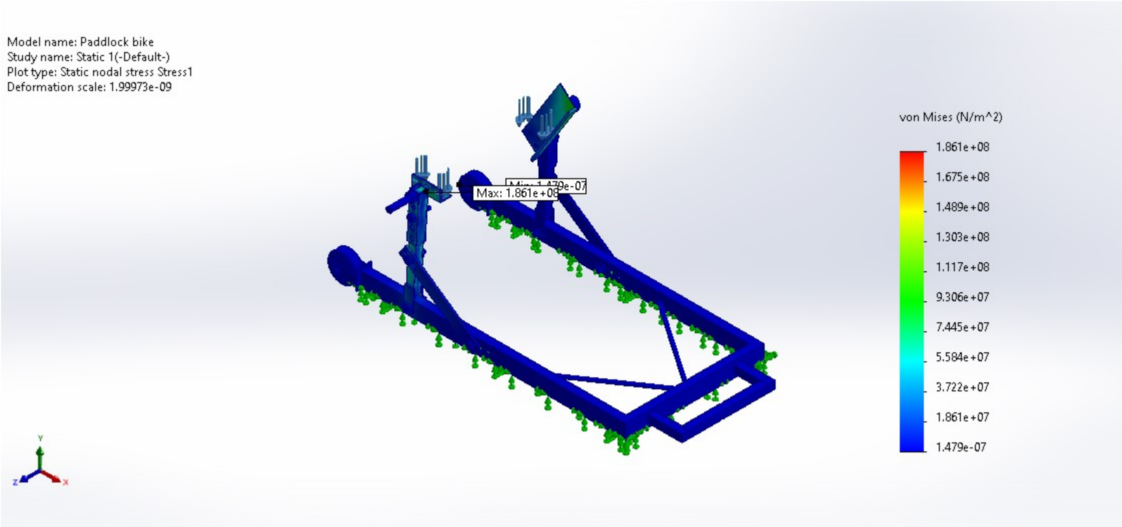

Figure 7.1: Stress Analysis of Paddock Stand

7.2 Equivalent Strain Analysis

The amount that an item expands or contracts as a result of an applied load is measured in terms of strain. The Greek symbol epsilon designates normal strain, which happens when an item stretches in response to a normal tension (i.e., one that is perpendicular to a surface). Positive values represent tensile strains, whereas negative values represent compressive strains. The Greek letter gamma is used to represent shear strain, which happens when an item deforms in response to a shear stress (i.e. parallel to a surface).

After doing a Equivalent strain study in the software, we discovered that the smallest strain found out to be -11.79 and maximum strain found out to be 10.13.

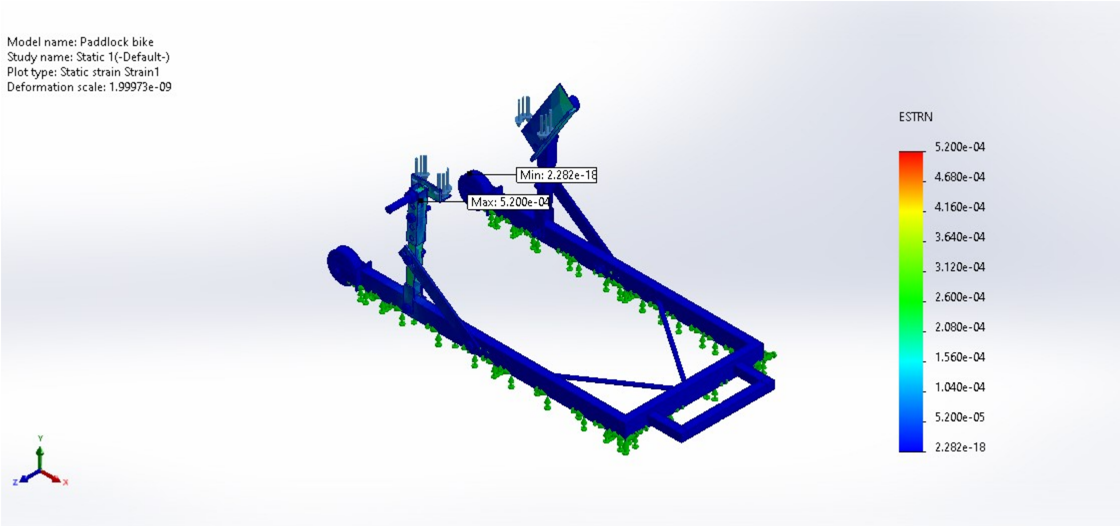

Figure 7.2: Equivalent Strain Analysis of Paddock Stand

7.3 Displacement

The degree of deformation is the difference between an object's altered dimensions or size in a certain direction. You can determine different strains based on the deformation you measure. Deformation = Strain * reference length If the stress is a linear function of strain, the deformation is referred to as elastic deformation. Therefore, strain and stress adhere to Hooke's rule. Stress and strain exhibit nonlinear behaviour outside of the linear domain, and this inelastic behaviour is referred to as plastic deformation.

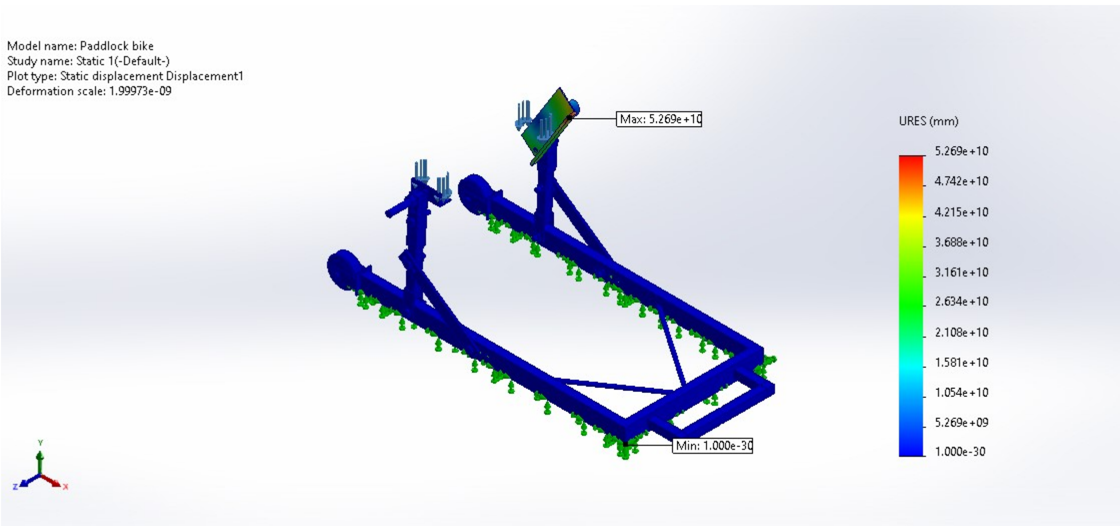

Figure 7.3: Displacement Analysis of Paddock Stand

The value of the deformation in the software found out to be 24.32mm.

7.4 Factor Of Safety (FOS)

The ability of a system's structural capability to remain stable beyond its anticipated or actual loads is known as the factor of safety (FOS). An FOS can be defined as a ratio between absolute strength and the load actually applied, or it can be expressed as a fixed number that a structure must reach or surpass in accordance with a contract, specification, legislation, or other norm.

The use and materials of an object affect its safety level. What FOS should be required varies depending on the industry. Although there is significant uncertainty surrounding safety considerations, there are several overarching principles that apply to many different industries. A greater FOS is likely to be necessary by design or by legislation if the consequences of failure are severe, such as loss of life, physical injury, or property damage. Safety factors must be computed using thorough analysis when a structure's capacity to carry weight must be assessed with an acceptable degree of precision yet extensive testing is unfeasible.

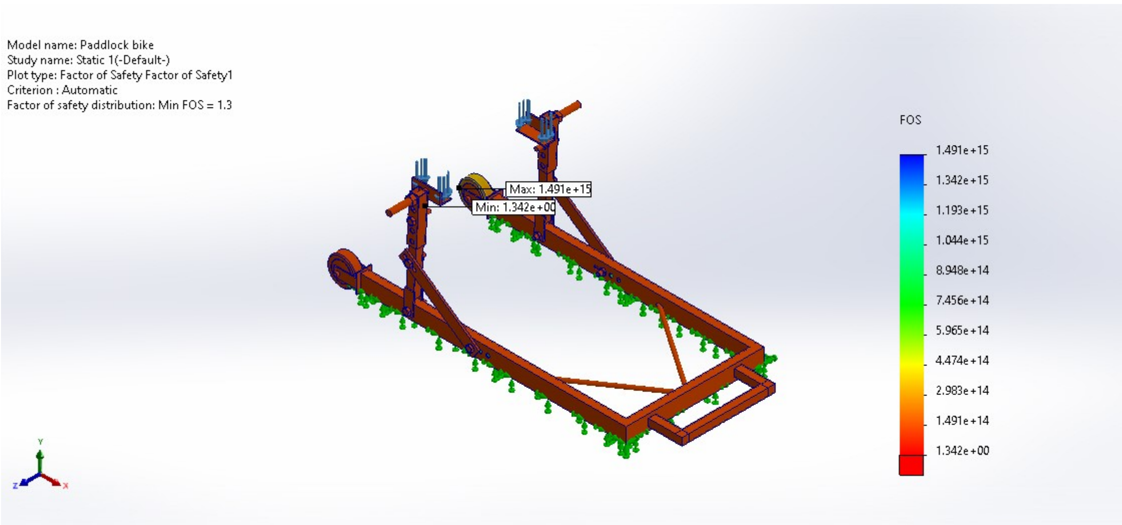

Figure 7.4: FOS Analysis of Paddock Stand

Chapter 8

Conclusion

8.1 Conclusion

We have successfully designed and fabricate a paddock stand within the timeframe. The paddock stand was tested by using it with actual bikes. Comparing the handling process, the proposed product is satisfied to be operated by one person only similar to the superbike hydraulic jack. Then, both of these types of paddock stand also offer safety element. The proposed paddock stand as shown in Figures is a favorable option among the available options due to the ability of the product's maneuverability.

Figure 8.1: Model Testing of Paddock Stand

These report focused on designing a paddock stand with prioritized product features based on market research and literature review. The improved paddock stand was produced and its mobility function was validated with real superbikes and a variety of motorcycles. Therefore, it satisfied the requirements as it was practical for use by a single user with space constraints. For future product development, the sharp edges can be cut, and this will require multiple analyses such as stress analysis, deformation analysis, and transitional displacement test analysis. Besides, it is recommended to study the application of lightweight material in the development of the paddock stand.

The paddock model was tested on the bike KTM 125 (Duke) and thw weight of the bike was approximately 160 kg. So after testing we came to know that our model was able to carry the weight and we got the same results as per the software.

Figure 8.2: Side view 1 of Paddock Stand

Figure 8.3: Side view 2 of Paddock Stand

Figure 8.4: Back View of Paddock Stand

References

Brière-Côté, A., Rivest, L., & Maranzana, R. (2012). Comparing 3d cad models: uses, methods, tools and perspectives. *Computer-Aided Design and Applications*, *9*(6), 771–794.

Crowe, S., Cresswell, K., Robertson, A., Huby, G., Avery, A., & Sheikh, A. (2011). The case study approach. *BMC medical research methodology*, *11*(1), 1–9.

Liu, W., Moultrie, J., & Ye, S. (2019). The customer-dominated innovation process: involving customers as designers and decision-makers in developing new product. *The Design Journal*, *22*(3), 299–324.

Pan, H. (2018). Development and application of lightweight high-strength metal materials. In *Matec web of conferences* (Vol. 207, p. 03010).

Patil, H. M., Sirsikar, S. S., & Gholap, N. N. (2017). Product design and development: phases and approach. *International Journal of Engineering Research & Technology*, *6*(7), 180–187.

Rashid, H., Abdullah, A., Noh, M. M., Hamid, A. A., & Abidin, N. Z. (2012). Design of a superbike paddock stand using cad and cae tools. *International Journal of Automotive and Mechanical Engineering*, *5*, 670–679.

Sokolovsky, M. (1996). Case study as a research method to study life histories of elderly people: Some ideas and a case study of a case study. *Journal of Aging Studies*, *10*(4), 281–294.