Design and Analysis of Swing Arm

J. Mahith, G. Balaji, Dr. N. Jeevan Kumaar

M. Tech Scholar Department Of Mechanical Engineering

Assistant Professor Department Of Mechanical Engineering,

HOD& Professor, Mechanical Engineering Department

Holy Mary Institute Of Technology And Science

Abstract: A motorbike or bicycle's swing arm is the mechanical link between the frame and the vehicle's rear wheel. Its job is to permit vertical motion of the back wheel, dampening out vibrations and shocks sent from the road. It also enables customized to the rider's needs. The swing arm may have one or two sides, and is usually composed of mild steel. Design and construction of the swing arm have a significant impact on the performance of a motorbike or bicycle, which play an important part in the vehicles overall stability and handling. Analysis of the stresses and deformations experienced by a swing arm during operation is what this project is all about. Are computed by the program once the material characteristics and boundary conditions have been applied to the updated model iron, and carbon fiber were all tested for their performance as swing arm materials under 350pa and 450pa, respectively. The stress and displacement study of a swing arm provides for a thorough examination over the arm, which in turn may aid in the localization of possible failure spots. The findings of are used to validate the design and find opportunities for improvement, such as making it stronger or lighter. Tools utilized ANSYS software for analysis CATIA software for swing arm modeling

Key words: swing arm, CATIA, ANSYS, structural analysis1.

Introduction

1.1 swing arm

The swing arm is a crucial component of every motorbike. Because of its role in fastening the motorcycles rear wheel to the frame, it is an essential part of the machine. The swing arm is responsible for transmitting the force generated by the rear wheels to the primary frame. The suspension is another important function of the swing arm. For this reason, the development of a new motorcycle's integral part of the process the swing arm of a motorbike is a crucial component. Because of its role in fastening the motorcycles rear wheel to the frame, it is an essential part of the machine. The swing arm is responsible for transmitting the force generated by the rear wheels to the primary frame. The suspension is another important function of the swing arm. For this reason, the development of a new motorcycle's integral part of the process Modern swing arms may be either single- or double-sided. The double-sided popular because of its ease of use and symmetrical structure

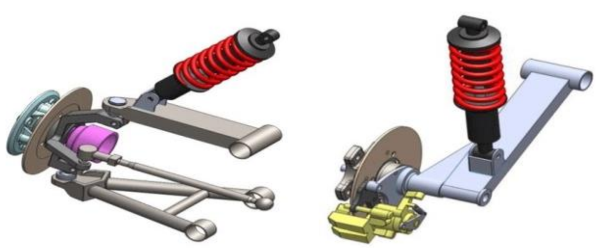


Fig 1.1 swing arm

1.2 History

For motorcycles, a swing arm (or "swinging arm" (UK)) is a single or double-sided mechanical device that connects the rear wheel to the body and allows it to swivel vertically. It was originally called fork. To cause by the rider during acceleration, braking, and cornering, the rear swingarm pivots while still holding the rear axle securely. Motorcycles' early frames were essentially just beefed-up copies of the bicycle's famous diamond frame; hence they lacked a rear suspension. Matches' cantilevered coiled spring swing arm is only two examples of the many suspension methods that were explored. Plunger suspensions, slid up and down between two upright pillars, were widely used just before and during World War II. The latter was driven by motion against coiled springs at both ends.

Fig 1.2 history of swing arm

1.3 Types of Swing arms

The first design was that held the rear axle in place and allowed it to swivel at the other end. Fastened to the frame under the seat rail, at the area directly forward of the rear axle

1.3.1 Cantilever

Shock absorber(s) positioned and operated by the movement of the swing arm through a triangulated frame. Although Matchless and Yamaha both employed variants of this swing arm design, the most well-known example. The Iconic Harley-Davidson Another kind of this swing arm, known as a soft ail, operates in the opposite direction, with the shocks being stretched rather than compressed.

1.3.2 Arm that swings just one way

A single-sided rear suspension that may be attached to a hub much like a car's wheel. Single-sided swing arms, like those used on scooters, are significantly stronger and heavier designed than double-sided ones to meet the increased torsional stresses that result from the swing arm's connection between the engine and the rear wheel. Wheel alignment is ensured by having a single attachment point.

2. Objectives

- A carbon fiber swing arm was developed for this research to achieve a balance between light weight and high rigidity.
- The purpose of this research is to find ways to enhance the current swing arm design in order to address its limitations. The major goal is to increase the swing arm's rigidity and strength, particularly in the face of rigorous riding circumstances.

3. Related Study

In order to face the problems age, a new kind of three-wheeled electric motorbike was recently developed, and its front single-sided swing arm is the subject of this research. are given special consideration among the many scenarios of force loadings evaluated. The structural integrity of various swing arm designs is analyzed by running in specialized Computer Aided Engineering (CAE) software. To aid in the redesign and to bring the overall weight down, a topology optimization method is also employed. Simulation findings under extreme stress conditions are very encouraging for moving forward with a physical prototype of the proposed structure. When the original swing arm design was compared to the revised version, it was found that the overall weight was reduced by 23.2%.

4. Methodology

The fundamental technique is the same in each of these methods.

In the first stage of processing, the problem's geometry (its physical boundaries) is established.

- The fluid volume is segmented into individual cells, or the mesh. The mesh may either be uniform or irregular.
- Enthalpy, radiation, and species conservation have been formulated as part of the physical modeling.
- The boundaries are established. The fluid's behavior and characteristics at the problem's borders must be specified. The beginning conditions are also specified for transitory difficulties.
- Repeatedly as a steady state or transient, and the simulation is launched.
- In the end, a postprocessor is employed to examine and display the answer.

4.1 Various Catia Modules

- Part Design
- Assembly Drawing
- Sheet Metal

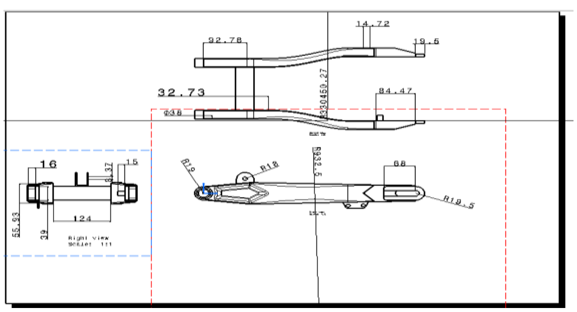


Fig 4.1 swing arm 2d diagram

Here, sketcher is utilized to create finished 2-dimensional artwork. The 2D drawing is then imported into the Part module for 3D modeling. The various components are brought together by means of assembly. The capillary tube is made up of a number of smaller components.

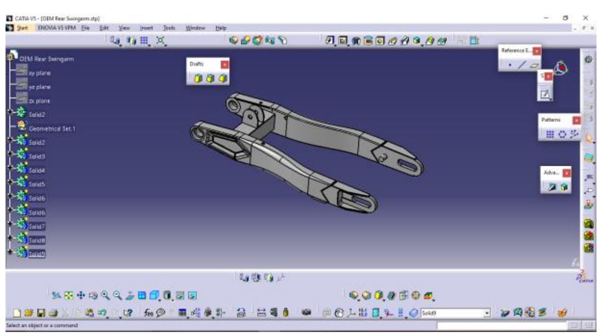


Fig 4.2 Swing arm 3D diagram

4.2 STATIC STRUCTURAL ANALYSIS OF SWING ARM

MATERIAL –STRUCTURAL STEEL, ALUMINUM ALLOY, GREY CAST IRON, TITANIUM ALLOY, CARBON FIBER

MATERIAL: CARBON FIBER

Carbon fiber assignment

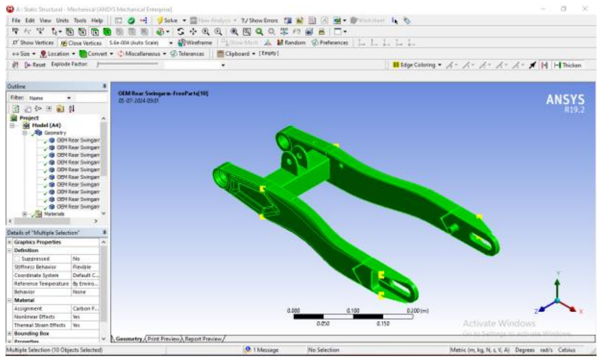


Fig 4.3 material selection

The following outcomes are realized

The problem-solving procedures in structural analysis

1. Engineering data
2. Geometry
3. Setup
4. Model
5. Solution
6. Result

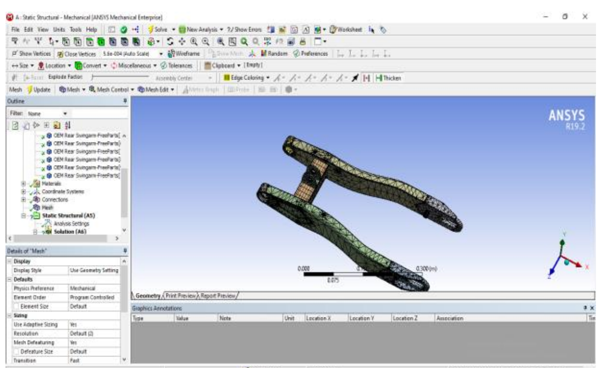


Fig 4.4 meshing

Meshing conditions and loads are imposed when meshing is finished. The user has a number of options for defining limitations and loads. The user is aided in keeping track of load scenarios in this way. The boundary condition includes all of the various forces, supports, restrictions, and other conditions needed for a full analysis to take place. Pressure of 350 kPa is applied externally, and an internal support is attached, as seen in Fig.

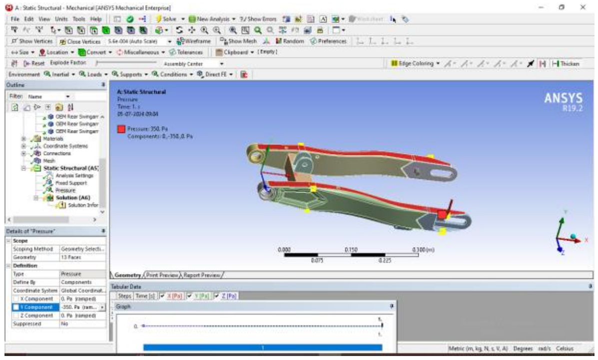


Fig 4.5 boundary conditions

Boundary conditions and loads are imposed when meshing is finished. The user has a number of options for defining limitations and loads. The user is aided in keeping track of load scenarios in this way. The boundary condition includes all of the various forces, supports, restrictions, and other conditions needed for a full analysis to take place. Pressure of 350 kPa is applied externally, and an internal support is attached, as seen in Fig.

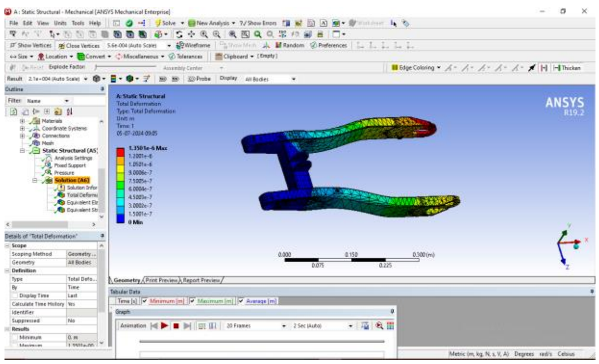


Fig 4.6 total deformation

This greatest total deformation at the hub occurs when the hub are applied to the swing arm model, as seen in the contour map above. Maximum deformation is shown to be 1.3501e-6m, with minimal static deformation at 1.0036e-7m in the above contour map.

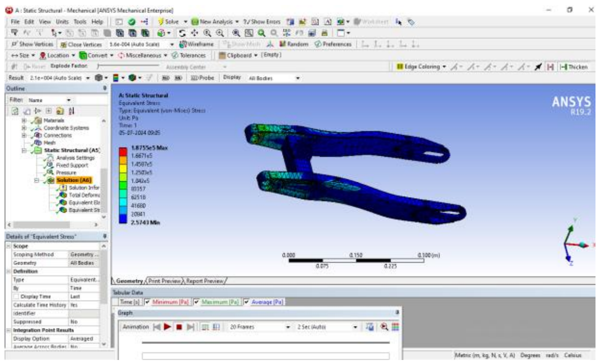


Fig 4.7stress

The highest stress, as shown by the contour plot above, occurs in the model, where the boundary conditions are fixed. Maximum stress is shown to be 1.8755e5m and lowest stress to be 1.414e-9m in the above contour map.

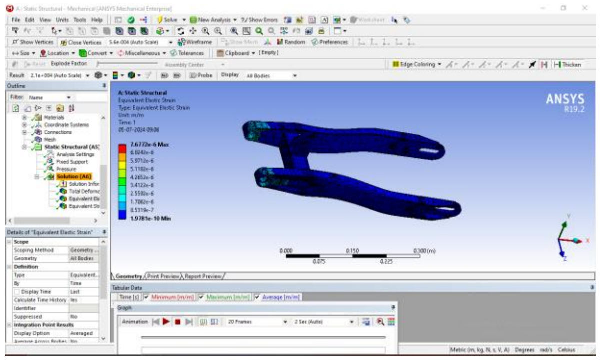


Fig 4.8 strain

The highest stress, as shown by the contour plot above, occurs in the model, where the boundary conditions are fixed. Maximum strain is shown to be 7.6772e-6m and lowest stress to be 2.826e-12 in the above contour map.

4.3 MODAL ANALYSIS OF SWING ARM

MATERIAL: CARBON FIBER

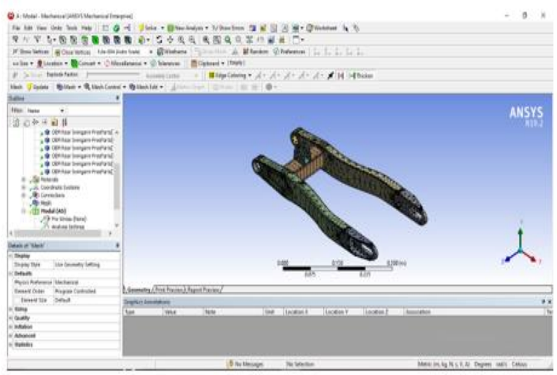
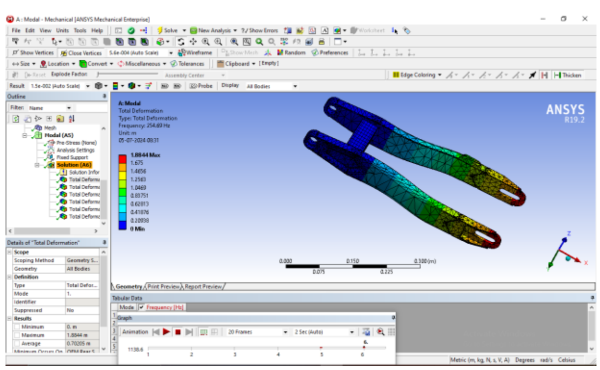


Fig 4.9 meshing



4.10 Total deformation1

This greatest total deformation at the hub occurs when the hub are applied to the swing arm model, as seen in the contour map above. Maximum deformation is shown to be 1.8844m, with minimal static deformation at 0.20938m in the above contour map.

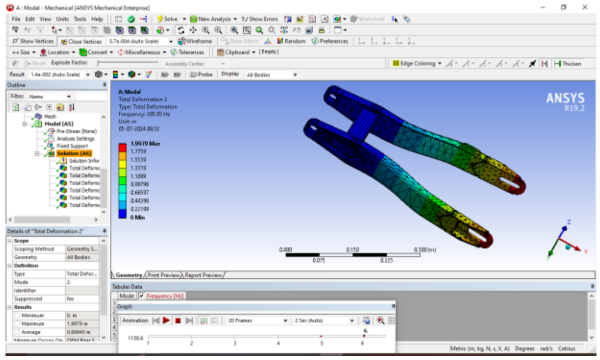


Fig 4.11 total deformation 2

The hub occurs when the hub are applied to the swing arm model, as seen in the contour map above. Maximum deformation is shown to be 1.9979m, with minimal static deformation at 1.0036e-7m in the above contour map.

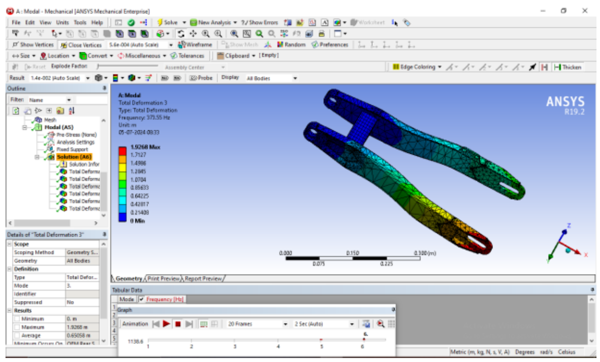


Fig 4.12 Total deformation 3

This greatest total deformation at the hub occurs when the hub are applied to the swing arm model, as seen in the contour map above. Maximum deformation is shown to be 1.9268m, with minimal static deformation at 1.0036e-7m in the above contour map.

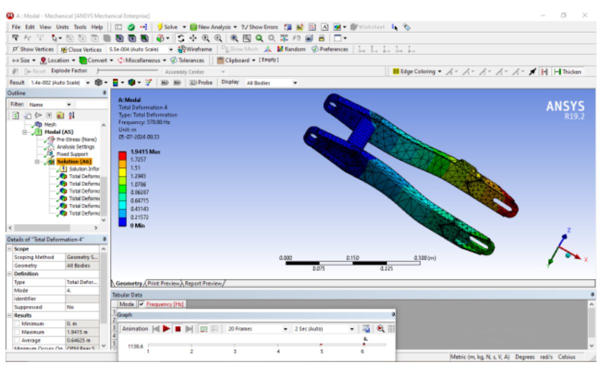


Fig 4.13 Total deformation 4

This greatest total deformation at the hub occurs when the hub are applied to the swing arm model, as seen in the contour map above. Maximum deformation is shown to be 1.9415m, with minimal static deformation at 1.0036e-7m in the above contour map.

5. Result table

5.1 Structural analysis results

Material	Input Pressure (Pa)	Total deformation	Stress	Strain
Structure steel	350	9.442e-7	3.8026e5	2.1698e-6
	450	1.2143e-6	4.889e5	2.7897e-6
Carbon fiber	350	1.3501e-6	1.8755e5	7.6772e-6
	450	3.433e-6	4.932e5	7.8702e-6
Aluminum alloy	350	2.6701e-6	3.836e5	6.1213e-6
	450	3.433e-6	4.932e5	7.8702e-6
Titanium alloy	350	1.9815e-6	3.8767e5	4.5379e-6
	450	2.5477e-6	4.9844e5	5.8344e-6
Grey cast iron	350	1.7127e-6	3.784e5	3.9432e-6
	450	2.2021e-6	4.8652e5	5.0698e-6

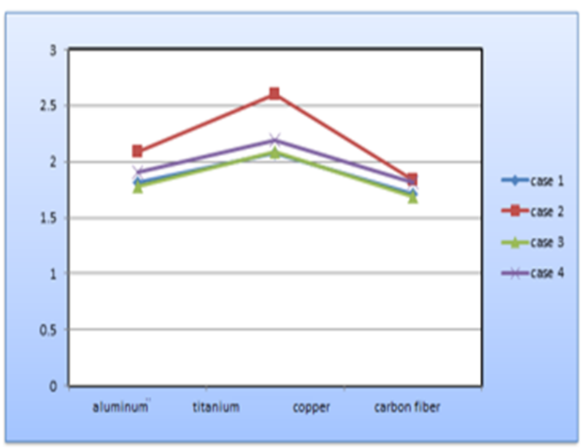
5.2 Modal analysis results

Material	Total deformation 1	Total deformation 2	Total deformation 3	Total deformation 4
Structure steel	1.0236	1.0493	0.94488	0.97154
Aluminum alloy	1.7215	1.765	1.596	1.6409
Titanium alloy	1.3316	1.3656	1.2405	1.2748
Carbon fiber	1.8844	1.9979	1.9268	1.9415

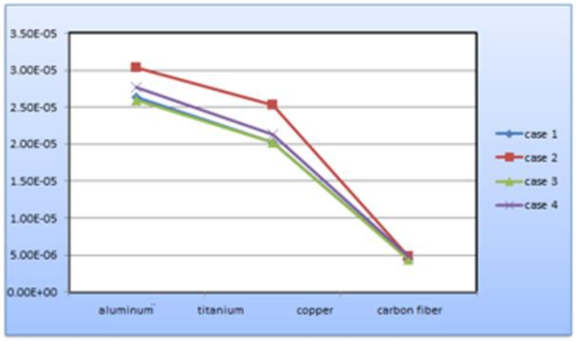
The findings of are used to validate the design and find opportunities for improvement, such as making it stronger or lighter. CATIA was used for the swing arm model after a thorough study of stress and displacement was performed in ANSYS. Carbon fiber has been shown to withstand pressure better than aluminum, steel, and titanium using static structural analysis. When compared to aluminum alloy, structural steel, and titanium alloy, modal study shows that carbon fiber has more prominent natural vibrations. After considering many different materials, we have decided that carbon fiber is the best option for the swing arm.

6. Graphs

6.1 Stress plot



6.2 Strain plot



6.3 Explanation about graphs and results

Boundary conditions have been applied to the updated model Swing arms made from various materials, including 350pa and 450pa grey cast iron, and structural steel, was tested. The stress and displacement study of a swing arm provides for a thorough examination over the arm, which in turn may aid in the localization of possible failure spots. The findings of are used to validate the design and find opportunities for improvement, such as making it stronger or lighter. CATIA was used for the swing arm model after a thorough study of stress and displacement was performed in ANSYS. Carbon fiber has been shown to withstand pressure better than aluminum, steel, and titanium using static structural analysis. When compared to aluminum alloy, structural steel, and titanium alloy, modal study shows that carbon fiber has more prominent natural vibrations.

7. Conclusion

Analysis of the stresses and deformations experienced by a swing arm during operation is what this project is all about. Are computed by the program once the material characteristics and boundary conditions have been applied to the updated model Swing arms made from various materials, including 350pa and 450pa grey cast iron, and structural steel, was tested. The stress and displacement study of a swing arm provides for a thorough examination over the arm, which in turn may aid in the localization of possible failure spots. The findings of are used to validate the design and find opportunities for improvement, such as making it stronger or lighter. CATIA was used for the swing arm model after a thorough study of stress and displacement was performed in ANSYS. Carbon fiber has been shown to withstand pressure better than aluminum, steel, and titanium using static structural analysis. When compared to aluminum alloy, structural steel, and titanium alloy, modal study shows that carbon fiber has more prominent natural vibrations. After considering many different materials, we have decided that carbon fiber is the best option for the swing arm.

References

[1] G. Risitano, L. Scappaticci, C. Grimaldi and F. Mariani, "Analysis of the Structural Behavior of Racing Motorcycle Swingarms", SAE Technical Paper, (2012), 10.4271/2012-01-0207

[2] V.S. Dixit, M.R. Nukulwar, S.T. Shinde and S.S. Pimpale, "Vibration response and Optimization of Swing arm through Hardening", International Journal of Current Engineering and Technology (IJCET), Vol. 6, No. 2, (2016), 562-567.

[3] G.V. Bhunte and Dr. T.R. Deshmukh, "A Review on Design and Analysis of Two Wheeler Chassis", International Journal for Research in Emerging Science and Technology (IJREST), Vol. 2, No. 1, (2015), 42-45.

[4] Prof. S. Božič, Prof. E. Gombač and Prof. A. Harmel, "Redesign of motorcycle rear suspension with cad technology", The Faculty of Maritime Studies and Transport Slovenia, (2009), 12-17.