

# Design and Analysis of Quad Bike Suspension System

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**Abstract**— The main objective of the paper is to design and analyze the entire double wishbone and mono-shock swing arm suspension system for quad bike Vehicle for improving the stability and handling of the vehicle. There has been development in the suspension system. The topic is focused on designing the above mentioned suspension systems considering the dynamics of the vehicle along with minimizing the un-sprung mass. The suspension system of a quad bike Vehicle needs to be durable, light weight, efficient and less expensive. The vehicle must be able to withstand the harsh environment of off-road terrain. Stability of the vehicle and the ride comfort is given a prominent importance in this project.

**Key words:** Quad Bike Suspension System

## I. INTRODUCTION

Quad bike is many manufacturing company made and various engine capacity available is available. But Yamaha and Polaris is world-wide in most of country in marketing and manufacturing of Quad bike Vehicles. This is a package of different systems that are designed to enrich the performance and to provide comfort to the driver. Different systems include chassis, steering system, suspension system, braking system and drive train. All these mentioned systems are inter-dependent. Failure of a single system or a part may lead to the death of the operator or driver. Quad bike are also popular for their good aesthetics and their sporty look. Suspension system is quad bike Vehicle in one of the most critical system that needs to be designed for better stability and comfort for the operator. Suspension system is generally designed in relationship with the steering system.

## II. SUSPENSION SYSTEM

Suspension system is referred to the springs, shock absorbers and linkages that connect the vehicle to the wheels and allows relative motion between the wheels and the vehicle body. Suspension system also keeps the driver or operator isolated from bumps, road vibrations, etc. Also, the most important role played by the suspension system is to keep the wheels in contact with the road all the time. Good suspension system and better handling is the characteristic of a good All Terrain Vehicle (ATV).

One of the functions of suspension system is to maintain the wheels in proper steer and camber attitudes to the road surface. It should react to the various forces that act in dynamic condition. These forces include longitudinal (acceleration and braking) forces, lateral forces (cornering forces) and braking and driving torques. It should resist roll of the chassis. It should keep the wheels follow any uneven road by isolating the chassis from the roughness of the road.

All the dynamic parameters are to be considered while designing the suspension system, especially the

behavior of the suspension for various loading cases. Besides the dynamic parameters, other factors considered in design process are cost, weight, package space, manufacturability, assembly, etc.

## III. TYPES OF SUSPENSION SYSTEM USED IN QUAD BIKE

- 1) double wishbone suspension system
- 2) mono-shock swing arm suspension system

## IV. DOUBLE WISHBONE SUSPENSION SYSTEM

Double Wishbone Suspension System consist of two lateral control arms (upper arm and lower arm) usually of unequal length along with a coil over spring and shock absorber. It is popular as front suspension mostly used in rear wheel drive vehicles. Design of the geometry of double wishbone suspension system along with design of spring plays a very important role in maintaining the stability of the vehicle. This type of suspension system provides increasing negative camber gain all the way to full jounce travel unlike Macpherson Strut. They also enable easy adjustment of wheel parameter such as camber. Double wishbone suspension system has got superior dynamic characteristics as well as load-handling capabilities.

### A. Comparison of Material properties

Properties	AISI 1018	AISI 1040	AISI 4130
Carbon Content (%)	0.18	0.40	0.30
Tensile Strength (MPa)	440	620	560
Yield Strength (MPa)	370	415	460
Hardness(BHN)	126	201	217
Cost (Rs./metre)	325	425	725

Table 1: Properties of Materials

## V. ANALYSIS OF WISHBONES

Analysis of wishbone in Ansys Analysis Software is necessary in order to determine the induced maximum stress and maximum deflection in wishbones. For analysis, wishbones are first needed to be modelled in software. The modelling of wishbones is done in Pro-E modelling software.

## VI. PRO-E MODELLING

Pro-E is modeling software which allows 3D- modeling and 2-D drafting of elements. In order to perform the analysis of wishbone in Ansys, it is necessary to model the wishbones in any of the modeling softwares such as Pro-Engineers, Catia or Solid Works, etc. We have selected to use Pro-Engineers (Pro-E) modeling software because of its availability.

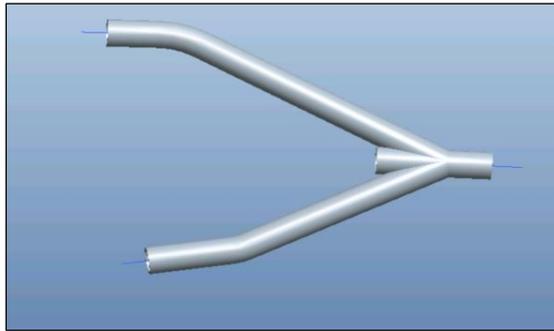


Fig. 1: Pro-E model of upper wishbone

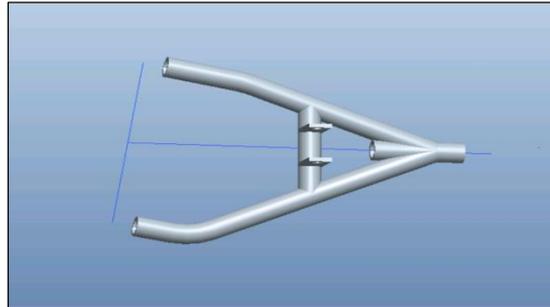


Fig. 2: Pro-E model of lower wishbone

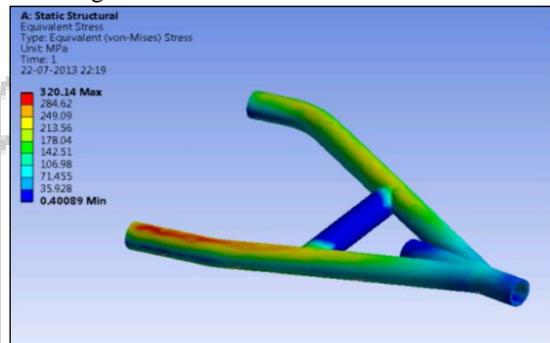


Fig. 3: Analysis of lower wishbone in Ansys

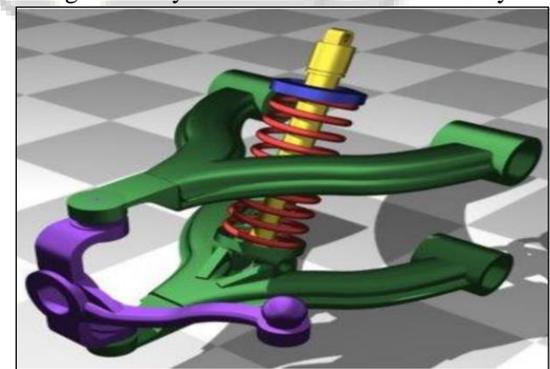


Fig. 4: double wishbone suspension assembly

A. Results of Analysis of Wishbones:-

Parameters	Values
Maximum Stress	320.14 MPa
Maximum Deflection	6.013 mm
Allowable Stress	345.83 MPa

Table 2: Results of Analysis of lower wishbone in Ansys

VII. DESIGN OF SPRING

A spring is an elastic object used to store mechanical energy. Springs are usually made out of spring steel. When a spring is compressed or stretched, the force it exerts is proportional

to its change in length. The rate or spring constant of a spring is the change in the force it exerts, divided by the change in deflection of the spring Spring is used in order to absorb shocks and for providing springing action for better & comfort of the passenger

Design parameter Considerations in Spring Design:-

- Sprung mass= 240 kg
- Un-sprung mass= 60 kg

A. Specifications of Spring

PARAMETERS	VALUES
Wire Diameter	10mm
Coil Mean Diameter	60mm
Number of coils	8
Solid length	80mm
Free length	180mm
Spring index	6
Pitch of spring	25.7mm
Stiffness of spring	50N/mm

B. Analysis of spring

Spring is analyzed in Ansys analysis software so as to determine the actual maximum deflection of spring corresponding to the maximum spring force. Also, the maximum stress value corresponding to the maximum spring force is determined.

Parameters	Value
Maximum Force	2000 N
Maximum Deflection	40mm
Maximum Stress	215 MPa

Table 3: Spring Analysis Results

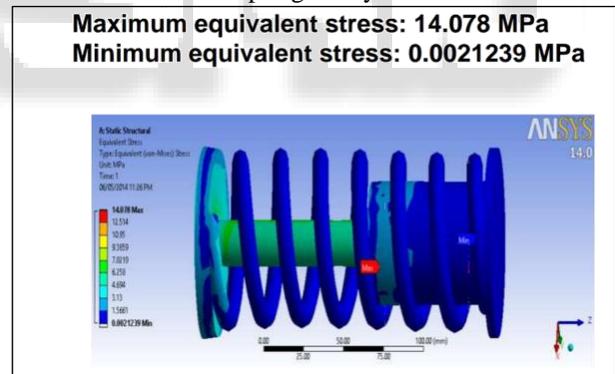


Fig. 5: Analysis of Spring in Ansys

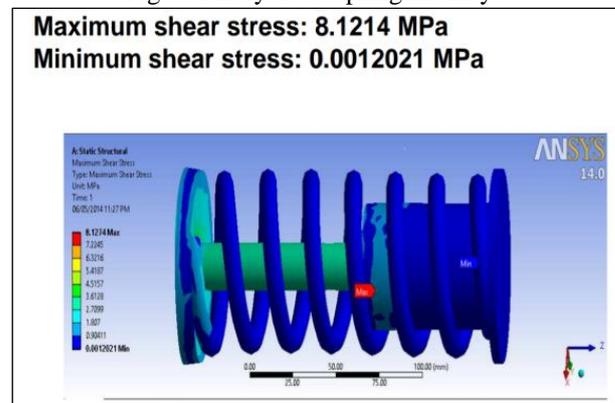


Fig. 6: Analysis of Spring in Ansys

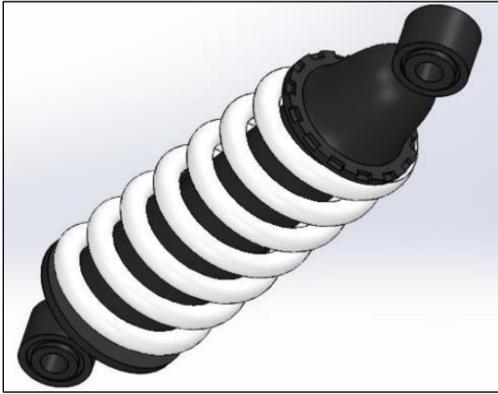


Fig. 7: Mono-shock suspension

#### VIII. CONCLUSION

This topic FUTURE WORK we have designed the double wishbone suspension and mono-shock suspension system and then analysis in the ansys software. This was followed by analysis of the system in the ANSYS. The stipulated objectives namely providing greater suspension travel, reducing the un-sprung mass of the vehicle, maximizing the performance of the suspension system of the vehicle and better handling of vehicle while cornering; have been achieved. The suspension system can be further modified for decreasing the weight and cost. And better strength of material used and light weight of suspension system .so it's better performance is provides. This project topics in future best suspension design an analysis for all terrain vehicle in best suspension and riding performance provide during off road track.

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