Design of Front Suspension System for an All-Terrain Vehicle

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ABSTRACT

A main obstacle in the development of off road automobile sector remained to be cost and its value for money. In order to uplift this field, efforts are required to make changes in the present design to enhance the grip and control of the automobile on the road. Up gradations in design may enhance its applications in other sectors too. The aim of this work is to optimize the relevant parameters of front suspension for all terrain vehicles. In this work, the design for the suspension of an ATV is carried out so that it can be an independent suspension system because it keeps chassis unit in such a manner that rise or fall of one wheel has no effect on the other. Moreover, it can produce maximum wheel travel during jounce and bounce in the road. The system also kept as light as possible for reducing un-sprung mass of the vehicle to meet competition regulation.

Introduction

Suspension system is a crucial element in off-road vehicle which helps to get maximize traction effort between surface and wheels and to offer smoothness to the rider. Due to application of load in the downward direction, the vehicle remains grounded, and load gets passed on to the tires through suspension system [1]. While designing, the two most important parameters to be considered are rough patches of roads and variable conditions.

The different road conditions like hilly areas or rough surfaces which can be defined as high frequency (hilly region) and low frequency (rough road). Fluctuation in load is because of several factors as in case of turning, braking action, sharp turns, sudden rise or fall in speed. Hence, to continue in the given environment, a durable suspension system is required in order to provide a smoother experience for the occupants of the vehicle while driving on any kind of teraain irrespective of load applied [2]. The shock absorber decreases the magnitude of induced reactive force because of obstacles in the way of automobile. The value of the given reaction is directly proportional to the free weight of the carrier [3]. With higher sprung to un-sprung weight ratio, further decrease in reaction force could be achieved thus benefiting both vehicle and the occupants along with better control of the vehicle [4].

Here, double wishbone and semi-trailing suspension system is selected for front and rear respectively, developed in LSA (Lotus Suspension Analysis). In the later stage of design, the hard points are utilized in A-arms and semi-trailing arms so as to complete design by using SOLIDWORKS software.

The whole process of the synthesis is categorized into two parts. In the first phase, the discussion about conceptual knowledge of the elements is carried out followed by modification in design parameters based on approximation of dynamic conditions then execution of static testing and analysis. In the second phase, mathematical modeling of finalized concept is done then dynamic testing and analysis is performed which further leads to modification of design parameters based on dynamic testing results

Table-1: Selected suspension geometry

Position	Type
Front	SLA double wishbone (damper to lower wishbone)
Rear	Semi -Trailing arm

Front Suspension Design Optimization

The sole purpose of front suspension is to offer the optimum wheel travel in bump as well as in droop.

1). Simulation of suspension Geometry in Lotus software

The suspension geometry is also simulated in lotus suspension analysis software to get hard points and testing the response of the wheel with respect to the body as well as ground. By the simulation of lotus, Bump steer is minimized and also rollover of the vehicle.

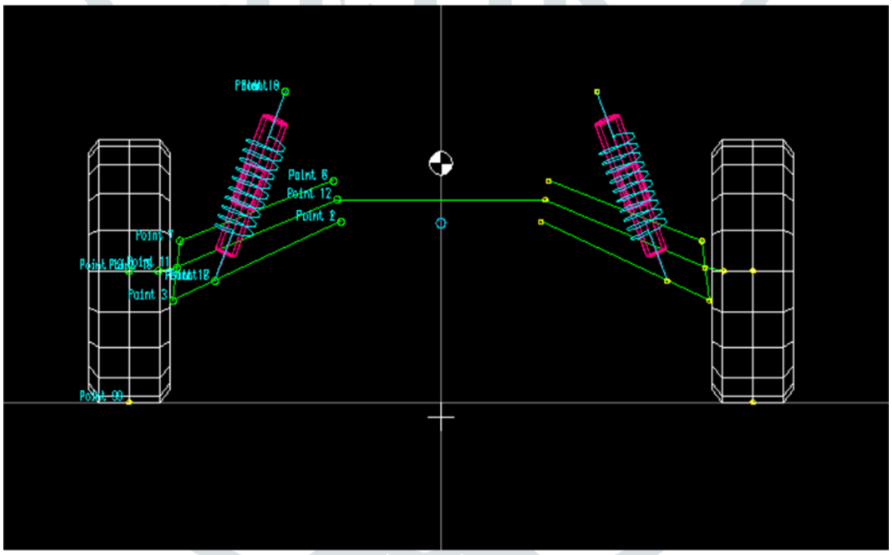

Figure-1: Front view of the front suspension

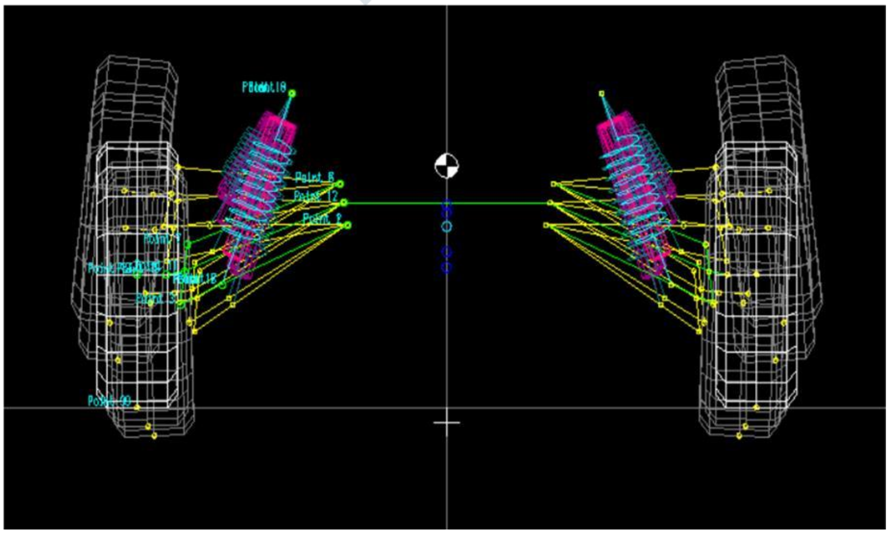

Figure2: Dynamic view of the front suspension during jounce and rebound

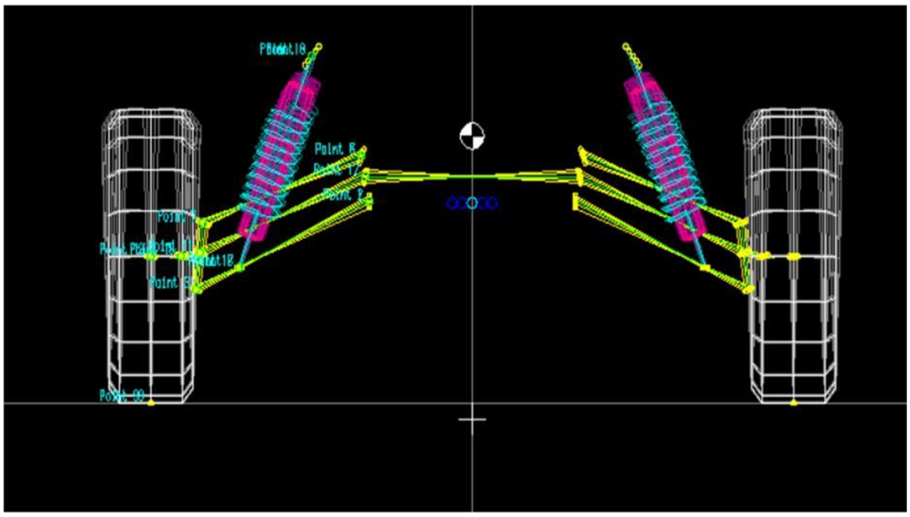

Figure3: Depiction of dynamic camber during vehicle roll

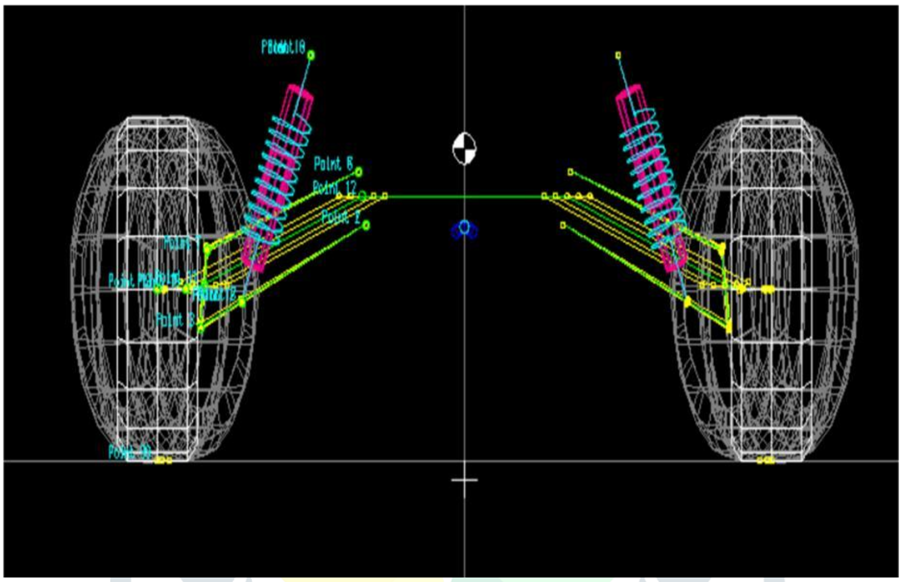

Figure 4: Simulated view of steering

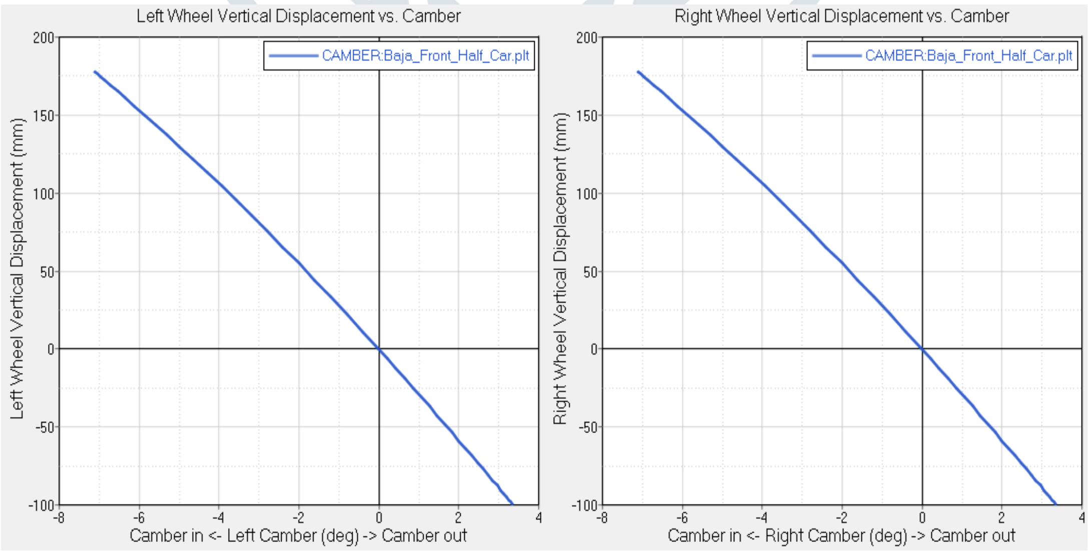

Figure5: Camber change during jounce and rebound of front Suspension

2). Simulation of suspension Geometry in Motion view

After minimizing the Bump Steer in Lotus software, the hard points are imported in motion view to perform 2-post analysis for optimizing the geometry by the study of various graphs.

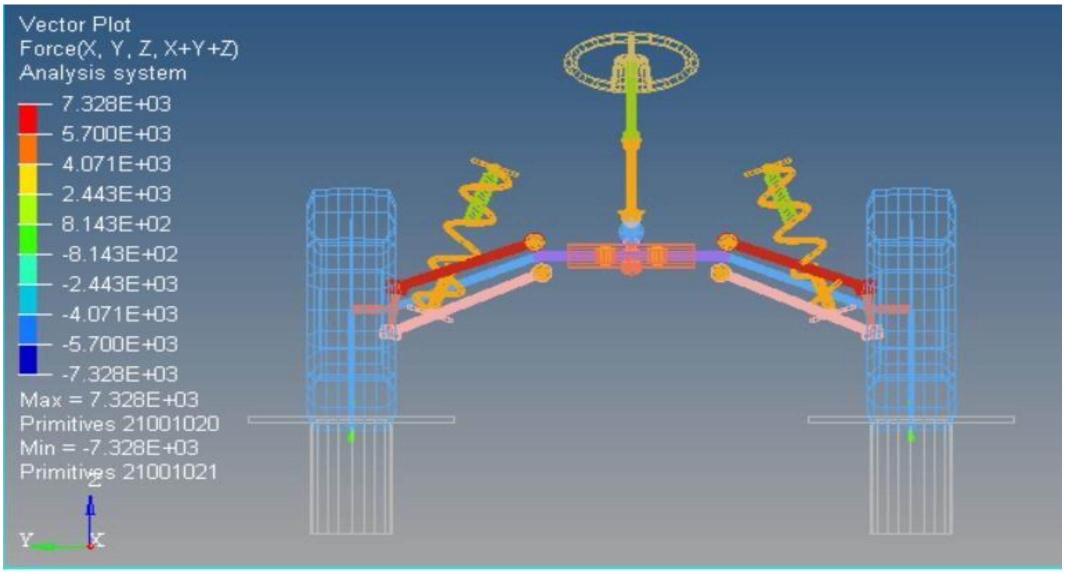

Figure6: Two-post analysis of front Suspension

3). 2-D Designing of geometry in Solidworks

Using all the data from Lotus software, the suspension is modeled in Solidworks software to validate iterated values. All the hard-points are verified as per the required conditions in vehicle

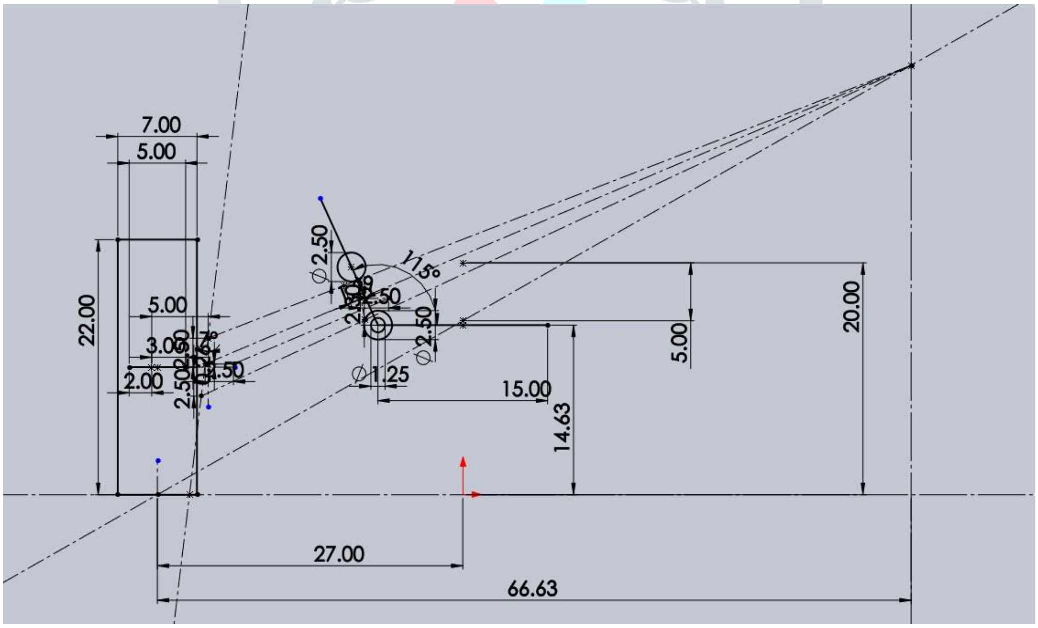

Figure 7: 2-D designing of front suspension geometry in Solidworks

Results and Conclusions

After performing the above discussed procedure, the location of center of mass and roll center is achieved to provide more stability and smoothness for the passengers. The values of the same are

Ground Clearance = 18”
Roll center at front = 11.14"

The paper presents the design of suspension of an All Terrain Vehicle (ATV). The dynamics of vehicle is the main factor in designing. The main aim of the given work is to find the relevant parameters of the suspension design. It also gives information about the factors contributing in the improvement of the response in suspension of the vehicle.

References

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