

## Design Analysis & Simulation Based Techno-Feasibility Testing Of Centre Mounted Suspension System

Neeraj Dadhwal<sup>1</sup>, BalRam Bhardwaj<sup>2</sup>, Suresh Bhardwaj<sup>3</sup>

<sup>3,1</sup> Mechanical Department, DITMR College, MDU University, Rohtak, Haryana, India,

<sup>2</sup> Maclec Technical Project Laboratory, New Delhi, India

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**Abstract :** Suspension systems can be described as the shock absorbing system installed along with the wheels in automobiles with the purpose of maintaining maximum possible required interaction between wheel and the surface. Apart from it, the suspension systems made vehicle driving experience luxurious, comfortable and pleasurable. Suspension systems also play vital role in maintaining vehicle balancing by keeping the centre of gravity in the centre, so that the overall gravitational pull does not interrupt in vehicle balancing during turning on steep corners, course of rough terrain and also during acceleration. At the time of vehicle acceleration, it is very much important to break static inertia of vehicle in such a manner so that the vehicle easily maintains kinetic inertia along with overall balancing. There are numerous suspension systems available which are still in use in order to maintain vehicle balance and comfort. The endeavour of this proposed research is to introduce a new class of suspension system in order to rid of existing risk factors associated with conventional suspension system. In order to fulfil desired goal, 3D analysis of proposed system will be done along with stress analysis to find out suitable composite material for its fabrication and its installation manual.

**Keywords:**–Acceleration, balancing, suspension, terrain, vehicle, etc.

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### I. Introduction

**Automotive Suspension** is the type of system which associates vehicle tires, pressurised tire air, Specific springs, hydraulic/air based shock absorbers and distinct linkages that connects a vehicle to its wheels through axial and allows required relative motion between the two. As far as its importance is concerned, the suspension systems perform two distinguished services by contributing to the vehicle's over all balancing in every terrain and assuring good active safety and driving pleasure through keeping vehicle occupants comfortable and a ride quality. Suspensions also maintain reasonably well isolated inner environment for vehicle from road noise, bumps, and vibrations by acting as an active shock absorber.

Conventional suspension systems are equipped with all above said features but lagging behind in some distinctive features such as providing balance in all terrains, maintain centre of gravity exactly during acceleration as well as distributing shock during obstacle crossing equally towards centre of the chassis. The proposed centre mounted suspension system is being evolved to cater all such needs in the development of all terrain vehicles. Centre mounted suspension system is beam based system which are directly attached to the central chassis of vehicle to give way to transfer the entire jerk towards centre. The system is simplest enough to install in any type of vehicle.

### II. Literature Review

In generally, there are three main types of suspension system which are passive type, semi-active type and active type of suspension system and widely investigated by many researchers with different techniques and algorithms as well. The passive suspension system in vehicles showed unsatisfactory performances in vehicle stability as compared with semi-active and active suspension system because of lack of situation specific components. The working behaviour of passive automotive suspension systems is determined through the selection of the spring stiffness and the coefficient of jerk or damper. The fixed type of damper and spring component of passive suspension system has not well enough for energy absorption to take the load or road obstacles acted over the vehicle system.

The semi-active type suspension system uses a distinct damper and other variable dissipation component in the automotive suspension and the example of a variable dissipater is a double tube viscous damper in which the damping coefficient can be varied by changing the diameter of the bore in a piston. Next example is of semi-active dissipater, which is a magneto rheological (MR) damper and used MR fluid system where MR fluids are materials who respond to an applied magnetic field with a change in rheological behaviour.

The Semi-active type suspension systems have been investigated in various literatures in place to achieve low energy utilization and as a good performance as full-active suspension systems because semi-active system can adjust the damping and thus improve either ride comfort or ride safety compared to the passive system.

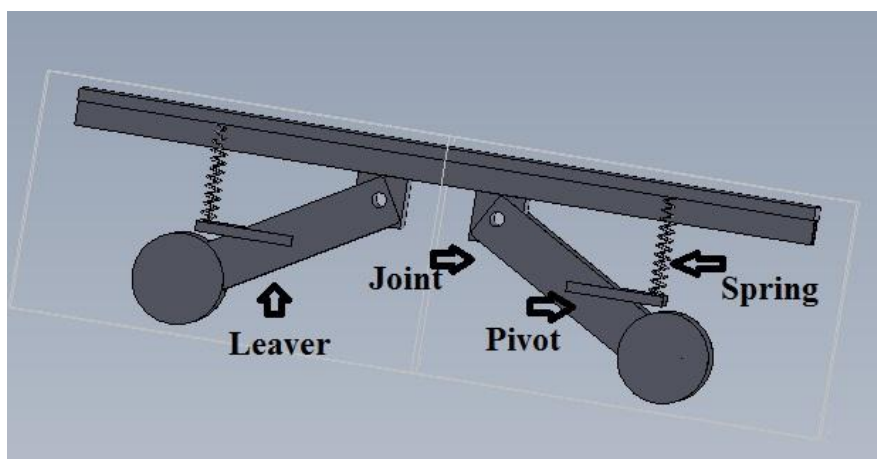
The Active type suspensions are equipped with electronic control systems which controlling operation of the suspension elements during real time use due to which they have not a limited performance like passive suspensions and create a new advancement in eliminating the drawbacks of the design compromise present in passive suspensions. The implementation of Active suspension system reduces car body acceleration by allowing the suspension to 'absorb' wheel accelerations using an actuator. Recent works and researches on active suspensions have been carried out by numerous researchers to improve the stability and ride handling performance of the vehicle.

The all above mention suspension system categories, the proposed centre mounted suspension system remain most advanced, distinct but remain in the category of passive suspension systems because it lack any electrical or mechatronical equipment and components, despite of all these laggings the centre mounted suspension system contains all guts to maintain vehicle jerks even during rush driving due to its unique designing and extra ordinarily simple formulation.

### III. Principle

The centre mounted suspension system is based upon two distinct phenomenon i.e. leverage and spring tension. The leverage remain Mechanical advantage which is measures of the force amplification achieved by using a tool, mechanical device or machine system and ideally during leverage the device preserves the input power and simply transfer this off against movement to obtain a desired amplification in the output force in another distinct point. This leverage advantage is present in the main shaft where the wheel is mounted and through which the entire suspension system attached to the chassis.

The Spring, in this case act as a pivot which transfer the torque from wheel base to the chassis and during this transformation, maximum displacement is disappeared as accordance to spring constant.



**Fig:** Centre Mounted suspension system Installation arrangement 3D.

### IV. Methodology

The above said features are embedded with the very initial design of suspension system, but these goals are generally at odds and depending upon the well tuning of suspension with the vehicle. The tuning of suspension with vehicle involves finding the right combination of strength, shock absorbing capacity and type of vehicle. It is utmost important for the suspension system to maintain maximum possible contact area between the road and the wheel because all the road or ground forces acting on the vehicle do so through the contact patches of the tires which finally provides required friction to facilitate breaching the static inertia of the vehicle and maintaining the kinetic inertia . The suspensions also act as a protector and protects the vehicle itself and any cargo or luggage from damage and wear by absorbing the shock generated due to rough driving or rough terrain.

In order to find of possibility to install the proposed suspension system into ATV, 3D modelling using SOLIDWORKS has been done and according to the working a small prototype is being fabricated.

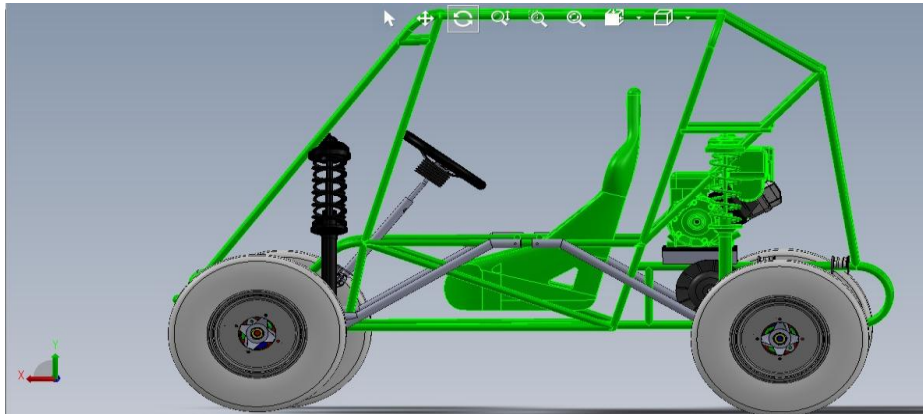


Fig: Implementation of Centre Mounted Suspension system.

### V. Mathematical Calculations

Fabrication As per the principle of leverage, it is being proved that using lever, torque could be transferred from one point to another.

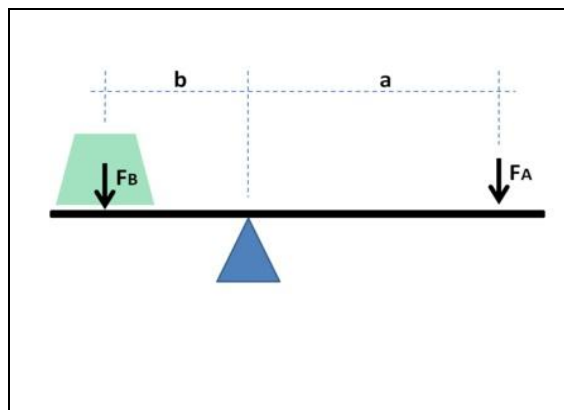


Fig: Graphical Presentation of Leverage system.

If  $a$  and  $b$  are the lever from the fulcrum to points  $A$  &  $B$  and if force  $F_A$  implanted to  $A$  is the incidental force and  $F_B$  is received &  $B$  is the output, the ratio of the velocities of points  $A$  and  $B$  is given by  $a/b$ , so the ratio of the outlet force to the inlet force or mechanical advantage generated due to leverage, is can be given by

$$MA = \frac{F_B}{F_A} = \frac{a}{b}$$

### VI. Results & Discussion

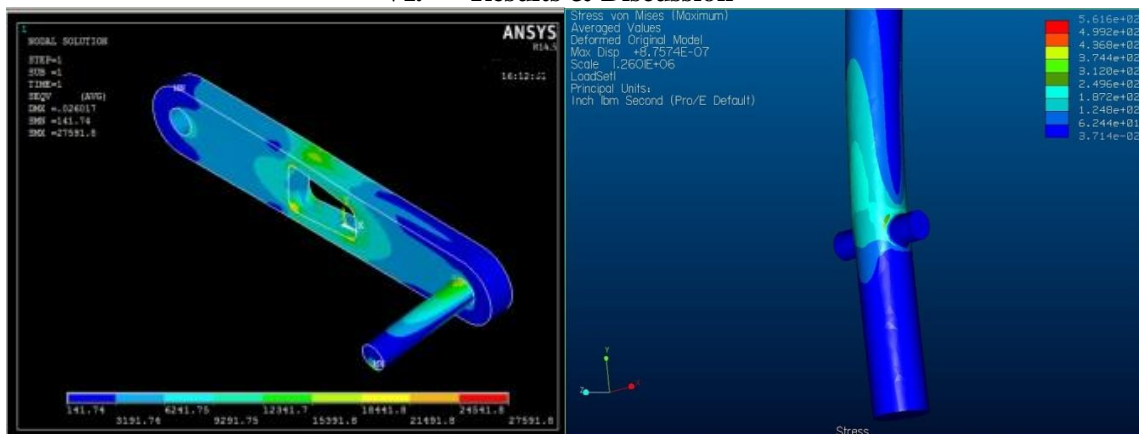


Fig: Stress Analysis of Leaver joints and leaver rod using ANSYS.

As per the Stress analysis and torque transmission analysis, it is being proved that the centre mounted suspension system provides major advantages during sharp turns and bumpy rides where other conventional suspension system get failed.

In comparison with existing suspension systems, the centre mounted suspension system is maintaining its uniqueness throughout, weather it is design or mode of installation. Unlike conventional suspension systems, the proposed system is directly attached with the centre of vehicle chassis and due to which the overall jerk, displacement and vibrations generated due to terrain and driving condition, the vehicle never get miss-balanced because of the distinctive specified design of the proposed suspension system.

The proposed system is based upon leverage phenomenon, in which the shaft which attached to the centre, act as a lever and the suspension spring, which installed at predefined and calculated place in between the joint and the wheel base is act as a PIVOT which allows to transfer all the jerk and vibration direct to the centre while absorbing most of the jerk in between.

## **VII. Conclusion**

There is tremendous scope to implement centre mounted suspension system in four wheelers and heavy loading vehicles in order to make ride more economic, luxurious, safe and advantageous. As far as the future scope is concerned, the system is capable enough to tackle all the existing problems related to conventional suspension systems in a single go.

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