Theoritical Analysis of Macpherson Suspension System

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Abstract- *This is very popular and efficient form of suspension system. It has one control arm and a strut assembly. A coil spring and shock absorber will normally from parts of the strut assembly. Macpherson suspension system is generally used as the front suspension system in passenger cars.*

Coil spring may be mounted on the control arm instead of being around the strut. On this type the shock absorber connects the knuckle to the frame. This type of suspension strut is often also used on rear suspension system. Macpherson strut is set up is still popular in high performance passenger's cars.

I. INTRODUCTION

Suspension is the system of tires, tire air, springs, absorbers, and linkages that connects a vehicle to its wheel and allows relative motion between the two. Its is important for the suspension to keep the road wheel in contact with the road Surface as much as possible, because all the road or ground forces acting on the vehicle. Obviously any four wheel vehicle needs suspension for both the front wheel and the rear wheel drive these can be very different configuration. Suspension system is provided in all vehicle so as to provide smooth and comfortable ride to passengers as well as to the drivers. The automobile chassis is mounted on the axle not directly but through some form of springs. This is done to isolate the vehicle body from the road which may be in the forms of bounce, pitch and roll. These tendencies give rise to uncomfortable ride also cause damage to the automobile frame and body. Another feature of suspension system is that it should keep the tires on road all the time, if there is no suspension system the tires would tend to lift off the ground every time and it would be transmitted directly to the passengers. It is also helpful for providing good road holding while driving ,braking and to maintain proper steering geometry.

There are various method of independent front suspension system used in vehicles, but Macpherson are commonly used in many modern cars, motors vehicles. This includes both front and rear suspension but usually located at the front of the car. In Macpherson strut type suspension system ,only lower wishbone are used. A strut containing shock absorber and the spring carries also the stub axle in which the wheel is mounted. Macpherson suspension system contains upper mounting point, shock absorber, spring, spring leaf and lower control arm. It contains only one lower arm so it also known as single wishbone system.

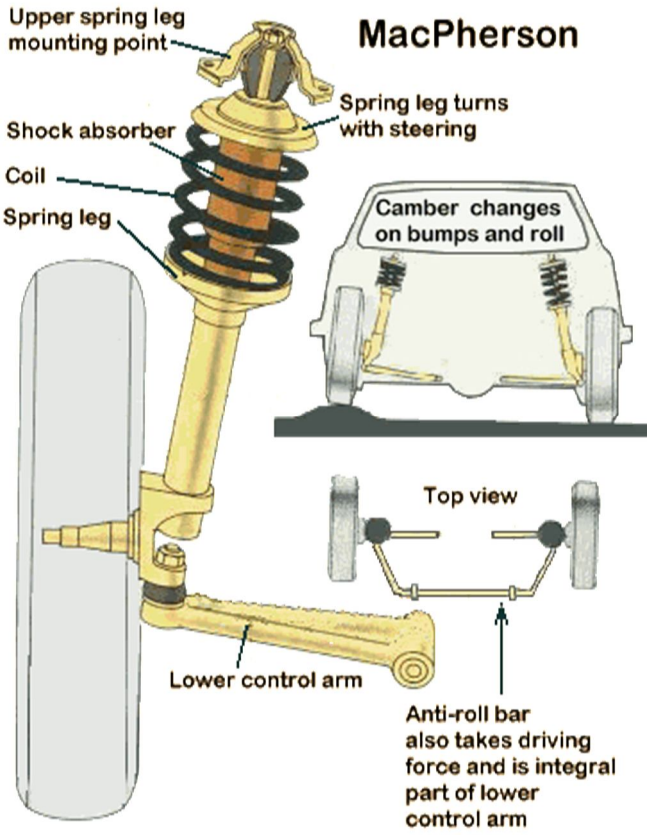

Fig-1.1 Schematic Figure of Macpherson Strut Suspension System

This system is simpler than the other type of suspension system gives the maximum room in the engine compartment and it is the only reason that it is commonly used on front wheel drive cars. It I also used to provide effective ride quality which means isolation of the chassis against excitations due to road roughness, to maintain the wheels in the appropriate position so as to have a better handling and to keep tire contact with the ground. However it is well known that these requirements are conflicting, for instance to achieve better isolation of the vehicle chassis from road irregularities a larger suspension deflection is required with soft damping yields better stability at the expense of comfort.

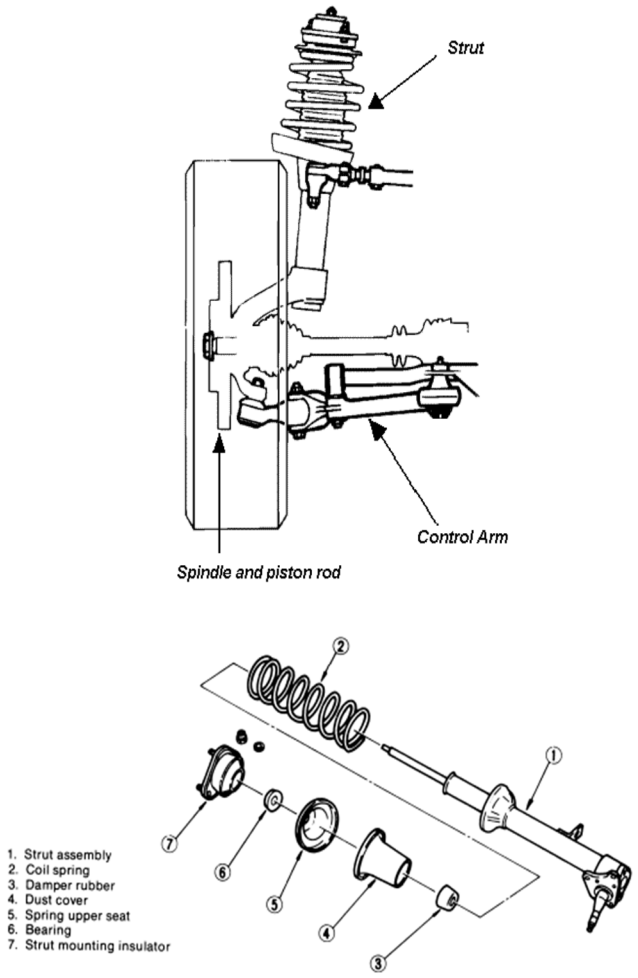

Fig-1.2 Assemblies and Disassemblies Of Macpherson Strut

II. LITERATURE REVIEW

- **Prof.Sumant P.Patel (2012):-**

Suspension system is a very essential part of the automobile vehicle. Stability and comfort is totally depend on the suspension system of vehicle. Suspension system basically has two main components which is shock absorber and spring, both have their own function. Spring gives vertical motion to the wheel and provides allowance to work for shock absorber. Shock absorber as name suggested absorb the shock that may be transmitted to the body if not provided. Basically the suspension system is employed to deal with bump in road surface, in other word enhancing ride comfort. So in every suspension is designed for the capacity of the vehicle.

Each of the main suspension components were modeled individually. Assembling the pieces with the proper geometry was essential to capture the dynamic performance of the suspension. The parts had to be placed in the right position with respect to each other as well as the correct mounting location.The suspension are thus designed to achieve a compromise among these conflicting requirements. The prime objective of using suspension is to improve the ride quality, directional stability and handling of the vehicle.

- **Gadhia Utsav D. (2012):-**

Generally the suspensions system can be broadly classified as dependent and independent types. Independent suspension (i.e. Double Wish Bone, Macpherson And Multilink) leads to better ride and handling capabilities. It is important to analyze the suspension system that have been designed to predict the behavior of the system than followed with improvements. The suspension system significantly affects ride and handling of the vehicle that is vibrational behavior including ride comfort, directional stability, steering characteristics and road suspension. The suspension must be properly designed because it is a crucial subsystem in vehicle in order to :-

1. Carry the weight of vehicle and also its weight.
2. Keep the wheels perpendicular to the road for maximum grip resultant good ride and handling performance.
3. Take the force for accelerating or braking the vehicle.

Front suspension is the independent suspension system. The main components of the independent suspension system including upper control arm, lower control arm, spindle, brake caliper and brake rotor. Each of these main components are several additional components that attach to have an important role in the behavior of suspension.

- **Dr.Pushpendra Sharma & Prof S.C. Jain (2014:-**

In Macpherson suspension system apart from the linkages, the basic components of any suspension are springs, dampers and stabilizer also called anti roll bars. For unsprung masses such as knuckles and control arms, light weight presents additional advantages. Thus a reduction of the weight of the unsprung masses will also remain a most important phenomenon for future developments in suspension system. As the car maneuvers over terrain such as bumps, the front suspension allows the wheel and tire to move up and down with respect to the frame. The specific direction of this movement is controlled through the geometry and mounting points of the upper control arm, lower control arm. The spring and shock absorber are attached to the lower control arm and frame of the vehicle. As the tire try to move upwards, the springs generates an opposite direction force to resist the motion the motion is stamped by the shock absorber.

Tie rod and spindle are attached using a ball joint. The spindle plays an important role in the front suspension. Not only it does connect to the upper and lower spindle arm and follow for turning of the vehicle, but the components that

allows the wheels to rotate as well as the braking component are attached to the spindle.

III. METHODOLOGY

1. Paper Geometry
2. PTC Creo 2.0
3. Coil Spring and Damper.

(1) Paper Geometry:-

Paper geometry is a process in which the sketch of vehicle is drawn by taking scale factor. In drawing all the dimensions like wheel track, wheel base, ground clearance. All upper and lower wishbone points are put and it is use to check in bump travels

(2) PTC (Parametric Technology Corporation) Creo 2.0:-

PTC Creo formally known as PRO/Engineer, is a 3D CAD/CAMCAE, feature based, associative solid modeling software. It is one of a suite of 10 collaborative application that provide solid modeling. Creo is a family or suite a design software supporting product design for discrete manufactures and is developed by PTC(Parametric Technology Corporation).The suite consist of application each delivering a distinct set of capabilities for a user role within product development.

Assembly modeling 2D orthographic views, finite element analysis, direct and parametric modeling and tooling functionality for mechanical designers. Creo Elements/Pro provides a complete set of design, analysis and manufacturing capabilities on one, integral, scalable platform. These required capabilities include solid modeling, surfacing rendering and tooling design.

Reason To Use Creo Parametric 2.0 For Designing of Macpherson Strut Suspension Are Listed Below:-

1. PTC Creo parametric offers power full, reliable, yet easy to use modeling tools.
2. The software lets you design parts and assemblies, create manufacturing drawing, perform analysis.
3. PTC Creo helps you to design higher quality product faster and allow you to communicate.
4. The capabilities of the product can be split into three main headings i.e. Design, Analysis and Manufacturing.
5. It insures the Subassembly interface.
6. Easy operating software and user friendly.

(3) Coil Spring:-

Coil spring are found on all Macpherson strut suspension. A mounting plate welded to the strut acts as the lower spring seat, while the upper seat is bolted to the strut position rod. The coil spring and strut turn with the motion of the steering wheel by means of a bearing or rubber bushing in the upper mount. As mentioned earlier, modified Macpherson suspension do not have the coil spring mounted on the strut. While this feature does provide a smoother ride under normal driving conditions, and the Macpherson provide smoother, more responsive ride over a wide range of driving conditions.

(4) Damper:-

A shock absorber or damper is a mechanical or hydraulic device designed to absorb and shock damp shock impulse. In a vehicle shock absorber reduce the effect of travelling over rough ground, leading to improved ride quality and vehicle handling. Shock absorber uses valving of oil and gases to absorb excess energy from the spring. Spring based shock absorber commonly use coil spring or leaf spring.

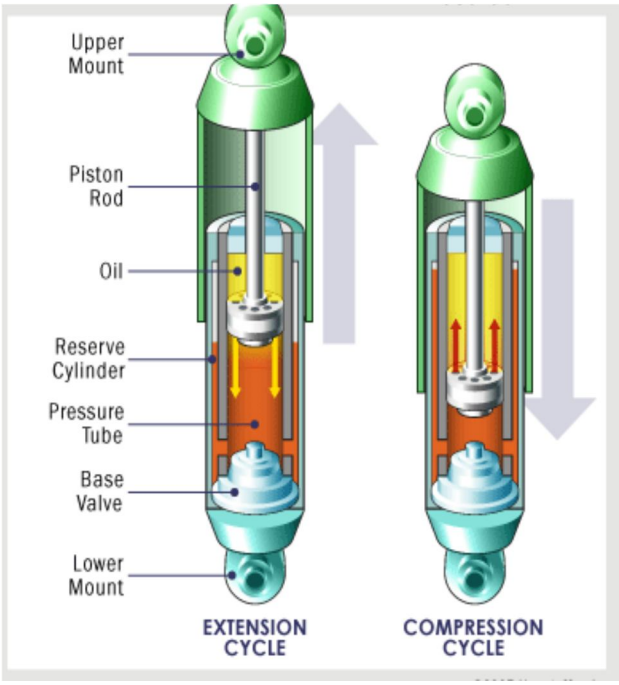

Fig 3.1 Damper On Extension Cycle And Compression Cycle

Without a damper structure a car spring will external and release the energy and it absorb from a dump at an uncontrolled rate. The spring will continue to bounce at its natural frequency until all of the energy originally put into it .A suspension built on spring alone would make for an extermly bouncy ride, depending on the terrain and uncontrolled car.

IV. RESULT OR FINDING

Suspension system use for comfort ride and to absorb the forces which are transformed in the upward direction. It absorb more irregularities of roads with different spring used together. Spring with lower stiffness absorb small irregularities and spring with the higher stiffness with the higher stiffness absorb high bumps of the road or high irregularities of roads. Hence Macpherson suspension system is better than conventional suspension system used in existing car.

The creo software is used to implement a simplified model of Macpherson suspension. With these developed models, the influence of suspension system parameter can be studied on the performance of passenger comfort. For three different types of suspension system, it has been extensively accepted than it is more effective in improving suspension performance than conventional passive and semi active suspension system.

V. CONCLUSION

The most unique feature of Macpherson strut suspension is that all of the component are constrained in a single assembly and the main aims are concentrated to design an independent suspension system to provide better contact of tire with road surface and less lateral displacement of tire. In many cases, suspension system provides a relatively small amount of displacement of wheel, such displacement in other system considered as relatively large.

Macpherson suspension assembly include a component/part named “Strut”, which is the heart of the Macpherson suspension system. Not only do strut look like conventional shock absorber, they also perform the same shock damping function. It also reduce space and weight requirements. Therefore, such suspension system provide good performance and directly effect in improvement life of tire and reduce additional weight in suspension system.

Best ride, handling experience, accurate positioning of the joints are needed also from further comparison we got that the double wishbone has less alteration then Macpherson. But at the time it is more complex than Macpherson, so according to the requirements the suspension system should be use for best ride and handling.

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