

# Modified Suspension of Motorcycle - a review

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## Abstract

This paper is a review on design and modification of suspension in motorcycle. Appropriate suspension is needed for better handling and safety while reducing shock impulse. The commonly used suspension in front of motorcycle is telescopic forks which are replaced by mono suspension. The effects of modified suspension are better ride comfort, quality as well as safety even on rough road. Material of the spring is also important factor which affects the quality of the ride. In motorcycle steering system is connected with the front suspension so careful design is mandatory. In this review work, mono shock absorber and spring suspension are studied in detail.

**Keywords:** *Mono-suspension, shock absorber, damper, modified suspension.*

## 1. Introduction

Suspension of vehicle handles shock impulse and dissipates kinetic energy with the help of shock absorber. Suspension contributes to the vehicle's handling providing safety and comfort by keeping the vehicle's passengers comfortably isolated from bumps, vibration and road noise. Shock absorbers work in two cycles-the compression cycle and the extension cycle. Designers have built suspension system that can provide both rider comfort and high speed performance. While designing suspension of vehicle, quality of product is to be taken in to consideration. Hence, designing vehicle is very crucial because it affects the quality of the ride.

Traditionally telescopic suspension is used in the two-wheeler. Motorcycles with only one shock absorber and helical coil spring over it are called mono shock motorcycles. Dual-shock rear suspension is commonly used in motorcycles. Telescopic forks are replaced by the Mono Shock for better ride comfort. Mono shock provides better handling and steering of vehicle increasing the life of suspension. Whereas in telescopic suspension, there is unequal length distribution while taking turn, this

disadvantage is eliminated in Mono suspension. It also provides safety while braking.

In rear mono shock, a single shock absorber is connected to the rear swing arm to the motorcycle's frame which further connects to the rear wheel. Motorcycle shocks always use a coil-over spring. The spring for the suspension is a coil spring with spring over, or around, Motorcycle rear shock absorbers suspension were invented in with the hope to minimize or reduce the effect that rough roads provide.

## 2. Suspension analysis

The purpose of this literature review is to examine journal articles, research paper, report and web sites to provide an overview of modified suspension, identifying the major challenges in implementing this technique, and examine their use in practical application.

**Lakshmana Kishore.** [1] explained that when shock impulses are damped by shock absorber of suspension system it dissipates Kinetic energy. The shock absorbers obligation is to take up or dissipates energy. The effect of traveling over rough ground is reduced in vehicle, leading to improved ride quality, and increase in comfort due to substantially reduced amplitude of disturbances. Spring is compressed quickly when a vehicle is traveling on a level road and the wheels strike a bump. The spring compressed will return to its normal loaded length and will rebound to its normal height, causing lifted body. The weight of the vehicle will then push the spring down below its normal loaded height. This will cause the spring to rebound again. Until the up-and-down movement finally stops the bouncing process repeated over and over little less each time. Handling of the vehicle would be very difficult and will cause uncomfortable ride, if bouncing is allowed to go uncontrolled. In suspension system design of spring is the most important factor.

**Prince Jerome Christophefer J, Pavendhan R [2]** stated that, Stress and deformation analysis of the helical spring is done. The output of shock absorber differs by varying the diameter of wire of coil spring. Mono suspension is studied with respect to two wheeler vehicle. When the wheel is strike by sudden jerk the spring compresses in reaction. The compressed spring is pulled back to its original dimension or normal length which causes the body to be lifted. Original or normal dimensions are the dimension when the spring is free and no load acts on it. The spring goes down below its normal height when the weight of the vehicle acts on the spring. Due to this strain energy induced in the spring causing it to rebound back. The calculations of the spring dimensions are also done. The bike mass, different loads and number of persons on the two wheelers are being the main concern of the design. Modeling/analysis is done by PRO-E and ansys.

**P.R.Jadhav, N.P Doshi, U. D. Gulhane [3]** explained that, Most commonly used element in suspension system is helical spring which is used to maintain a force between contacting surface. The function of helical spring is to distort or deflect of elastic member under the action of applied load. When load is released it retains its original shape. Along the axis of helix, load is being applied and is made of coiled wire into helical form. When load is applied at both the ends, main property of helical spring is to act in tension or in compression reducing the effect of shock and vibrations in vehicle and machine foundation is the important application of helical compression spring. Forces are also measured with the help of spring. Mono suspension is been analysed by using FE analysis and analytical validated with varying speed.

**A.V.Lade, R.V.Paropate, A.M. Choube [4]** suggested that, different material can be used for suspension. Yield stress and Poisson's ratio of different material are calculated. Shock absorber absorbs and dissipates energy, this has been taken into consideration while designing shock absorber. The helical spring with other material such as carbon steel and brass are considered for suspension. F.E method is used for the analysis of helical spring. Deflection and shear stress of these different metals are compared using the Analytical and F.E method.

**Shetty Thrivent, G. Ranjith Kumar, and Dr. G. Harinath Gowd [5]** explained that, the optimal spring dimension is obtained without affecting the riding comfort for mono suspension system. The strength of existing spring of HONDA CB Unicorn and Yamaha FZ spring is

been tested by compression test. An analysis of this spring is done using ANSYS. Therefore implied dimension will be obtained. Modified dimensions reduces amplitude of disturbances up to great extent. It also improves quality of ride as well as comfort while traveling on rough ground.

**Prof. D. K. Chavan, Sachin V. Margaje, Priyanka A. Chinchorkar. [6]** States that, Shock absorber is necessary to prevent bouncing ride. Now a day's Mono shock absorber is used in the rear of bike. -There are various type of shock absorbers which are analyzed individually. Air Shock Absorber, Damper Shock Absorber, Twin Tube Shock Absorber and Spring Shock Absorber are the various shock dampers given in detail. Positioning suspension is close to center of gravity. Besides advantage, disadvantage and application of mono suspension is given in brief. It provides a smooth comfortable ride absorbing bumps and imperfections in the road as the wheels roll over bumps.

**Krzystof Michalczyk. [7]** Explained new method of calculation of change of axial twisting angle of compressed helical spring's end-coils. Derivation of formulas using the Castigliano rule is done. These formulas can be applied only for Clapeyron systems. The calculations are experimentally verified. Angle of mutual rotation of spring's end-coils is calculatated. The stiffness of spring is influenced by the shape of end coils. The susceptibility to buckling is influenced by the way in which the spring ends coils. The calculation of the axial twisting angle and change of statically-compressed helical spring is done.

**P. S. Valsange. [8]** In this, author discusses the basic concerns such as fatigue loading, spring stability, spring surge, strain energy, spring relaxation and design procedures of helical coil spring in addition to stress distribution. There is also study on fundamental stress distribution and characteristics of helical spring. Material selection of spring and taking the square cross section of the material from helical spring is studied in much detail. F.E method and ANSYS analysis is done on the spring material. Automobile industry needs reduction of weight which is also a prime concern. Thus high stresses with small dimensions are kept in mind, while designing the springs.

**Karthik Dhayakar. [9]** States that, Compression and expansion cycle works on the principle of fluid displacement, which is used as working principle for shock absorber. Shock absorber which is manufactured to reduce the shock impulse of the vehicle which is the main part of the vehicle suspension system. Prompt braking, safety, better handling and comfort is obtained in motorcycle with

the help of shock absorber. This is use to keep away the passenger from road bumps, vibrations and noise. Mono shocks which provides safety while braking and superior vehicle handling is used instead of telescopic fork in front suspension of motorcycle. By using mass centralization concept in the pivoted center point of front suspension in motorcycle using mono shock an uneven vibration of telescopic fork have been balanced. The front suspension design using mass centralized concept, the presence of telescopic forks may obsolete. Better control over the machine while riding is obtained with the help of mono shocks which also allows the rider to fine tune the machine. Many practical conditions such as road tracks, aerodynamic properties and dynamic resistance are considered while designing springs for mono shock. Rising rate of damping characteristic to the front suspension is given by mono shock geometry and is restricted by the downgraded dynamics when it returns to immobility state posterior to bumps and humps with the help of designed spring.

**Niranjan Singh. [10]** The objective of this research paper fatigue stress analysis of the spring used in automobile. Spring is an elastic body that can be pulled, stretched or twisted by relatively many force. Elastic object such as spring is used to store the mechanical energy. As the force is released it returns to its original shape. As it is a pliant element it is used to store energy, exert torque and exert force at the same time. All the elements of the suspension system provide the connection between vehicle body and tyre. Like rubber band around roll of drawing, linear push force or pulls force or radial is similarly acted on it. Actions and activities assigned to automobile suspension systems are to set apart the occupants and structure from vibrations and shocks generated by the road surface. Rotational effect can be produced with the help of torque. Analysis of the springs is done with the help of Numerical Experimental and Theoretical methods but best method is finite element method for analysis and calculating of shear stress springs, lifecycle and fatigue stress.

**Basileios Mavroudakos, Peter Eberhard [11]** explain that, Alternative for front suspension system is to replace telescopic suspension with tests. The main changes among the recommended design are related to direct and indirect linkages among hub-steering between handle bars and steering system. The four design variations are Hossack system, Bimota Tesi, James Parker layout and Battle of the Twins series. This four design variations are tested and studied. Five frame and rear suspension are also described. Simulations results are also provided.

## 4. Conclusions

- The results for present spring design and modified spring design, the value of stress and displacement is less for modified design. As per analysis it is concluded that using steel for spring is best and design modified is safe.[1]
- By reducing diameter shock absorber design is modified and test is been performed for stress analysis. The weight of the modified spring is reduced and provided with safety.[2]
- It is observed that in mono suspension increase in speed leads to increase in deflection. And on other hand leads to decrease in shear stress.[3]
- With the same shear stress for both carbon steel and brass ,it is observed that deflection for carbon steel is lower and deflection for brass is maximum.[4]
- To achieve the overall weight reduction of the automobile without affecting the riding comfort of the two-wheeler suspension investigation is to be made on different alternative materials.[5]
- Comparatively Performance of mono suspension is vastly superior then twin suspension motorcycle.[6]
- The result calculated experimentally and with help of formula for reducing simplifying assumptions gave results even more distant from experiment results than calculated with formula however the assumptions proved wrong.[7]
- Stresses on inside coil surface reduces if It the inner side of the coil spring is that needed and increases fatigue life of coil spring.[8]
- Modified suspension lead to weight reduction and is proved to be safe.[9]
- For getting better and comfortable ride in future, it will help the designers for predicting the safe design of mechanical springs used in the automobiles .[10]
- The design layout depicted in design seems to combine desirable characteristics to a higher degree while judging kinematically and dynamically than the other validated designs.[11]

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## BIOGRAPHIES

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