A Review of an Experimental and Theoretical Analysis & Modification of Bajaj Discover 150cc

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Abstract— A suspension system or shock absorber is a mechanical device designed to smooth out or damp shock impulse, and dissipate kinetic energy. The shock absorbers duty is to absorb or dissipate energy and the helical spring is the most common element that has been used in suspension system. In this present study Non alloy steel helical spring will be used to suspend vehicle system. The uniform loading effect has been studied and Experimental, FEA analysis will be compared with analytical solution. Afterwards, the analysis will be done by considering different parameters. Experimental analysis will be done to validate the strength and modal analysis is done to determine the displacements for different loading condition. Comparison is done by changing the wire diameter of the coil spring to check the best dimension for the spring in shock absorber. Modeling and Analysis is done by using Pro/ENGINEER and ANSYS respectively.

Key words: Bajaj Discover 150cc, Theoretical Analysis & Modification of Bajaj Discover 150cc

I. INTRODUCTION

The shock absorber is a mechanical device designed to smooth out or damp shock impulse, and dissipate kinetic energy. The Pneumatic and hydraulic shock absorbers constructions in the form of a cylinder and sliding piston. The cylinder is filled with a fluid (such as hydraulic fluid) or air. This fluid-filled piston/cylinder combination is known as a dashpot. In most dashpots, energy is converted to heat inside the viscous fluid or air. In hydraulic cylinders, the hydraulic fluid will be heated, while in air cylinders the temperature will increase and hot air is available and same will be exhausted to the atmosphere subsequently. While the dashpot with electromagnetic coil the dissipated energy can be stored and utilized later. In general terms, shock absorbers help to reduce shocks and impulses.

When a vehicle is travelling on a level road and the wheels strike a bump, the spring is compressed quickly. The compressed spring will attempt to return to its normal loaded length and, in so doing, will rebound past its normal height, causing the body to be lifted. The weight of the vehicle will then push the spring down below its normal loaded height. This, in turn, causes the spring to rebound again. This bouncing process is repeated over and over, a little less each time, until the up-and-down movement finally stops. If bouncing is allowed to go uncontrolled, it will not only cause an uncomfortable ride but will make handling of the vehicle very difficult. The design of spring in suspension system is very important.

II. LITERATURE REVIEW

A few papers where discussed about the different types of mechanical springs used in the suspension system of automobiles. Also the different modes of spring failure and modifications were developed and validating the procedures for predicting the fatigue stress analysis.

Prince Jerome Christopher.J, Pavendhan. R, "Design and Analysis of Two Wheeler Shock Absorber Coil Spring" have conclude that the reducing diameter of the shock absorber and stress analysis, therefore the stress value is lesser in our designed spring than in original, this is advantage the design.

The helical spring is used for Shock absorber and which is one of the Suspension systems is designed automatically to handle shock impulse and dissipate kinetic energy. It reduces the amplitude of turbulence principal to increase in comfort and improved ride quality. Hence, the designing of spring in a suspension system is very critical. Design in an important industrial activity which influences the quality of the product. The Shock absorber coil spring is designed by using the modeling software Pro/ENGINEER. In modeling the time is spent in drawing the coil spring model and the danger concerned in design and manufacturing process can be easily minimized. So the modeling of the coil spring is made by using Pro/ENGINEER. Later this Pro/ENGINEER model is imported to ANSYS for the analysis work. The ANSYS software is used for analyzing the component by varying the load applied on it and the results are observed. A solver mode in ANSYS software calculates the stresses and their relation without manual interventions thereby reducing the time compared with the manual theoretical work[1].

Achyut P. Banginwar, Nitin D. Bhusale, Kautuk V. Totawar, "Design and analysis of shock absorber using FEA tool", have conclude that the results for both materials, the total deformation value is less for Spring Steel than Phosphor Bronze. So stiffness is more for Spring Steel.

In this paper discussed that the shock absorber is designed and a 3D model is created using Pro/Engineer. Structural analysis and modal analysis are done on the shock absorber by varying material for spring, Spring Steel and Phosphor Bronze . Structural analysis is done to validate the strength and modal analysis is done to determine the displacements for different frequencies for number of modes. Comparison is done for two materials to verify best material for spring in Shock absorber[2].

Vidhyadhar P.Kshirsagar, "Design, Modelling And Analysis For Experimental Investigation Of Double Spring Damper Shock Absorber Performance", have concluded that the vibration transmissibility from the rough road to the vehicle's body for all these suspensions was determined under the constraint that damping varies opposed to the excitation frequency which evaluate simulation of shock absorber velocity and displacement. Then, the optimal damping and stiffness ratios were decided in order to minimize the transmissibility of vibration from the rough pavement to the vehicle's body with sinusoidal test in

simulation to maximize the vehicle's ride comfort with double spring damper shock absorber[3].

Setty Thriveni, "Design Evaluation & Optimization of a Two-Wheeler Suspension System", have conclude that the shear stress equation was used for calculating the maximum stress induced in the spring. Comparison had made for theoretical results obtained from the shear stress equation to the Finite Element Analysis (FEA) results. In both the cases the analysis results gives the better results than the existing one. By these FEA result was give the better accuracy. There is a chance for Investigations to be made on different alternate available suitable materials to achieve the overall weight reduction of the automobile without affecting the riding comfort of the two-wheeler suspension[4].

S. S. Gaikwad, "Static Analysis of Helical Compression Spring Used in Two-Wheeler Horn", have conclude that the maximum safe pay load for the given specification of the helical compression spring was 4 N. At lower loads both theoretical and NASTRAN results are very close, but when load increases the NASTRAN results are uniformly reduced compared to theoretical results.

In this project first he analyse the existing spring along with dimension and he took the suitable material as per requirement(spring steel).then he complete the Static analysis of the safe stress and corresponding pay load of the helical compression spring. This work describes static analysis of the helical compression spring is performed using NASTRAN solver and compared with analytical results. The pre processing of the spring model was done by using HYPERMESH software[5].

Mr. Sudarshan Martande, "Design and Analysis of Shock Absorber", have conclude that the Percentage error in analytical results and ANSYS results are within 15%. This error occurs due to various reasons.

In this project a shock absorber is designed and a 3D model is created using any one designing software. The model is choose from the existing spring. Structural analysis and modal analysis were done on the shock absorber by varying material for spring, Spring Steel and other. The analysis is done by considering load and boundary conditions. Structural analysis were done to validate the strength and modal analysis was done to determine The different stress and deflection values in shock absorber components were obtained using FEA tools and compared with analytical solutions. Percentage error is calculated and it is found that percentage error is less than 15%.Various stress results are below allowable limits of material. Error in FE and analytical results occurs because of various reasons such as assumptions in analytical formulation, approximations in FE formulations, choice of element in FE analysis[6].

D.V. Dodiya, &. D.U. Panchal, "Static analysis of leading arm in suspensions system with horizontal shock absorbers", have that conclude that the work attempt was made to analyze a leading arm in a horizontally oriented spring damper assembly and the geometric and space and force requirements were studied to improve road handling abilities. The leading arm had been incorporated which essentially transmits the road undulations to the suspension shock absorber with the help of an arm which was robustly built and designed and its analysis had been carried out with ANSYS. The suspension system of the front wheels has a steering system to accommodate[7]

Gajendra Singh Rathore, "Fatigue Stress Analysis Of Helical Compression Spring",have conclude that the spring undergo the fluctuating loading over the service life. FEM software used for performing meshing simulation. And the fatigue stress, shear stress calculation play more significant role in the design of helical compression spring. This study was shown that shear stress and deflection equation is used for calculating the number of active turns and mean diameter in helical compression spring. Comparison of the theoretical obtained result by the shear stress equation to the Finite Element Analysis result of helical compression spring.

In this paper the research methodology such as Theoretical, Numerical and Experimental. Researchers employ the Theoretical, Numerical and FEM methods and after completed the study concludes Finite Element method is the best method for numerical solution and calculating the fatigue stress, life cycle and shear stress of helical compression spring[8].

B. Pytte, "Fatigue behaviour of helical compression springs at a very high number of cycles–Investigation of various influences", have conclude that the long-term fatigue tests on shot peened helical compression springs were conducted by means of a special spring fatigue testing machine at 40Hz. Test springs were made of three different spring materials- oil hardened and tempered SiCr- and SiCrV-alloyed valve spring steel and stainless steel up to 500 spring with a wire diameter of d = 3.0 mm or 900 spring with d = 1.6 mm were tested at different stress levels. Method to be used experimental procedure the VHCF-test on different wire diameter of spring. The paper includes a comparison of the result of the different spring sizes, materials, number of cycles and shot peening conditions and outlines further investigations in the VHCF-region[9].

Niranjan Singh, "General Review Of Mechanical Springs Used automobiles Suspension System", have conclude that the shear stress and deflection equation is used for calculating the number of active turns and mean diameter in helical compression springs. Comparison of the theoretical results obtained by the shear stress equation and Finite Element Analysis (FEM) of springs provides the better solution of the problems arises in the existing design of the mechanical spring[10].

III. AIM AND OBJECTIVES

Aim this project a shock absorber is to design and a 3D model will be create using Pro/Engineer. The model will tested for design parameters of the spring and Analytical calculation and modal analysis will be done on the shock absorber by Spring Steel and Non Alloy steel (IS 4454 PART-1 1981 GRADE-2).The analysis will be done by considering rider loads (one & two person). The necessary strength and modal analysis will be done to determine the deflection for different load for verity of modes. The final selection will be done by comparing the analysis. Modelling will be done using Pro/ENGINEER and analysis with the help of ANSYS software.

A. Objectives

To study briefly about the Alloy steel(IS 4454 PART-1 1981 GRADE-2) used in shock absorber spring.

- To select the designing parameter and calculate the stress along with the deflection and weight optimization.
- To prepare the model in Pro-E.
- Import the Pro-E model in Ansys and analysis of stress and deflection and to compare the same with existing shock absorber helical compression spring.
- Final step is to prepare experimental model according to research carried out in the previous steps.

IV. Conclusion

In this study, the shock absorber has been redesigned so that the stress acting on the shock absorber is reduced. The proposed redesign will reduce the deformation and induced stress magnitude for the same applied loading conditions when compared with the existing design. This in turn increases the life of the shock absorber by reducing its failures. The analytical results conform to the simulation results from the ANSYS.

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