Design and Analysis of Shock Absorber by Using Beryllium Copper

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***Abstract*- The vehicles problem happens while driving on bumping road condition. The objective of this project is to modify the design and analysis of Shock absorber by varying the wire diameter of the coil spring. The Shock absorber which is one of the Suspension systems is designed mechanically to handle shock impulse and dissipate kinetic energy. The spring will be compressed quickly when the wheel strikes the bump. The compressed spring rebound to its normal dimension or normal loaded length which causes the body to be lifted. The spring goes down below its normal height when the weight of the vehicle pushes the spring down. This, in turn, causes the spring to rebound again. The spring bouncing process occurs over and over every less each time, until the up and down movement finally to stops. The vehicle handle becomes very much difficult and leads to its uncomfortable for ride when bouncing is allowed uncontrolled. The designing of spring in a suspension system is a very crucial. The analysis can be done by considering bike loads, and no of persons seated on bike. Comparison is done by various spring materials of shock absorber. The Modeling and Analysis is done using CATIA and ANSYS respectively.**

***Index terms*- Spring, Spring steel, Phosphor Bronze, Beryllium copper, Piston.**

I.INTRODUCTION

A shock absorber is a mechanical device designed to smooth out or damp shock impulse, and dissipate kinetic energy, which is a type of dashpot. Spring-based shock absorbers commonly use coil springs or leaf springs, though torsion bars are used in torsional shocks as well. Ideal springs alone, however, are not shock absorbers, as springs only store and do not dissipate or absorb energy. Vehicles typically employ both hydraulic shock absorbers and springs or torsion bars. In this combination, "shock absorber" refers specifically to the hydraulic piston that absorbs and dissipates vibration. Pneumatic and hydraulic shock absorbers include cushions and springs. An automobile shock absorber contains spring-loaded check valves and orifices to control the flow of oil through an internal piston.

A safe vehicle must be able to stop and maneuver over a wide range of road conditions. Good contact between the tires and the road will able to stop and maneuver quickly Suspension is the term given to the system of springs, shock absorbers and linkages that connects a vehicle to its wheels. Shock absorber is an important part of automotive suspension system which has an effect on ride characteristics. Shock absorbers are also critical for tire to road contact which to reduce the tendency of a tire to lift off the road. Some people use shocks to modify spring rates but this is not the correct use. Spring-based shock absorbers commonly use coil springs or leaf springs, though torsion bars are used in torsional shocks as well. Ideal springs alone, however, are not shock absorbers, as springs only store and do not dissipate or absorb energy. In this combination, "shock absorber" refers specifically to the hydraulic piston that absorbs and dissipates vibration.

II. SHOCK ABSORBER

A shock absorber is a mechanical or hydraulic device designed to absorb and damp shock impulses. It does this by converting the kinetic energy of the shock into another form of energy which is then dissipated. Most shock absorbers are a form of dashpot. Spring-based shock absorbers commonly use coil springs or leaf springs, though torsion bars are used in torsional shocks as well. Vehicles typically employ both hydraulic shock absorbers and springs or torsion bars. In this combination, "shock absorber" refers specifically to the hydraulic piston that absorbs and dissipates vibration.

Fig.1.Shock Absorber

A. Metal Spring

Simply locating metal springs to absorb the impact loads are a low cost method of reducing the collision speed and reducing the shock loading. They are able to operate in very arduous conditions under a wide range of temperatures. There are a number of different types of metal springs including helical springs, Bellville washers (cone-springs), leaf springs, ring springs, mesh springs etc. Each spring type has its own operating characteristics.

Fig.2. Metal Spring

B. Compensating Hydraulic

These devices are similar to the hydraulic dashpot type except that a number of orifices are provided allowing different degrees of restriction throughout the stroke.

Fig.3.Compensating Hydraulic

III. METHODOLOGY USED IN SHOCK ABSORER

In this project a shock absorber is designed and a 3D model is created using CATIA. Modeling is done in CATIA and analysis is done in ANSYS. The model is also changed by changing the thickness of the spring. Structural analysis are done on the shock absorber by varying material for spring, spring steel, phosphor bronze and Beryllium Copper.

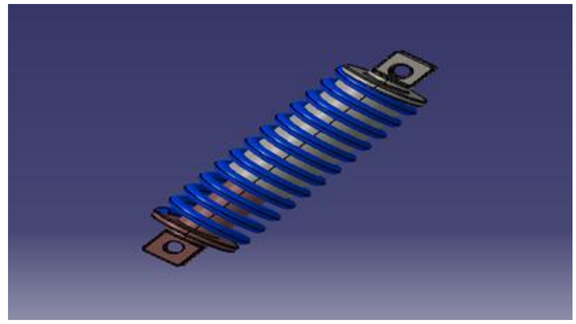

Fig.4.Design Model of Shock Absorber in 3D

IV. INTRODUCTION TO FEA

Finite Element Analysis (FEA) was first developed in 1943 by R. Courant, who utilized the Ritz method of numerical analysis and minimization of variational calculus to obtain approximate solutions to vibration systems. Shortly thereafter, a paper published in 1956 by M. J. Turner, R. W. Clough, H. C. Martin, and L. J. Topp established a broader definition of numerical analysis. The paper centered on the "stiffness and deflection of complex structures".

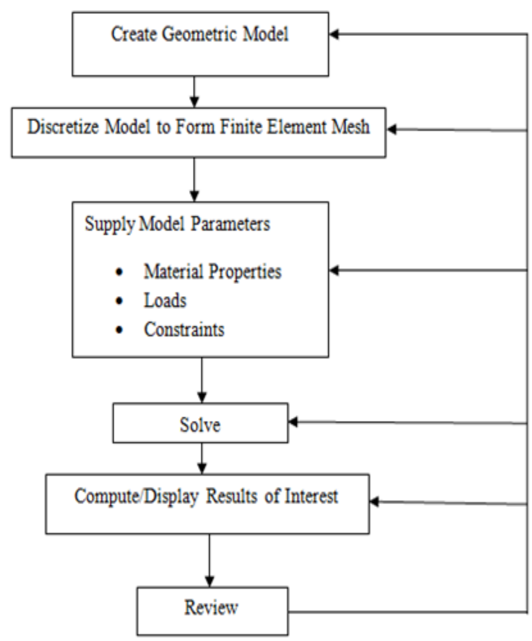

Fig.5.Steps involved in FEA solution

FEA has become a solution to the task of predicting failure due to unknown stresses by showing problem areas in a material and allowing designers to see all of the theoretical stresses within. This method of product design and testing is far superior to the manufacturing costs which would accrue if each sample was actually built and tested. In practice, a finite element analysis usually consists of three principal steps.

- Preprocessing
- Analysis
- Post processing

V. INTRODUCTION TO ANSYS

ANSYS is general-purpose finite element analysis (FEA) software package. Finite Element Analysis is a numerical method of deconstructing a complex system into very small pieces called elements. This type of analysis is typically used for the design and optimization of a system far too complex to analyze by hand. Systems that may fit into this category are too complex due to their geometry, scale, or governing equations.

ANSYS is the standard FEA teaching tool within the Mechanical Engineering Department at many colleges. This type of product development is termed virtual prototyping. With virtual prototyping techniques, users can iterate various scenarios to optimize the product long before the manufacturing is started. The multifaceted nature of ANSYS also provides a means to ensure that users are able to see the effect of a design on the whole behavior of the product, be it electromagnetic, thermal, mechanical etc.

VI. RESULTS AND DISCUSSION

The static structural consists of six steps 1. Engineering data 2. Geometry 3. Model 4. Setup 5. Solution 6. Results. The first step is engineering data that is apply the material properties and select the material Phosphor Bronze then the next step is geometry, now import the new geometry of shock absorber. The load applied in the model was 4500N. After the model imported then the model was meshed.

1. ANALYSIS OF SHOCK ASORER BY USING SPRING STEEL

Material used : Spring Steel
Density : 7800 kg/m3
Young’s modulus: 2.1x105 N/mm2
Poisson ratio : 0.313

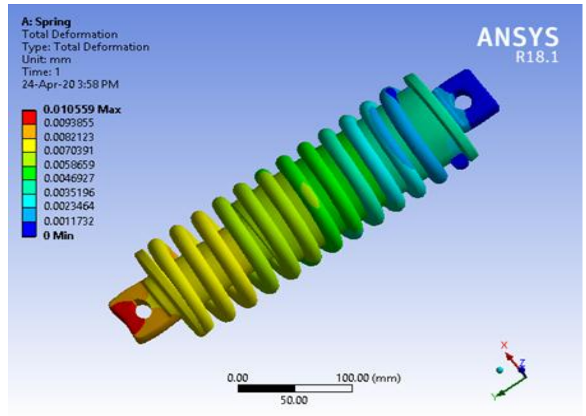

Fig.6.Total Deformation

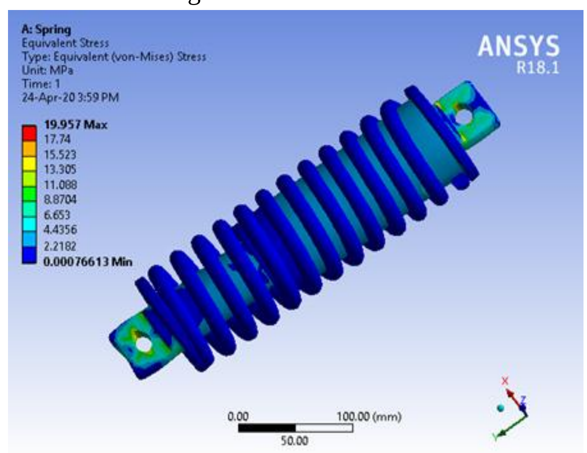

Fig.7.Equivalent Stress

2. ANALYSIS OF SHOCK ASORER BY USING PHOSPHOR BRONZE

Material used : Phosphor Bronze
Density : 8860 kg/m3
Young’s modulus: 1.1x105 N/mm2
Poisson ratio : 0.341

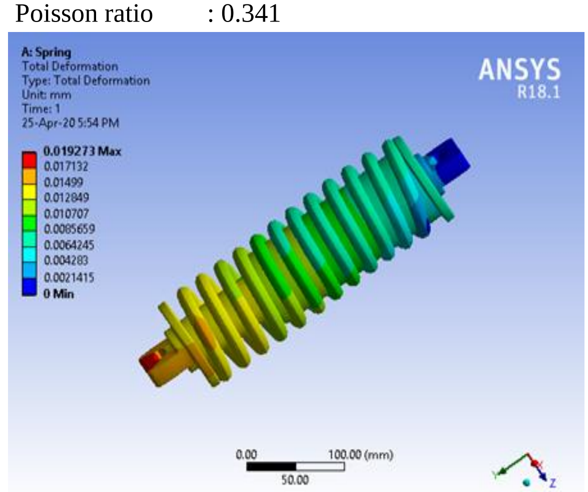

Fig.8.Total Deformation

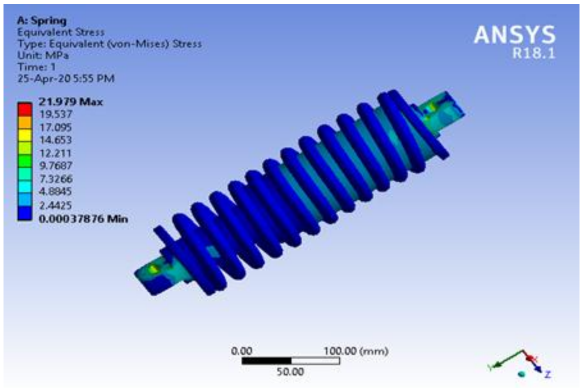

Fig.9.Equivalent Stress

3. ANALYSIS OF SHOCK ASORER BY USING BERYLLIUM COPPER

Material used : Beryllium Copper
Density : 8250 kg/m3
Young's modulus: 1.9x105 N/mm2
Poisson ratio : 0.30

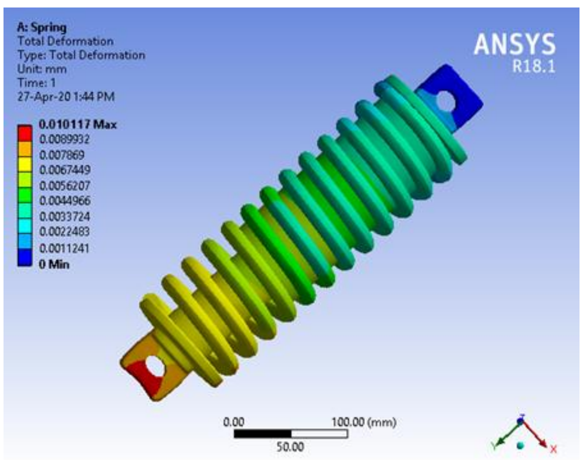

Fig.10.Total Deformation

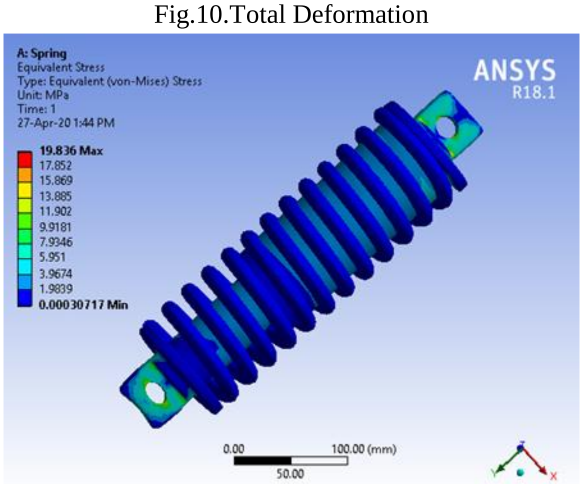

Fig.11.Equivalent Stress

Table 1 Results comparison of spring material

S. No	Parameters	Spring steel	Phosphor bronze	Beryllium copper
1	Deformation (mm)	0.010559	0.019273	0.010117
2	Equivalent elastic stress (N/mm^2)	19.957	21.979	19.836

VII. CONCLUSION

Comparison of above three materials we concluded that,

- To validate the strength of our design, we have done structural analysis on the shock absorber. We have done analysis by varying spring materials such as Spring Steel, Phosphor bronze and Beryllium Copper.
- By observing the analysis results, the analyzed stress values are less than their respective yield stress values. So our design is safe.
- By comparing the results for these materials, the stress and deformation value is less for Beryllium Copper than the other two materials.
- Also the shock absorber design is modified by reducing the diameter of spring by 2mm and structural analysis is done on the shock absorber. By reducing the diameter, the weight of the spring reduces.
- So we can conclude that as per our analysis using material beryllium copper for spring is best.

VIII. ACKNOWLEDGMENT

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