Design and Analysis of Shock Absorber

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Abstract :In vehicles problem happens while driving on bumping road condition. The objective of this project is to design and analyze the performance 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. It reduces the amplitude of disturbances leading to increase in comfort and improved ride quality. The spring is 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 stops. The vehicle handling becomes very difficult and leads to uncomfortable ride when bouncing is allowed uncontrolled. Hence, the designing of spring in a suspension system is very crucial. The analysis is done by considering bike mass, loads, and no of persons seated on bike. Comparison is done by varying the material and diameter of the coil spring to verify the best dimension for the spring in shock absorber. Modeling and Analysis is done using CATIA and ANSYS respectively.

I. INTRODUCTION

A shock absorber (in reality, a shock "damper") 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 (typically heat) which is then dissipated. Most shockups are a form of dashpot.In a vehicle, shock absorbers reduce the effect of traveling over rough ground, leading to improved ride quality and vehicle handling. While shock absorbers serve the purpose of limiting excessive suspension movement, their intended sole purpose is to damp spring oscillations.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. Now composite suspension system are used mainly in 2 wheelers.

II. DESIGN AND MODELLING

The present study is to design shock absorber for two wheelers by changing the material and dimensions of the helical spring accordingly to it.

Materials.	**Young's Modulus. (Gpa)**	**Poisson Ratio.**	**Density. (Kg/m^3)**
Carbon Fibre	33 msi (228 Gpa)	0.26-0.28	1750-1950
Beryllium Copper	128 Gpa	0.30	8100-8250

Table1. Shows the properties of the materials used for the shock absorber.

III. SHOCK ABSORBER DESIGN:

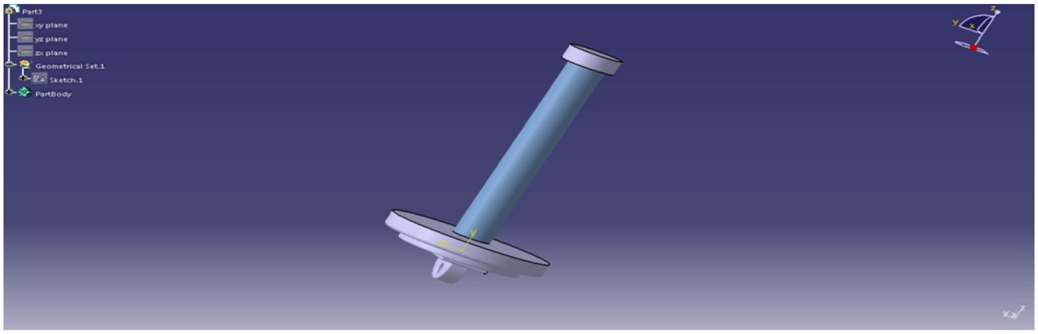

Fig 1. Lower part of the Shock Absorber.

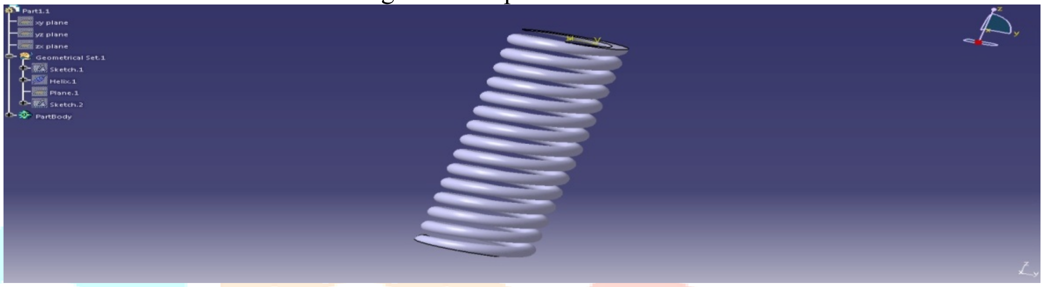

Fig 2. Spring of the Shock Absorber.

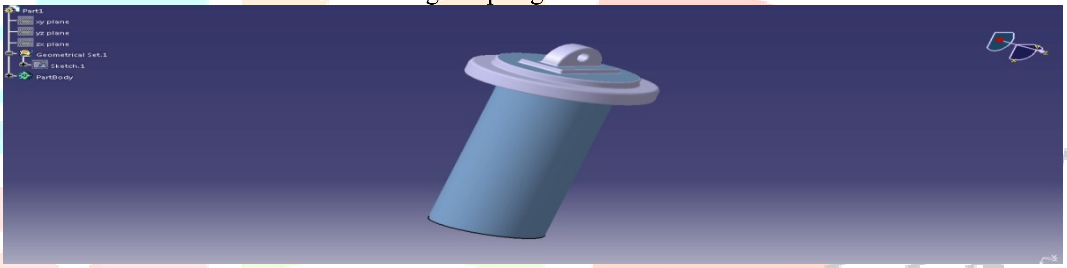

Fig 3. Upper part of the Shock Absorber

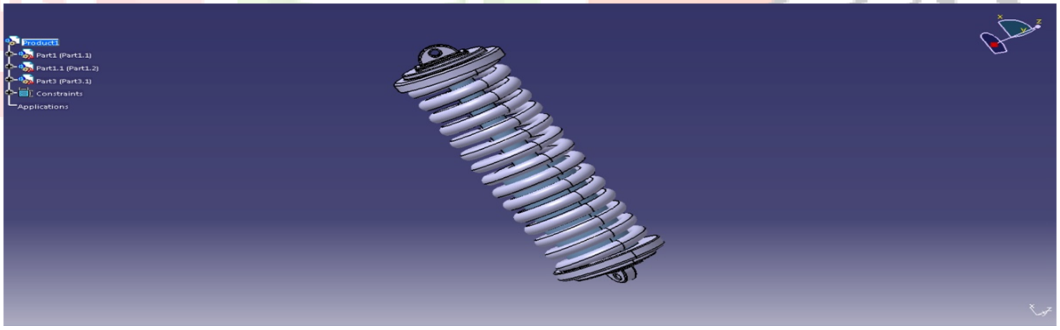

Fig 4. Assembly of the Shock Absorber.

IV. SHOCK ABSORBER MODELLING:

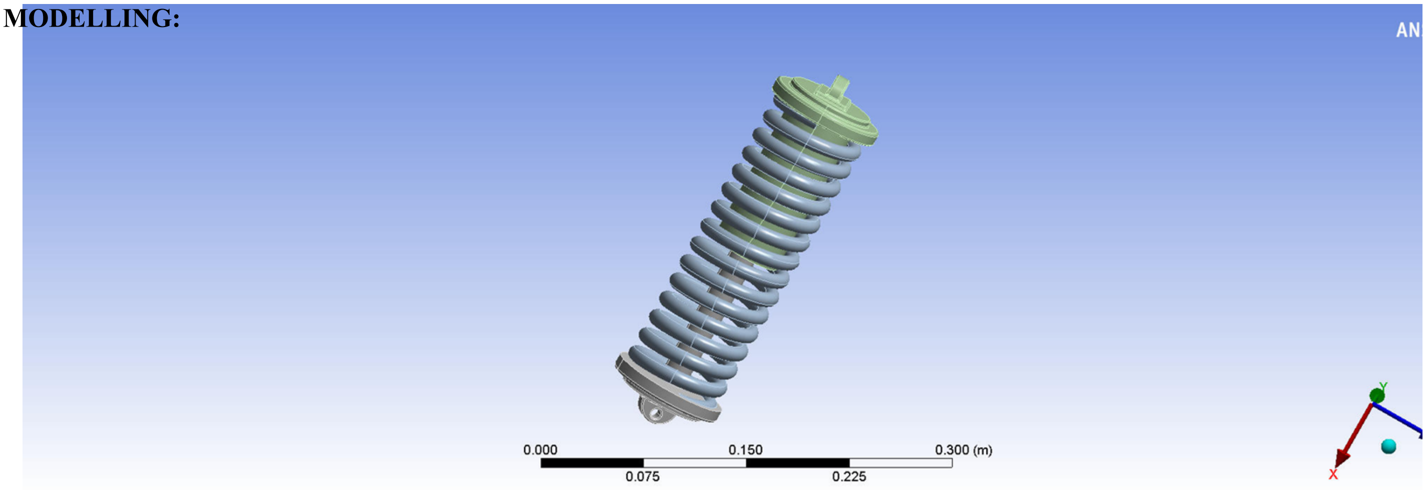

Fig 5. Assembled Model.

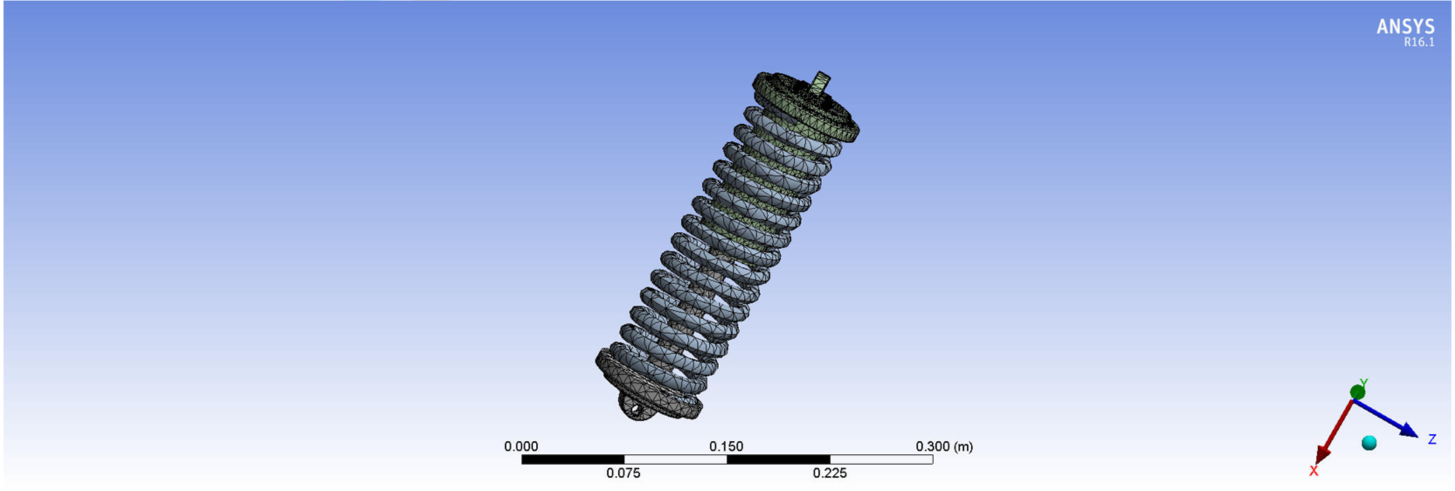

Fig 6. Meshed Model.

V. FINITE ELEMENTANALYSIS

The method yields approximate values of the unknowns at discrete number of points over the domain. To solve the problem, it subdivides a large problem into smaller, simpler parts that are called finite elements. The simple equations that model these finite elements are then assembled into a larger system of equations that models the entire problem.FEM then uses variational methods from the calculus of variations to approximate a solution by minimizing an associated error function. FEA is a good choice for analyzing problems over complicated domains, when the domain changes, when the desired precision varies over the entire domain or when the solution lacks smoothness.FEA simulations provide a valuable resources as they remove multiple instances of creation and testing of hard prototypes for various high fidelity situations.

VI. RESULTS AND DISCCUSSION: ANALYSIS:

In this analysis the behavior of the system or process is unchanging with stress and strain deflections. The parameters used for analysis is set at pre-determined standard values . We used five different diameters and two different materials to analyse the Shock absorber

ANALYSIS OF SHOCK ABSORBER USING CARBON FIBRE:

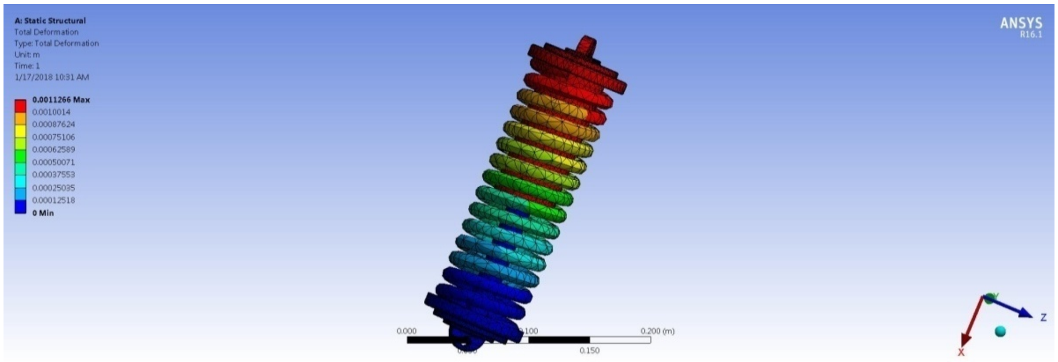

Fig 7. Total deformation of the Shock Absorber.

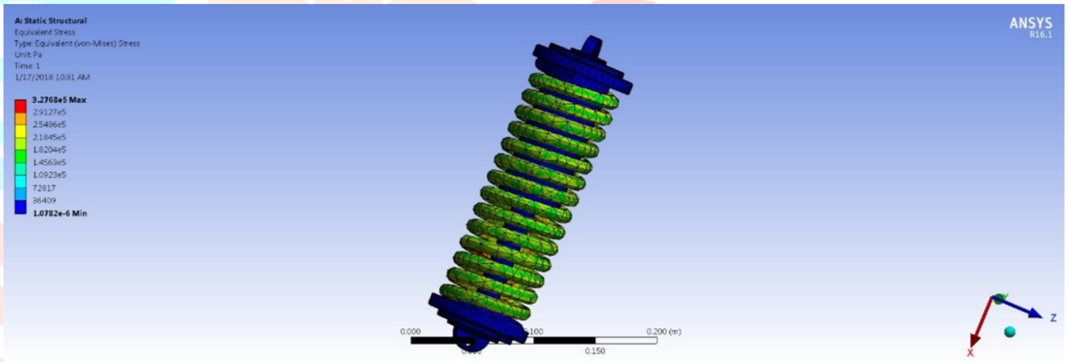

Fig 8. Equivalent Stress acting in Shock Absorber.

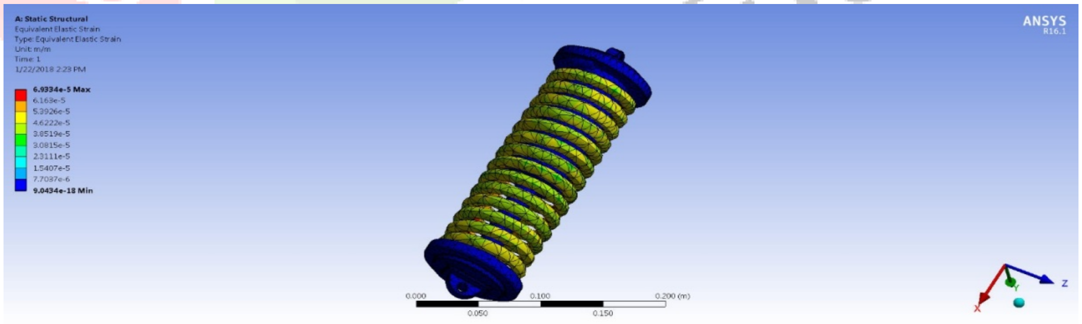

Fig 9. Equivalent Elastic Strain acting in Shock Absorber.

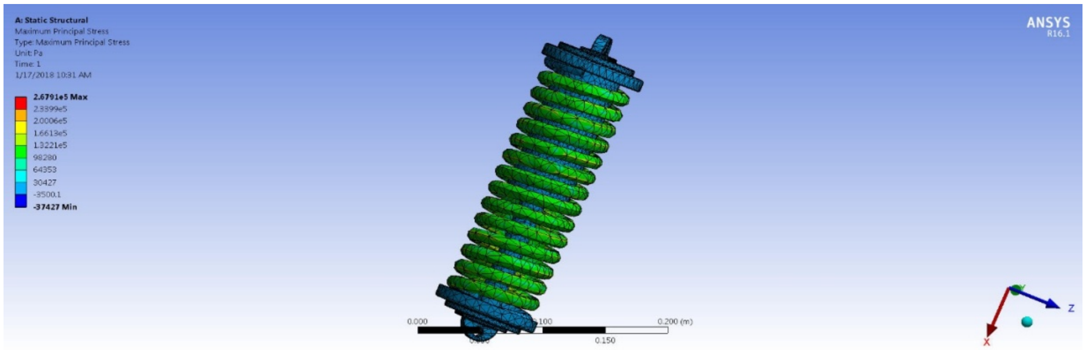

Fig 10. Maximum Stress acting in Shock Absorber.

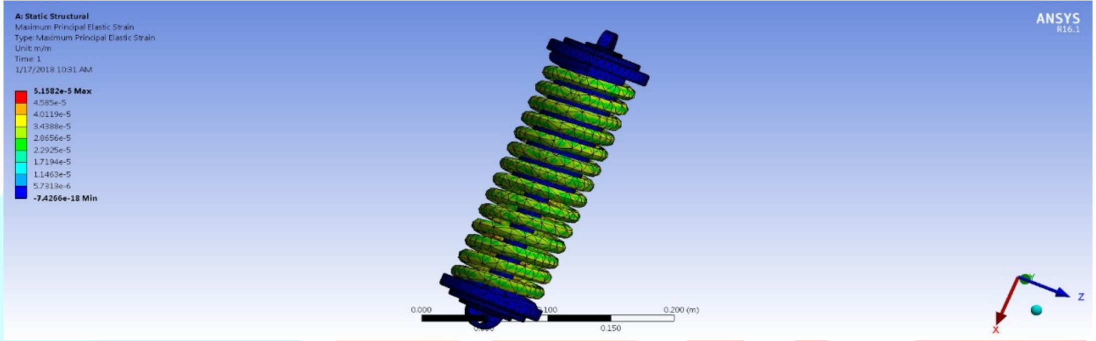

Fig 11. Maximum Strain acting in Shock Absorber.

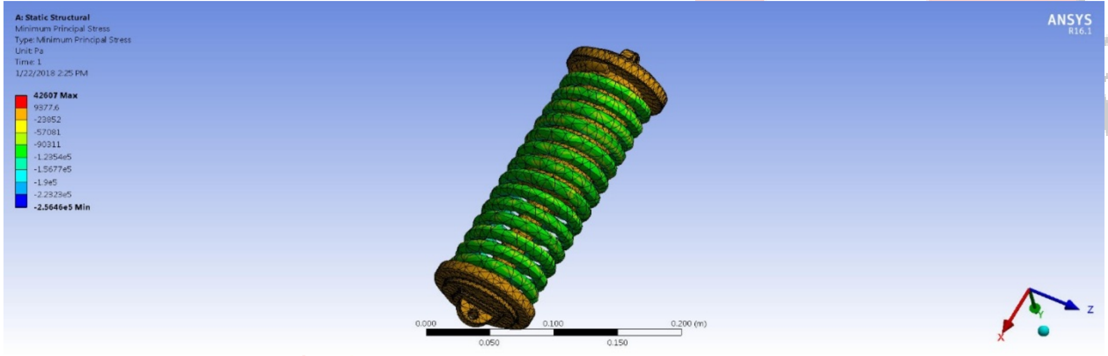

Fig 12.Minimum Principal Stress acting in shock Absorber.

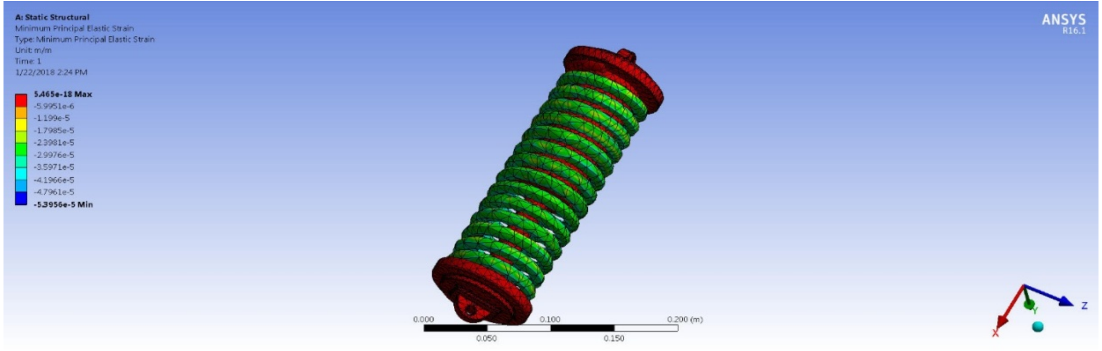

Fig 13.Minimum Principal Elastic Strain acting in shock Absorber.

S.NO	DIAMETER (mm)	STRESS		STRAIN	
		MINIMUM	MAXIMUM	MINIMUM	MAXIMUM
1	10.9	1.0782e-6	3.2768e5	9.0434e-18	6.9334e-5
2	11.2	1235.7	5.2883e5	2.4882e-7	0.00010763
3	11.4	1182.3	4.7892e5	2.4033e-7	9.794e-5
4	11.6	1081.4	4.5751e5	2.42e-7	9.4869e-5
5	11.8	1039.5	4.328e5	9.9343e-6	8.7578e-5

Table 2.Stress and Strain values using Carbon

Fibre. ANALYSIS OF SHOCK ABSORBER USING BERYLLIUM COPPER:

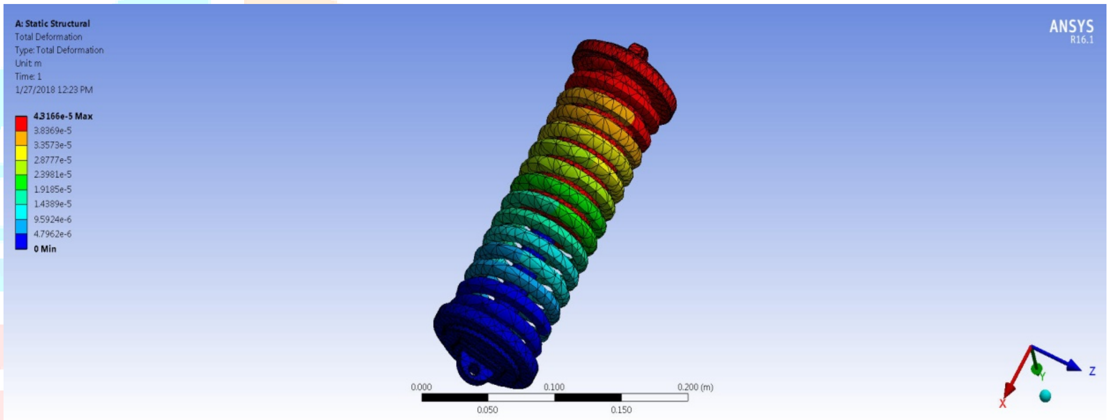

Fig 14. Total deformation of the Shock Absorber.

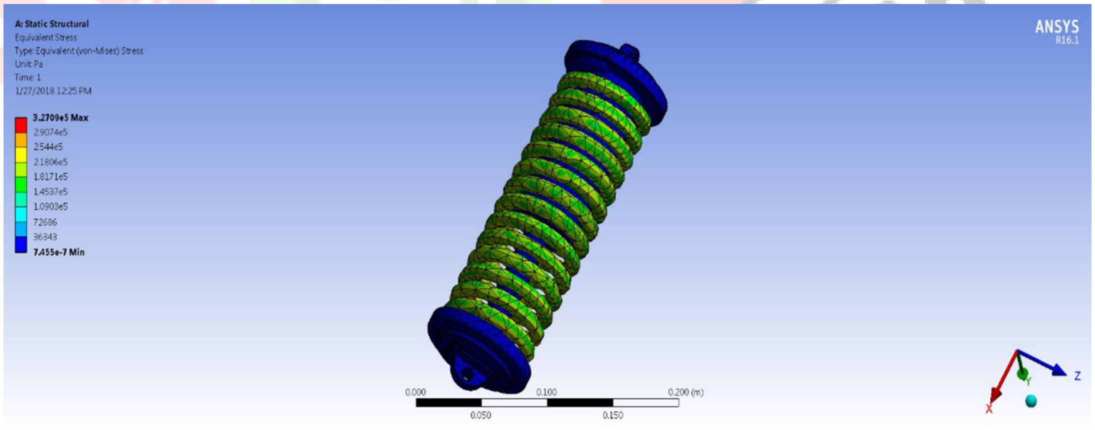

Fig 15. Equivalent Stress acting in Shock Absorber.

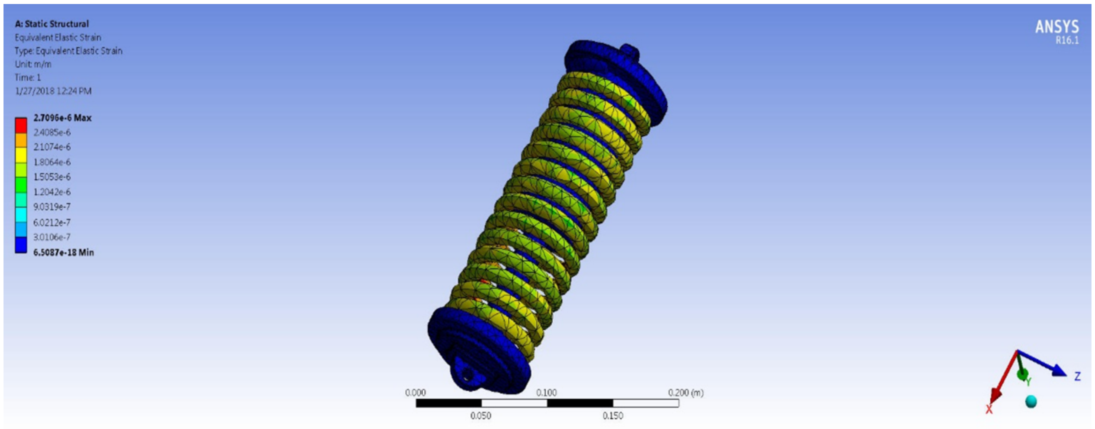

Fig 16. Equivalent Elastic Strain acting in Shock Absorber.

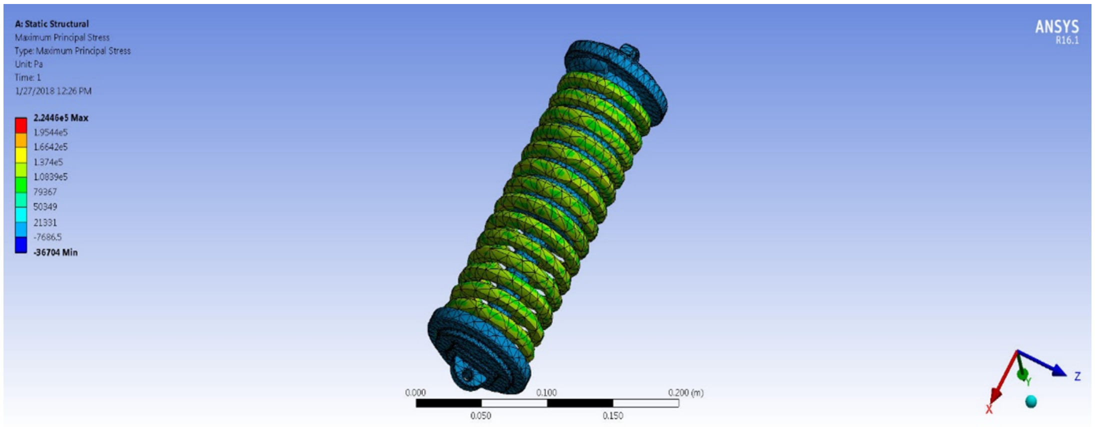

Fig 17. Maximum Principal Stress acting in shock Absorber.

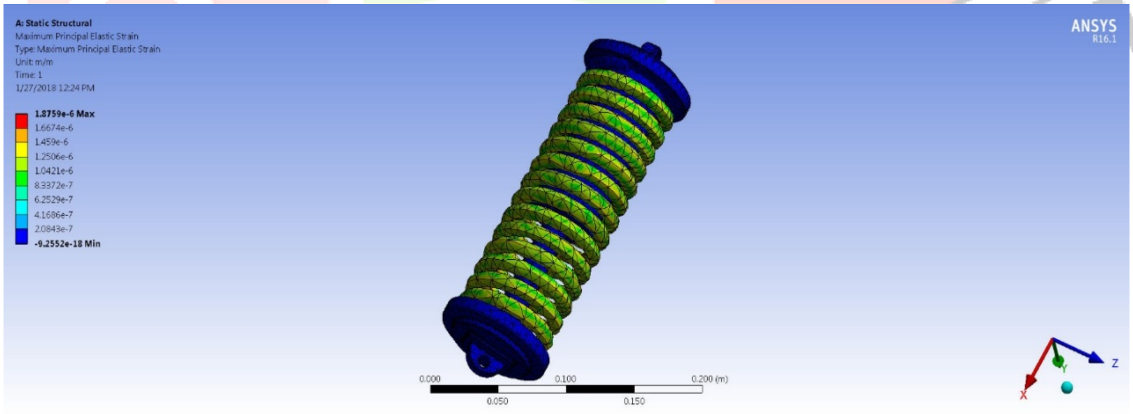

Fig 18. Maximum Principal Elastic Strain acting in shock Absorber.

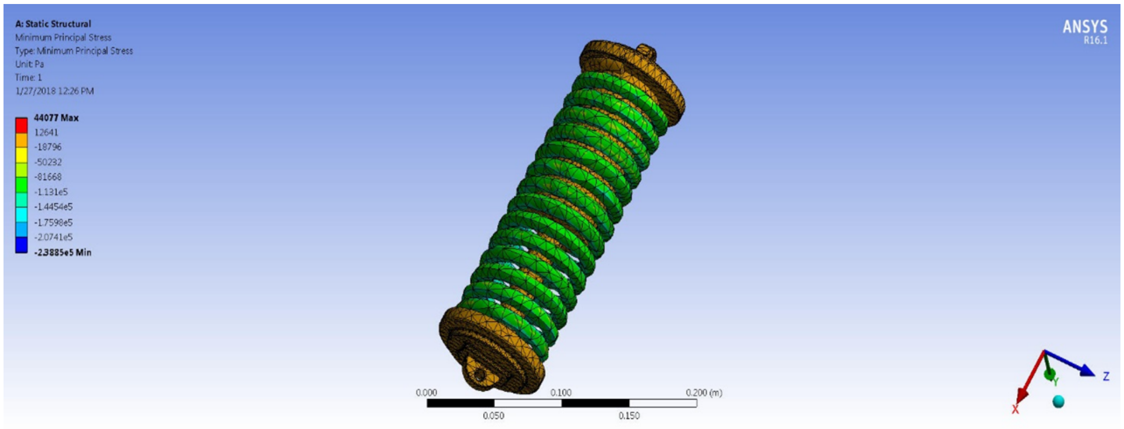

Fig 19. Minimum Principal Stress acting in shock Absorber.

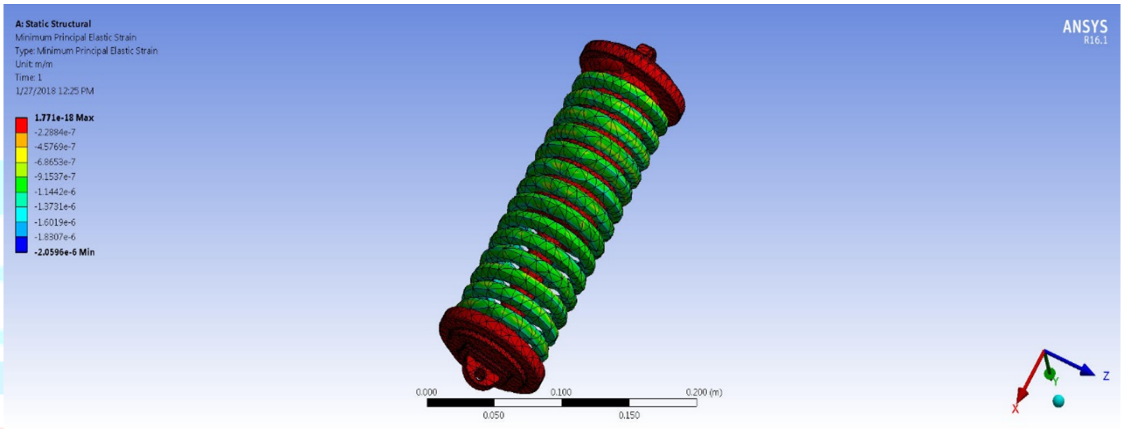

Fig 20. Minimum Principal Elastic Strain acting in shock Absorber.

S.NO	**DIAMETER (mm)**	**STRESS**		**STRAIN**	
		MINIMUM	**MAXIMUM**	**MINIMUM**	**MAXIMUM**
1	10.9	7.455e-7	3.2709e5	6.5087e-18	2.7096e-6
2	11.2	1247.1	5.3297e5	9.7932e-9	4.2369e-6
3	11.4	1185.9	4.8135e5	9.3703e-9	3.8459e-6
4	11.6	1053.9	4.584e5	9.2156e-9	3.7097e-6
5	11.8	1033.5	4.3532e5	8.9257e-9	3.4421e-6

Table 3.Stress and Strain values using Beryllium copper.

CONCLUSION:

Thus with the help of two materials we analysed the deflection of shock absorber by varying the stress and strain of a material with their following properties and also by varying different diameter of the springs in shock absorber for both materials respectievely

S.NO	DIAMETER (mm)	DEFLECTION(mm)	
		CARBON FIBRE	BERYLLIUM COPPER
1.	10.9	0.0011266	4.3166e-5
2.	11.2	2.4273	0.094814
3.	11.4	2.3628	0.92297
4.	11.6	2.3293	0.090987
5.	11.8	2.2891	0.89416

The Equivalent Stress produced in Carbon Fibre is more than Beryllium Copper hence there will be more chances of breaking in case of Carbon Fibre. But the deflection of the Carbon Fibre material is more than the Beryllium Copper hence Shock absorbing capacity is more in Carbon Fibre compared to Beryllium Copper. So we conclude that Carbon Fibre is best in absorbing Shocks.

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