Modeling and Structural analysis of bike rear shock absorber spring

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Abstract – *Shock absorber is a mechanical device and a part of the suspension system used to provide comfort on riding and helping to reduce the vibrations on the vehicle. It reduces the travelling effect of the vehicle over a rough ground. Suspension system is a unit having the property of absorbing the road shocks which are obtain by the road bumps. The shock absorber has been used to reduce the vibrations on the vehicle; it gives the more efficiency and gives more comfortable ride to the passengers. Here the working of the shock absorber is when a bump occurred due to the road the shock then the shock absorber has dissipates the kinetic energy then the spring on the shock absorber has absorbs the load and spring has compresses then the spring bounces. This bouncing process will be repeat over the shock absorber until the load has been released the shock absorber and it gets its original position gradually. In this project we are conducting the modeling and structural analysis of the shock absorber spring. Modifications have done on different sizes of the spring by using the CATIA software and analysis has been done by using different materials like as the chromium vanadium, high carbon spring wire. On bike weight, 1 person load and 2 person load conditions. The analysis has done by adding dual springs with both of the materials.*

1. INTRODUCTION

A vehicle is travelling on an uneven surface or road, then the vehicle faces some jumps or bumps for these damping's. This will be causes due to rolling of the wheel on an uneven road. These damping's are causes to the passengers an uncomfortable ride on such roads and also handling of vehicle is difficult for rider. In such conditions the breaking system also faces some problems for these bumps. This situation makes heavy vibrations on the vehicle body. These vibrations are going to damages the engine, transmission system and other sensitive parts on the vehicle. The life time of the vehicle are also going to reduces because of these bumps. Hence, to overcome from this type of critical situation will be solved by using the suspension system and it provides the suspension of the vehicle.

A good suspension system are contains springiness, damping springiness and absorbs the energy caused due to the bumps. The working of the suspension system is to maintain the wheels to be making contact with the surface and reduce the damping forces which are developed due to the road shocks. This suspension system absorbs the damping energy and dissipates that energy then protects the vehicle from the stress developed by the bumps. This system provides a comfortable riding for the passengers and provides the safety to the engine, transmission system and breaking system and other sensitive parts on the vehicle. By providing the rubber material to the springs to the shock absorber then it makes the less noise to the vehicle.

The suspension system has been located in between the wheels and the frame of the vehicle. It is having internal parts those are

- **i.** Springs
- **ii.** Shock absorbers
- **iii.** Linkages

All of these parts are helps to connect the vehicle with the wheels and springs on the suspension system. It has been used to reduce the forces induced on the vehicle by bouncing process of spring. When load has been released from the vehicle it is gradually regains its original position. The shock absorber has been works like as a damper for damping the forces induced by the road shocks. Finally linkage is connected between the shock absorber and wheel.

The principles of the suspension system have been explained below those are:

1. It is used to reduce the weight of the vehicle loading on the wheels and gives minimum shock vibrations to the body of vehicle.
2. Reduction of rolling and pitching of the vehicle should be minimising the design of the spring. This spring is suitable to the vehicle.
3. Provides the comfortable riding to the passengers from the high shocks occurred from the uneven road surface.

Every suspension system must obey these three principles for providing the good suspension to the vehicle.

Shock absorber:

A shock absorber is a mechanical or hydraulic or pneumatic device which is designed to absorb the shock raised by the uneven road surface. Mostly shock absorbers are in the form of the dashpots.

2. Design of the shock absorber

Modeling is an activity that is found in every domain of research and science, and takes place even when we are not aware of it. The role of modeling and the quality of models are extremely important not only in engineering but for science in general.

In mechanical engineering the design is make a key role hence it will used to create a modeling theory based on knowledge and experience in the areas of mechanical engineering. There are some types of modeling methods are part modeling, shape modeling, sheet metal modeling & assembly modeling.

CATIA V5: The full form of the software is the Computer Aided Three-dimensional Interactive Application. This software has been developed by the dassault systems on the year of 1977 for the design and manufacturing of aeronautical applications. This software has consisted of the CAD (Computer Aided Design), CAE (Computer Aided Engineering), CAM (Computer Aided Manufacturing) on various industries.

Steps involved in the modeling of shock absorber are:

1. Modeling of top part
2. Modeling of the bottom part
3. Modeling of the Helical spring
4. Assembly of all parts

1.Modeling of top part:

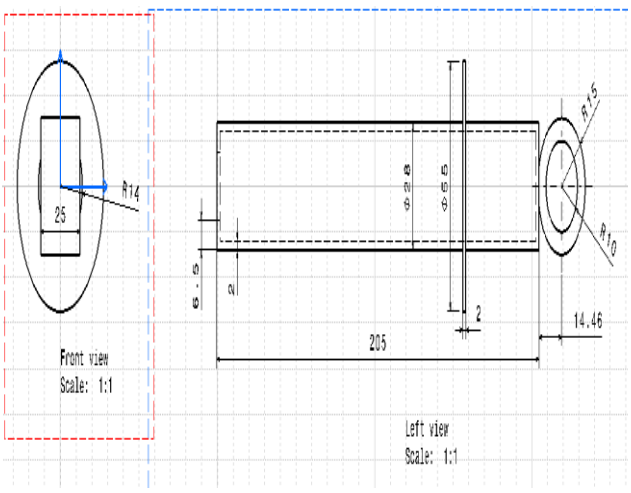


Fig: 1 Top part

2.Modeling of the bottom part:

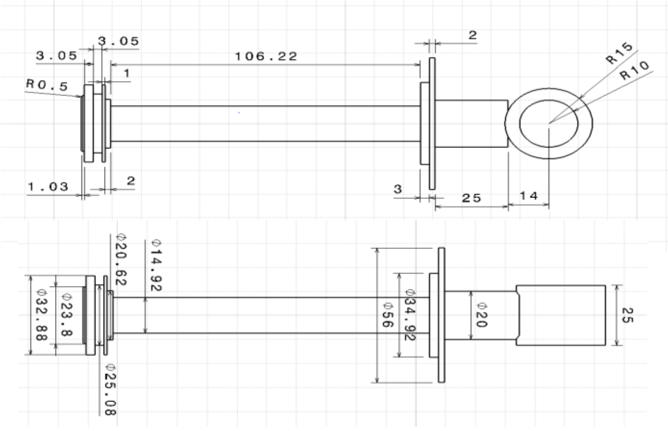


Fig: 2 Bottom Part

3.Modeling of the helical spring:

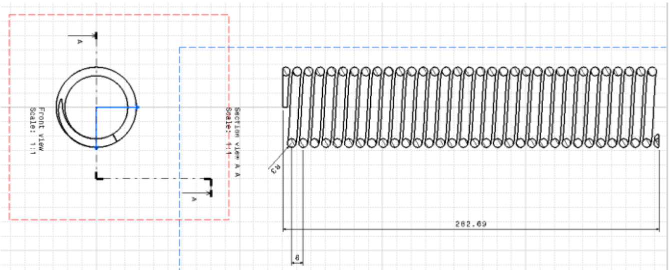


Fig: 3 helical springs

4.Assembly of all parts:

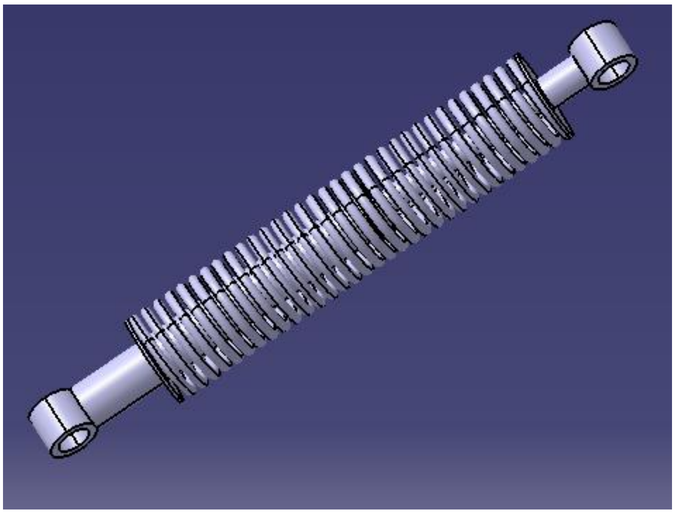


Fig: 4 Assembly of shock absorber

2.1 Analysis of shock absorber:

Case 1:

Applied with the Chromium vanadium:

Load Condition: bike weight:

Results:

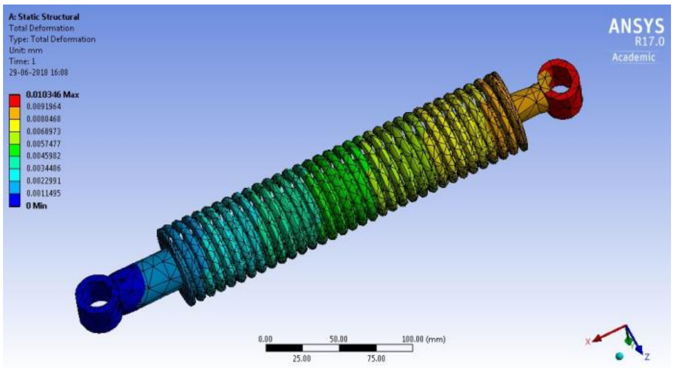


Fig: 5 deformations at bike weight

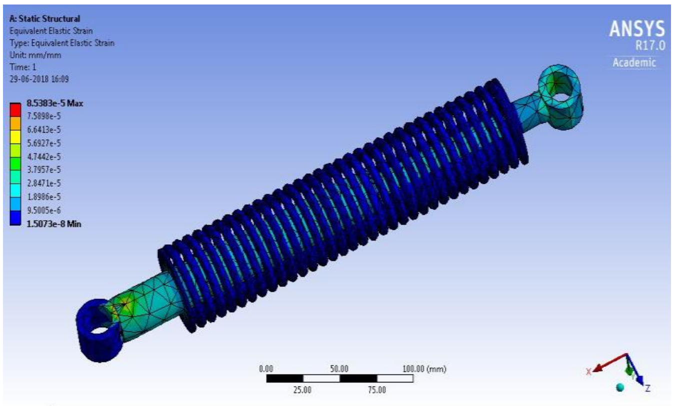


Fig: 6 strain at bike weight

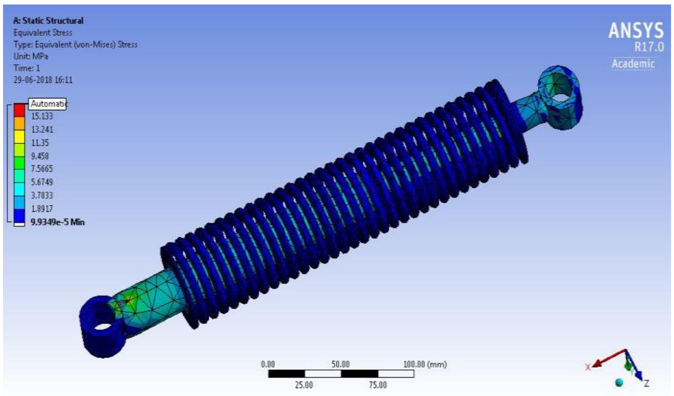


Fig: 7 stress at bike weight

Load Condition: bike weight + 1 Person weight:

Results:

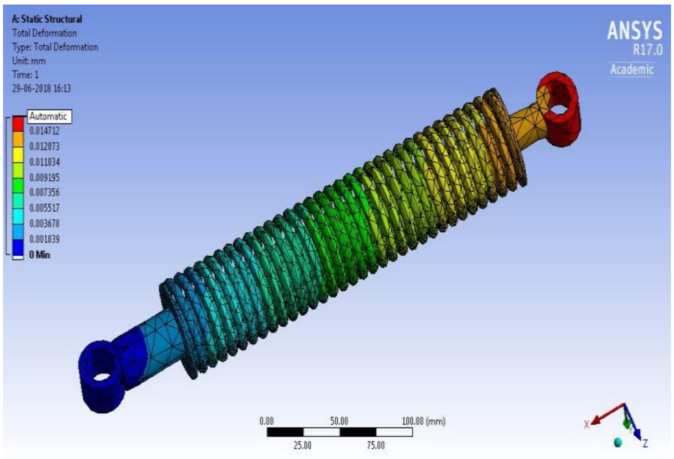


Fig: 8 deformations at 1 person weight

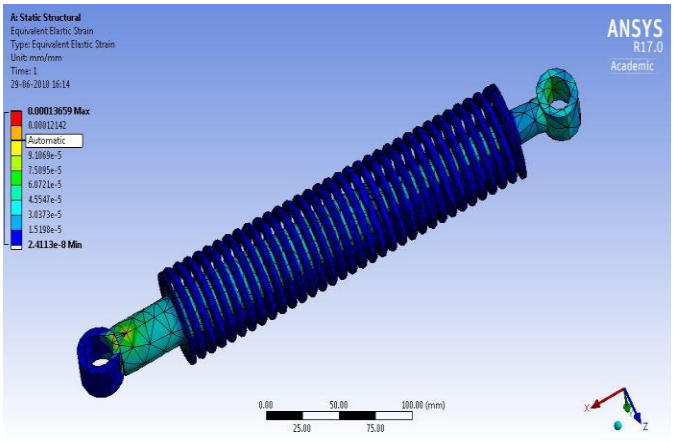


Fig: 9 strain at 1 person weight

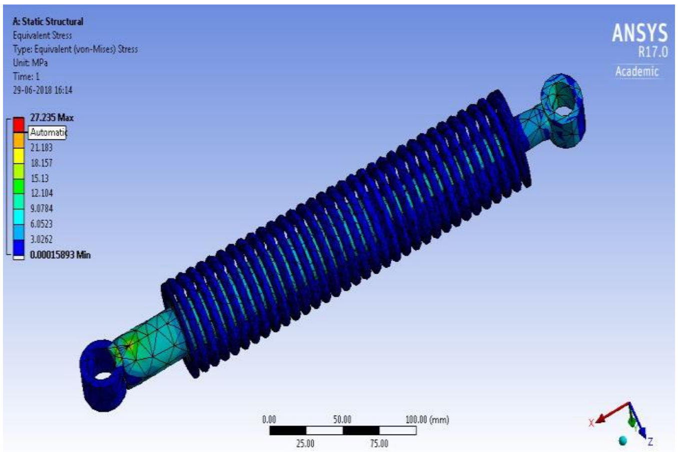


Fig: 10 stress at 1 person

Load Condition: bike weight + 2 person's weight:
Results:

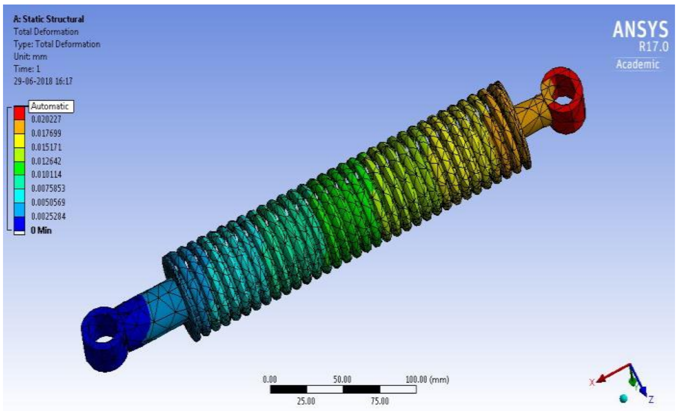


Fig: 11 Deformation at the 2 person weight

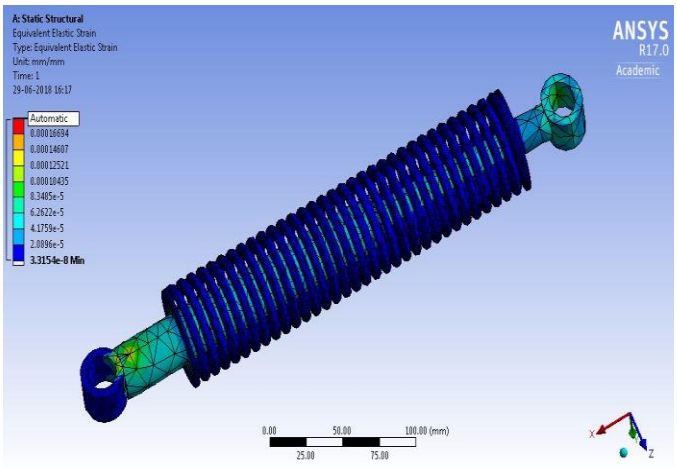


Fig: 12 Strain at 2 person's weight

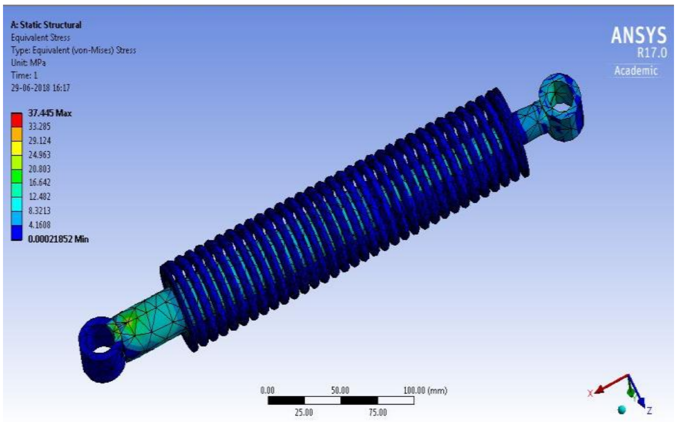


Fig: 13 Stress at 2 person's weight

Case 2:

Analysis with the High carbon spring wire:

Load Condition: bike weight:

Results:

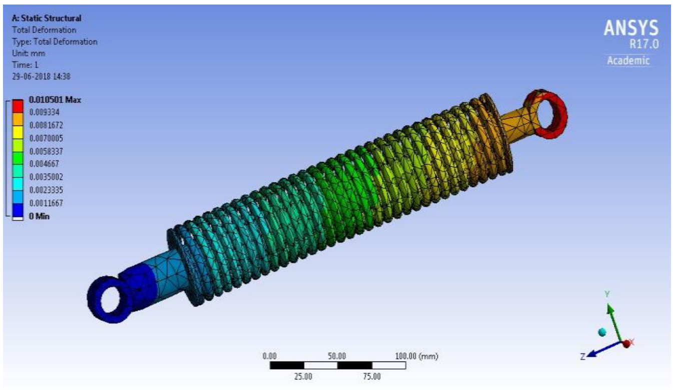


Fig: 14 Deformation at bike weight

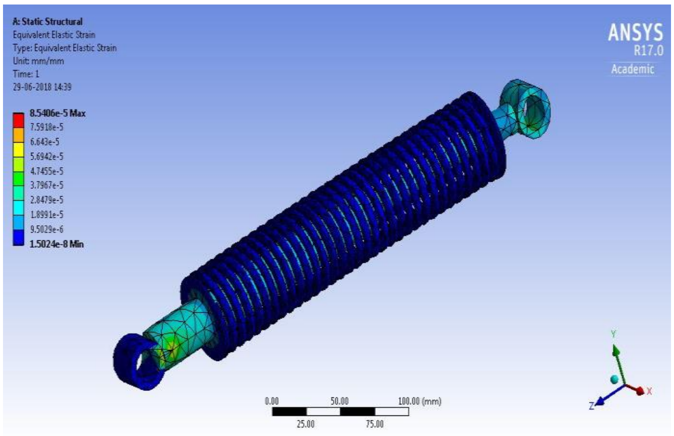


Fig: 15 Strain at bike weight

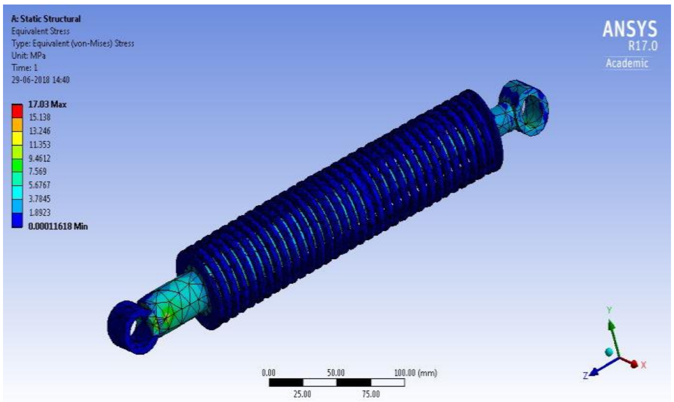


Fig: 16 Stress at bike weight

Load Condition: bike weight + 1 Person weight:

Results:

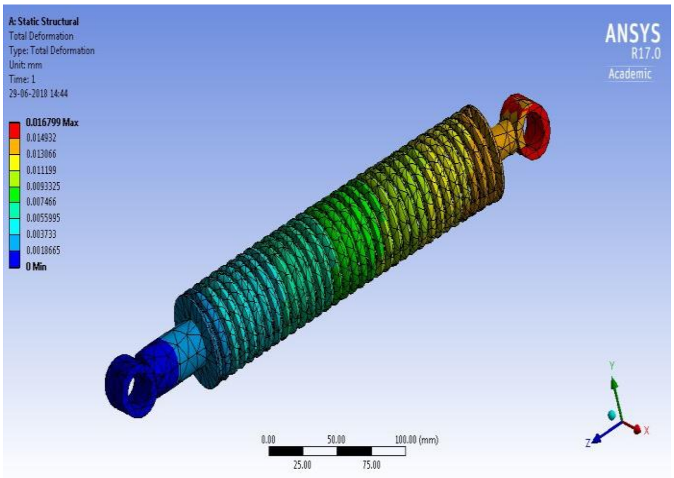


Fig: 17 Deformation at 1 Person weight

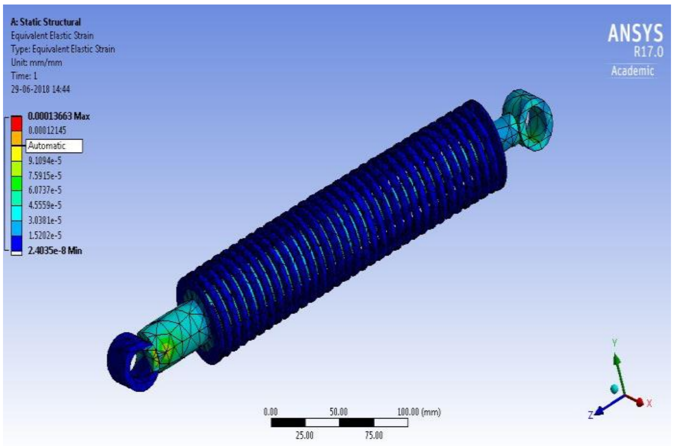


Fig: 18 strain at 1 person weight

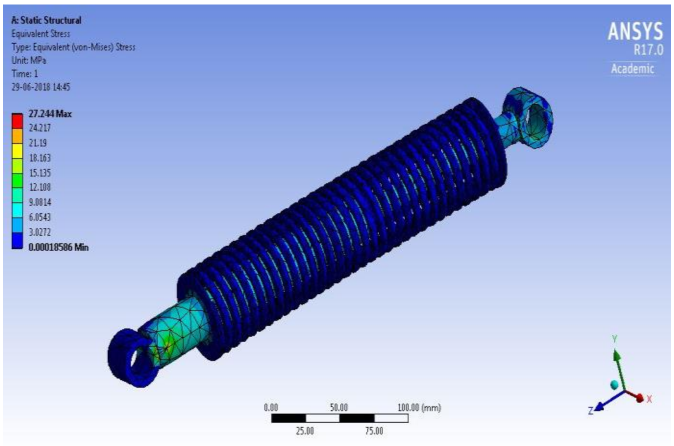


Fig: 19 Stress at 1 Person weight

Load Condition: bike weight:

Results:

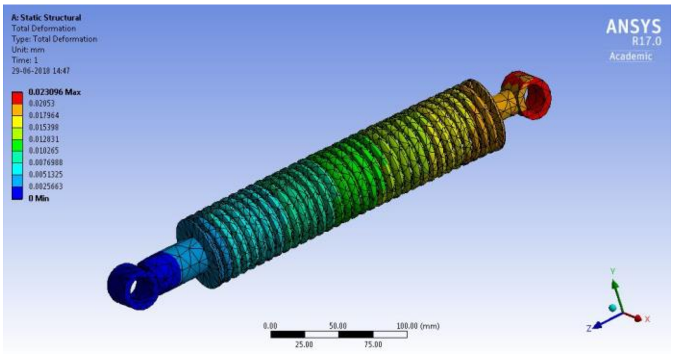


Fig: 20 Deformation at the 2 person's weight

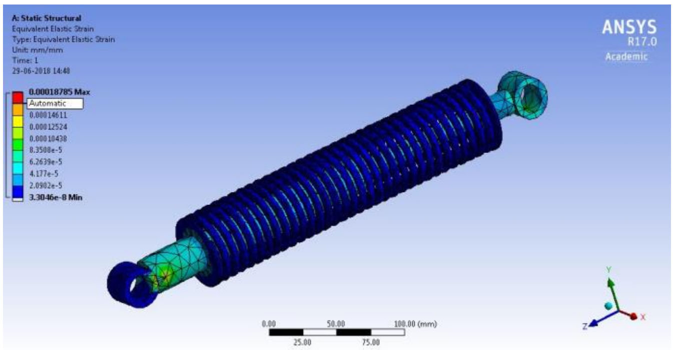


Fig: 21 Strain at the 2 Person's weight

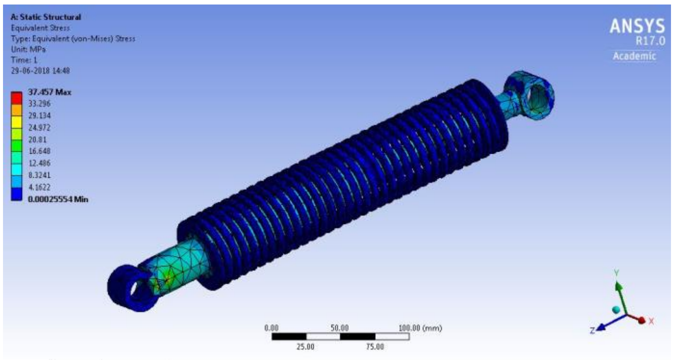


Fig: 22 Stress at the 2 Person's weight

Case 3:

Analysis at modified design:

Analysis done on modified design which is having the duel springs applied the materials of the chromium vanadium and High Caron Spring wire.

Load Condition: bike weight:

Results:

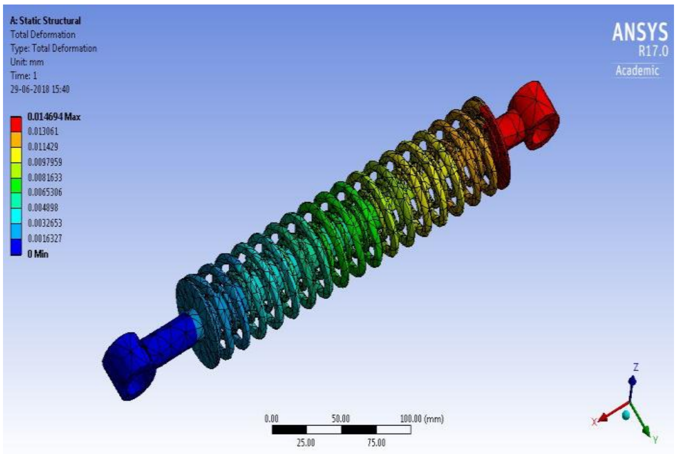


Fig: 23 Deformation at the bike weight

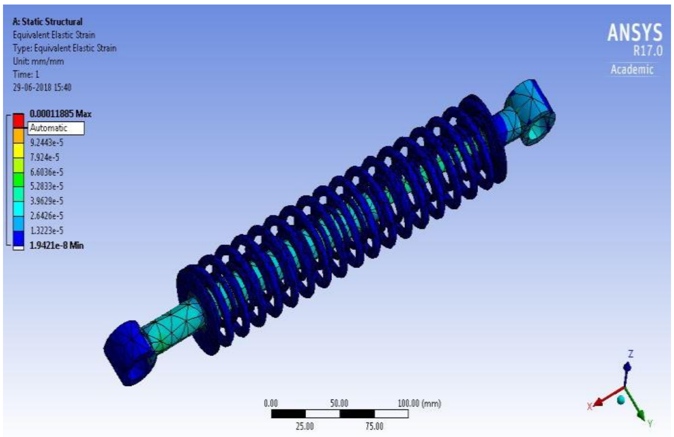


Fig: 24 Strain at bike weight

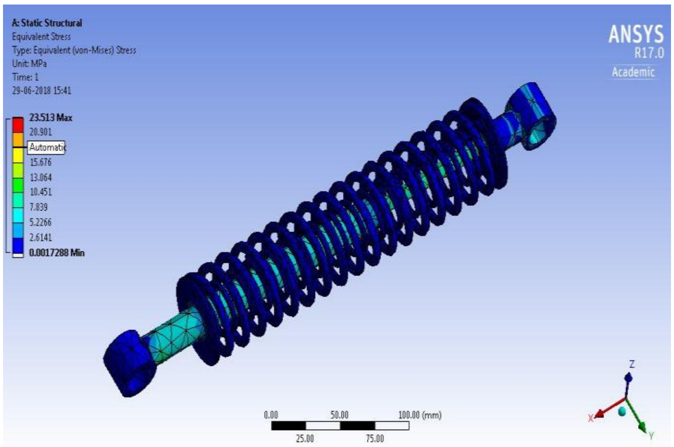


Fig: 25 Stress at the bike weight

Load Condition: bike weight + 1 person weight:

Results:

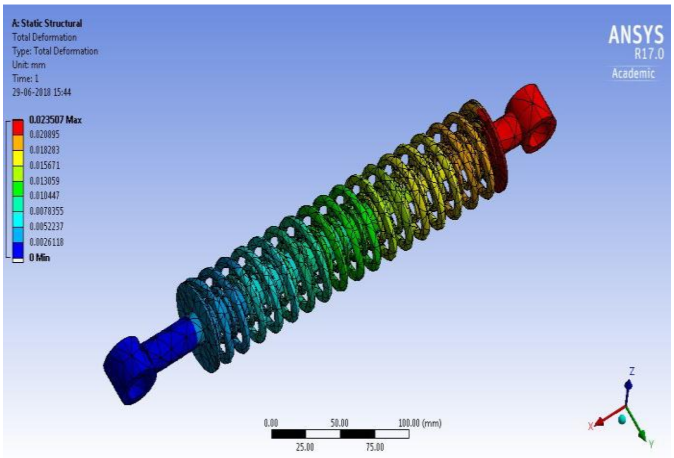


Fig: 26 Deformation at 1 person weight

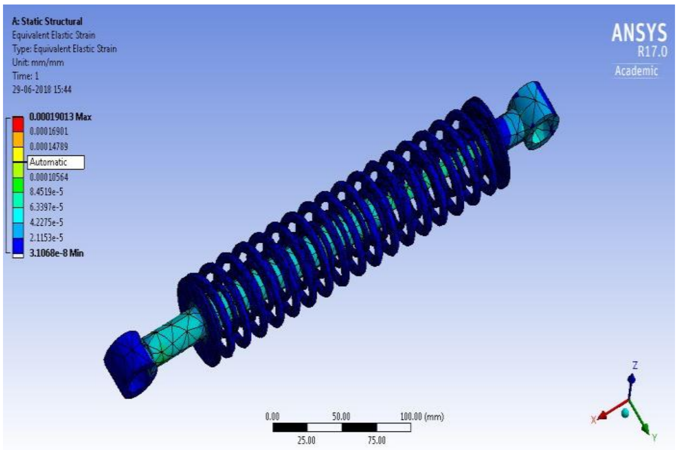


Fig: 27 Strain at 1 person weight

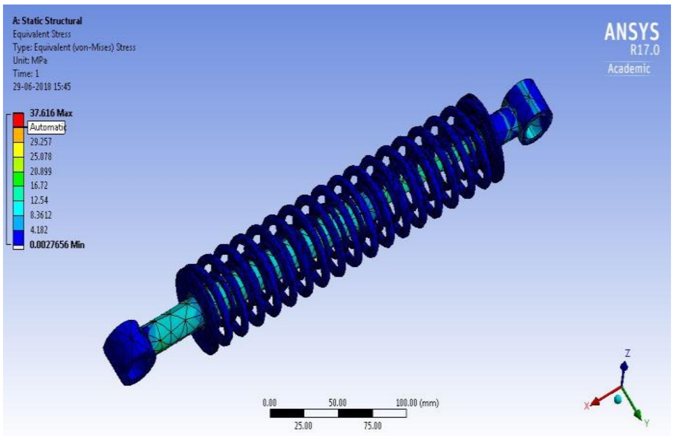


Fig: 28 Stress at 1 person weight

Load Condition: bike weight + 2 person weight:

Results:

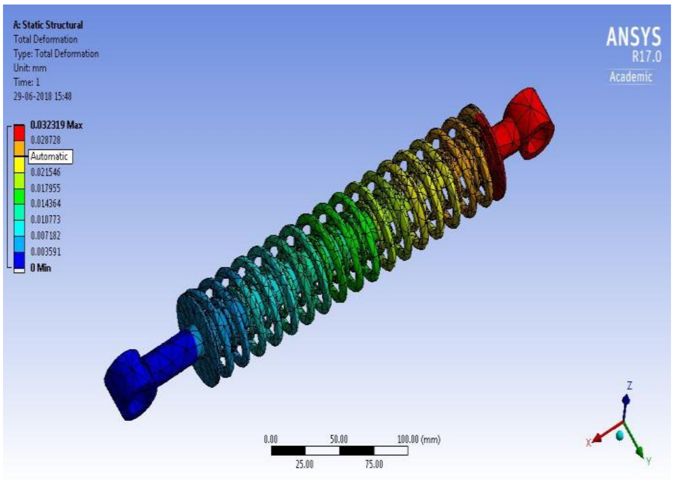


Fig: 29 Deformation at 2 person's weight

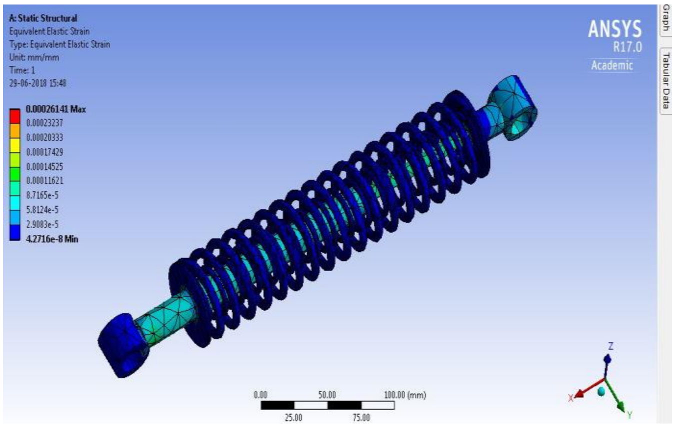


Fig: 30 Strain at 2 Person's weight

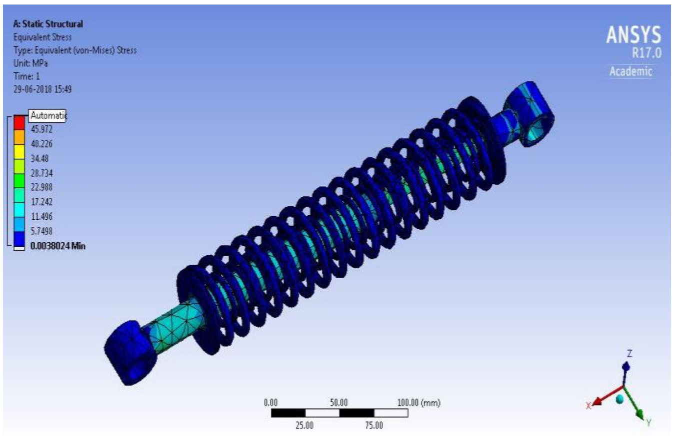
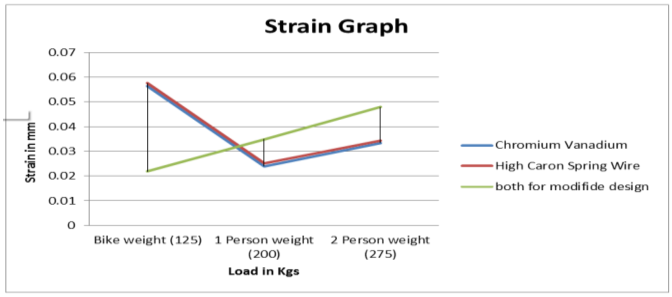


Fig: 31 Stress at 2 Person's weight

Graph: 1 Deformation Graph

Graph: 2 Strain Graph



Graph:3 stress graph

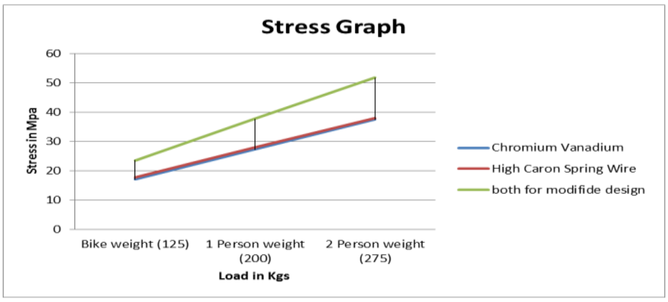


Table- 1: Results for shock absorber model

Chromium vanadium				
Loads	**displacement MM**	**strain mm**	**stress Mpa**	**facor of saftey**
Bike Weight	1.0346 e-2	8.5383 e-5	17.024	14.685
1 Person Weight	1.6551 e-2	1.3659 e-4	27.235	9.1794
2 Person Weight	2.2756 e-2	1.878 e-4	37.445	6.6764

Table- 2: Result for shock absorber model

High Carbon spring wire

Loads	displacement MM	strain mm	stress Mpa	facor of saftey
Bike Weight	1.0501 e-2	8.5406 e-5	17.03	14.68
1 Person Weight	1.6799 e-2	1.3663 e-4	27.244	9.1764
2 Person Weight	2.30696 e-2	1.8785 e-4	37.457	6.6742

Table-3: Result for shock absorber modified model

Outer high carbon spring wire and inner cromium vanidium				
Loads	**displacement MM**	**strain mm**	**stress Mpa**	**facor of saftey**
Bike Weight	1.4694 e-2	1.1885 e-4	23.513	10.632
1 Person Weight	2.3507 e-2	1.9013 e-4	37.616	6.6462
2 Person Weight	3.2319 e-2	2.6141 e-4	51.718	4.8339

3. CONCLUSIONS

Finally the model which is modified is safe at different load conditions and various materials. Which is provides the more comfortable for passenger then previous version which has been considered as reference. Here the final conclusion is declared below.

- To validate the strength of the shock absorber by done the structural analysis. Analysis has done by applying the chromium vanadium and high carbon spring wire.
- By observing the analysis the analyzed stress values are less than the yield strength values. Here the displacement of the model is also within the limits hence it is a safe design.
- By comparing the both the materials the stress values on high carbon spring wire material is high when compared with the chromium vanadium. Hence the material chromium vanadium is safest.
- Where the design is modified with the adding of another spring and minor changes are also done on this shock absorber.
- By reducing the diameter of the design has also within the limits of the stress and displacements on various load conditions, hence our model is safe.
- By observing the results of modification design the model is having the displacement and stresses are also within the range of the limits hence the modified design is also safer

REFERENCES

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