MODELLING AND ANALYSIS OF TWO WHEELER SUSPENSION SYSTEM

A. Harshavardhan Reddy[1], G. Rajasekhar Reddy[2], G. Phanindra[3], K. Vijay Kumar[4]

[1] *Asst. Professor, Mechanical, Gurunanak Institutions, Telangana, India*
[2,3,4] *Student, Mechanical, Gurunanak Institutions, Telangana, India*

---***---

ABSTRACT - *A suspension system or shock absorber is a mechanical device designed to duty is to absorb or dissipate energy. In a vehicle, it reduces the effect of travelling over rough ground, leading to improved ride quality, and increase in comfort due to substantially reduced amplitude of disturbances. The design of spring in suspension system is very important.*

In this project a shock absorber is designed a 3D model software using solid works. The model is also changed by changing the material and load of the spring.

Structural analysis and is done on the shock absorber by varying material for spring, magnesium, steel and titanium. The analysis is done by considering loads, bike weight, single person and 2 persons. Structural analysis is done to validate the strength and static structural analysis is done to determine the total displacements for different loads and materials. Comparison is done for three materials to verify best material for Shock absorber.

Key Words: ANSYS, Damp Stock, Kinetic Energy, Ride Quality, SOLID WORKS.

1. INTRODUCTION TO SUSPENSION SYSTEM

Shock absorbers are important part of vehicle's suspension- which is fabricated to reduce shock impulse. Shock absorber minimizes the effect of travelling on a rough ground. Modern vehicles are designed with strong shock absorbers to tolerate any type of bouncy conditions. If supposedly shock absorber is not used then to control excessive suspension movement- stiffer springs will be used. The shock absorbers duty is to absorb or dissipate energy. One design consideration- when designing or choosing a Shock absorber is where that energy will go. In most dashpots- energy is converted to heat inside the viscous fluid.

1.2 Literature Review

For providing the best design of spring coil to the suspension system of two wheeler vehicles. A lot of technical papers and reduction processes were studied before deciding upon the most feasible process for project. The following list presents a gist of the main papers referred to, throughout the duration of the project.
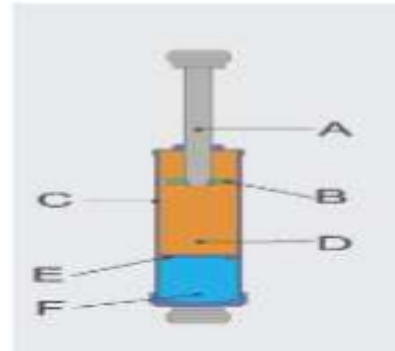
1.3 Construction and Working

Construction

Fig. 1 Construction

Components are:

1. Rod
2. The piston with seals.
3. Cylinder.
4. Oil reservoir.
5. Floating piston.
6. Air chamber

2. MODELING OF COMPONENT

Part 1: Lower Shaft

To create go to SOLIDWORKS software and click on start –and select part design module. In part design module then go to sketcher tool and select sketcher tool and select required plane. Then we enter into sketcher module and go to profile and create a profile structure as shown in fig.
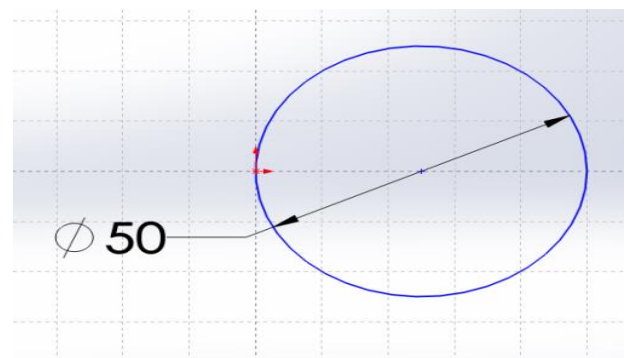

FIG.2 Sketch for Lower Suspension

After completing sketcher go to workbench and select exit work bench. Then we enter into part module again. In part module, go to HELIX TOOL and select shaft tool. In shaft definition, select above sketch as sele ction profile and specify angle as shown in fig
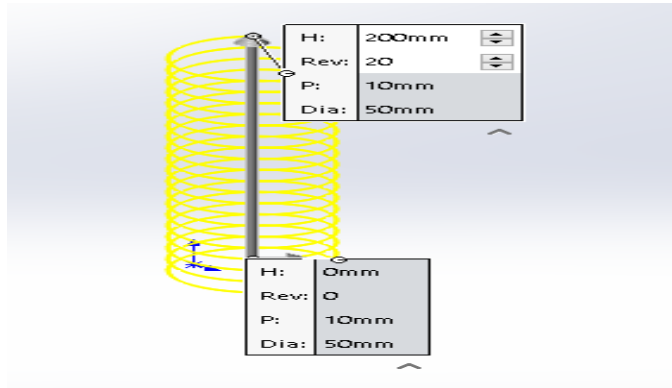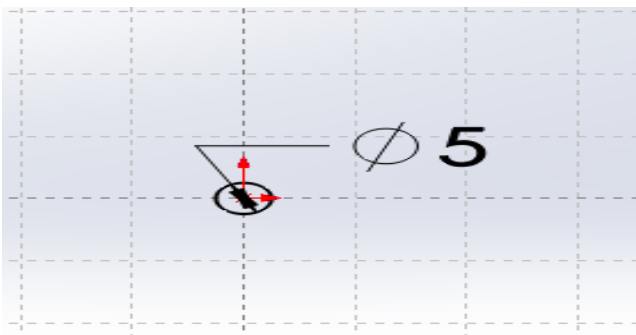

FIG.3 Spring

Now again, in part design module then go to sketcher tool and select sketcher tool and select required plane. Then we enter into sketcher module and go to profile and create a profile structure as shown in fig.
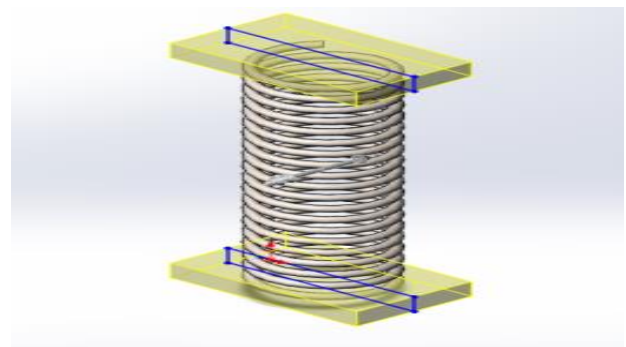

FIG.4 Sketch for Locker

After completing sketcher go to workbench and select exit work bench. Then we enter into part module again. In part module, feature tool and select pad tool. In pad definition, select above sketch as selection profile and specify length as shown in fig and click on mirrored extent option.
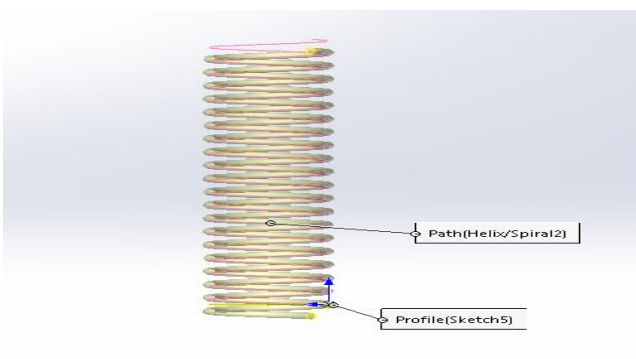
FIG.5 Pad for Lock

In part modules go to dress up based feature and select edge fillet tool. In edge fillet definition, Select edge of developed part and from dress up features select edge fillet and make fillet with 5mm radius.
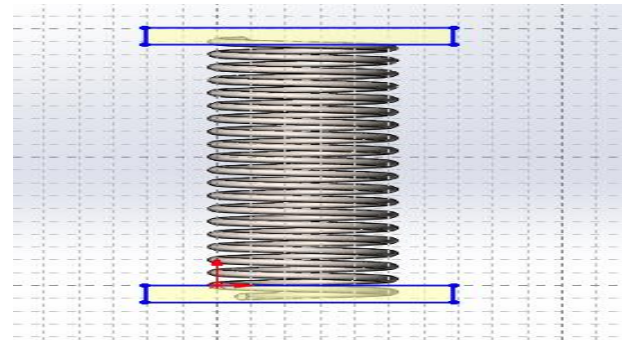
FIG.6 Fillet for Support

Part 2: **Upper Suspension Shaft**

To create go to catia software and click on start – mechanical design and select part design module. In part design module then go to sketcher tool and select sketcher tool and select required plane. Then we enter into sketcher module and go to profile and create a profile structure as shown in fig.

FIG.7 Sketch for Upper Suspension

After completing sketcher go to workbench and select exit work bench. Then we enter into part module again. In part module, go to sketcher based feature and select shaft tool. In shaft definition, select above sketch as selection profile and specify angle as shown in fig
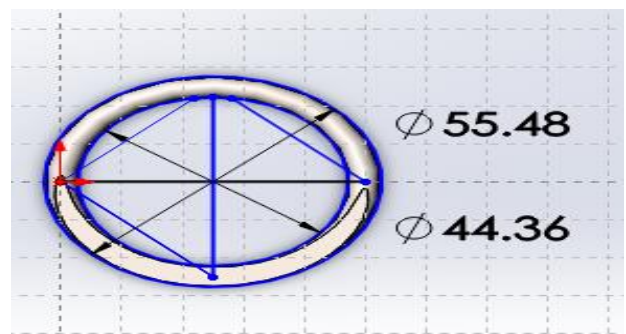

FIG.8 Shaft Definition

In part design module then go to sketcher tool and select sketcher tool and select required plane or surface. Then we enter into sketcher module and go to profile and create a profile structure as shown in fig
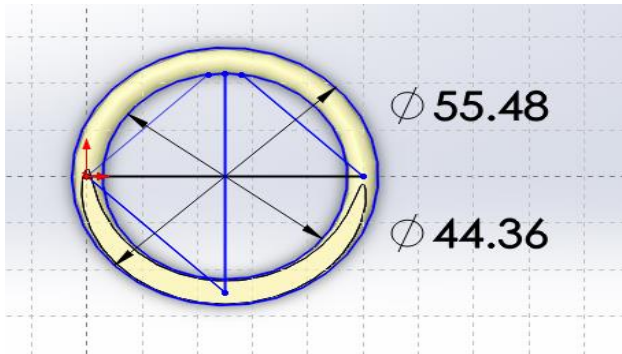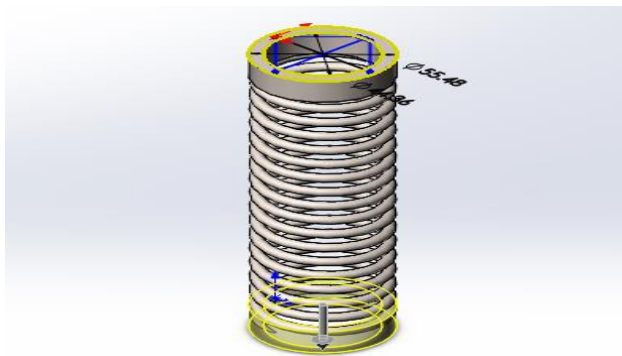

FIG.8 Sketch for Lock

After completing sketcher go to workbench and select exit work bench. Then we enter into part module again. In part module, go to sketcher based feature and select pad tool. In pad definition, select above sketch as selection profile and specify length as shown in fig

FIG.9 Pad for Lock

In part design from dress up features select edge fillet at the edge with given dimension as shown below.

Part 3: Spring
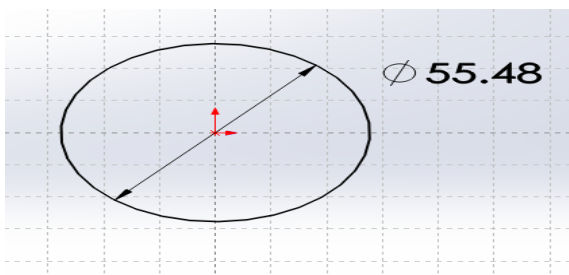
To create go to SOLID WORKS software and click on start –mechanical design and select wireframes and surface design module. In wireframes and surface design module then go to sketcher tool bar and select sketch and select yz plane. Then we enter into sketcher module, then

go profile tool and select line tool and specify as shown in fig then click on exit workbench
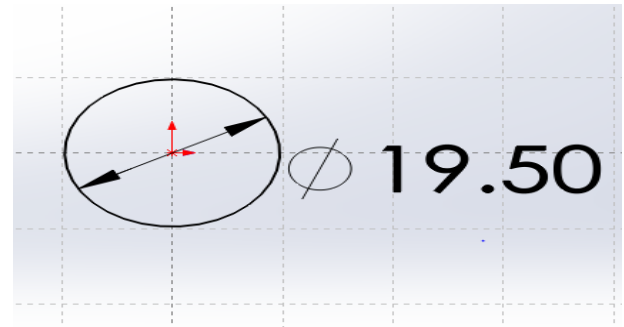
FIG.10 Varying Length for Different Pitch

In wireframes and surface design module then go to wireframe tool bar and select helix tool. In helix definition select above point as a starting point and z axis a reference axis. Then specify pitch and height as shown in fig.
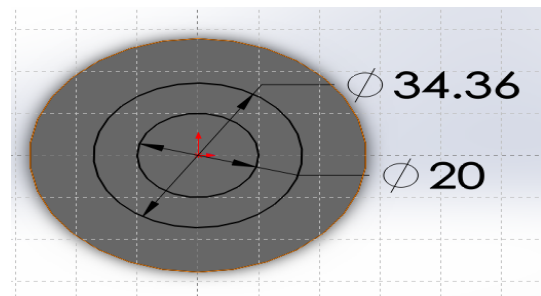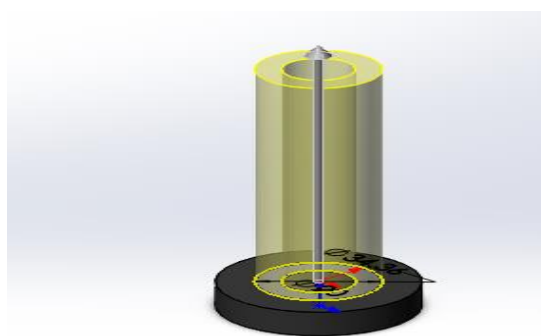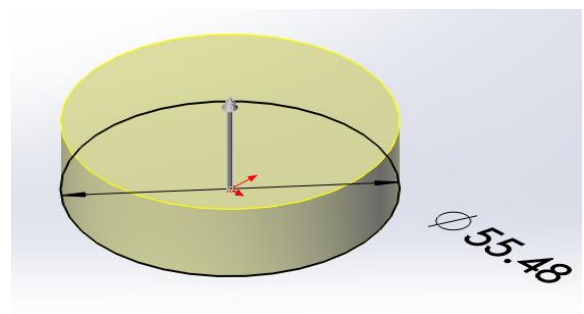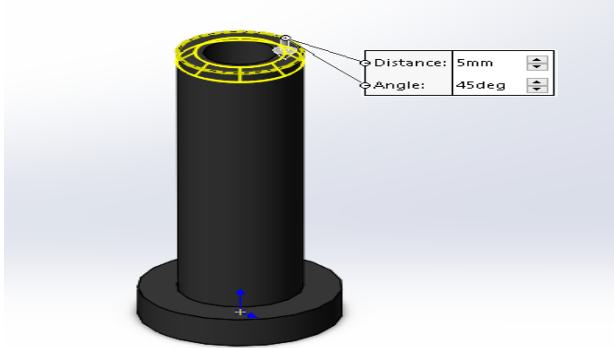

FIG.11 Helix Definition

FIG.12 Creating Spring Inside Definition

In wireframes and surface design module then go to wireframe tool bar and select helix tool. In helix definition select above point as a starting point and z axis a reference axis. Then specify pitch and height as shown in fig.

FIG.13 Creating Fillets

In wireframes and surface design module then go to operation and select join. In join definition select all three helix as show in fig. then ok to make one single helix.
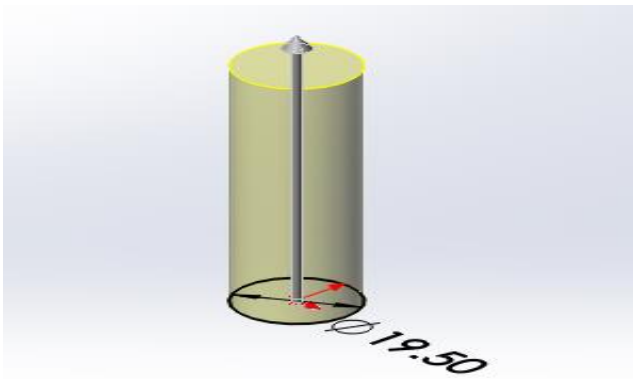

FIG.14 Rib Definition

Now select front plane and go to sketcher in sketcher from profile tool bar select rectangle and draw a rectangle on bottom side as shown below. Exit from workbench in part design from sketch based features select pocket .In pocket definition specify as per given diagram and select reverse side then click ok
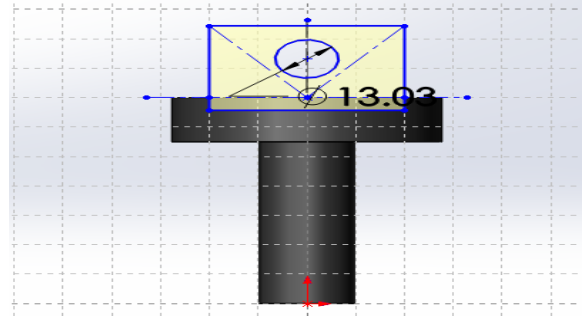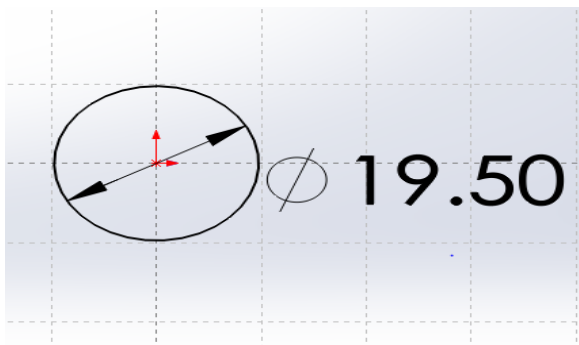

FIG.15 Remove or Making Flat Support for Spring

Part 4: Watcher

Go to SOLID WORKS software and click on start – mechanical design and select part design module. In part design module then go to sketcher tool and select sketcher tool and select required plane. Then we enter into sketcher module and go to profile and create a profile structure as shown in fig.
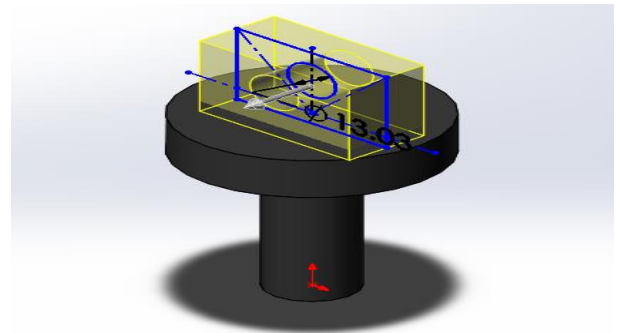

FIG.16 Sketch for Watcher

After completing sketcher go to workbench and select exit work bench. Then we enter into part module again. In part module, go to sketcher based feature and select shaft tool. In shaft definition, select above sketch as selection profile and specify angle as shown in fig
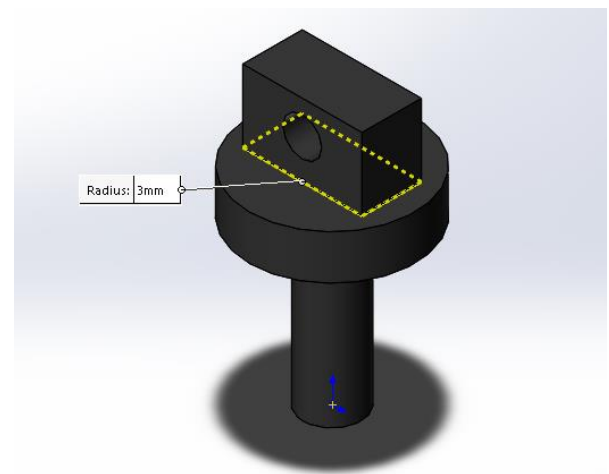

FIG.17 Pad Definition

3. Assembly of model component

FIG.18 ASSEMBLE PART

PROCESS OF ANALSING IN ANSYS

Static Structural Analysis with Different Materials
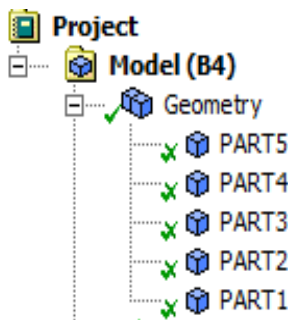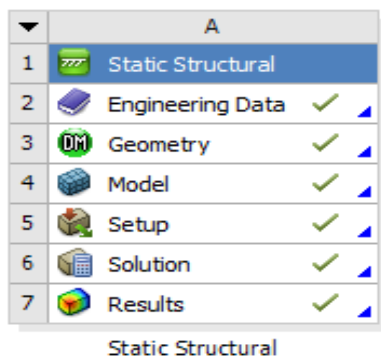

Static Structural

FIG.19 Project and its Parts

After importing the model into project schematic window drag and drop the Static structural analysis tab on to the screen from the toolbox window and link the geometry to geometry both will be linked together. Double click on the model it opens the mechanical window with object.
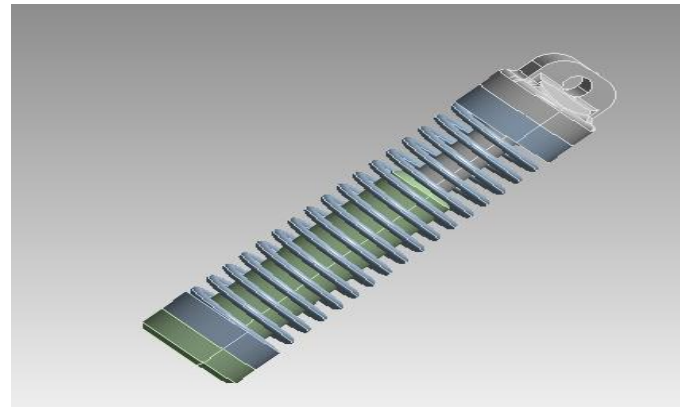
IMPORTED PART
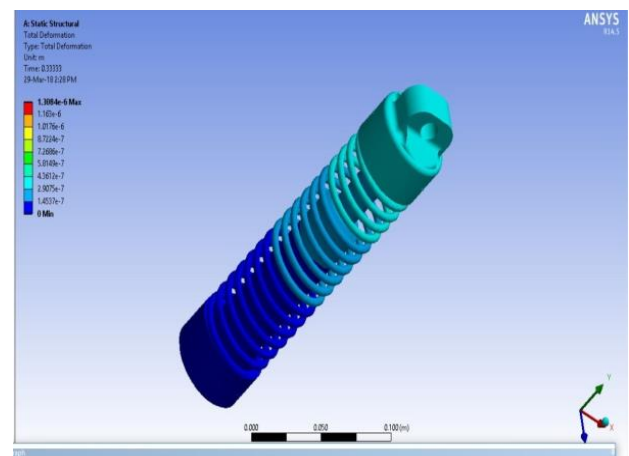

FIG.20 Imported Geometry
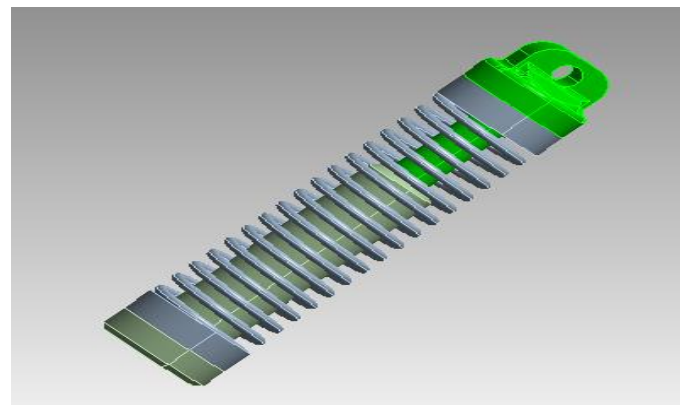
FIG.21 Contact Region

4. STRACTURAL ANALYSIS

STEEL MATERIAl

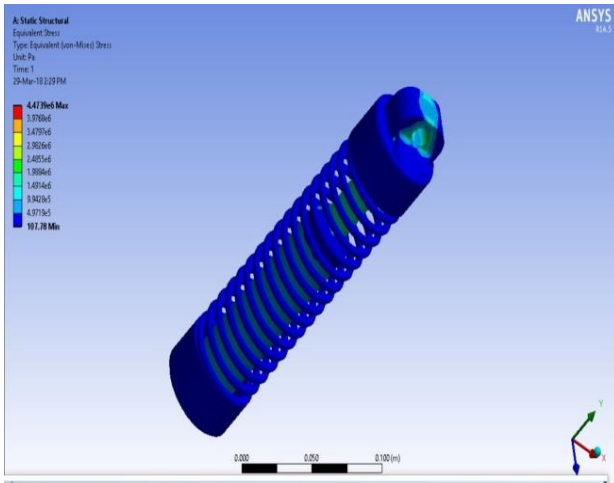Total deformation & equivalent stress by applying of 50KG load

Fig.22 Total deformation & equivalent stress

Total deformation & equivalent stress by applying of 125KG load
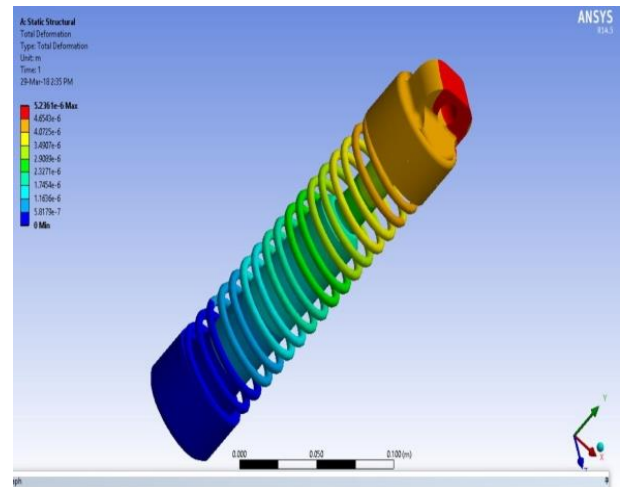

Fig.23 Total deformation & equivalent stress

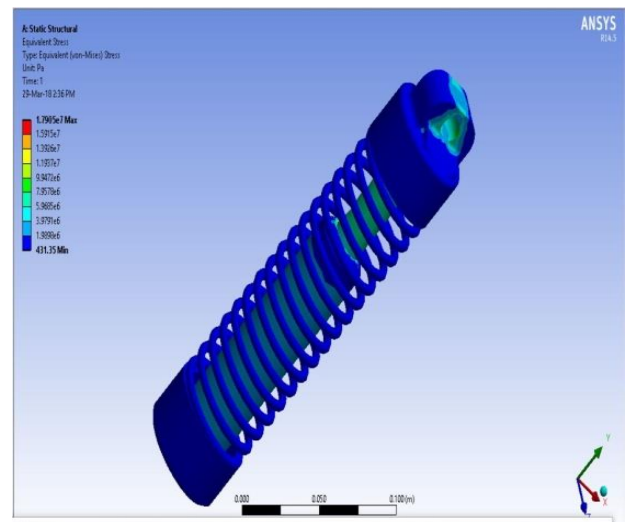Total deformation & equivalent stress by applying of 200KG load
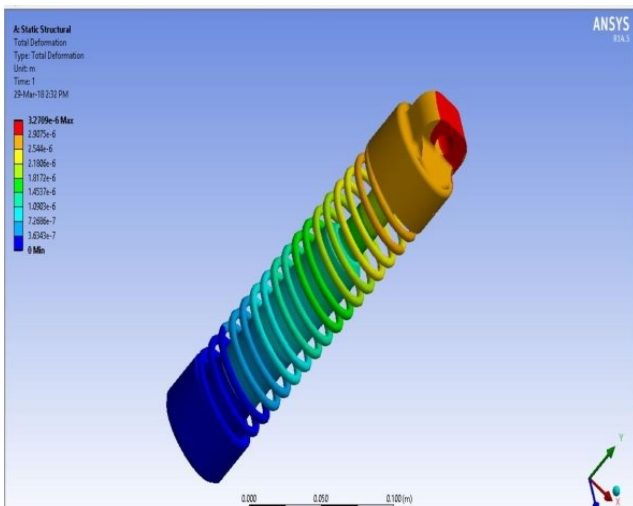

Fig.24 Total deformation & equivalent stress

MAGNESIUM MATERIAL

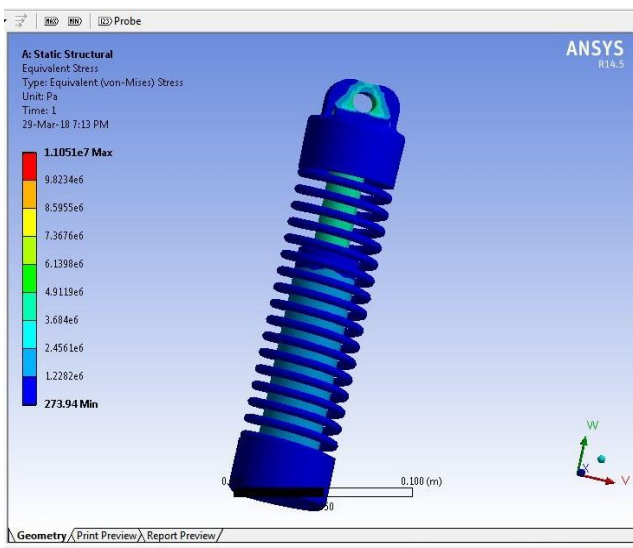Total deformation & equivalent stress by applying of 50KG load

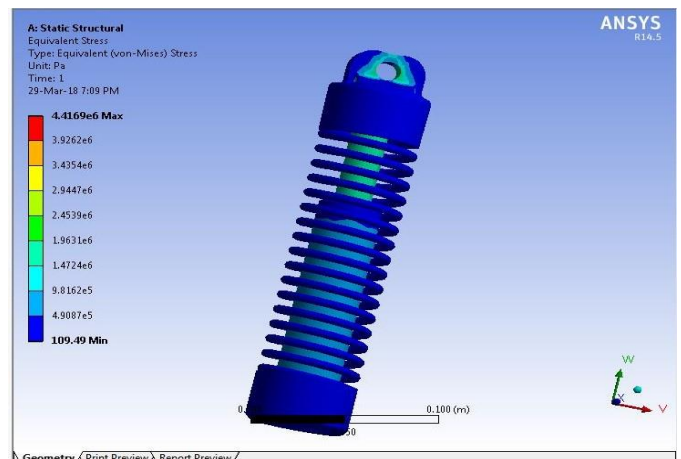**Fig.25** Total deformation & equivalent stress

Total deformation & equivalent stress by applying of 125KG load

Fig.26 Total deformation & equivalent stress

Total deformation & equivalent stress by applying of 200KG load

Fig.27 Total deformation & equivalent stress

TITANIUM MATERIAL

Total deformation & equivalent stress by applying of 50KG load
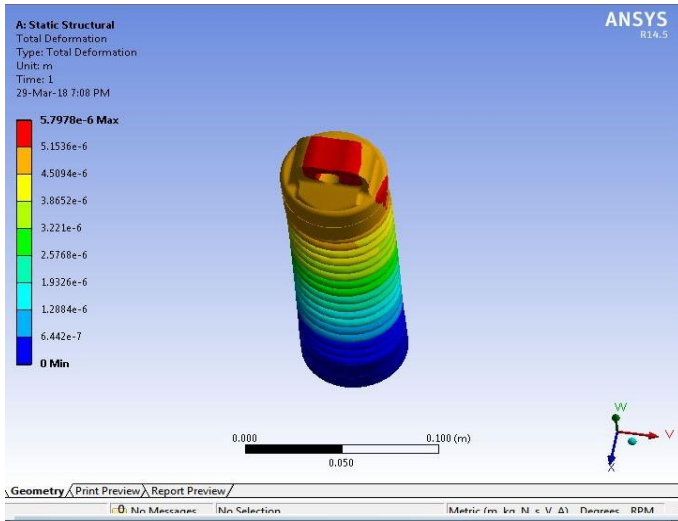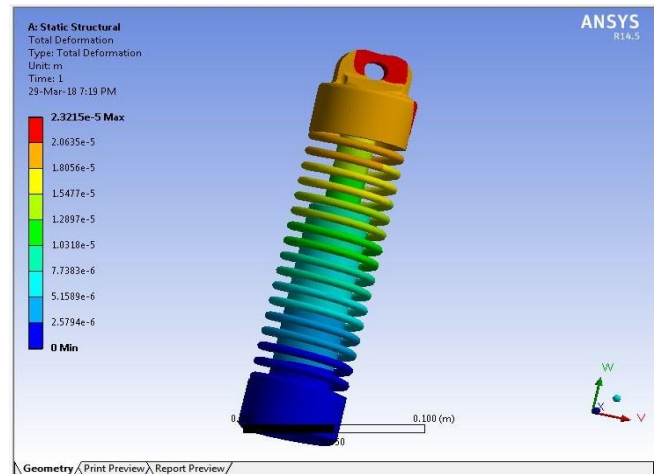
Fig.28 Total deformation & equivalent stress

Total Deformation & Equivalent Stress By Applying Of 125KG Load

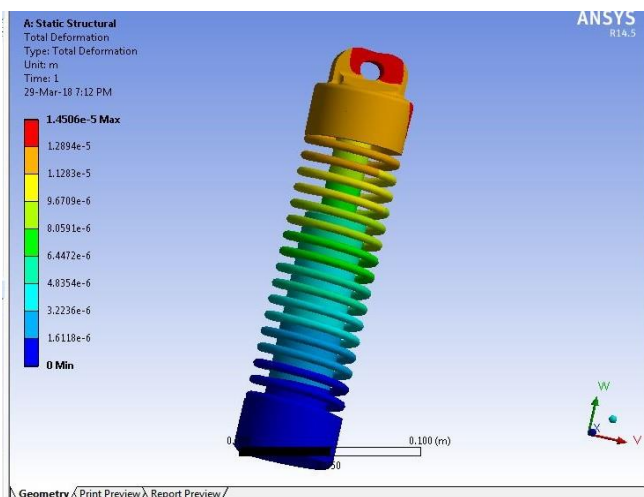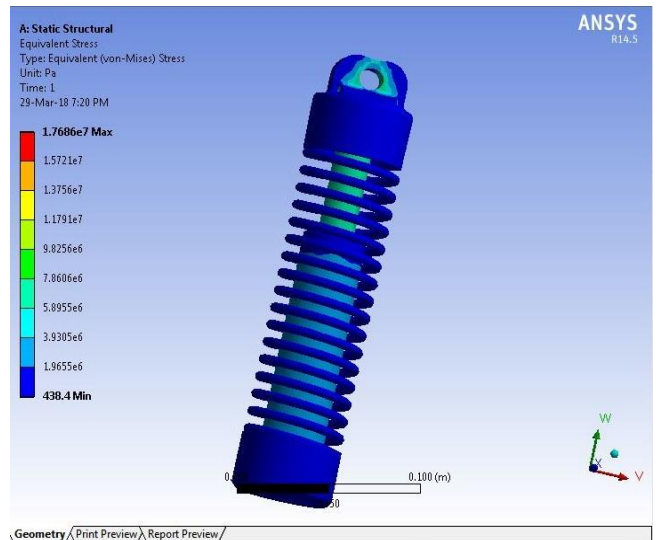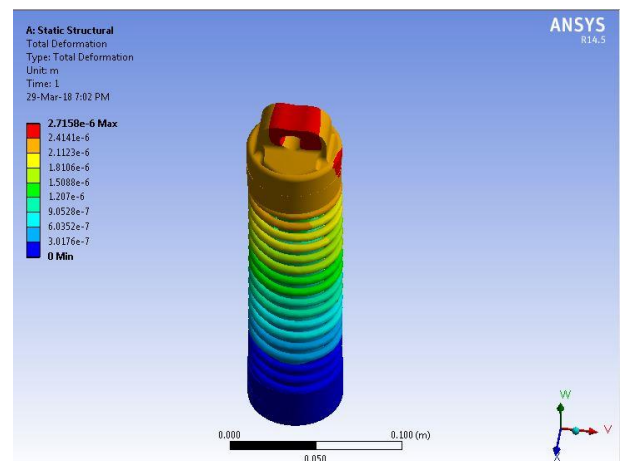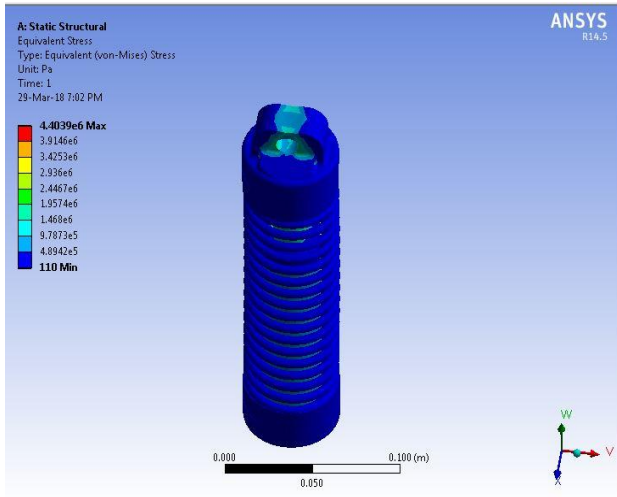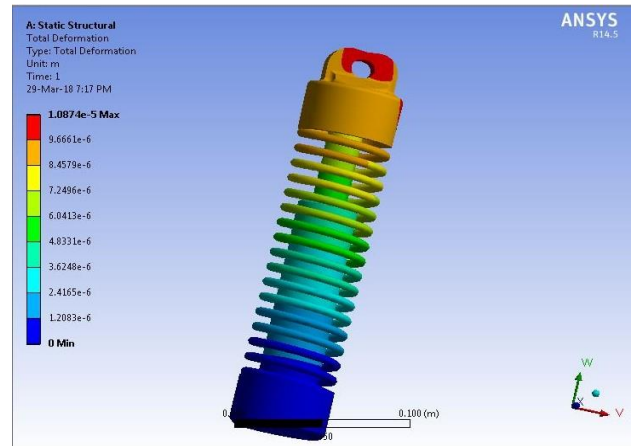Total deformation & equivalent stress by applying of 200KG load

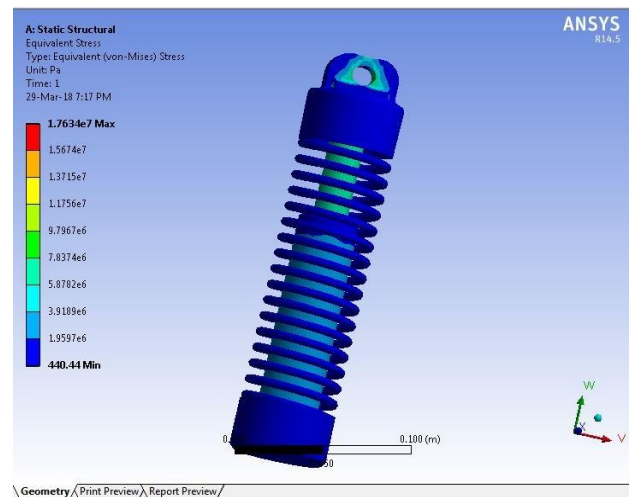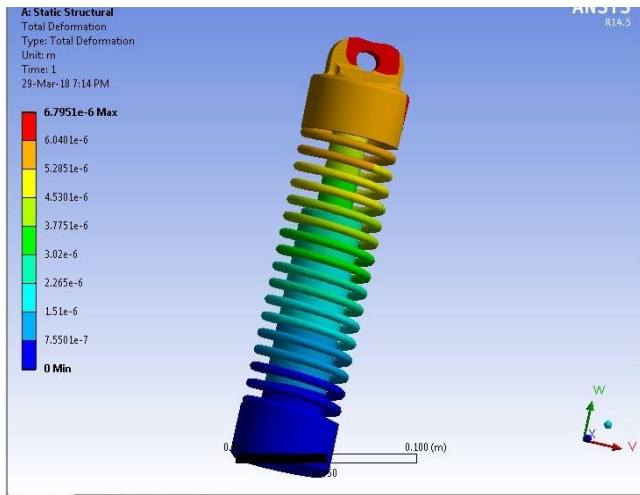**Fig.30** Total deformation & equivalent stress

5. MODEL ANALYSIS
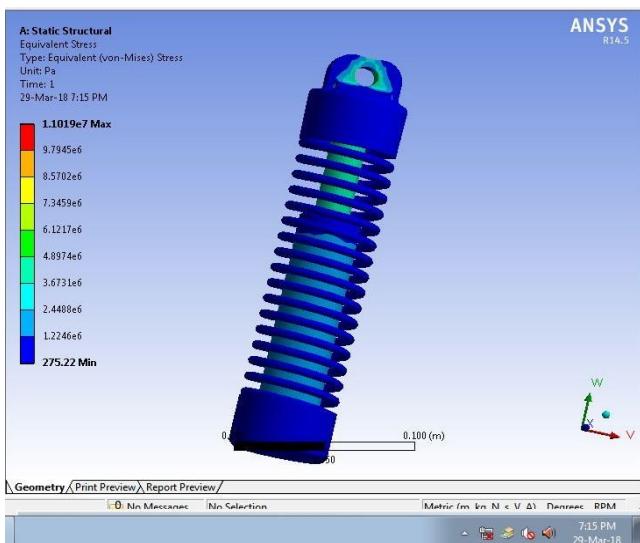
Total Deformation and Frequency Range in Steel Material

Fig .31 Total Deformation and Frequency Range in Steel Material

Fig.29 Total deformation & equivalent stress

Total Deformation and Frequency Range in Magnesium

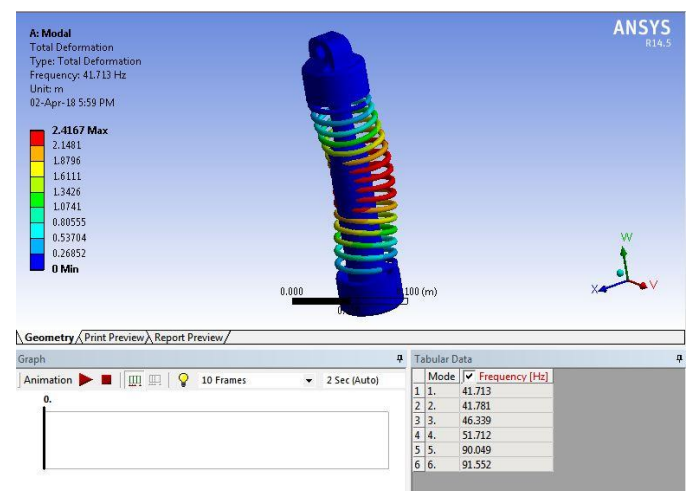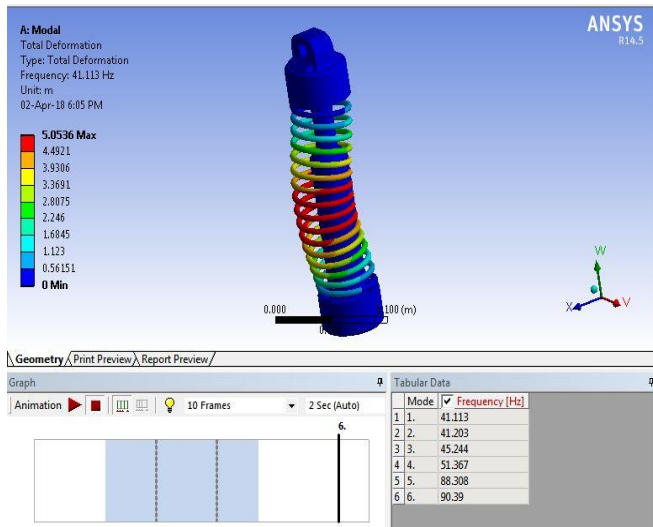**Fig.32** Total Deformation and Frequency Range in Magnesium
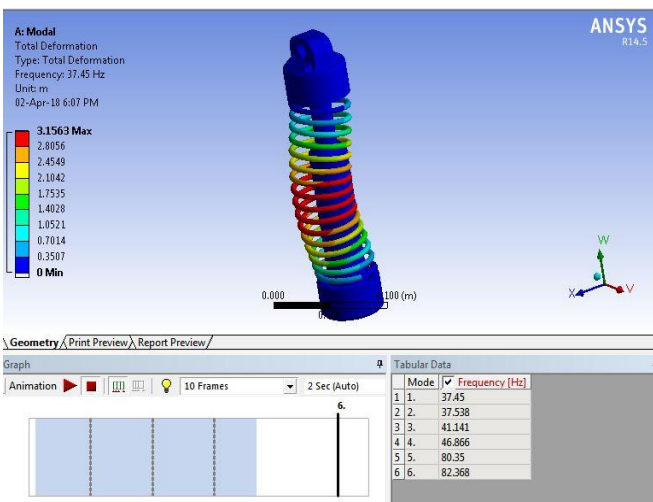
Total Deformation and Frequency Range in Titanium

Fig.33 Total Deformation And Frequency Range In Titanium

STEEL MATERIAL DATA

TABLE 18

Structural Steel > Constants

Density	7850 kg m^-3
Coefficient of Thermal Expansion	1.2e-005 C^-1
Specific Heat	434 J kg^-1 C^-1
Thermal Conductivity	60.5 W m^-1 C^-1
Resistivity	1.7e-007 ohm m

MAGNESIUM DATA

Magnesium Alloy > Constants

Density	1800 kg m^-3
Coefficient of Thermal Expansion	2.6e-005 C^-1
Specific Heat	1024 J kg^-1 C^-1
Thermal Conductivity	156 W m^-1 C^-1
Resistivity	7.7e-007 ohm m

TITANIUM DATA

Titanium Alloy > Constants

Density	4620 kg m^-3
Coefficient of Thermal Expansion	9.4e-006 C^-1
Specific Heat	522 J kg^-1 C^-1
Thermal Conductivity	21.9 W m^-1 C^-1
Resistivity	1.7e-006 ohm m

TABLE 1 Results and Comparison

S NO	MATERIAL	LOADS	al Deformation M	quivalent Stres
		50	1.31E-06	4.47E+06
		50+75	3.27E-06	1.11E+07
1	STEEL	50+75+75	5.24E-06	1.80E+07
		50	5.80E-06	4.42E+06
		50+75	1.45E-05	1.11E+07
2	MAGNESIUM	50+75+75	2.32E-05	1.77E+07
		50	2.72E-06	4.40E+06
		50+75	6.80E-06	1.10E+07
3	TITANIUM	50+75+75	1.09E-05	1.76E+07

TOTAL DEFORMATION& EQUIVALENT STRESS

TOTAL DEFORMATION& EQUIVALENT STRESS Graph
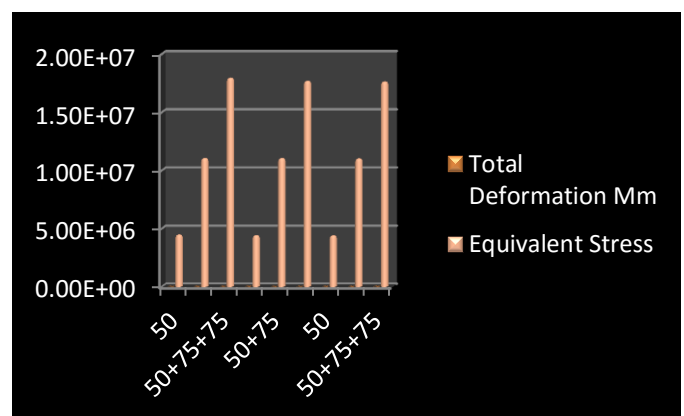
FREQUENCY VARIATION IN STEEL MATERIAL

FIGURE 1
Model (A4) > Modal (A5) > Solution (A6)
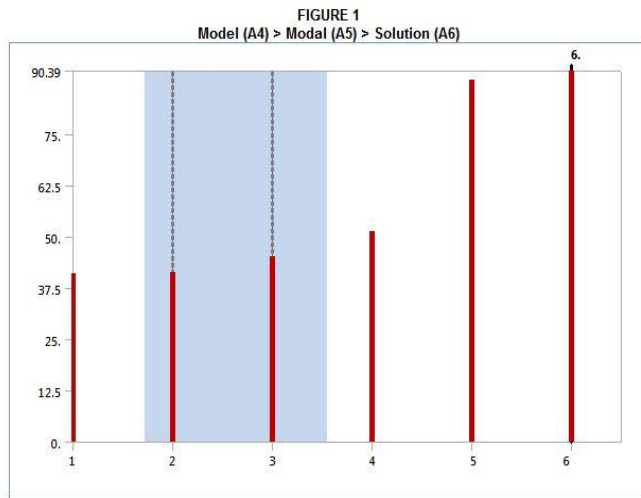
FREQUENCY VARIATION IN MAGNESIUM MATERIAL

FIGURE 1
Model (A4) > Modal (A5) > Solution (A6)
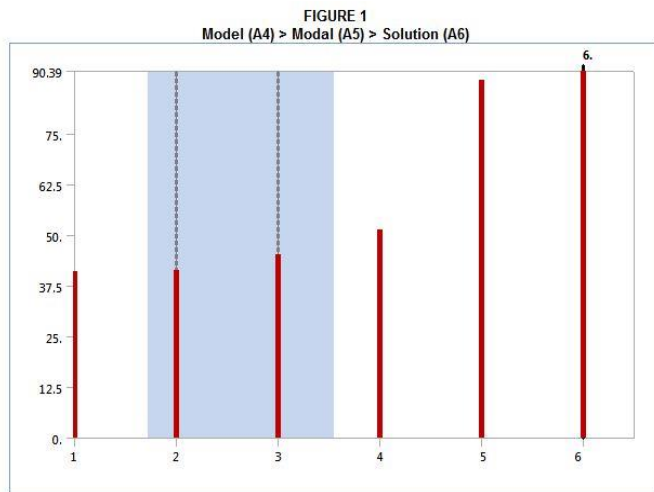
FREQUENCY VARIATION IN TITANIUM MATERIAL

FIGURE 1
Model (A4) > Modal (A5) > Solution (A6)
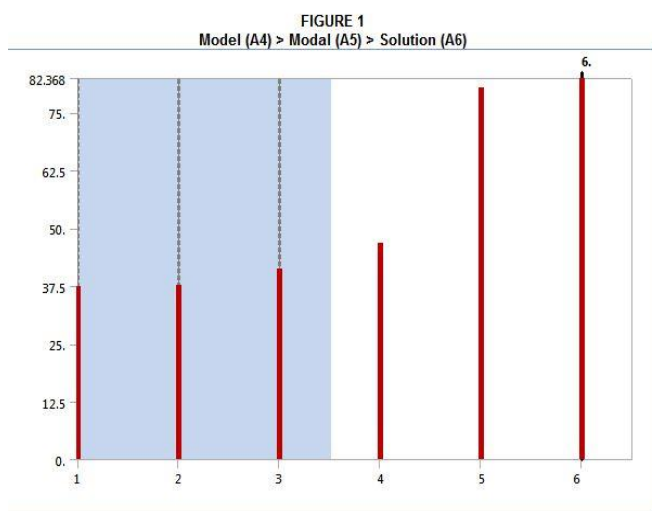
CONCLUSION

In our project we have designed a shock absorber used in a 150cc bike .We modeled shock absorber By using SOLID WORKS. To validate the strength of our design, we have done structural analysis and modal analysis on the shock absorber. We have done analysis by varying spring material is Steel, magnesium and titanium. 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 both materials, the stress value is less for titanium than steel and magnesium. Also the shock absorber design is modified by changes the diameter 2mm and loads 50kg, 125kg and 200kg and structural, modal analysis is done on the shock absorber. By comparing the results for both materials, the stress value is less for titanium than steel and magnesium. By comparing the results for present design and modified design, the stress and displacement values are less for modified design.

REFERENCES

1. Reza N. Jazar (2008). Vehicle Dynamics: Theory and Applications. Spring. p. 455. Retrieved 2012-06-24.

2. "Suspension Basics 1 - Why We Need It". Initial Dave. Retrieved 2015-01-29.

3. Adams, William Bridges (1837). English Pleasure Carriages. London: Charles Knight & Co.

4. "Suspension Basics 3 - Leaf Springs". Initial Dave. Retrieved 2015-01-29.

5. "wagon and carriage".

6. "The Washington Times, Sunday 30 June 1901". Chroniclingamerica.loc.gov. Retrieved2012-08-16.

7. Jain, K.K.; Asthana, R.B. Automobile Engineering. London: Tata McGraw-Hill. pp. 293– 294. ISBN 0-07-044529-X. 12. Pages 617-620 (particularly page 619) of "Race Car Vehicle Dynamics" by William and Douglas Milliken

8. R.S. Khurmi & J.K Gupta (2003), "A textbook of machine design", S. Chand & company.