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Design and Fem Analysis of Two Wheeler Suspension System

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I. INTRODUCTION

Suspension framework serves to store strain energy by avoiding themselves when the wheels go over any knock out and about. As soon as the wheels go off the bump, the spring rebound back owing it their inherent elastic action. The automobile frame & body is attached to the front & rear axle by suspension system which minimizes the effect of road shocks transmitted to the frame, thus protecting the various working parts of the vehicle and the occupants of a motor vehicle. Suspension system consists of a spring & a damper (shock absorber).

Objectives of Suspension System:

- To provide comfortable riding by minimizing road shocks.
- It reduces the stresses and strains on various components.
- It maintains stability in the moving vehicle by absorbing road shocks.
- To provide the particular height to body structure and to be bear the torque and braking reactions.

II. THEORETICAL DESIGN

A. Material: Spring Steel

Modulus of Rigidity: 70 TO 80 GPA
Weight of the Bike: HONDA: 149Kgs
YAMAHA: 135Kgs
Young's Modulus (EX):210000N/mm2
Poisson'sRatio:0.3
Density: 7850Kg/mm3
Consider,
Weight of the bike: 125 kgs
Weight of 2 persons: 75*2=150kgs
Rear suspension weight 65%
For Single shock absorber Weight: W/2 = 1617N

B. Formula Used For Stress

Maximum Shear Stress:

Let
D = Mean diameter
d = wire diameter
n = No. of active coils
G = Modulus of Rigidity for the spring material
W = axial load
τ = Maximum shear stress
C = spring index D/d
P = pitch of the coils
δ = Deflection of the spring

Maximum shear stress τ = Torsional Shear stress τ 1 + Direct shear stress τ 2

Torsional Shear stress (τ 1) = $\frac{8WD}{\pi d^3}$

Torsional Shear stress (τ 2) = $\frac{4W}{\pi d^2}$

Now

$\tau = 4W/\pi d^2\,[2D/d+1]$

$= 8WD/\pi d^3\,(1+1/2C)$

where C = D/d

$$\tau = k_s\,(8WD/\pi d^3)$$

where ks= Shear stress factor = 1+1/2C

Or

Maximum shear stress $\tau = k\,(8WD/\pi d^3)$

Wahl's Stress factor (k) = $\frac{4C-1}{4C-4} + \frac{0.615}{C}$

Formula Used For Deflection:

Deflection of the spring $\delta = 8WD^3n/Gd^4$

Deflection:

Deflection of the spring $\delta = 8WD^3n/Gd^4$
= 8x19600x2113x6.75/79300x33.54 = 99.55 mm

Displacement:

Displacement of the Coil Spring x = F/K

As per Honda Dimensions:

Maximum stress induced in the coil spring=156.663 N/mm2
Displacement of the Coil Spring= 5.3585mm

As per Yamaha Dimensions:

Maximum stress induced in the coil spring = 181.342 N/mm2
Displacement of the Coil Spring= 7.8258 mm

As per Case-1 Dimensions:

Maximum stress induced in the coil spring = 173.823 N/mm2
Displacement of the Coil Spring= 7.2142 mm

As per Case-2 Dimensions:

Maximum stress induced in the coil spring = 134.815 N/mm2
Displacement of the Coil Spring= 4.9077 mm

III. SOLID MODELING OF A COIL SPRINGS

Modeling of coil spring are done by usin SOLID WORKS –II cad software by considerin the dimensions of existin coil spring used in HONDA CB UNICORN & YAMAHA FZ bikes , since the coil springs are fixed at their ends for shock absorber , the ends of the springs are been extruded for the cuts on the top &the bottom . Load is applied at the top of the coil springs &constraints are fixed t the bottom of the springs. The solid models of coils springs are shown in the Figs. 1, 2, 3 & 4 respectively

Fig.1. honda cb unicorn.

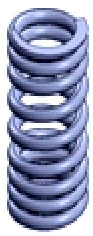

Fig.2. yamahafz.

Fig.3. case1.

Fig.4. case4.

For reducing the stresses induced in the coil springs the dimensions of the existing bikes springs are modified. In the below case in between dimensions of springs are considered. i.e., the below diagram has the dimensions of the existing springs. By considering the above case, the spring has benefit than the YAMAHA FZ only. For considering the HONDA the spring has been modified as per reducing dimensions of the Honda spring as shown below Figs.5 and 6.

TABLE I: Material Properties

S. No	Properties	Spring Steel	Beryllium Copper
1	Density(Kg/m^3)	7850	1850
2	Young'sModulus(N/m^2)	2.05e+011	3.034e+011
3	Poisson's Ratio	0.3	0.18
4	Compressive Strength (MPa.)	184	207
5	Thermal Conductivity (W/(m-K))	42.7	216.3

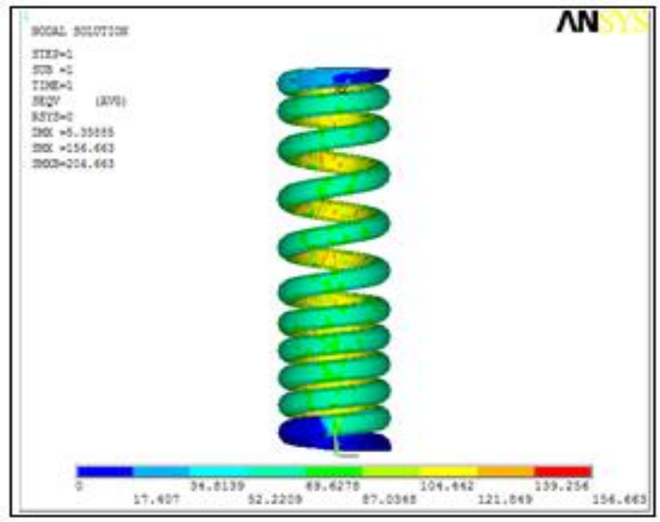

Fig.5. Vonmises Stresses.

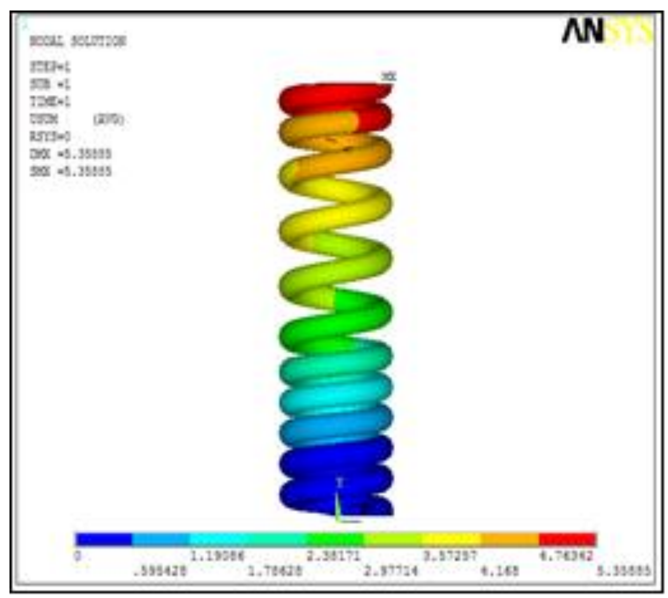

Fig.6. Displacement Vector.

A. Structural Analysis of Honda Spring using Spring Steel

From the static analysis, displacement and Von-misses stress of Honda coil spring is 5.3585mm and 156.663N/mm2. The results are shown in figs.7 and 8. The obtained results are within the allowable limits

B. Structural Analysis of Yamaha Spring using Spring Steel

From the static analysis, displacement and Von-misses stress of Yamaha coil spring is 7.8258mm and 181.342N/mm2. The results are shown from Figs.9 and 10. The obtained results are within the allowable limits.

C. Structural Analysis Of Spring In Case-1 Using Spring Steel

By considering above two coil springs Honda has a low stresses & displacement than the Yamaha. As per customer convenience Honda gives the best result than the Yamaha (i.e., mileage, comfort riding etc.). By these results we can easily say that analysis results are within the permissible limits. For modifying these types of Unicomfortness of the customer, the modification has been made on the dimensions of both springs.

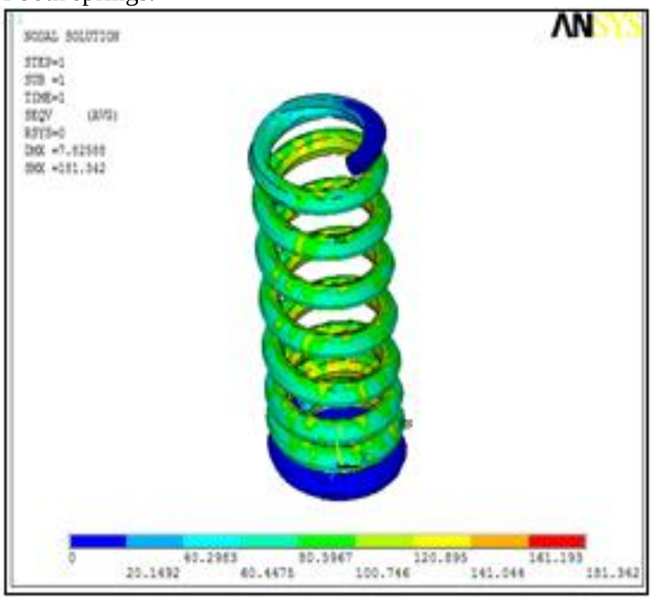

Fig.7. Vonmises Stresses.

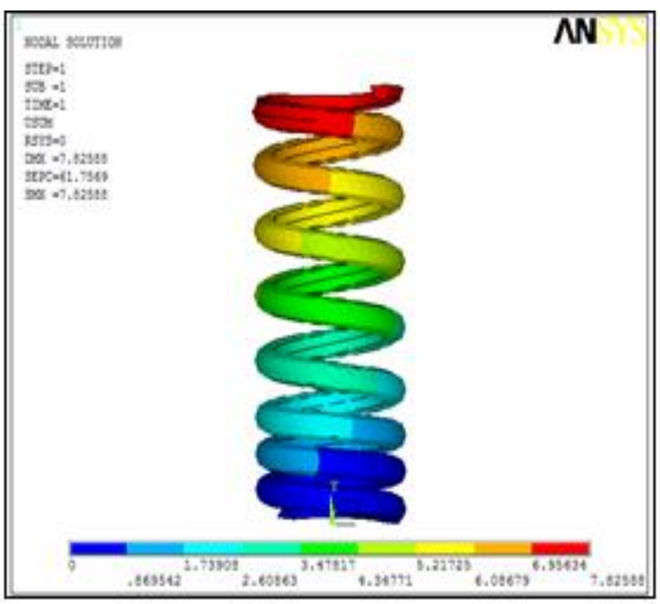

Fig.8. Displacement Vector.

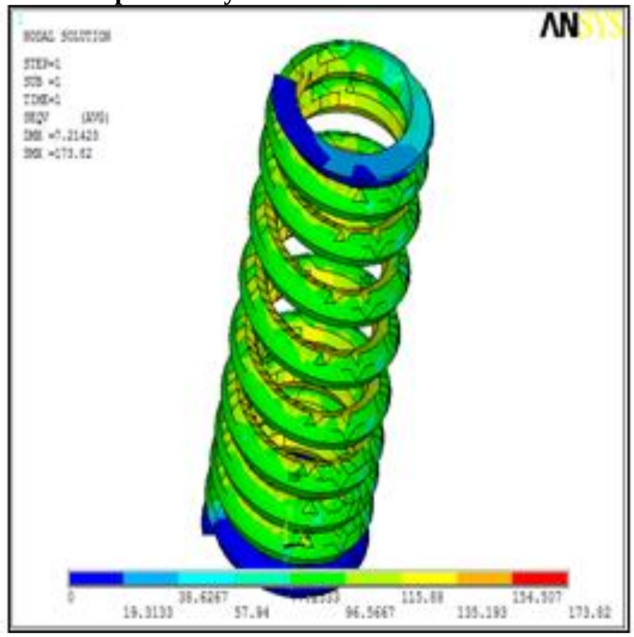

Fig.9. Vonmises Stresses.

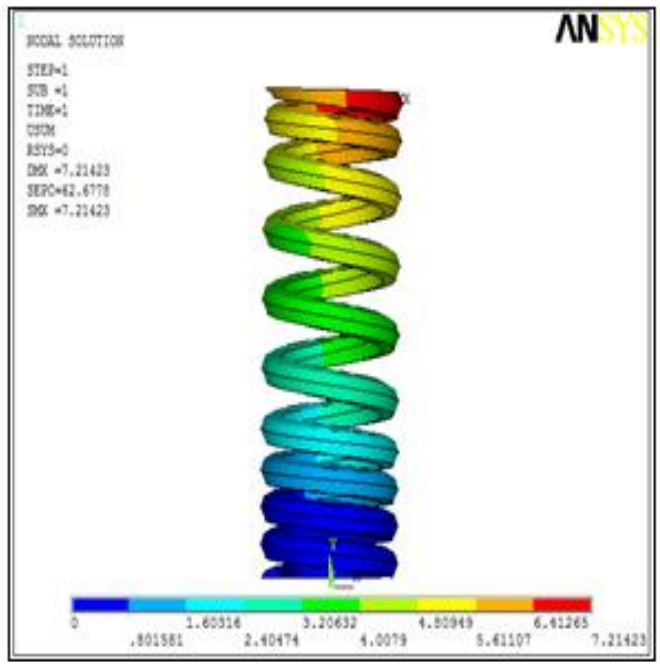

Fig.10. Displacement.

Here by observing the stresses & Displacements in the above case have higher results than Honda. In that manner again the dimensions of Honda coil spring are modified in the manner to reduce the stress. . In this case the Displacement & Stresses of coil spring is 4.9077mm & 134.815N/mm2. The above figure shows that reduced stresses & displacements than the Honda coil spring. In this case the Displacement & Stresses of coil spring is 7.2142mm & 173.82N/mm2. The above fig. shows that the stresses & displacements are below the Yamaha coil spring.

D. Structural Analysis of spring in Case-2 using Spring Steel

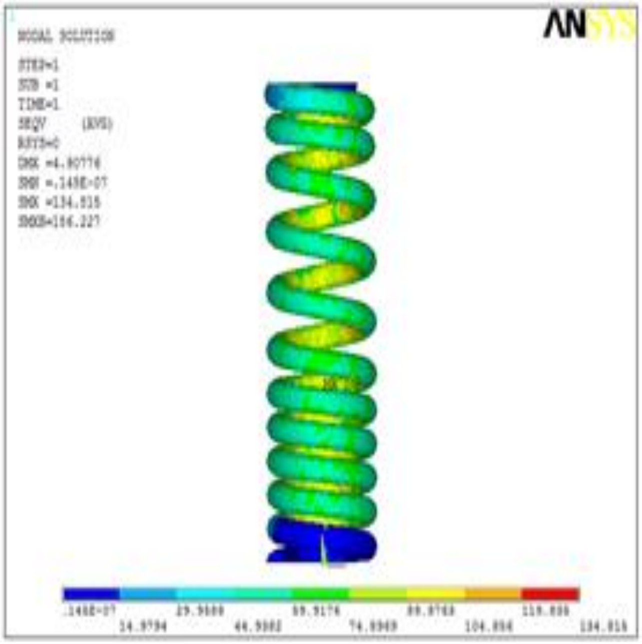

Fig.11. Vonmises Stresses.

From the results of static analysis of coil springs, the displacements are 5.358mm, 7.825mm, 7.214mm, & 4.907mm respectively as shown in Figs.11 and 12. And the corresponding Von-Misses stress values are 151.37N/mm2, 169.92N/mm2,173.82N/mm2 and 134.82N/mm2 respectively.

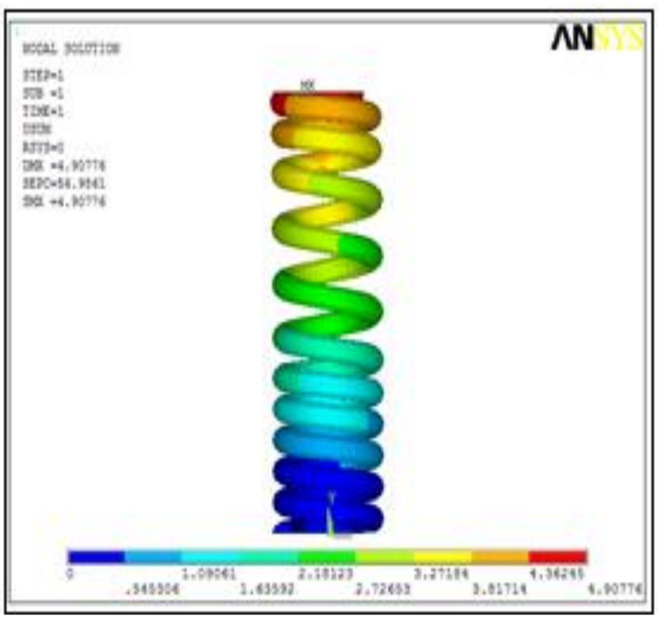

Fig.12. Displacement Vector.

E. Structural Analysis of Honda Spring using Beryllium Copper

From the static analysis, displacement and Von-misses stress of Honda coil spring is mm and N/mm2 respectively. The results are shown in Figs.13 and 14. The obtained results are within the allowable limits

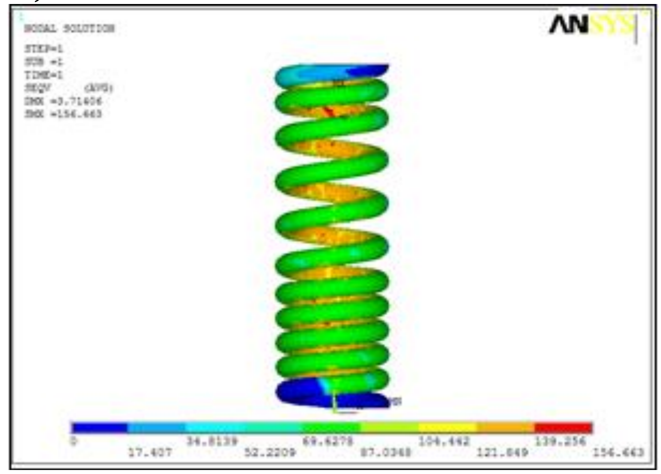

Fig.13. Vonmises Stresses.

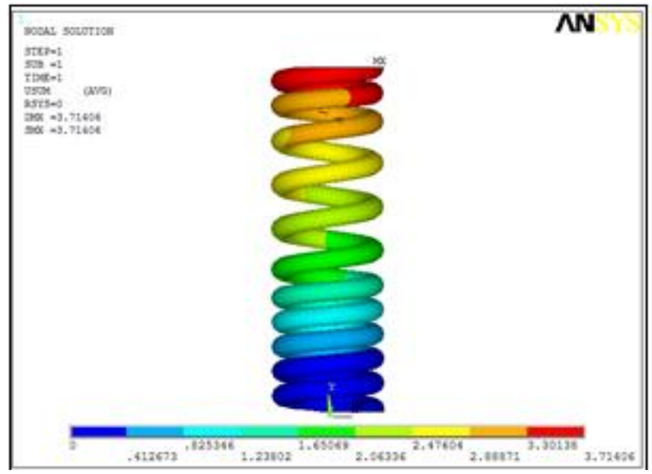

Fig.14. Displacement Vector Sum.

F. Structural Analysis of Yamaha Spring using Beryllium Copper

From the static analysis, displacement and Von-misses stress of Yamaha coil spring is mm and N/mm2 respectively. The results are shown from Figs.15 and 16. The obtained results are within the allowable limits.

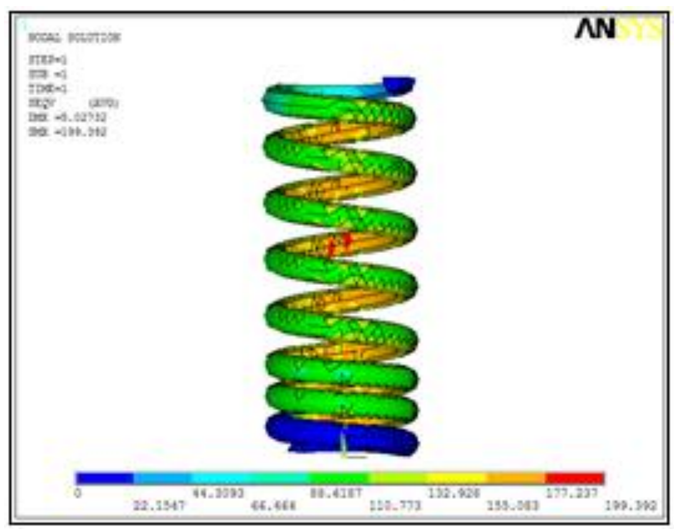

Fig.15. Vonmises Stresses.

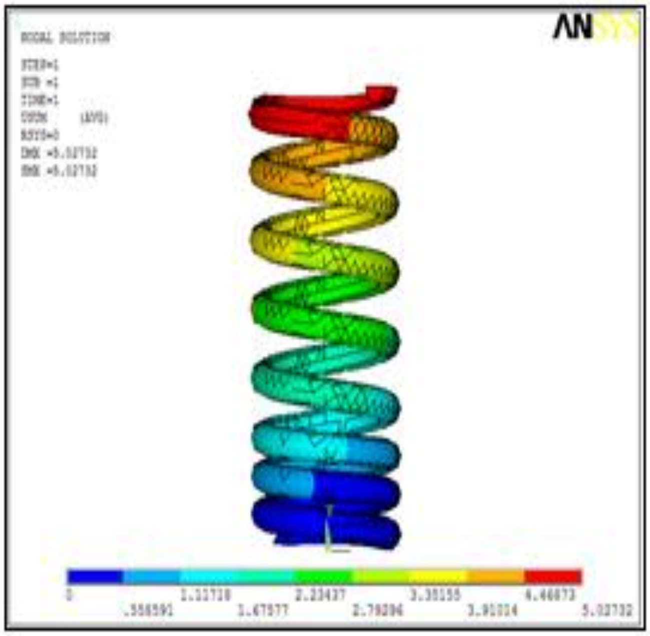

Fig.16. Displacement Vector.

G. Structural Analysis of springin Case-1 using Beryllium Copper

By considering above two coil springs Honda has a low stresses & displacement than the Yamaha. As per customer convenience Honda gives the best result than the Yamaha (i.e., mileage, comfort riding etc.). By these results we can easily say that analysis results are within the permissible limits. For modifying these types of Un comfortless of the customer, the modification has been made on the dimensions of both springs. In this case the Displacement & Stresses of coil spring is mm & mm respectively. The below Figs.17 and 18. shows that the stresses & displacements are below the Yamaha coil spring.

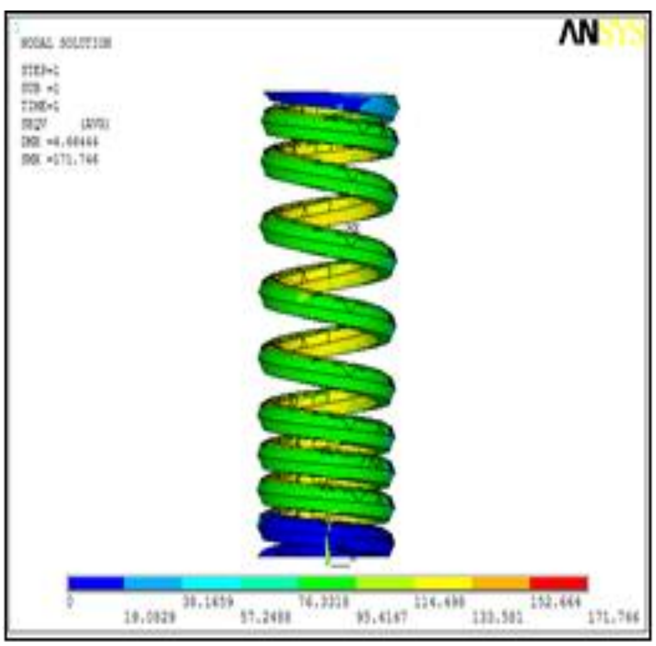

Fig.17. Vonmises stresses.

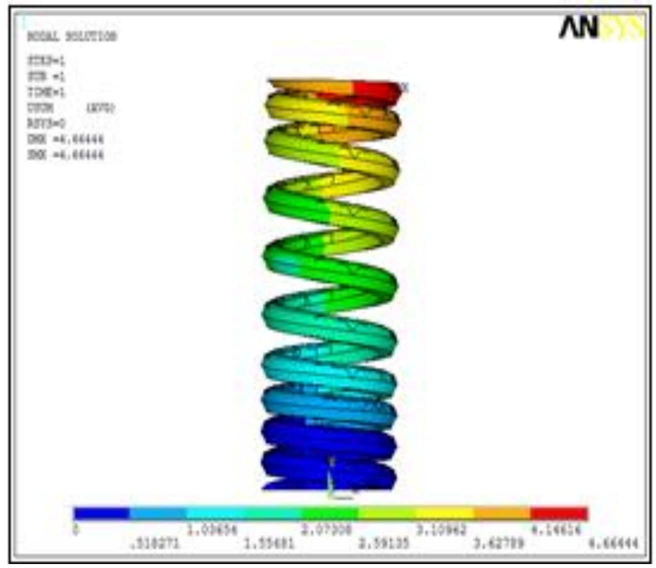

Fig.18. Displacement Vector.

Here by observing the stresses & Displacements in the above case have higher results than Honda. In that manner again the dimensions of Honda coil spring are modified in the manner to reduce the stress. . In this case the Displacement &Stresses of coil spring is mm & N/mm2 respectively. The below figure shows that reduced stresses & displacements than the Honda coil spring.

H. Structural Analysis of springin Case-2 using Beryllium Copper

From the results of static analysis of coil springs, the displacements are 5.358mm, 7.825mm, 7.214mm, & 4.907mm respectively. And the corresponding Von-Misses stress values are 151.37 N/mm2, 169.92 N/mm2, 173.82 N/mm2 and 134.82 N/mm2 respectively as shown in Figs.19 and 20.

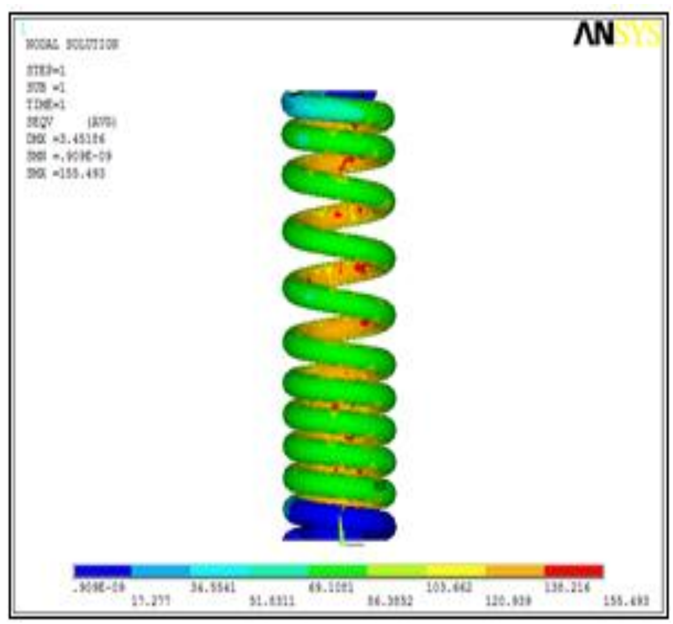

Fig.19. Vonmises Stresses.

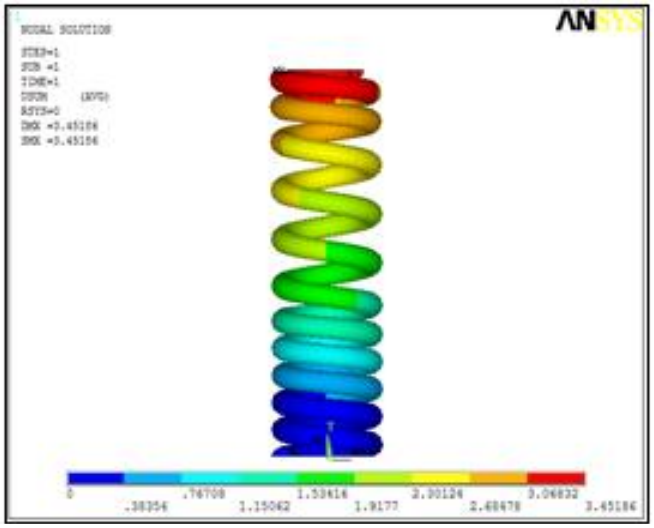

Fig.20. Displacement Vector.

IV. ANALYTICAL RESULTS

Analytical results obtained for Existing & Proposed coil springs using ANSYS 14.0 is shown in the table.

TABLE II: Analytical Results

Type Of Spring	Spring Steel		Beryllium Copper	
	Vonmisses Stresses (N/mm2)	Displacement (mm)	Vonmisses Stresses (N/mm2)	Displacement (mm)
Honda	156.663	5.3585	156.663	3.7141
Yamaha	181.342	7.8258	199.392	5.0273
Case-1	173.821	7.2142	171.746	4.6644
Case-2	134.815	4.9077	155.493	3.4518

The table 2 gives the results of the two materials i.e. Spring steel & beryllium copper. It shows that Beryllium Copper gives approximately same deformation and stress when loads are applied. Therefore Beryllium Copper alloy is preferred for the coil springs.

A. Analytical Results

Shear stress equation is used for calculating the maximum stress induced in the spring. Alternating material is used for reducing the weight of the vehicle. For that Beryllium Copper is used here to find out the stresses & displacements of the Coil Springs. Finally Comparison has been made for theoretical results obtained from the shear stress equation to the Finite Element Analysis (FEA) results& for two types of materials which is used for the springs. An analysis result gives the better results than the existing one. By these FEA results gives the better accuracy. Beryllium Copper gives the better weight reduction in the vehicle. There is a chance for Investigations to be made on different shapes for the coil of the spring to achieve the overall weight reduction of the automobile without affecting the riding comfort of the two-wheeler suspension.

V. REFERENCES

[1]Kommalapati. Ramesh Babu, TippaBhimasankara Rao. “Design Evaluation of a Two Wheeler Suspension System for Variable Load Conditions” International Journal of Computational Engineering Research Vol. 03 Issue 4 April, 2013.

[2]S. Segla1 S. Reich2. “Optimization and comparison of passive, active, and semi-active vehicle suspension systems” 12th IFTOMM World Congress, Besancon (France), June18-21, 2007.

[3]Pinjarla.Poornamohan 1, Lakshmana Kishore.T 2. “Design and Analysis of a Shock absorber” ISSN: 2319 - 1163 Volume: 1 Issue: 4 578 – 592.

[4]Prof. D. K. Chavan1 Sachin V. Margaje2 Priyanka A. Chinchorkar3 “Suspension in Bikes Considering Preload, Damping Parameters and Employment of Mono Suspension in Recent Bikes” ISSN: 2231-5381, International Journal of Engineering Trends and Technology- Volume4Issue2- 2013.

[5]P.S.Valsange “Design Of Helical Coil Compression Spring” A Review” (IJERA) Vol. 2, Issue 6, November-December 2012, pp.513-522.

[6]Niranjan Singh “General review of mechanical springs used in Automobiles suspension system” Singh, international journal of advanced engineering research and studies, E-ISSN2249–8974, Int. J. Adv. Engg. Res. Studies/iii/i/oct.-dec.,2013/115-122 Review article.

[7]Adam G. Rasbach, Orion, MI (US). “United States Patent Application Publication” Pub. N0. US 2013/0127101 A1 Rasbach (43) Pub. Date: May 23, 2013.