Design And FEA Analysis of Two Wheeler Shock Absorber Spring

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***Abstract*— In two-wheeler, helical compression springs are used for the suspension. The shock absorbing capacity of helical compression spring is good. Steel type springs are used in two-wheeler. The main aim of our project is to study and design the helical compression springs that will be used in two wheelers. We will take steel spring and its testing will be done on UTM. In next step we will take another spring of Stainless-steel grade 304 and it also tested on UTM. After that the comparison of springs will be concluded. The FEA analysis of springs is also carried out to see compare the practical and analysis results. After going through this we see that the deflection of Stainless-steel grade 304 is more as compared to the Steel spring grade 2. So, it is concluded that we can use Stainless steel spring instead of Steel spring in two wheelers to increase the suspension of the vehicle.**

Index Terms*— *Helical compression spring, UTM, Stainless Steel, Spring Steel, FEA

I. INTRODUCTION (HEADING 1)

Suspension is the system of tires, tire air, springs, shock absorbers and linkages that connects a vehicle to its wheels and allows relative motion between the two. Suspension systems must support both road holding/handling and ride quality, which are at odds with each other. The tuning of suspensions involves finding the right compromise. It is important for the suspension to keep the road wheel in contact with the road surface as much as possible, because all the road or ground forces acting on the vehicle do so through the contact patches of the tires. The suspension also protects the vehicle itself and any cargo or luggage from damage and wear. The design of front and rear suspension of a car may be different.

II. SPRING RATE

Spring rate is a ratio used to measure how resistant a spring is to being compressed or expanded during the spring's deflection. The magnitude of the spring force increases as deflection increases according to Hooke's Law. Briefly, this can be stated as
$F = - K*X$
Where, F is the force the spring exerts
k is the spring rate of the spring.
x is the deflection of the spring from its equilibrium position (i.e., when no force is applied on the spring)

III. PROBLEM STATEMENT

In two-wheeler system steel springs are used whose shock absorbing capacity is less. So, to increase the shock absorbing capacity Stainless spring will be used.

IV. OBJECTIVES

- To find out the deflection generated in spring under loading and dead weight loading condition.
- Comparison of steel spring deflection and stainless spring deflection.
- To analyze the Stainless-steel spring over the steel spring.
- Weight optimization for existing spring by designing new spring of different material.

V. METHODOLOGY

STAGE 1: - We started the work of this project with literature survey. We gathered many research papers which are relevant to this topic. After going through these papers, we learnt about various types of springs and selected the project design and analysis of two-wheeler shock absorbing spring.

STAGE 2: - The two springs are considered such as steel spring and stainless-steel spring. The testing of these two springs are carried out on UTM to determine the deflection of spring.

STAGE 3: - After that the Analysis of these two springs will be carried out with the help of ANSYS software to determine the load and stress values for both the springs.

STAGE 4: - After analyzing the results, graphs and charts are plotted and then the conclusion will be drawn.

VI. CALCULATIONS:

SPRING 1 GRADE 2:

GIVEN:

Outer Diameter = 29mm
Wire diameter (d) = 4.5mm
Mean Coil Diameter (D) = O.D. – d = 29- 4.5 = 24.5mm
Free Length (L_f) = 245mm
Force (F) = 1.74KN
Deflection (δ) = 104.5mm
Modulus of rigidity (G) = 75GPa
CALCULATIONS:

1. Spring Stiffness (K) –
   We know that F = K*δ
   K = F / δ
   K = 16.65 N/mm
2. Spring Index (C) –
   C = D /d
   C = 24.5 / 4.5 = 5.4

3. No. of turns (n) –
   K= (G*d) / (8*C^3*n)
   n= 17

4. Pitch (p)-
   L_f = p*n + d
   245 = p*17 + 4.5
   P = 14.15mm

5. Solid Length (L_s) –
   L_s = (n + 1) d = (17+1) 4.5

   L_s = 81mm

SPRING 2 GRADE 304:
GIVEN:
Outer Diameter = 29mm
Wire diameter (d) = 4.5mm
Mean Coil Diameter (D) = O.D. – d = 29- 4.5 = 24.5mm
Free Length (L_f) = 245mm
Force (F) = 1.86KN
Deflection (δ) = 103.9mm
Modulus of rigidity (G) = 77GPa
CALCULATIONS:

1. Spring Stiffness (K) –
   We know that F = K*δ
   K = F / δ
   K = 17.9 N/mm

2. Spring Index (C) –
   C = D /d
   C = 24.5 / 4.5 = 5.4

3. No. of turns (n) –
   K= (G*d) / (8*C^3*n)
   n= 17

4. Pitch (p)-
   L_f = p*n + d
   245 = p*17 + 4.5
   P = 14.15mm

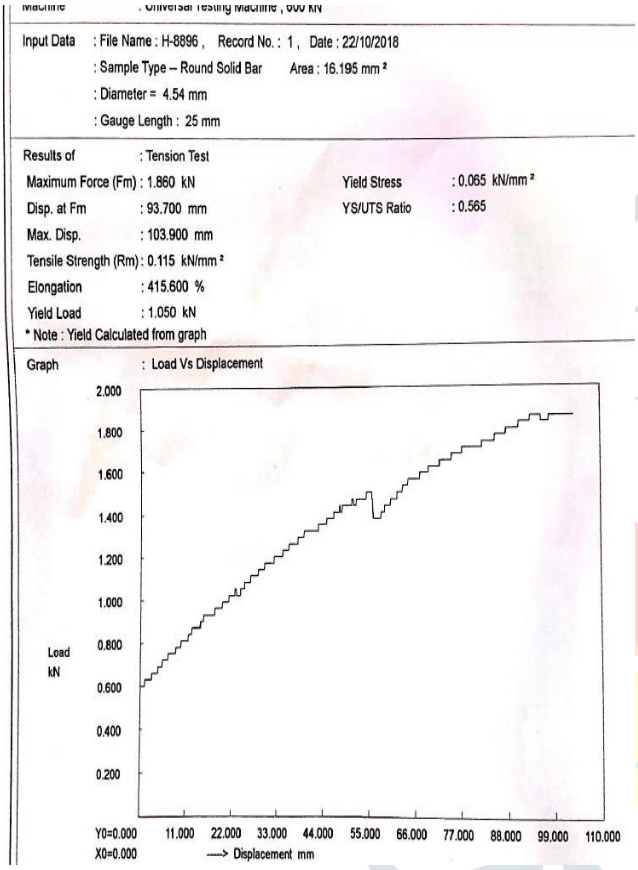
5. Solid Length (L_s) –

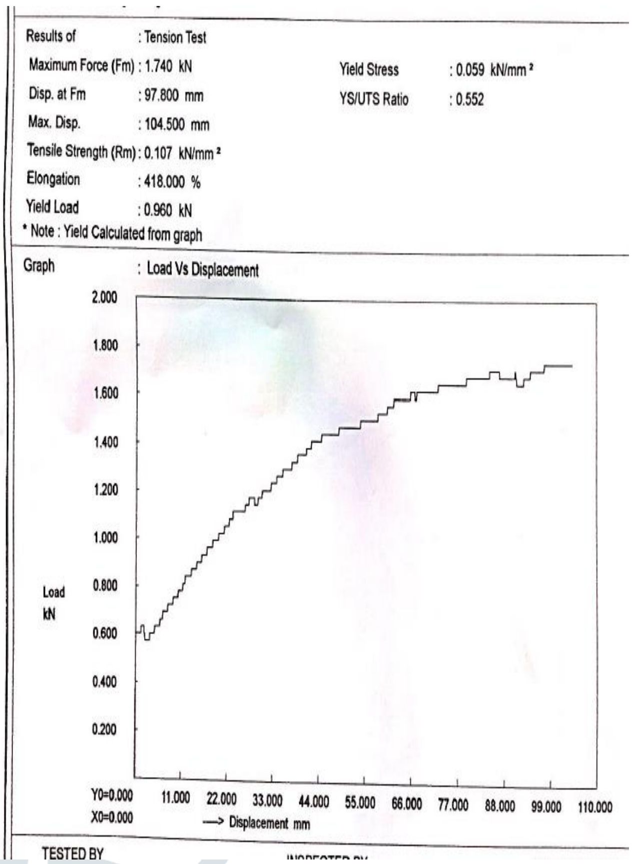
$L_s = (n + 1)\, d = (17+1)\, 4.5$

$L_s = 81\text{mm}$

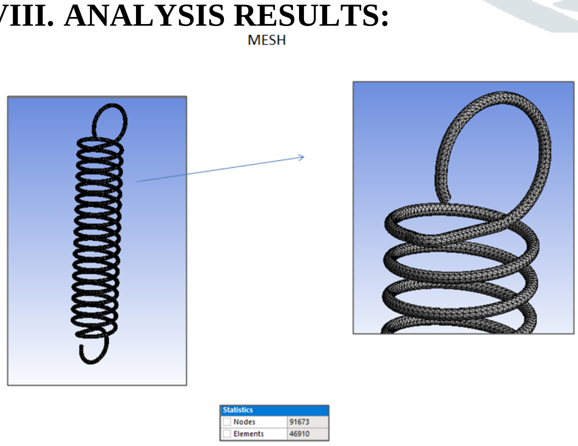
VII. EXPERIMENTAL TESTING:

The experimental testing of springs will be carried out on UTM. A universal testing machine (UTM), also known as a universal tester, materials testing machine or materials test frame, is used to test the tensile strength and compressive strength of materials. An earlier name for a tensile testing machine is a tensometer. The "universal" part of the name reflects that it can perform many standard tensile and compression tests on materials, components, and structures (in other words, that it is versatile).

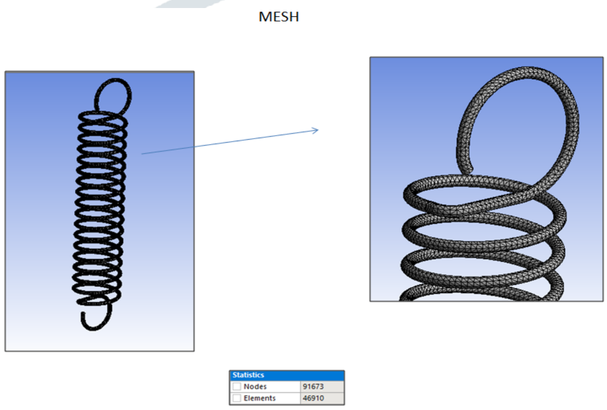




VIII. ANALYSIS RESULTS:

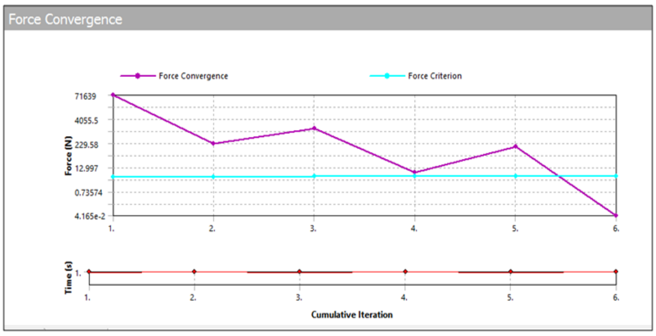


Meshing of Stainless-Steel



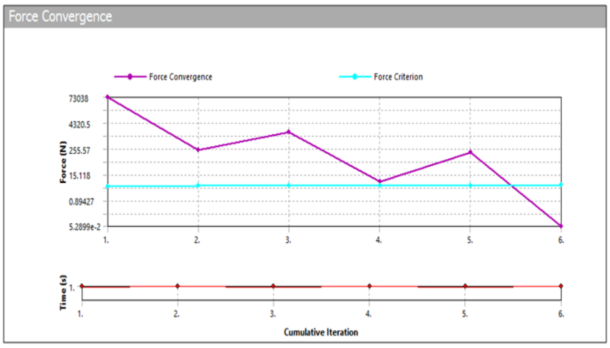
Meshing of Spring steel

Nonlinear Convergence



Stainless Steel

Nonlinear Convergence



Spring steel

IX. RESULT & CONCLUSION:

SR.NO.	CHARACTERISTICS	STAINLESS STEEL	SPRING STEEL
1	Total Deformation (mm)	103.02	104.02
2.	Equivalent Stress (MPa)	573.16	578.82
3.	Maximum Principal Stress (MPa)	379.82	383.69
4.	Minimum Principal Stress (MPa)	0.49057	0.49532

From the above table, it is clear that the deformation is more in spring steel as compared to stainless steel.

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