# Analysis of Coil Spring Used In Two Wheeler Suspension System

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*Abstract*— **The present work is carried on modeling, analysis and testing of suspension coil spring is to replace the existed coil spring used in popular two wheeler vehicle. The deflection of the coil spring is going to be reduced by using the new material. Static analysis determines the stress and deflection of the coil spring in finite element analysis. The testing prototype is used to test the spring under different loading conditions. FEA are the methods of finding approximate solutions to a physical problem defined in a finite region in this finite element analysis values are compared to the experimental values. A typical two wheeler suspension spring is chosen for study, analysis is carried out on ANSYS 16.2**

***Keywords: spring constant, modeling, ANSYS 16.2***

## I.INTRODUCTION

When people think about automobile performance, they normally think of horse power, torque and 0-100 km ph acceleration. But all of the power generated by a piston engine is useless if the driver can't control the bike. That's why the suspension system in an automobile is important and so much attention is given to it. The vehicle suspension system is responsible for the vehicle control, driving comfort and safety as the suspension carries the vehicle body and transmits all the forces between the road and the body.

**Spring:** A spring is defined as an elastic body, whose function is to distort when loaded and when the load is removed it regains its original shape.

**Types of spring:**

1. Helical spring
2. Torsional spring
3. Laminated or leaf spring
4. Special purpose spring

## II. PROBLEM STATEMENT

Objectives of project are,

- Modeling, analysis & testing of coil spring used in two wheeler.
- Design and analysis of stress & deflection of coil spring.
- To test the spring under different loading condition.
- Use FEA method.

## III. METHODOLOGY

- In this work ,modeling of new spring and analysis of spring material in order to optimize load carrying capacity of selected spring.
- Material select for analysis are vanadium chrome steel, oil tempered low carbon steel and Inconel X 750 alloy steel.
- The modeling of spring is to verify by using ANSYS 16.2 software to perform finite element analysis.
- The calculated results are to compare on common scale and the prediction of the spring can be conclude.
- Specification of coil spring Are as follows:

**Table No. 3.1 Specification**

| Sr no. | Specification | Value |
|---|---|---|
| 1 | Material name | EN 42 steel |
| 2 | Outside diameter | 49mm |
| 3 | Inside diameter | 35mm |
| 4 | Mean diameter | 42mm |
| 5 | Wire diameter | 7mm |
| 6 | Spring index | 6 |
| 7 | Free length | 230mm |
| 8 | Solid length | 122mm |
| 9 | No of active coils | 17 |
| 10 | No of total coils | 19 |
| 11 | Density | 78000kg/m$^3$ |
| 12 | Young's Modulus | 210000Mpa |
| 12 | Modulus of rigidity | 80000Mpa |

### 3.1 Equations of spring design:

1. $K=Gd^4/8D^3N$
2. $\partial=P/K$

Where,

K= stiffness of spring (N/mm)
G= modulus of rigidity (N/mm$^2$)
D= mean coil diameter (mm)
N= no of active coils
ȡ= deflection of coil (mm)
p= Load on coil (N)

### 3.2 Material and properties of spring design:

**Table No 3.2 Material properties**

| Material's | Modulus of Elasticity (Mpa) | Modulus of Rigidity (Mpa) | Poisson's Ratio (Mpa) |
|---|---|---|---|

| | | | |
|---|---|---|---|
| EN42 | 210 | 80.7 | 0.3 |
| Vanadium Chrome Steel | 207 | 81.4 | 0.27 |
| Oil Tempered Steel | 207 | 80.2 | 0.29 |
| Inconel X750 | 214 | 82.9 | 0.29 |

## IV. ANALYSIS OF COIL SPRING BY THEROROTICALLY

**Table No. 4.1 load vs deflection**

| Material | Deflection at various loads | | | |
|---|---|---|---|---|
| load | AISI 1074 | ASTM A231 | ASTM A229 | AMS 5698 |
| 30kg | 15.304 | 15.172 | 15.399 | 14.898 |
| 60kg | 30.608 | 30.345 | 30.799 | 29.797 |
| 90kg | 45.912 | 45.518 | 46.199 | 44.696 |
| 120kg | 61.210 | 60.691 | 61.590 | 59.594 |
| 150kg | 76.521 | 75.864 | 76.998 | 74.493 |

## V. FEA ANALYSIS OF COIL SPRING

### 5.1 Introduction to FEA:

A primary reason to use FEA in coil design is to reduce the error caused by simplifications of the equations. The most accurate FEA results can be obtained by creating 3-D parts of a coil spring, followed by using finer meshing of the parts with 3-D solid element.

Steps used in analysis of coil spring by FEA:

1. Preprocessing.

Preprocessing consist of preparation of data such as nodal coordinate, connectivity, boundry conditions, loading and material information.

2. Processing.

It involves stiffness generation, stiffness modification, and solution of equation, resulting in the evaluation of nodal variable.

3. Post processing.

It deals with the preparation of result.

### 5.2 Material:

**1. EN 42 (AISI 1074)**

Fig 1, 2,3,4,5 shows the load vs deflection diagram for various load 150 kg, 120 kg, 90kg, 60 kg, 30kg respectively.

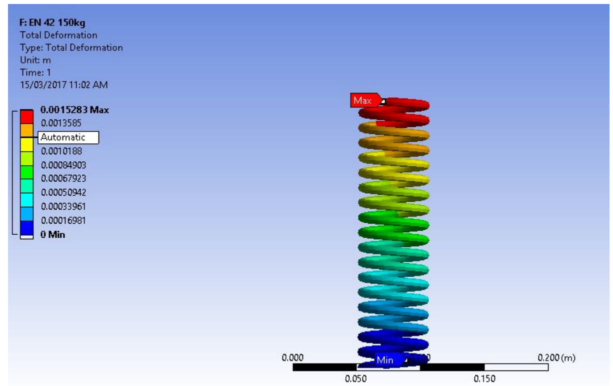



Fig.1 load (150 kg) vs deflection.

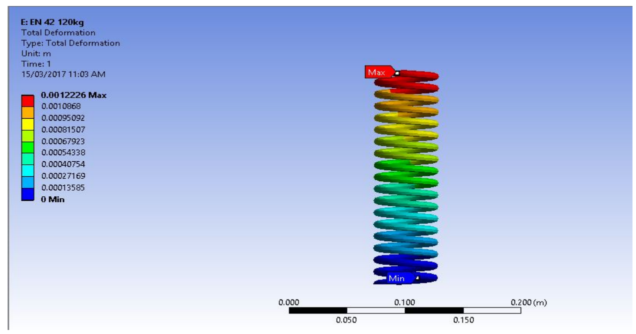



Fig.2 load (120 kg) vs deflection.

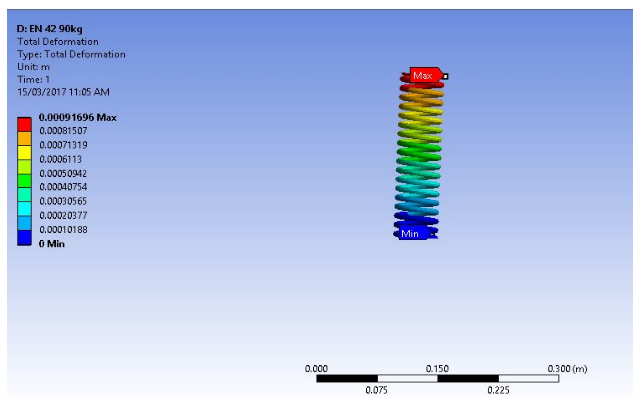



Fig.3 load (90 kg) vs deflection.

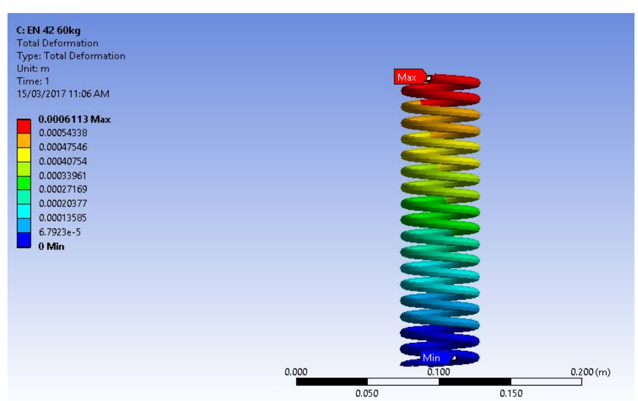



Fig.4 load (60 kg) vs deflection.

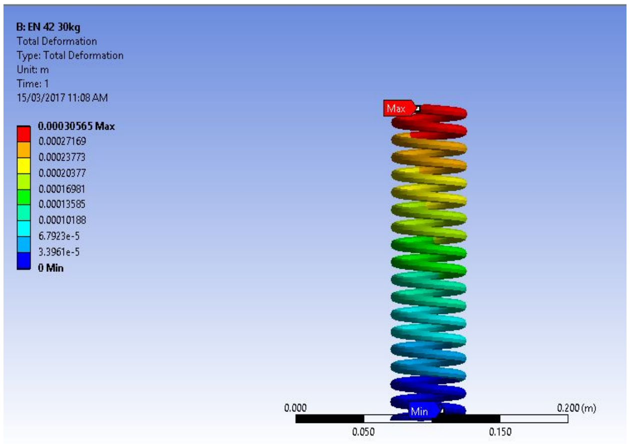



Fig.5 load (30 kg) vs deflection.

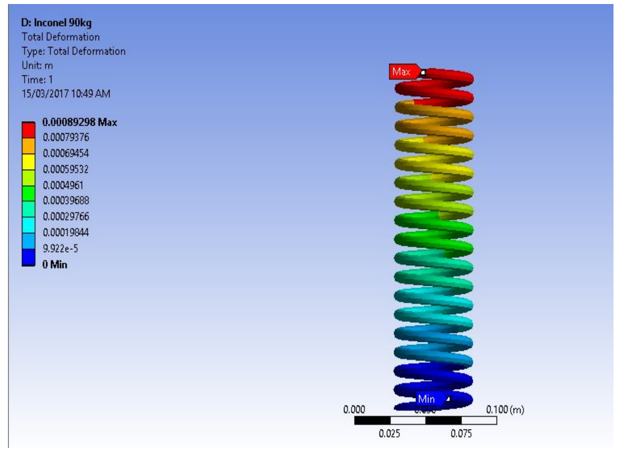



Fig.8 load (90 kg) vs deflection.

**2. Inconel X 750 (AMS 5698)**

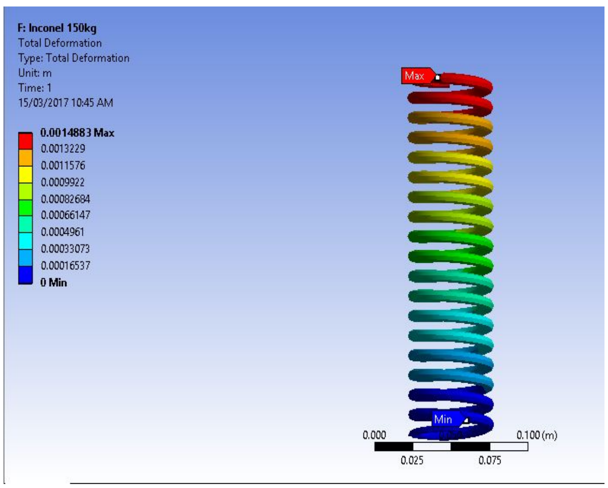



Fig.6 load (150 kg) vs deflection.

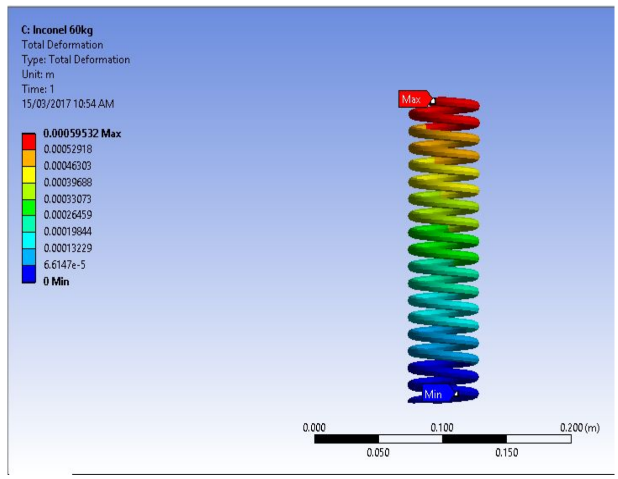



Fig.9 load (60 kg) vs deflection.

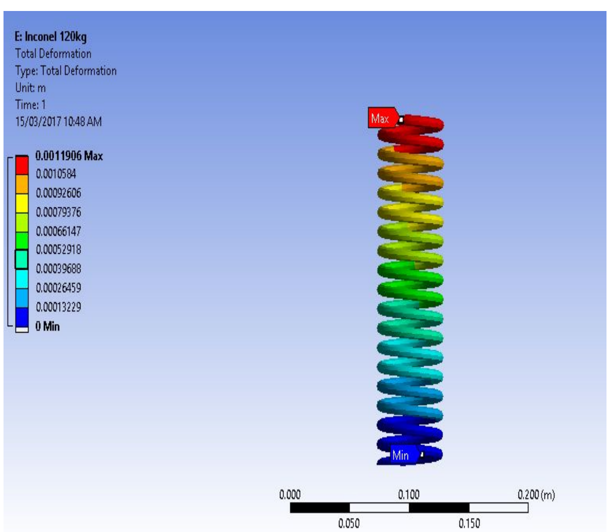



Fig.7 load (120 kg) vs deflection.

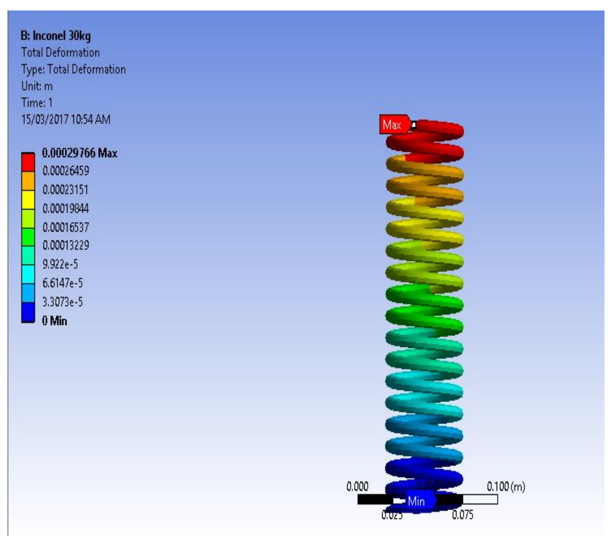



Fig.10 load (30 kg) vs deflection.

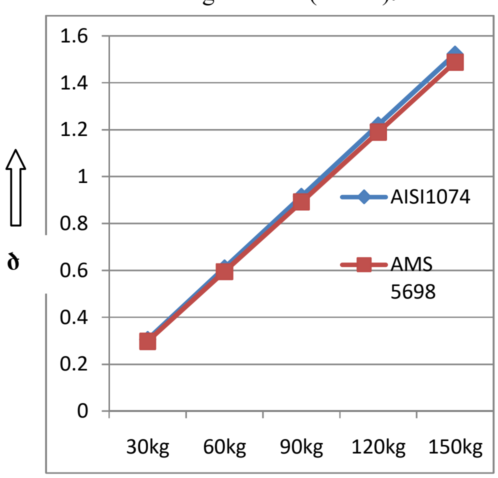
**5.3 Analysis of coil spring by software ANSYS 16.2**

**Table No. 5.1 load vs deflection**

| Material | Deflections at various loads, mm | | | |
|---|---|---|---|---|
| Loads | AISI 1074 | AST M A231 | AST M A229 | AM S 5698 |
| 30kg | 0.306 | 0.303 | 0.307 | 0.29 |
| 60kg | 0.611 | 0.606 | 0.615 | 0.59 |
| 90kg | 0.916 | 0.909 | 0.923 | 0.89 |
| 120kg | 1.22 | 1.212 | 1.230 | 1.19 |
| 150 | 1.523 | 1.515 | 1.53 | 1.48 |

## VI. CONCLUSION

1) From theoretical analysis the deflection for the En 42 at 150 kg is 76.521 mm and for Inconel X 750 is 74.493mm.
2) From FEA analysis the deflection for the En 42 at 150 kg is 1.523 mm and for Inconel X 750 is 1.48mm.
3) From above both analysis we conclude that Inconel X 750 has more load carrying capacity y so that it deflects less than other coil spring and existing coil spring.
4) From graph we conclude that Inconel X 750 material is better than existing material (EN 42).




**Load (Kg)**

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