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DESIGN AND ANALYSIS OF HELICAL COIL SPRING USED IN TWO WHEELER MOTORCYCLE USING FEA APPROACH

Parth I. Gondaliya[1], Vipul B Gondaliya[2]

[1]PG scholar Mechanical Engineering Department RK University Rajkot
[2] Assistant professor, Mechanical Engineering Department , Om Engineering College Junagadh.

ABSTRACT — In vehicles problem happens while driving on bumping road condition. The objective of this project is to design and analyze the performance of Shock absorber by varying the wire diameter of the coil spring. The Shock absorber which is one of the Suspension systems is designed mechanically to handle shock impulse and dissipate kinetic energy. It reduces the amplitude of disturbances leading to increase in comfort and improved ride quality. The spring is compressed quickly when the wheel strikes the bump. The compressed spring rebound to its normal dimension or normal loaded length which causes the body to be lifted. The spring goes down below its normal height when the weight of the vehicle pushes the spring down. This, in turn, causes the spring to rebound again. The spring bouncing process occurs over and over every less each time, until the up-and-down movement finally stops. The vehicle handling becomes very difficult and leads to uncomfortable ride when bouncing is allowed uncontrolled. Hence, the designing of spring in a suspension system is very crucial. The analysis is done by considering bike mass, loads, and no of persons seated on bike. Comparison is done by varying the wire diameter of the coil spring to verify the best dimension for the spring in shock absorber. Modelling and Analysis is done using creo parametric3.0 and ANSYS workbench respectively.

Keywords- Shock Absorber, Coil Spring, Modified design, Stress analysis

I. INTRODUCTION

Helical compression springs are generally used to absorb the energy due to the impacts and to form a flexible link which deflects under loading and restore the objects to the normal position where force is not avail. Helical compression springs are generally used to absorb the energy due to the impacts and to form a flexible link which deflects under loading and restore the objects to the normal position where the disturbing forces are removed.

Problem Definition: The present work attempts to analyze the design of a helical compression spring (as shown in fig 1) used in the suspension system of a two wheeler (motor-bike) currently used in Indian roads. The spring bouncing process occurs over and over every less each time, until the up-and-down movement finally stops. The vehicle handling becomes very difficult and leads to uncomfortable ride when bouncing is allowed uncontrolled. Hence, the designing of spring in a suspension system is very crucial. The analysis is done by considering bike mass, loads, and no of persons seated on bike. Comparison is done by varying the wire diameter of the coil spring to verify the best dimension for the spring in shock absorber. Modeling and Analysis is done using creo parametric3.0 and ANSYS workbench respectively.

II. CONCEPTS & WORKDONE

Modelling: Helical compression springs are general used to absorb the energy due to the impacts and to form a flexible link which deflects under loading and restore the objects to the normal position where the disturbing forces are removed. The helical springs are said to be closely coiled when the spring wire is coiled so close that the plane containing each turn is nearly at right angles to the axis of the helix and the wire is subjected to torsion. In other words, in a closely coiled helical spring, the helix angle is very small;

it is usually less than 10 degree. The major stresses produced in helical springs are shear stresses due to twisting. The load applied is parallel to or along the axis of the spring. In open coiled helical springs, the spring wire is coiled in such a way that there is a gap between the two consecutive turns, as a result of which the helix angle is large. Loaded geometry of the helical spring is as shown in below.

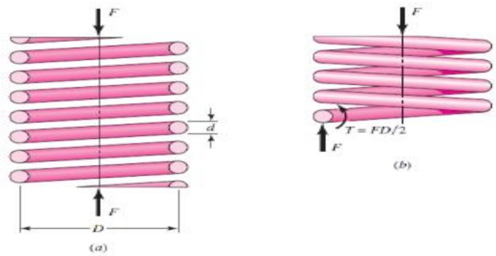


Fig 1.1: loaded spring

Expected outcome

To find optimum design of shock absorber for varying load condition with respect to fatigue life.

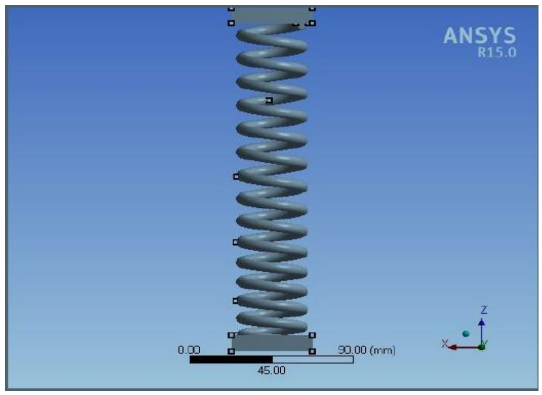
III. REVIEW OF LITERATURE

The research papers published in many aspects as follow Analysis And Testing Of Two Wheeler Suspension Helical Compression Spring (-C.Madan Mohan Reddy, D.Ravindra Naik, Dr M.Lakshmi Kantha Reddy) A spring is defined as an elastic body, whose function is to distort when loaded and to recover its original shape when the load is removed. It is an elastic object used to store mechanical energy. Springs are usually made out of spring steel. Small springs can be wound from pre-hardened stock, while larger ones are made from annealed steel and hardened after fabrication. Some non-ferrous metals are also used including phosphor bronze and titanium for parts requiring corrosion resistance and beryllium copper for springs carrying electrical current (because of its low electrical resistance). When a spring is compressed or stretched, the force it exerts is proportional to its change in length.

Static Analysis of Helical Compression Spring used in Two-Wheeler Horn - S. S. Gaikwad, P. S. Kachare G Harinath Gowd and E Venugopal Goud in this paper describe “static analysis of leaf spring”, used in automobile suspension systems. The advantage of leaf spring over helical spring is that the ends of the spring may be guided along a definite path as it deflects to act as a structural member in addition to energy absorbing device. The main function of leaf spring is not only to support vertical load but also to isolate road induced vibrations. It is subjected to millions of load cycles leading to fatigue failure. Static analysis determines the safe stress and corresponding pay load of the leaf spring and also to study the behavior of structures under practical conditions. The present work attempts to analyze the safe load of the leaf spring, which will indicate the speed at which a comfortable speed and safe drive is possible. Finite element analysis has been carried out to determine the safe stresses and pay loads.

Mr. V. K. Aher, and Mr. P. M. Sonawane in this paper describe, “Static and Fatigue Analysis Of Multi Leaf Spring Used In The Suspension System of LCV”, has done the work regarding the leaf spring used in automobiles and one of the components of suspension system. The purpose of this paper is to predict the fatigue life of semi-elliptical steel leaf spring along with analytical stress and deflection calculations. This present work describes static and fatigue analysis of a modified steel leaf spring of a light commercial vehicle (LCV). The dimensions of a modified leaf spring of a LCV are taken and are verified by design calculations. The non-linear static analysis of 2D model of the leaf spring is performed using NASTRAN solver and compared with analytical results. The pre processing of the modified model is done by using HYPERMESH software. The stiffness of the modified leaf spring is studied by plotting load versus deflection curve for working range loads. The simulation results are compared with analytical results. The fatigue life of the leaf spring is also predicted using MSC Fatigue software. Shigley's [3] book of "Design of Mechanical Elements", include, spring chapter. In this chapter we will discuss the more frequently used types of springs, their necessary parametric relationships, and their design. IV. MODELING & ANALYSIS OF HELICAL COMPRESSION SPRING In computer-aided design, geometric modeling is concerned with the computer compatible mathematical description of the geometry of an object. The mathematical description allows the model of the object to be displayed and manipulated on a graphics terminal through signals from the CPU of the CAD system. The software that provides geometric modeling capabilities must be designed for efficient use both by the and computer.

After this we have gone through from the model of creo parametric 3.0. also then then we are going for to analyse three different condition of load in ansys 15.0. Thus analysis report of that is as mentioned below



(Fig 1.2: STP file of spring Imported in Ansys 15.0)

Units

Model (C4) > Geometry

Bounding Box	
Length X	45.095 mm
Length Y	45.095 mm
Length Z	220. mm
Properties	
Volume	93977 mm³
Mass	0.73772 kg
Scale Factor Value	1.
Object Name	Mesh
State	Solved

Defaults	
Physics Preference	Mechanical
Relevance	40
Sizing	
Use Advanced Size Function	Off
Relevance Center	Coarse
Element Size	1.0 mm
Initial Size Seed	Active Assembly
Smoothing	Medium
Transition	Fast
Span Angle Center	Coarse
Minimum Edge Length	6.70 mm
Inflation	
Use Automatic Inflation	None
Inflation Option	Smooth Transition
Transition Ratio	0.272
Maximum Layers	5
Growth Rate	1.2
Inflation Algorithm	Pre
View Advanced Options	No
Patch Conforming Options	
Triangle Surface Mesher	Program Controlled
Patch Independent Options	
Topology Checking	Yes

Advanced	
Number of CPUs for Parallel Part Meshing	Program Controlled
Shape Checking	Standard Mechanical
Element Midside Nodes	Program Controlled
Straight Sided Elements	No
Number of Retries	0
Extra Retries For Assembly	Yes
Rigid Body Behavior	Dimensionally Reduced
Mesh Morphing	Disabled
Defeaturing	
Pinch Tolerance	Please Define
Generate Pinch on Refresh	No
Automatic Mesh Based Defeaturing	On
Defeaturing Tolerance	Default
Statistics	
Nodes	153372
Elements	85812
Mesh Metric	None

Object Name	*Fixed Support*	*Force*
State	Fully Defined	
Scope		

Scoping Method	Geometry Selection	
Geometry	1 Face	
Definition		
Type	Fixed Support	Force
Suppressed	No	
Define By		Components
Coordinate System		Global Coordinate System
X Component		0. N (ramped)
Y Component		0. N (ramped)
Z Component		-407. N (ramped)
Object Name	Fixed Support	Force
State	Fully Defined	
Scope		
Scoping Method	Geometry Selection	
Geometry	1 Face	
Definition		
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Suppressed	No	
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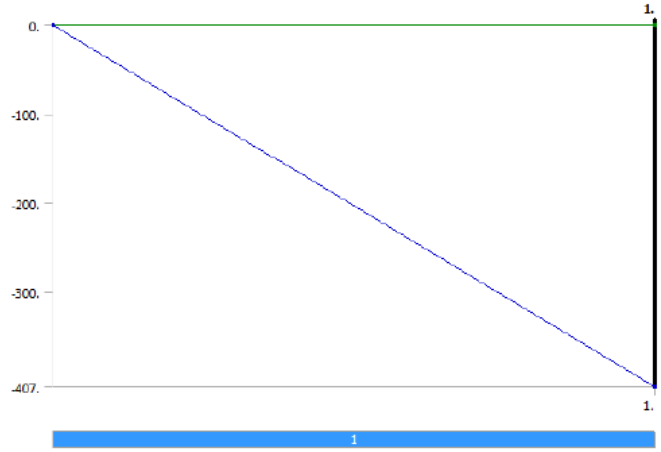
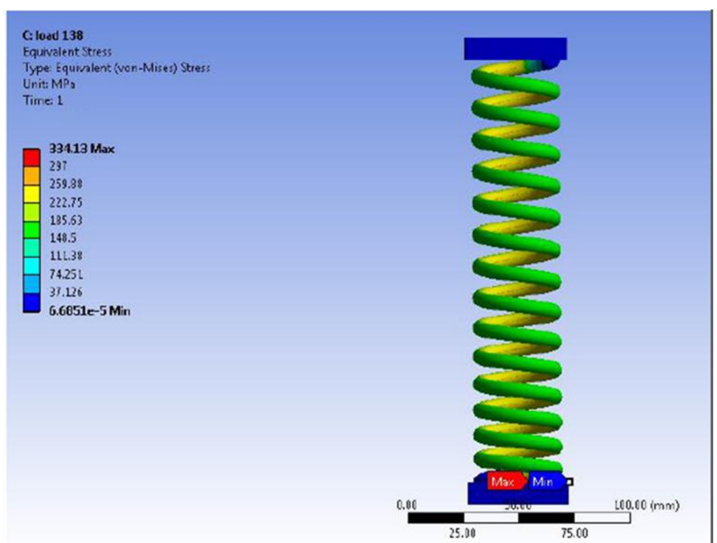
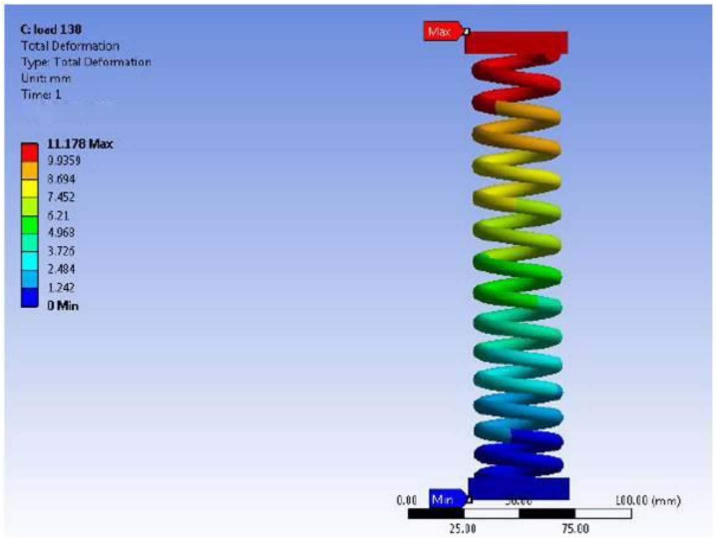
Y Component		0. N (ramped)
Z Component		-407. N (ramped)



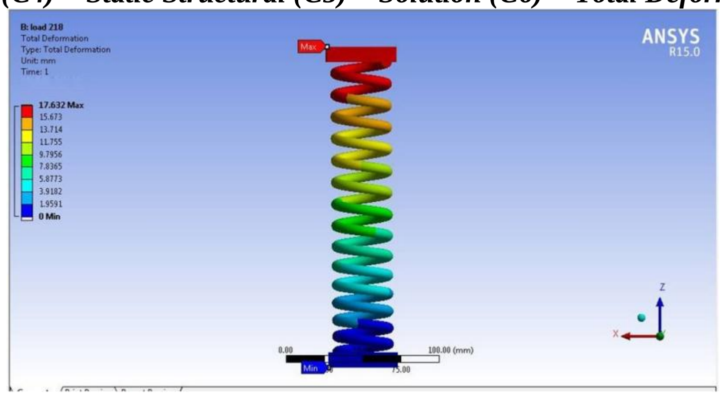
(Fig 1.3: Static Structural (C5) > Force)



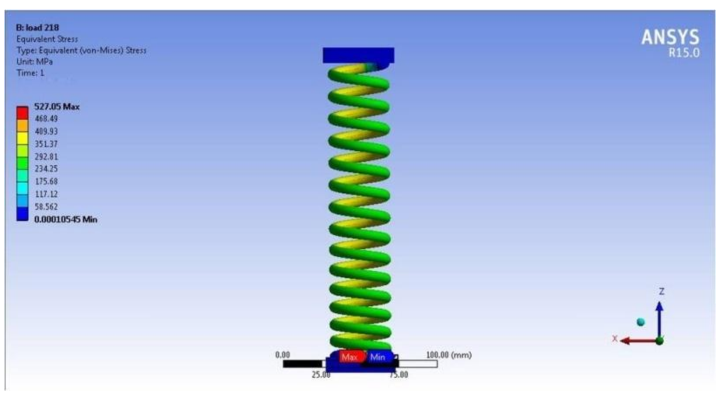
(Fig 1.4: Model (C4) > Static Structural (C5) > Solution (C6) > Equivalent Stress > Image)



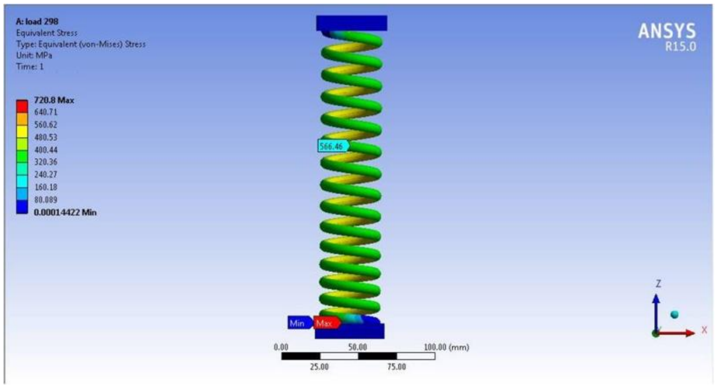
(Fig 1.5: Model (C4) > Static Structural (C5) > Solution (C6) > Total Deformation > Image)



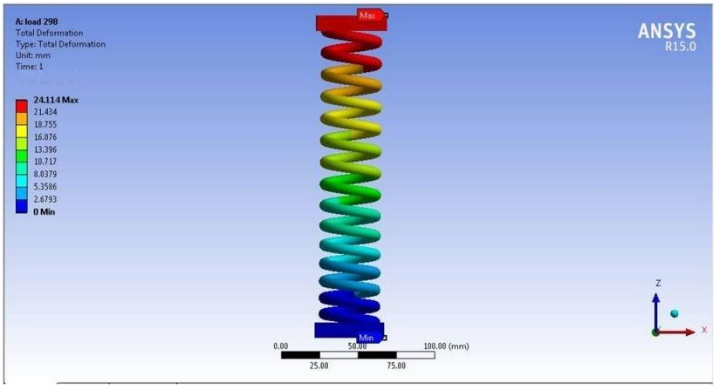
(Fig 1.6: Model (C4) > Static Structural (C5) > Solution (C6) > Total Deformation1 > Image)



(Fig 1.7: Model (C4) > Static Structural (C5) > Solution (C6) > Equivalent Stress> Image)



(Fig 1.8: Model (C4) > Static Structural (C5) > Solution (C6) > Equivalent Stress > Image)



(Fig 1.9: Model (C4) > Static Structural (C5) > Solution (C6) > Total Deformation > Image)

Density	7.85e-006 kg mm^-3
Coefficient of Thermal Expansion	1.2e-005 C^-1
Specific Heat	4.34e+005 mJ kg^-1 C^-1
Thermal Conductivity	6.05e-002 W mm^-1 C^-1
Resistivity	1.7e-004 ohm mm

Alternating Stress MPa	Cycles	Mean Stress MPa
3999	10	0

2827	20	0
1896	50	0
1413	100	0
1069	200	0
441	2000	0
262	10000	0
214	20000	0
138	1.e+005	0
114	2.e+005	0
86.2	1.e+006	0

Structural > Alternating Stress Mean Stress

Thus it is varying with respect to loading condition.

IV. CONCLUSION

In this study analyse the shock absorber of a bike having 150cc of three different loading conditions with the help of Ansys 15.0 and we just compared that for further compensation. After this stage we are going to modify the design and get optimum design by changing various design consideration.

The helical spring has been design so that the stress acting on the spring is decreased the proposed redesign will reduce the deformation and induced stress magnitude for the same applied loading conditions when compare with the existing design .This intern increases the life of the spring, reduced the vibrations and noises to rider by reducing it's failures. The analytical results conformed to the simulation results from the ANSYS.

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