

Review on Finite element analysis of two wheeler suspension helical spring for conventional and composite material

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Abstract — Presently the automobile manufacturers are facing challenges of improvements in the quality and performance of the components together with the reduction in weight and cost of manufacturing. Efforts are directed towards the use of alternative materials in design which results in increase of strength to weight ratio. The use of composite materials is increasing in the design of automobile components due to their light weight and costs. The present work attempts to study the feasibility of select composite materials in the design of helical compression spring used in automobile suspension systems. The design of helical compression spring is first analyzed for the conventional steel material and then compared with that of for the composites used as spring materials study their behaviors at the different loading conditions. Composite materials considered for the analysis are Eglasss/Epoxy and Carbon/Epoxy. The modeling of the helical spring has been done using software and simulation were performed using ANSYS to predict the stresses, deflections at the stated loads. It was found that the stresses developed in conventional steel helical compression spring is more as compared to the stresses developed in composite material helical compression spring. Also the deflection is observed to be higher for composite materials. The results indicate that composite materials are feasible option at normal loading conditions which will also reduce the manufacturing and maintenance costs

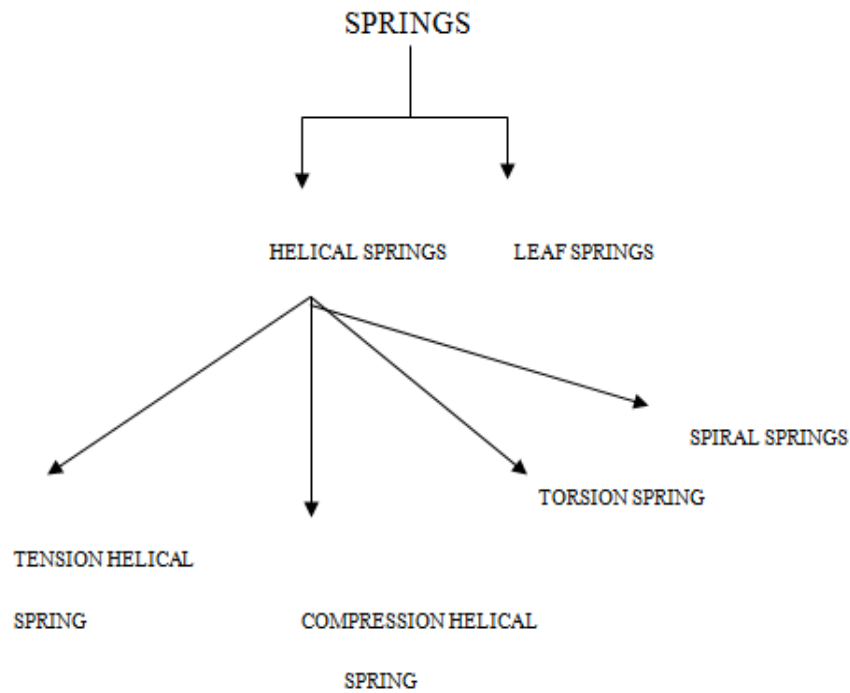
Keywords- Helical compression spring, Composite materials, E-glass/Epoxy, Carbon/Epoxy and Finite Element Analysis.

I. INTRODUCTION

Helical coil compression springs are generally used for 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. These springs mostly in the suspension system of two wheelers (motor bikes) may fail due to overloading which occurs in Indian conditions .Automobile manufacturers today are facing challenges to reduce the manufacturing and maintenance costs without confirming the quality and functionality of parts .Helical compression springs contribute majorly in the total costs and weight of the suspension system and are therefore liable for modification improvement in design. To analyze the design of a spring used in a two wheeler vehicle with the objectives of comparing the behavior of conventional material and composites used as spring materials.



II. TYPES OF SPRINGS



III. TYPES OF HELICAL SPRING

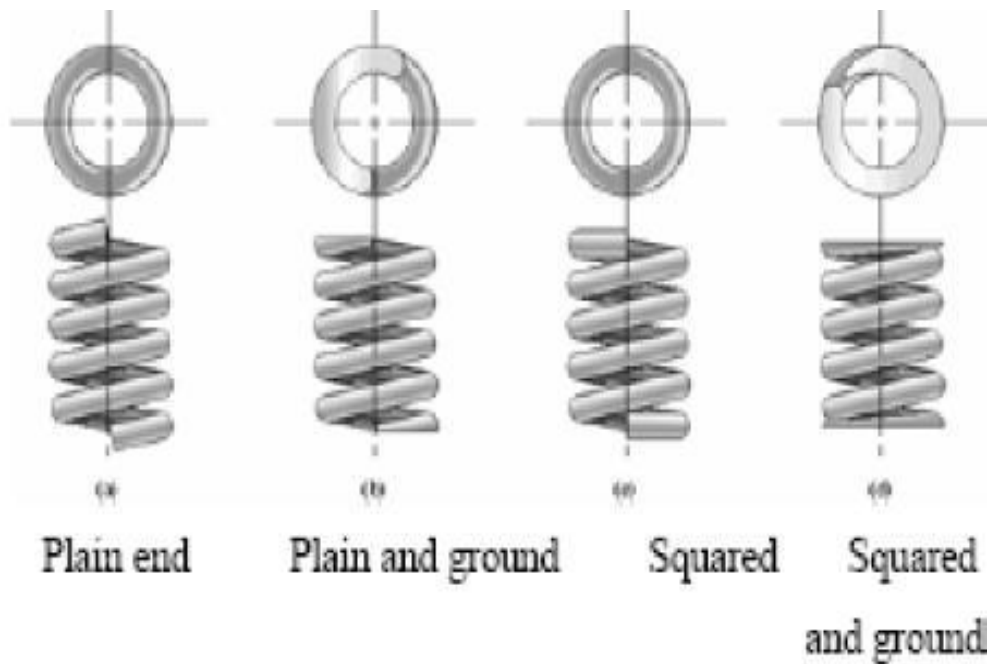
DEFINITION: - It is made of wire coiled in the form of helix.

CROSS-SECTION: Circular, square or rectangular

CLASSIFICATION: 1) Compression helical springs

2) Tension helical spring

Though there are many types of springs, these are the main springs which we can see often. There are four standard types on helical compression springs. They are plain end, squared end, plain-ground end, and squared-ground.



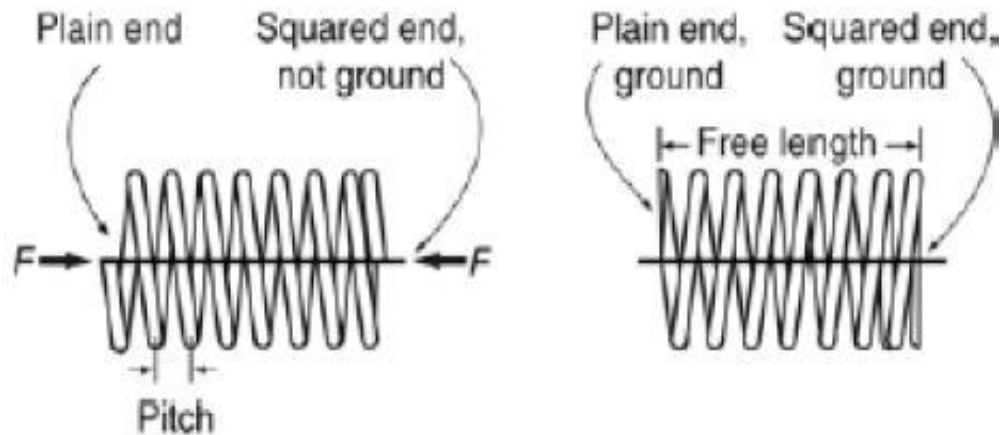


Fig1 Types of helical spring

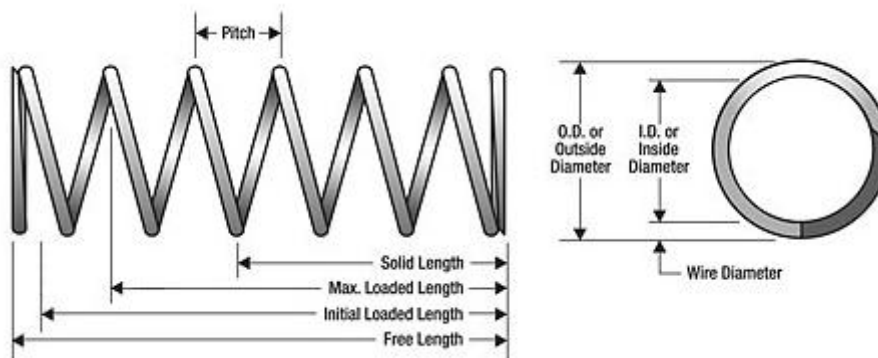
A spring with plain ends has non-interrupted helicoids the ends are the same as if a long spring had been cut into sections. A spring with plain ends that are squared or closed is obtained by deforming the ends to a zero-degree helix angle. Springs should always be both squared and ground for many applications, because a better transfer of the load is obtained. A spring of squared and ground ends compressed between rigid plates can be considered to have fixed ends.

IV. CONCEPT OF SPRING DESIGN

In new design of spring have the following considerations:

- Space into which the spring must fit and operate.
- forces and deflections working values.
- Requires accuracy and reliability.
- Tolerances and permissible variations in specifications.
- Environmental conditions such as temperature, presence of a corrosive atmosphere.
- Cost and qualities needed.

These factors used to select a material and specify suitable values for the diameter of spring wire, the number of coils, mean coil diameter and the free length and the spring rate needed to satisfy working force deflection requirements. The design constraints are that the size of wire should be commercially available and that the stress at the solid length be no longer greater than the torsional yield strength.



V. LITERATURE REVIEW

Dr. Dhananjay. R. Dolas, Kuldeep. K. Jagtap [2016]¹, The aim of this paper is to analyze the performance of Shock absorber spring by varying stiffness, which is obtained by doing optimization using Genetic Algorithm as optimization technique to used maximum ride comfort. By using the CAE software (Pro-E and ANSYS) compared the conventional spring to modify spring stress and deflection. Also achieving the weight reduction of modifies spring.

Harshad B. Pawar, Prof. Amol R. Patil, Dr. Sanjay B. Zope [2016]², In that paper, mathematical and finite element analysis methodology using the obtained the weight reduction of the helical compression spring. Using modeling software solid works completed the modeling and by using Ansys software meshing. The researchers are also selecting the minimum no of spring coil are use. Helical compression coil spring used for three wheeler spring material is IS 4454 Grade 2.

Ganesh Bhimrao Jadhav, Prof. Vipin Gawande[2015]³, A review paper, combination of conventional steel and composite material analyzing the feasible region for the material. Conventional steel is simply replaced by the Glass Fiber Epoxy resin and achieving the weight of composite material. Also the composite material have corrosion resistance, it can also supportable for high temperature.

Logavigneshwaran S., Sriram G.[2015]⁴, By the aim of the studies the comfortable rides vehicles, to changing the wire diameter of coil spring and design to the shock absorber. In that paper analyze the bike weight, and one or two person weight is seated on bike and checking comparison the wire diameter of coil spring. Modeling and analysis is done on Pro-E and ANSYS software. In this case coil turn increases the life of shock absorber by reducing its failures.

Muhammad Abu Rahat, Muhammad Ferdous Raiyan [2015]⁵, In that case study, the different load is applied on helical compression spring and determining the spring stiffness. It includes a set of different springs to compare spring rates and effect of different spring sizes. Spring testing machine is built up and various testing perforated such as, different load, displacement, spring stiffness.

Animesh Das, Awinash kumar [2015]⁶, In that paper selection of spring material using Integrated preference ranking organization method for enrichment evaluation (PROMETHEE) method and graphical analysis for interactive assistance technique (GAIA) is applied to solve this material selection problem. Chrome silicon alloy steel (ASTM A 401) is the best spring material, followed by high carbon steel (ASTM A 228). The PROMETHEE-I (partial ranking) and PROMETHEE-II (Complete ranking) were are developed by J.P. Brans and PROMETHEE-III (ranking based on intervals) and PROMETHEE-VI (MCDA includes segmentation constrain) and PROMETHEE-IV (represented of the human brain). PROMETHEE method is easily obtained and understood by both decision makers and analysis.

Bhaves R. Valiya, Prashant S. Bajaj [2015]⁷, To study Non alloy steel helical spring will be used to suspend vehicle system. The uniform loading effect has been studied and Experimental, FEA analysis will be compared with analytical solution. The proposed redesign will reduce the deformation and induced stress magnitude for the same applied loading conditions when compared with the existing design. It is also changing the wire diameter of coil and number of turns to life of spring.

K.Vinay Kumar, R.Rudrabhiramu [2015]⁸, In that paper, the uneven vibrations in the telescopic forks have been balanced by using the Mass Centralization concept in the pivoted centre point of the front suspension in the motorcycle using Mono Shocks. There are three different materials like alloy steel, chromium vanadium steel, stainless steel were used with a constant load of 850N. Alloy steel material for bike suspension spring due it its material stability and ductility by observing those analysis stress and deformation values.

Suresh.G, Vignesh.R [2014]⁹, Helical spring made of fiber reinforced polymer of Woven Roving Fiber (WRF), and Thermo set polymer (Epoxy Resin) with Nano clay (Garamite). The objective is to compare the load carrying capacity, stiffness and weight savings of composite helical spring with that of steel helical spring. As compared to steel springs of the same dimensions, the stiffness of composite coil springs is less. In order to increase the stiffness of the spring the dimensions of the composite spring is to be increased which in turn increases the weight of the spring.

Sangmesh Pattar, Sanjay S.J [2014]¹⁰, that paper is helical compression spring is considering as a part of automobile horn. The spring is analyzed the deformation value as well as the maximum shear stress value by using the analytical and finite element method. Helical compression spring is modeled and static analysis carried out by using ANSYS result.

VI. CONCLUSION

Workability of composite materials is checked, composite helical springs can be easily replaced in light weight vehicles with slight endure of the size. In regular vehicles, combination of springs with composite and conventional material can be used to overcome low stiffness of composite materials and weight of spring can be optimized.

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