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"Analysis of helical spring, a review"

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Abstract

A spring is an elastic object used to store mechanical energy. Springs are elastic bodies that can be twisted, pulled, or stretched by some force. They can return to their original shape when the force is released, it is also termed as a resilient member. They are extensively used in automobile, railway shock absorber for suspension, to apply a force in clutch, brake and spring-loaded valve etc. The aim of this paper is to represent study of Design Parameter of spring which are extensively used in engineering applications it is important to find out the quality of spring material, the design parameter of spring material which influenced the working of helical spring.

Keywords- Helical springs, CATIA, ANYSYS, stress, displacement, shear stress.

INTRODUCTION

Helical springs are typically made from round wire, wrapped into a straight, cylindrical form with a constant pitch between adjacent coils. Square or rectangular wire may also be used helical compression spring, usually installed around the ink supply barrel. Suspension systems for cars, trucks, and motorcycles frequently incorporate these springs. Other automotive applications include the valve springs in engines, hood linkage counterbalancing, and the clutch pressure-plate springs. In manufacturing, springs are used in dies to actuate strip per plates; in hydraulic control valves; as pneumatic cylinder return springs; and in the mounting of heavy equipment for shock isolation. Many small devices such as electrical switches and ball check valves incorporate helical compression springs

LITERATURE REVIEW

The following literature review describes important research results regarding the rotor dynamics

1) **ANALYSIS OF HELICAL SPRING IN TWO-WHEELER SUSPENSION FOR DIFFERENT MATERIALS** In a vehicle, shock absorbers reduce the effect of traveling over rough ground, leading to improved ride quality and vehicle handling. The limiting excessive suspension movement is serves by the spring. Hysteresis is the tendency for elastic materials to rebound with less force. Hence, the designing of suspension system is very crucial. In modeling,

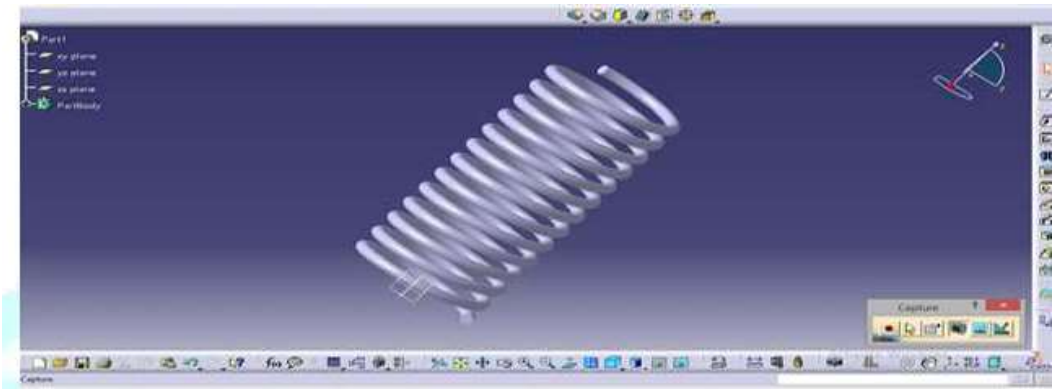

Fig 1. HELICAL SPRING DESIGN

the time is spent in drawing the helical coil spring model and the front suspension system, where the risk involved in design and manufacturing process can be easily reduced So the modeling of the coil spring is made by using SOLID WORKS. Later the model is imported to ANSYS for the analysis work. The materials used for this work Carbon steel, Chromium vanadium, Inconel X-718.In this study, the helical spring has been designed so that the stress acting on the spring is reduced. The proposed redesign will reduce the deformation and induced stress magnitude for the same applied loading conditions when compared with the existing design. Comparing all the three materials (Carbon steel, Chromium vanadium, and Inconel X-718) Carbon steel material has maximum shear stress and minimum deformation. So Carbon steel is best suitable material for manufacturing a helical spring which is proved by this work.

2) Modeling and Analysis of Helical Springs Using CATIA-V5R19 and ANSYS 16.0

In this paper investigation is done to find out the quality of the material which is assembled in a part of any working equipment or a practical model. Considering the availability, quality level, price and the matching with working processes, the most suitable material can be chosen. In the present work, materials with different cross-sectional areas were selected from the existing work bench of CATIA V5 R19 solid-modeling software. At present spring design engineers in manufacturing sector prefer this technique without taking real material. Once solid modeling is over, then one needs to test dynamic behavior of spring on virtual screen using commercially available analysis software like ANSYS. This reduces the investment cost. Three different materials were chosen to simulate the spring under various values of load. The results showed that the less value of total deformation happened in the case of spring made of structural steel for all the values of load. The deformation reduced by 12% low carbon steels compared with the deformation in chrome vanadium steels and reduced by about 14% compared with total deformation in structural steels. The deformation, strain stress and shear stress increased by increasing the load.

3 DESIGN AND ANALYSIS OF HELICAL COMPRESSION SPRING AND CARBON/EPOXY COMPOSITE SPRING USED IN DAMPER BY USING FEA.

In This paper the study represents new approach to design helical compression spring by using workbench. The composite materials used are E-glass/Epoxy or Carbon fiber/Epoxy. Spring analysis is completed with FEA and results are compared with steel spring. The study shows that the weight reduction achieved with composite spring. Thus, indicating that the composite material springs may be effectively used as replacement for heavy steel springs. during this study, the most investigation of the study is to reduce the weight of product whereas upholding its strength. Then to unravel problem during this regard composite materials play a very important role.

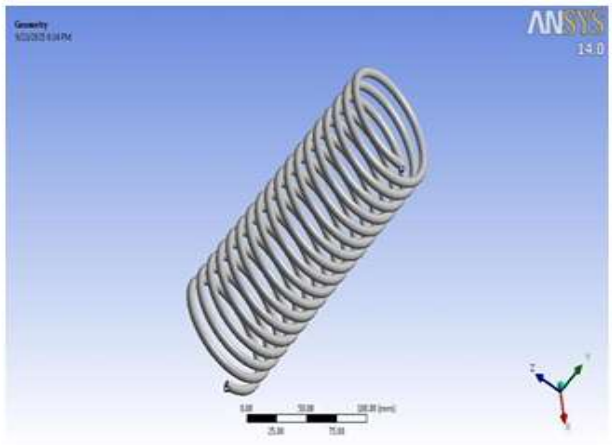

Fig. 2 Spring Geometry model in Ansys

The main objectives of this work is to determine such critical parameters, To analyze the spring using FEA techniques/ practically, To recommend improvements in the areas of design/ Material/ Process for enhancing the life of the spring etc. They found that the original material of helical compression spring acting maximum stresses than Epoxy. From analytical and FEA results it has been found that steel helical springs can be replaced with combination of conventional steel and composite material helical spring with stiffness remaining same. The composite helical springs can be effectively used in automobiles without affecting the performance of the suspension system of the vehicles. They provide around 50-70 % weight reduction as compared to steel spring.

4) Design and Analysis of Helical Springs with Non Circular Cross Section

In this paper, This paper deals with the static structural analysis of the helical springs by using ANSYS Workbench 15.0 simulation software. Using the finite element approach the results are compared for various wire cross section. The 3D modelling is a process of transformation program which creates an ANSYS input record from the geometry portrayal created in CATIA V5.The model is imported to ANSYS In this paper helical springs related to the light vehicle suspension systems under the effect of uniform loading has been modelled with non-circular wire cross sections using CATIA V5.

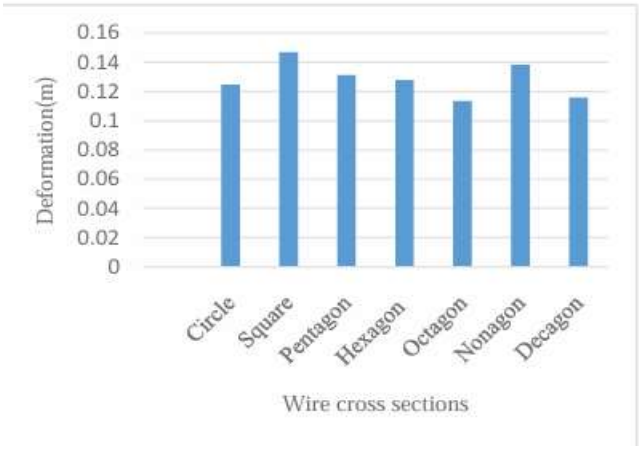

Fig.3 graph showing deformation of various profiles under static strutctural analysis

They found that by static structural analysis the spring profile can be octagon or decagon as it has better properties than circular cross section. The deformation of decagon cross section 7% less whereas for octagon it is 9%. The difference in shear stress for octagon and decagon with circular cross section is 5.6% and 5.9% respectively

5) Nonlinear electromagnetic vibration energy harvester comprising dual helical-plane springs and multiple Halbach arrays for low-frequency and small-amplitude vibrations

In this paper, a novel electromagnetic vibration energy harvester comprising dual helical- plane springs and multiple Halbach arrays is proposed. The structural characteristics are analyzed, which indicate that the helical-plane springs can have nonlinear stiffness under small-amplitude vibrations and multiple Halbach arrays can greatly enhance the magnetic field. Then a magnet-electro-mechanical model is built by combining mechanical dynamics &electrodynamics, which is numerically solved by using the Runge-Kutta algorithm. Finally, the feasibility of the nonlinear electromagnetic vibration energy harvester is validated both numerically and experimentally. The results show that it has a nonlinear stiffness, a resonance bandwidth of 3 Hz and a peak power of 14 mW when the excitation amplitude is only 0.5 g. In particular, the resonance frequency range depends on the excitation amplitude. Furthermore, the prototype of a self-powered wireless temperature sensor is constructed and testified. The results of this study indicate that the proposed structure can be utilized and extended to build compact, reliable and nonlinear electromagnetic vibration energy harvesters for low- frequency, small-amplitude and broadband vibrations in real-world applications.

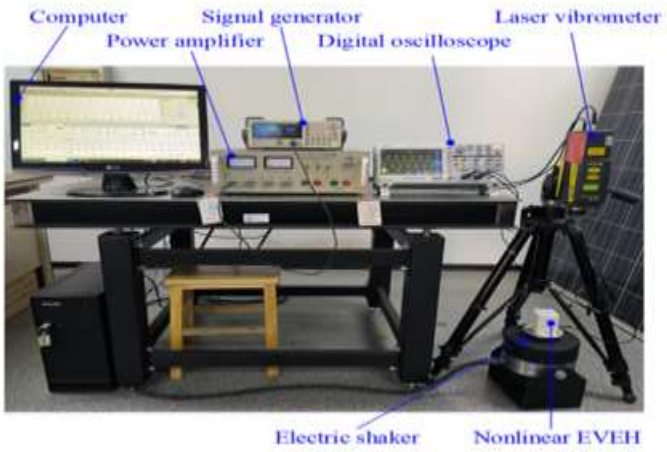

Fig 4 experimental setup

experiments work done to validate the proposed structure. Main highlights of this paper may include: i) It is evident that the dual helical-plane springs exhibit nonlinear stiffness under small-amplitude vibrations, which is directly related to the cantilever's thickness and width; ii) The magnetic field distribution of each Halbach array is autonomous, so that employing multiple Halbach arrays can considerably amplify the magnetic field; iii) Effect of key parameters on the performance of the proposed nonlinear EVEH is revealed, which will provide guidelines for designing in real-world applications; iv) Compared with existing cantilever-like or levitation-like nonlinear structures using magnetic springs, the dual helical-plane springs can generate nonlinearity within small volumes.

6) Understanding the static performance of composite helical springs with braided nested structures

In this study, a novel composite helical spring with a braided nested structure (BNCHS) is proposed. The fiber volume fraction of BNCHS with braided angle of 15◦and 30◦ (BNCHS15◦and BNCHS30◦) only increases by 0.9% and 1.8% respectively comparing with that of unidirectional composite helical spring with Vf of 55% (UCHS55%). The compression experimental results show that the spring constant of BNCHS15◦and BNCHS30◦ can reach 105.4% and 171.4% higher

than that of UCHS55% respectively. The internal mechanism of significantly improving compression performance of BNCHS is revealed by using a meso model. Numerical result shows that the mises stress of BNCHS15◦ and BNCHS30◦ can be 2.43 and 3.14 times higher than that of UCHS55% respectively. Finally, the resilience and specific spring stiffness of BNCHS and steel are compared, highlighting the obvious advantage of static performance of BNCHS. It is observed that the spring constant of BNCHS increases with an increase in the braid angle. Furthermore, FEM analysis reveals the internal mechanism responsible for this improvement. The mises stress of the braided reinforcement of BNCHS significantly surpasses that of the resin and reinforcement core, underscoring the crucial load-bearing role of the peripheral braided reinforcement in BNCHS. The fluctuation amplitude of the braided reinforcement of BNCHS30◦ is less than that of BNCHS15◦ across 0–360◦, indicating improved force uniformity with a higher braid angle. Max. principal stress of left and right braided reinforcements is further analyzed to detect the damage initial. The results show that initial damage will first occur in the external radial zone of left braided reinforcement. The fluctuation range and cycle of max. principal stress of left and right braided reinforcements illustrate that the right braided reinforcement of BNCHS is subjected to pressure, while the left braided reinforcement is under tension during compression.

7) Static Analysis of Helical Compression Spring Used in Two-Wheeler

In this paper present work attempts to analyze the safe load of the helical compression spring. A typical helical compression spring configuration of two-wheeler horn is chosen for study. This work describes static analysis of the helical compression spring is performed using NASTRAN solver and compared with analytical results. The preprocessing of the spring model is done by using HYPERMESH software. In the present work, helical compression spring is modeled and static analysis is carried out by using NASTRAN software. It is observed that the maximum stress is developed at the inner side of the spring coil. From the theoretical and the NASTRAN, the allowable design stress is found between the corresponding loads 3 to 6 N. It is seen that at 7N load, it crosses the yield stress (yield stress is 903 N/mm2). By considering the factor of safety 1.5 to 2. It is obvious that the allowable design stress is 419 to 838 N/mm2. So the corresponding loads are 3 to 6 N. Therefore, it is concluded that the maximum safe pay load for the given specification of the helical compression spring is 4 N. At lower loads both theoretical and NASTRAN results are very close, but when load increases the NASTRAN results are uniformly reduced compared to theoretical results.

Conclusion

In this paper they are investigating the behavior of spring by experimental and by software applications by using different software like solid modeling, Ansys etc. A helical spring is a mechanical device which is used to absorb shocks and store maximum energy between contracting surface. In a vehicle, shock absorbers reduce the effect of traveling over rough ground, leading to improved ride quality and vehicle handling.so it is important to analyzed the different design parameter that affects the working of spring.

REFERENCES

1) ANALYSIS OF HELICAL SPRING IN TWO WHEELER SUSPENSION FOR DIFFERENT MATERIALS 1Dr.V. Jayaseelan, 2 Dr.P.Jayaraman, 3V.S.Ramakrishna, 4Sheik Saleem, 5Ullasa Anandababu 1,2Professor, Department of Mechanical Engineering, Prathyusha Engineering College, Thiruvallur, Chennai, India..

2) Modeling and Analysis of Helical Springs Using CATIA-V5R19 and ANSYS 16.0 Dr. Reddy Sreenivasulu, N. Yaswanth Krishna, M. Sukumar, O.N. Gouse Basha, N. ArunKumar, K. Heamanth and M. Vamsi Krishna Department of Mechanical Engineering, R.V.R & J.C. College of Engineering (A), Guntur, Andhra Pradesh 522019 India.

3) DESIGN AND ANALYSIS OF HELICAL COMPRESSION SPRING AND CARBON/EPOXY COMPOSITE SPRING USED IN DAMPER BY USING FEA Mr. Ranjit R. Mali*1, Dr. A.D. Diwate*2 *1Student, Department of Mechanical Engineering, TSSM's BSCOER, Pune, Maharashtra, India. *2Associate Professor, Department of Mechanical Engineering, TSSM's BSCOER, Pune, Maharashtra, India.

4) Design and Analysis of Helical Springs with Non Circular Cross Section J. Kanimozhi1, J.K. Jothi1, T. Jawahar Srinath1, M. Jayasimman1, Dr. K. Srinivasan2 2Professor Department of Mechanical Engineering, Adhiyamaan College of Engineering, Anna University, Hosur, India

5) Nonlinear electromagnetic vibration energy harvester comprising dual helical-plane springs and multiple Halbach arrays for low-frequency and small-amplitude vibrations Zhongsheng Chen a a , b , * , Zhiwen Chen b , Yongxiang Wei College of Automotive Engineering, Changzhou Institute of Technology, Changzhou, China b b , Yeping Xiong College of Electrical and Information Engineering, Hunan University of Technology, Zhuzhou, China c Faculty of Engineering and Physical Sciences, University of Southampton, SO16 7QF, UK c

6) Understanding the static performance of composite helical springs with braided nested structures Ling Chena,b, Joel Chonga,c, Qian Jiangb, Liwei Wub,*, Youhong Tanga,

7) International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-2, Issue-3 February 2013 161 Static Analysis of Helical Compression Spring Used in Two-Wheeler Horn S. S. Gaikwad, P. S. Kachare.

8) MACHINE ELEMENTS IN MECHANICAL DESIGN Sixth Edition Robert L. Mott University of Dayton Edward M. Vavrek Purdue University Jyhwen Wang Texas A&M University.

9) Shigley's Mechanical Engineering Design Ninth Edition Richard G. Budynas Professor Emeritus, Kate Gleason College of Engineering, Rochester Institute of Technology J. Keith Nisbett Associate Professor of Mechanical Engineering, Missouri University of Science and Technology.