DESIGN AND ANALYSIS OF WAVE SPRING FOR MOTAR CYCLE SHOCK ABSORBER

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ABSTRACT:

A suspension system or shock absorber is a mechanical device designed to smooth out or damp shock impulse, and dissipate kinetic energy. The shock absorbers duty is to absorb or dissipate energy. In a vehicle, it reduces the effect of traveling over rough ground, leading to improved ride quality, and increase in comfort due to substantially reduced amplitude of disturbances. When a vehicle is traveling on a level road and the wheels strike a bump, the spring is compressed quickly. The compressed spring will attempt to return to its normal loaded length and, in so doing, will rebound past its normal height, causing the body to be lifted. The weight of the vehicle will then push the spring down below its normal loaded height. This, in turn, causes the spring to rebound again the design of spring in suspension system is very important. In this project a shock absorber is designed (helical type spring and wave spring) and a 3D model is created using CREO. Structural analysis and modal analysis are done on the suspension system by varying material for spring, Spring Steel and chromium vanadium steel. The analysis is done by considering loads, bike weight, single person and 2 persons. Structural analysis is done to validate the strength and modal analysis is done to determine the displacements for different frequencies for number of modes. Comparison is done for two materials to verify best material and best model for spring in suspension system. Analysis done in ANSYS In this thesis the random vibration analysis is determine the directional deformation, shear stress and shear stain for which is the best material for spring.

Introduction

Wave spring peak to peak wave springs work as a heap bearing gadget, using a bowing minute as opposed to depending on torsion. Giving an indistinguishable power and redirection from customary springs, wave spring innovation eliminates material utilization by up to half, leaving a light-weight, flexible item that can take care of issues and improve new item planEdge curling spring-tempered level wire to frame our Single Turn Springs is more strong, exact, and repeatable than its stamped partners. For some applications having an alternative to fit the spring precisely to the correct distances across enhances execution and can frequently help the gathering procedure. Springs are made from only one wire, and in this manner couldn't be more straightforward in many regards, yet they hold the bright structure to be dynamically utilitarian, reliable and completely essential to numerous components.

Helical compression springs characteristics:

- The gap between the successive coils is larger.
- It is made of round wire and wrapped in cylindrical shape with a constant pitch between the coils.

- By applying the load the spring contracts in action.

Elastomeric shock observers:
These are low cost options for reducing the collision speed and reducing the shock loading and providing system damping. They are conveniently molded to suitable shapes. These devices have high stopping forces at end of stroke with significant internal damping. Elastomeric dampers are very widely used because of the associated advantages of low cost and mouldability together with performance benefits. However elastomeric based shock absorbers are limited in being affected by high and low temperatures. And are subject to chemical attack Silicone rubber is able to provide reasonable mechanical properties between temperatures of -50O to +180O deg. C- most other elastomer has inferior temperature tolerance.

Figure: shock absorber

Collapsing Safety Shock Absorbers:
These are single use units which are generally specially designed for specific duties. They are designed such that at impact they collapse and the impact energy is absorbed as the materials distort in their inelastic/yield range

Literature review:
N.P.Doshi ,U.D. Gulhane[1] the investigation of elastomeric covering effect on powerful thunderous anxieties esteems in spring is introduced in this paper. The fitting conditions deciding the viability of dynamic anxiety lessening in thunderous conditions as an element of covering parameters were determined. It was demonstrated that elastic covering won't perform in attractive way because of its low modulus of versatility in shear. It was likewise shown that about reverberation regions of expanded anxieties are more extensive and more extensive alongside the progressive resonances and accomplish critical esteems even everywhere separates from the reverberation frequencies.

Dr. Dhananjay. R. Dolas ,Kuldeep. K. Jagtap[2] Long haul exhaustion tests on shot peened helical pressure springs were directed by methods for an extraordinary spring weariness testing machine at 40 Hz. Test springs were made of three diverse spring materials – oil solidified and tempered Si Cr-and Si Cr V-alloyed valve spring steel and stainless steel

T S Manjunatha and D Abdul Budan [3] Elastomeric segments have wide utilization in numerous ventures. The regular administration stacking for the greater part of these segments is variable adequacy and multiaxial. In this examination a general approach forever forecast of elastomeric parts under these average stacking conditions was produced and represented for a traveler vehicle support mount. Split start life expectation was performed utilizing diverse harm criteria.

Jadhav, N.P. Doshi,U.DGulhane[4] This paper displays a 3D geometric demonstrating of a twin helical spring and its limited component examination to contemplate the spring mechanical conduct under pliable hub stacking. The spiraled shape visual computerization is accomplished using Computer Aided Design (CAD) instruments, of which a limited component demonstrates is created. Therefore, a 3D 18-dof pentaedric components are utilized to discrete the complex "wired-shape" of the spring, permitting the examination of the mechanical reaction of the twin spiraled helical spring under a pivotal load

3.0 Methodology:

If a spring is intended for dynamic application, ensure that the % worry at working stature is fewer than 80%. Spring will take a set if subjected to a higher stress.

Few things to recollect:

If the work stature per turn is under (2 * Wire Thickness), the spring will work in a 'non-straight' range and real loads might be higher than ascertained

Number of turns must be in the vicinity of 2 and 20

Number of waves per turn (N) must be in ½ increases

Min. Spiral divider = (3 * Wire Thickness)

Max. Spiral Wall = (10 * Wire Thickness)

PRINCIPLE OF WAVE SPRING:

- Wave springs lessen spring stature by half
- Same power and diversion as common loop/pressure springs
- Wave springs fit tight outspread and hub spaces

Over 4,000 standard springs in carbon and stainless steel (.188" to 16", 5 mm to 400 mm breadths) No Tooling Charges™ on specially crafts (.157" to 120", 4 mm to 3000 mm distances

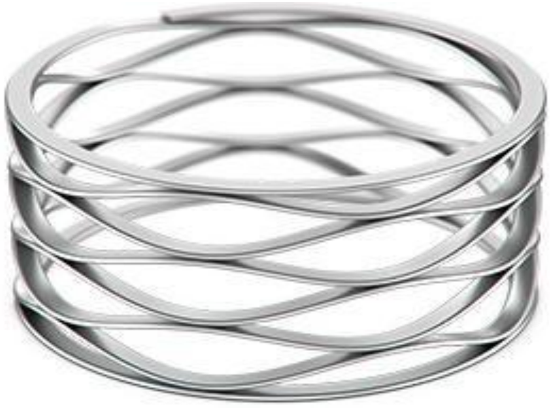


Figure: CREST-TO-CREST WAVE SPRINGS WITH SHIM ENDS

Rest-to-Crest Wave Springs are additionally accessible with squared-shim closes. Shim closes give a 360° contact surface when contrasted with the wave point contact of plain closures

MATERIAL PROPERTIES

Spring steel is a low combination, medium carbon steel with a high return quality. This permits objects made of spring steel to come back to their unique shape in spite of huge bowing or winding

SPRING STEEL:

Density	7850kg/m^3
Tensile strength	1700M pa
Young's modulus	210 G pa
Poisons ratio	0.27

Chromium vanadium steel:

Normalized SAE-AISI 6150 is a type of SAE-AISI 6150 steel. It is furnished in the normalized condition. The graph bars on the material properties cards below compare normalized SAE-AISI 6150 to: wrought alloy steels (top), all iron alloys (middle), and the entire database (bottom). The length of each bar shows the given value as % of the largest value in the relevant set

Density	7860kg/m^3
Tensile Strength: Ultimate (UTS)	940M pa
Young's modulus	190 G pa
Fatigue Strength	430 G pa

MODEL OF WAVE SPRING:

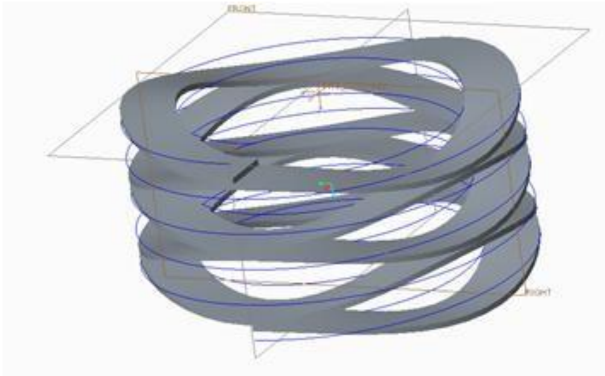


Figure: 3D model view of wave spring

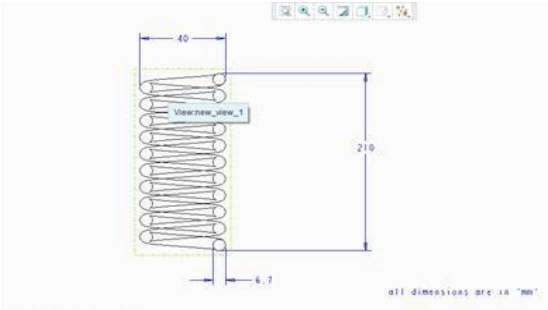


Figure: Geometric view

Static analysis of helical spring:

Used software for this project work bench
Open work bench in Ansys 14.5
Select static structural>select geometry>import IGES model>OK

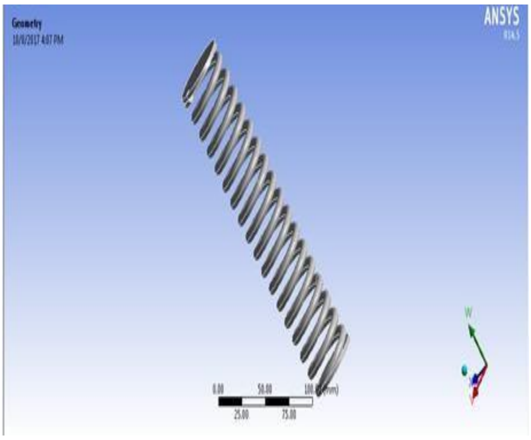


Figure:imported model

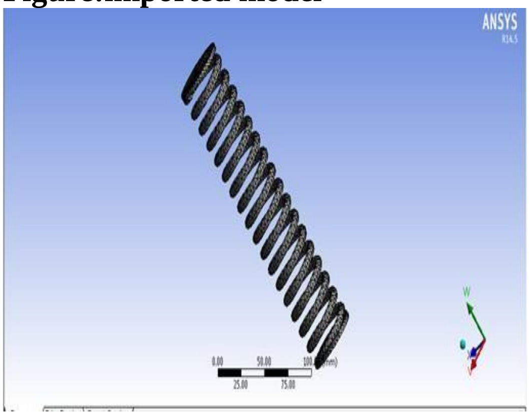


Figure: meshed model

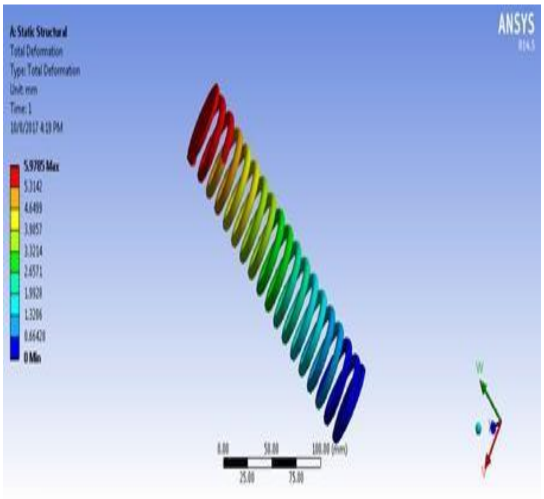


Figure: material – spring steel load – bike load 113kg deformation

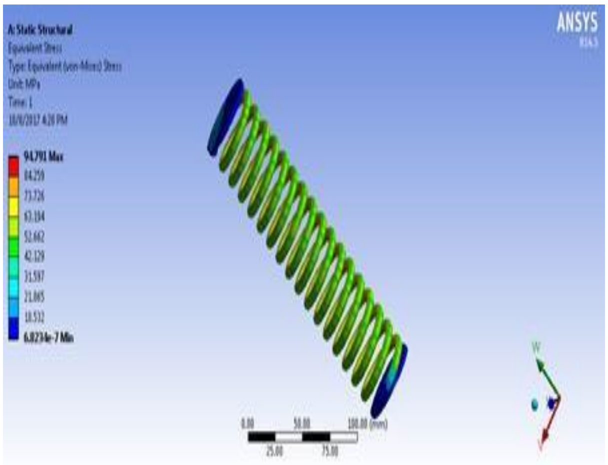


Figure: equivalent stress

Static analysis spring steel load:

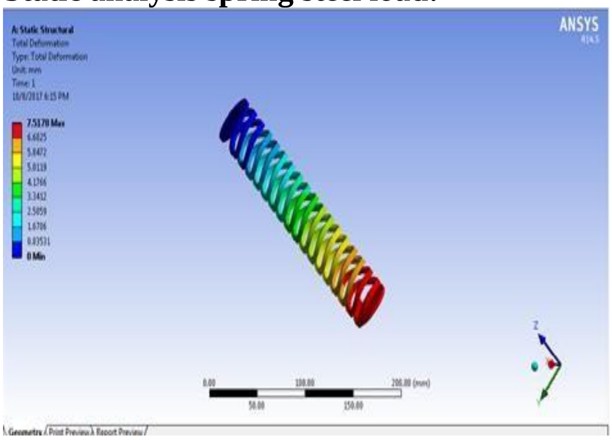


Figure: bike load 113kg deformation

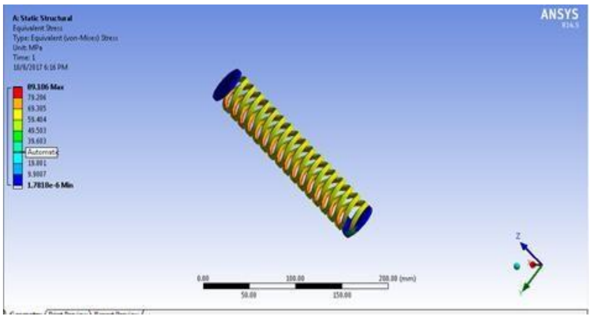


Figure: Equivalent stress

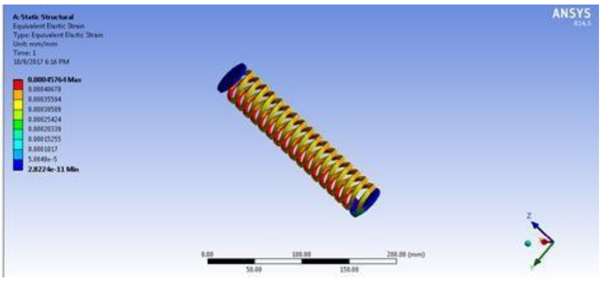


Figure: Equivalent elastic strains

Modal analysis of wave spring material:

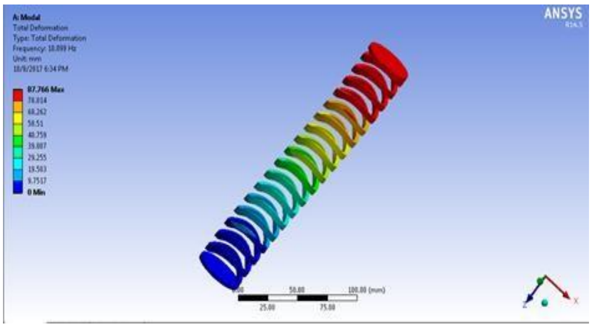


Figure: MODE SHAPE 1

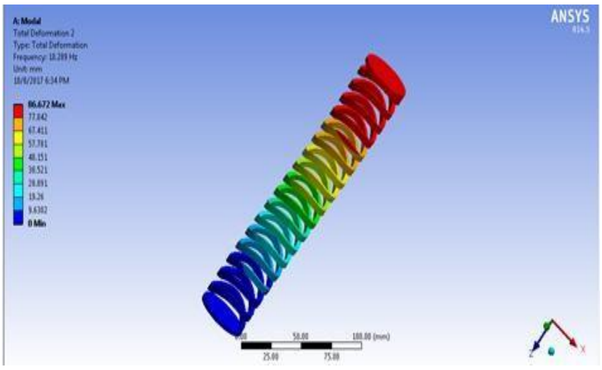


Figure: MODE SHAPE 2

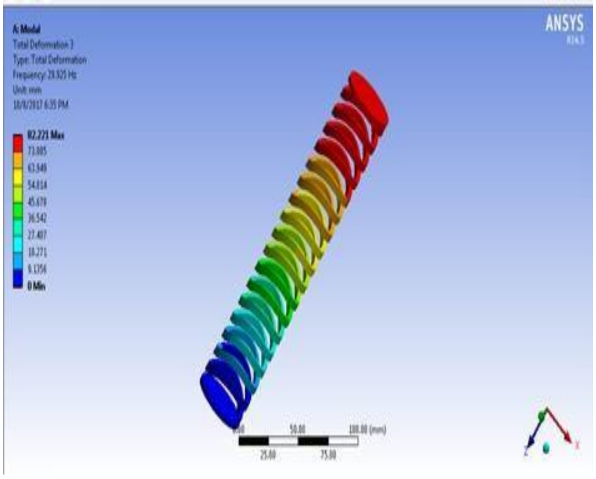
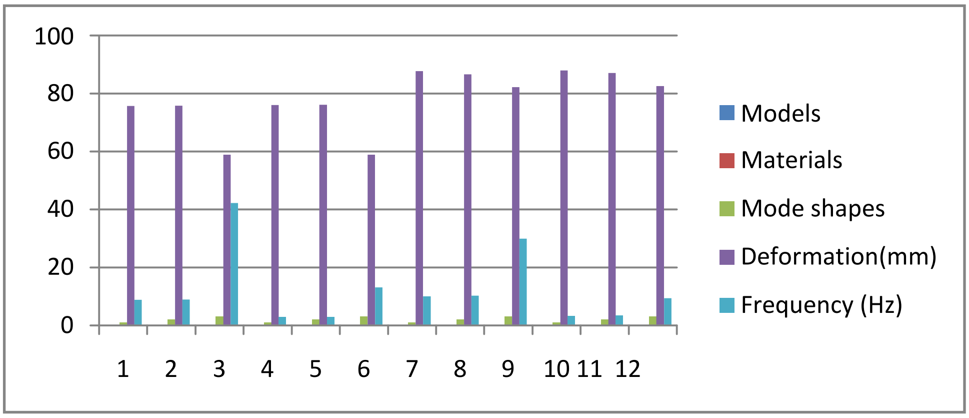


Figure: MODE SHAPE 3

Table: Modal analysis wave spring and helical results:

Models	Materials	Mode shapes	Deformation(mm)	Frequency (Hz)
Helical spring	Spring steel	1	75.696	8.8715
		2	75.776	8.9021
		3	58.95	42.168
	Chromium vanadium steel	1	76.01	2.8422
		2	76.09	2.8527
		3	58.921	13.144
Wave spring	Spring steel	1	87.766	10.099
		2	86.672	10.289
		3	82.221	29.925
	Chromium vanadium steel	1	87.905	3.2196
		2	87.066	3.2765
		3	82.525	9.3457



Graph: Modal analysis wave spring and helical results

Conclusion:

The design of spring in suspension system is very important. In this project a shock absorber is designed (helical type spring and wave spring) and a 3D model is created using CREO. Structural analysis and modal analysis are done on the suspension system by varying material for spring, Spring Steel and chromium vanadium steel. The analysis is done by considering loads, bike weight, single person and 2 persons.In this thesis the random vibration analysis is determine the directional deformation, shear stress and shear stain for which is the best material for spring.By observing the static analysis the load increases by increasing the stress, deformation and strain values. when we compared helical spring and wave spring the stress values are decreased for wave spring with chromiumvanadium steel material By observing the modal analysis the deformation increases for wave spring and frequencies decreases for wave spring By observing the static and modal analysis the chromium vanadium steel material is the best material for suspension spring so we have done the random vibration analysis for chromium vanadium steel.

References:

[1] P.R. Jadhav1, N.P.Doshi ,U.D. Gulhane . Investigation of Helical Spring in Mono suspension System Used in Motorcycle, International Journal of Research in Advent Technology, Vol.2, No.10, October 2014 E-ISSN: 2321-9637

[2] Dr. Dhananjay. R. Dolas ,Kuldeep. K. Jagtap Analysis of Coil Spring Used in Shock Absorber utilizing CAE International Journal of Engineering Research ISSN: 2319-6890), 2347-5013 Volume No.5, Issue No.2, pp : 123-126 1 Feb. 2016.

[3] T S Manjunatha and D Abdul Budan, assembling and experimentation of composite helical springs for car suspension .Res ISSN 2278 – 0149 ,Vol. 1, No. 2, July 2012

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