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DEVOLOPEMENT AND TRANSIENT ANALYSIS OF SHOCK ABSORBER SPRING BY USING CAD/CAE TOOLS

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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 travelling over rough ground, leading to improved ride quality, and increase in comfort due to substantially reduced amplitude of disturbances. When a vehicle is travelling 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. This bouncing process is repeated over and over, a little less each time, until the up-and-down movement finally stops. If bouncing is allowed to go uncontrolled, it will not only cause an uncomfortable ride but will make handling of the vehicle very difficult. The design of spring in suspension system is very important.

In this project a shock absorber is designed and a 3D model is created using Pro/Engineer. The model is also changed by changing the thickness of the spring. Structural analysis done on the shock absorber by different materials. The analysis is done by considering loads, bike weight, single person and 2 persons. Structural analysis is done to validate the strength. Comparison is done for two materials to verify best material for spring in Shock absorber. Modelling is done in SOLID WORKS and analysis is done in ANSYS Workbench. In this process transient analysis boundary conditions were applied on object and calculated deflection values and stress values for 1 to 15sec of time, in this period of time which material will get into original position is consider to be best material in least time, (materials were chosen: mild steel (existing,), ss416, new material)

Tools were used:

CAD TOOL: SOLID WORKS

CAE TOOL: ANSYS WORKBENCH

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INTRODUCTION

A shock absorber (in reality, a shock "damper") is a mechanical or hydraulic device designed to absorb and damp shock impulses. It does this by converting the kinetic energy of the shock into another form of energy (typically heat) which is then dissipated. A shock absorber is a type of dashpot. Pneumatic and hydraulic shock absorbers are used in conjunction with cushions and springs. An automobile shock absorber contains spring-loaded check valves and orifices to control the flow of oil through an internal piston. One design consideration, when designing or choosing a shock absorber, is where that energy will go. In most shock absorbers, energy is converted to heat inside the viscous fluid. In hydraulic cylinders, the hydraulic fluid heats up, while in air cylinders, the hot air is usually exhausted to the atmosphere. In other types of shock absorbers, such as electromagnetic types, the dissipated energy can be stored and used later. In general terms, shock absorbers help cushion vehicles on uneven roads.

In a vehicle, shock absorbers reduce the effect of traveling over rough ground, leading to improved ride quality and vehicle handling. While shock absorbers serve the purpose of limiting excessive suspension movement, their intended sole purpose is to damp spring oscillations. Shock absorbers use valving of oil and gasses to absorb excess energy from the springs. Spring rates are chosen by the manufacturer based on the weight of the vehicle, loaded and unloaded. Some people use shocks to modify spring rates but this is not the correct use. Along with hysteresis in the tire itself, they damp the energy stored in the motion of the unsprung weight up and down. Effective wheel bounce damping may require tuning shocks to an optimal resistance.

Spring-based shock absorbers commonly use coil springs or leaf springs, though torsion bars are used in torsion shocks as well. Ideal springs alone, however, are not shock absorbers, as springs only store and do not dissipate or absorb energy. Vehicles typically employ both hydraulic shock absorbers and springs or torsion bars. In this combination, "shock absorber" refers specifically to the hydraulic piston that absorbs and dissipates vibration.

LITERATURE REVIEW

In this section, literatures survey study gathered regarding the information about the stress for the helical compression spring. Springs are mechanical shock absorber system. A mechanical spring is defined as an elastic body which has the primary function to deflect or distort under load, and to return to its original shape when the load is removed. The researchers throughout the years had given various research methods such as Theoretical, Numerical and Experimental. Researchers employ the Theoretical, Numerical and FEM methods. Study concludes Finite Element method is the best method for numerical solution and calculating the stress, life cycle and shear stress of helical compression spring Lavanya et al. [1] presented the work to analyze the

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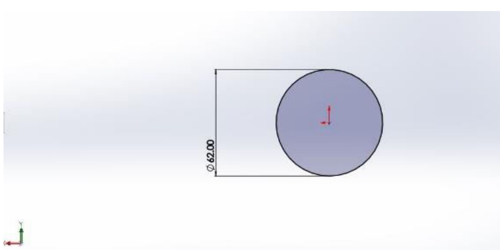
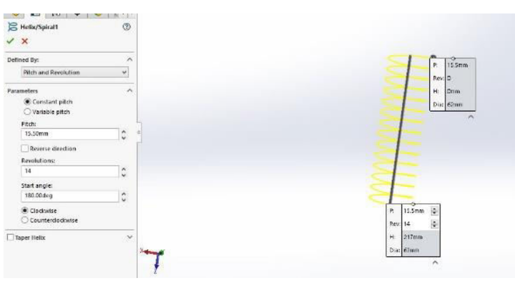
safe load of the light vehicle suspension spring with different materials and investigation includes comparison of modeling and analyses of primary suspension spring made of low carbon-structural steel and chrome vanadium steel and suggested the suitability for optimum design. The results showed that reduction in overall stress and deflection of spring for chosen materials. Youli Zhu et al.[2] analyzed compression coil spring fractured at the transition position from the bearing coil to the first active coil in service, Visual observations indicated that a wear scar wasformed on the first active coil and the fracture surface showed radiating ridges emanating from the wear scar. Scanning electron microscopy examination showed crescent shaped region and beach marks, typical of fatigue failure.

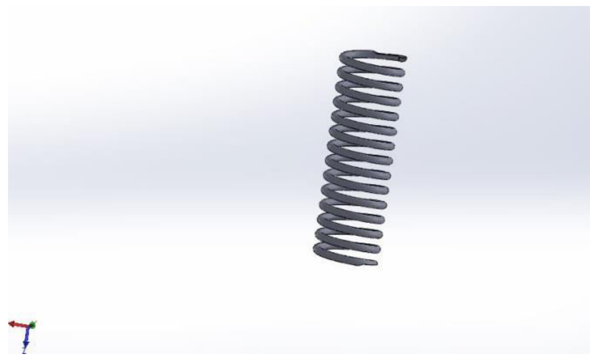
Designing process step by step



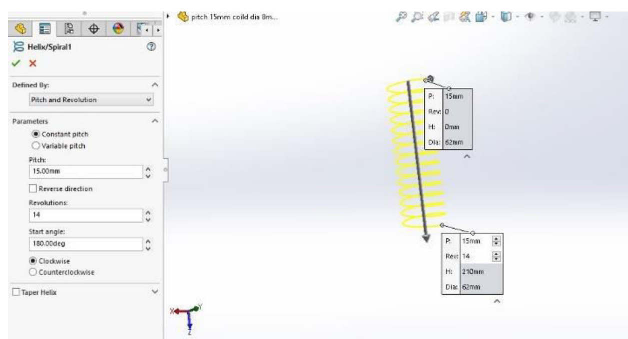


15.5mm pitch helix

15.5mm helix pitch with 7.5mm coil diameter



15.5mm helix pitch with 7.5mm coil diameter final model



15mm pitch helix

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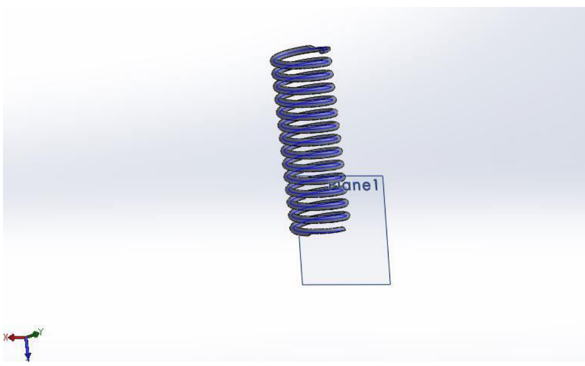
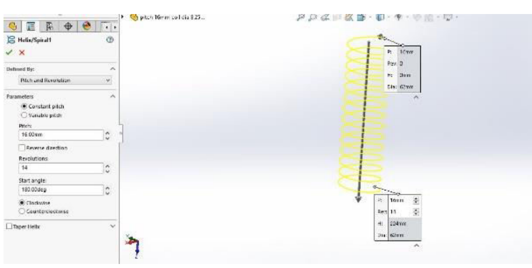
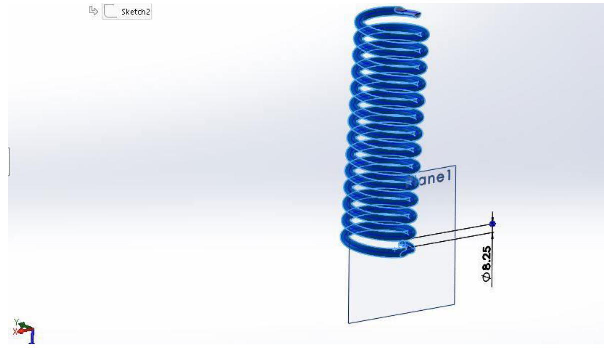
15mm helix pitch with 8mm coil diameter



15mm helix pitch with 8mm coil diameter final model



16mm pitch helix



16mm helix pitch with 8.25mm coil diameter

16mm helix pitch with 8.25mm coil diameter final model

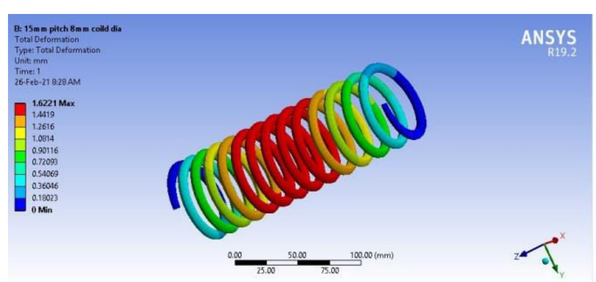
Ansys process

Results

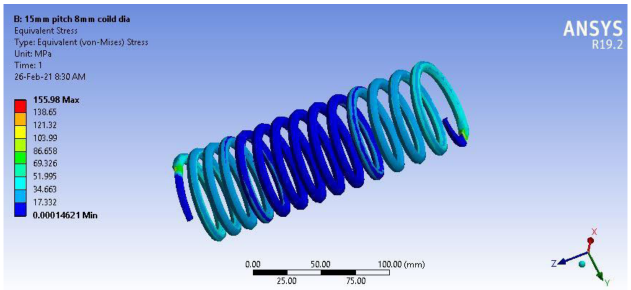
15mm pitch with 8mm coil diameter spring

Steel material

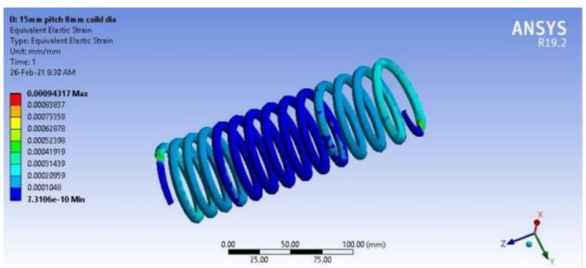
Deformation



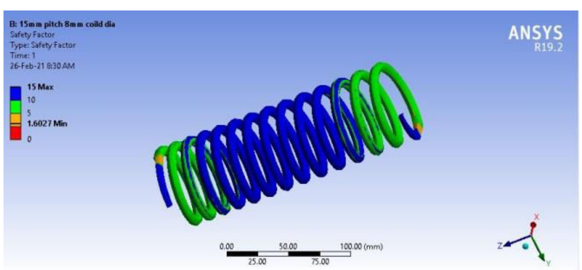
Stress



Strain



Safety factor



Static analysis results

15mm pitch with 8mm coil diameter spring

	steel	Steel 416
Deformation (mm)	1.6221	1.6818
Stress (Mpa)	155.98	156.23
Strain	0.00094317	0.00099328
Safety factor	1.6027	1.9363

15.5mm pitch with 7.5mm coil diameter spring

	steel	Steel 416
Deformation (mm)	2.0833	2.1598
Stress (Mpa)	143.86	144.17
Strain	0.00081606	0.00085455
Safety factor	1.7378	2.0982

16mm pitch with 8.25mm coil diameter spring

	steel	Steel 416
Deformation (mm)	1.4418	1.4948
Stress (Mpa)	135.5	135.93
Strain	0.00075831	0.0007942
Safety factor	1.845	2.2254

Dynamic analysis results

15mm pitch with 8mm coil diameter spring

	Steel416	Steel
Mode 1 (Hz)	48.443	48.044
Mode 2 (Hz)	48.884	48.494
Mode 3 (Hz)	54.54	54.225
Mode 4 (Hz)	61.416	60.821
Mode 5 (Hz)	106.41	105.64
Mode 6 (Hz)	107.03	106.13

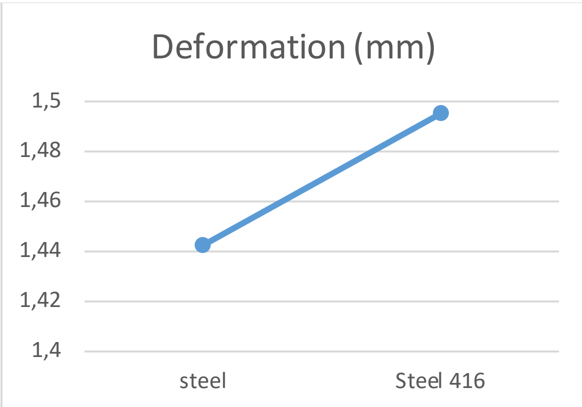
15.5mm pitch with 7.5mm coil diameter spring

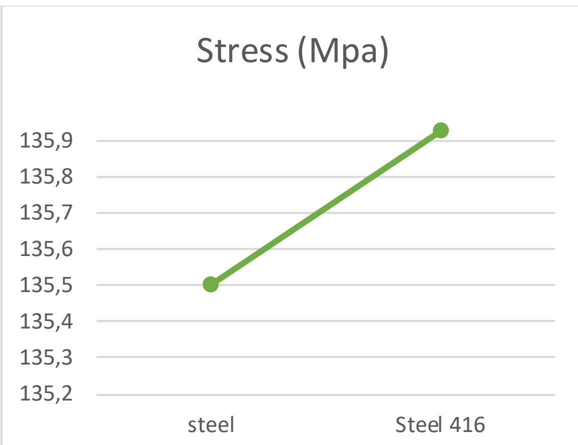
	Steel416	Steel
Mode 1 (Hz)	44.942	44.577
Mode 2 (Hz)	45.082	44.714
Mode 3 (Hz)	51.2	50.909
Mode 4 (Hz)	57.749	57.176
Mode 5 (Hz)	99.239	98.452
Mode 6 (Hz)	99.695	98.861

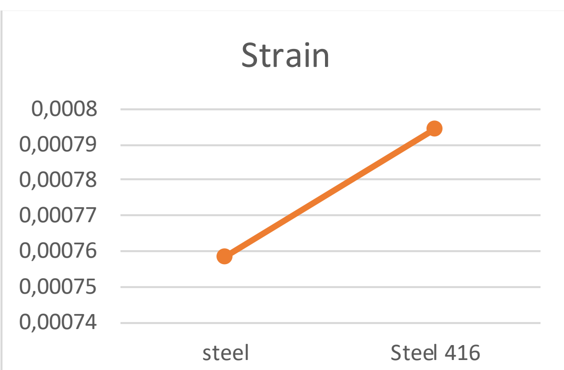
16mm pitch with 8.25mm coil diameter spring

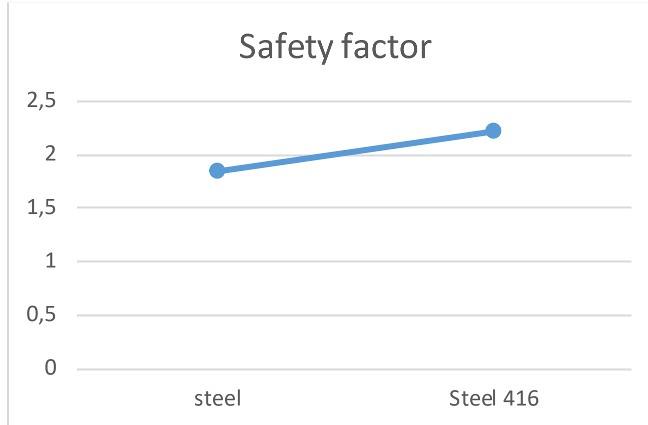
	Steel416	Steel
Mode 1 (Hz)	47.326	46.951
Mode 2 (Hz)	47.575	47.191
Mode 3 (Hz)	55.932	55.613
Mode 4 (Hz)	62.721	62.113
Mode 5 (Hz)	105.77	104.95
Mode 6 (Hz)	106.35	105.98

Graphs









Conclusion

In this thesis helical spring were designed with the help of solid works tool, in this process 3 different pitch values and 3 different coil diameter values helical springs were designed, in this process difference in their deformation and stress values and safety factor values were noted down, here helical spring material consider as mild steel, and new material were chosen as stainless steel 416, 15mm pitch with 8mm coil diameter design were consider as existing design which is taken from previous base paper work, and here 2 different helical springs 15.5mm pitch with 7.5mm coil diameter, and 16mm pitch with 8.25coil diameter were also designed and analyzed,

From static analysis results both designs has got better safety factor values than existing material, but when pitch value increased and coil diameter decreases the total deformation values were increased and it increases the stiffness of the object, and when pitch value is increased with increased coil diameter the total deformation values were reduced, and also stress values reduced, From dynamic analysis results steel 416 material is having better frequency range values than existing material steel,

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