

Comparison of Suspension for Hatchback, Sedan and Mini SUV

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ABSTRACT

The aim of this paper is to design the helical compression spring for suspension system used in hatchback, sedan and mini SUV car in CATIA V5R18 and analyze the spring in ANSYS 14.0 to check the deformation value as well as maximum shear stress value. Proper calculations are made for designing of spring. Reduction in weight is a need of automobile industry, thus the springs are to be designed for higher stress with small dimensions thereby reducing the cost of material of spring.

Keywords

Helical compression spring, deformation value, maximum shear stress, 3D design in CATIA V5R18, analysis in ANSYS 14.0 .

1. INTRODUCTION

Spring is an elastic body which deflects under the action of load and return to its original shape when the load is removed. Spring mainly used to store energy, absorb shocks and vibrations, weighing balances and scales and used to apply force and control motion. Helical compression springs are widely used over the world. The main function of a helical compression spring used in vehicle's suspension system is to isolate the structure and the occupants from shocks and vibrations generated by the road surface. Helical springs exhibit high sensitivity to supporting conditions. The helical spring is generally made from a steel wire, usually of circular cross-section, which is bent in the form of helix with a constant pitch between adjacent coils. This paper discusses about basic terms like spring index, solid length, free length, pitch, total axial gap, permissible and induced shear stress and deflection of helical spring. Basic design procedure of helical compression spring is also discussed.

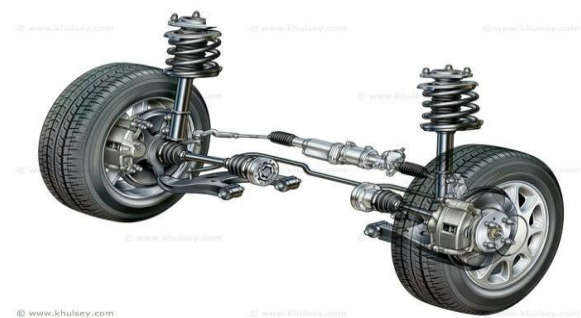


Fig. 1: Shows suspension system

2. MATERIAL USED

Material which is used in designing of helical compression spring is high carbon steel i.e. music wire also known as piano wire (.70 to 1.00% C) good for high stresses caused by cyclic repeated loading and a high tensile strength material.

2.1 MATERIAL PARAMETERS

ASTM A228(MUSIC WIRE)	C(0.7 to 1.0%),Mn(0.2 to .60%)
Density	7.85 g/cc
Minimum ultimate tensile strength(S_{ut})	1590 Mpa
Poisson's ratio	0.313(calculated)
Shear modulus(G)	80000 Mpa
Modulus of elasticity(E)	210000 Mpa

3. SPRING SPECIFICATIONS

3.1 For Hatchback

Spring wire diameter (d) =13 mm,
Coil mean diameter (D) =104 mm,
Coil free length (h) =191.4 mm,

Number of active coils (n) =6,
Pitch (P) =27.34 mm

3.2 For Sedan

Spring wire diameter (d) =12 mm,
Coil mean diameter (D) =108 mm,
Coil free length (h) =250.7 mm,
Number of active coils (n) =6,
Pitch (P) =36 mm

3.3 For Mini Suv

Spring wire diameter (d) =20 mm,
Coil mean diameter (D) =200 mm,
Coil free length (h) =304 mm,
Number of active coils (n) =6,
Pitch (P) =43.40 mm

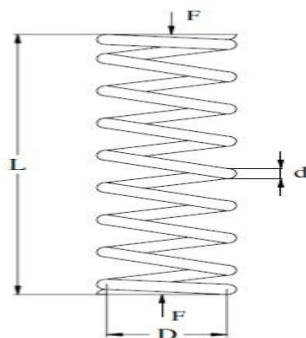


Fig.2: Shows cross section of helical spring

3.4 Formulae Used

- δ (deflection) = $\frac{8PD^3N}{Gd^4}$
- solid length = $N_t D$
- Free length = solid length + axial gap + δ
- Induced shear stress = $\frac{8PK}{\pi d^2}$
- $K = \frac{4C-1}{4C-4} + \frac{0.615}{C}$
- Pitch = $\frac{\text{Free Length } h}{N_t - 1}$

3.5 Calculations

Parameters	Hatchback	Sedan	Mini SUV
Spring index(C)	8	9	10
Wahl factor(K)	1.184	1.162	1.145
Deflection(δ)	76mm	134.53mm	125.07mm
$\tau_{\text{permissible}}$	795 N/mm ²	795 N/mm ²	795 N/mm ²
τ_{induced}	458.53 N/mm ²	682.60 N/mm ²	303.89 N/mm ²

4. DESIGN AND DETAILS OF MODELS PARTS

During the designing of the suspension we used construction parameters of already designed suspensions.

Spring: A helical metal coil, that can be pressed or pulled but returns to its original shape when released.

CATIA V5 construction:

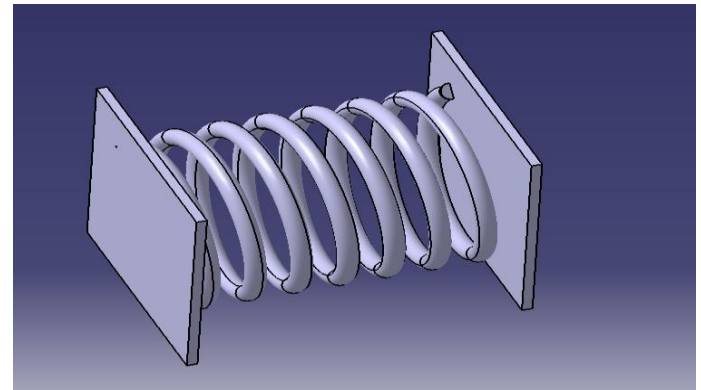


Fig.3: Shows design of helical spring

5. Analysis of helical compression springs of Hatchback, Sedan and Mini SUV

5.1 For Hatchback

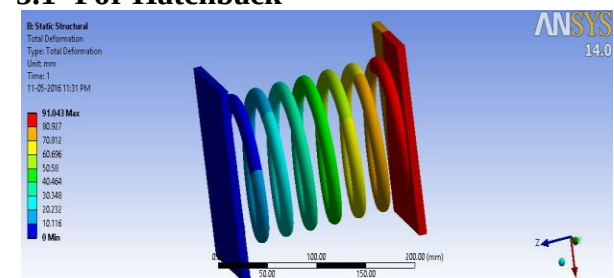


Fig. 4: Shows total deformation

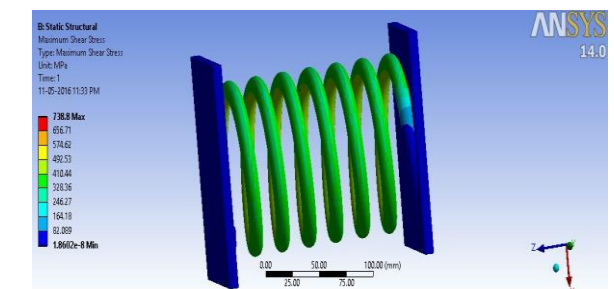


Fig. 5: Shows Maximum Shear Stress

5.2 For Sedan

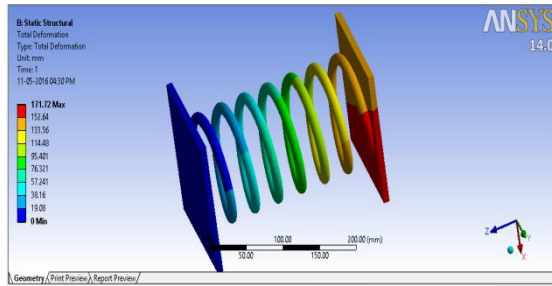


Fig. 6: Shows total deformation

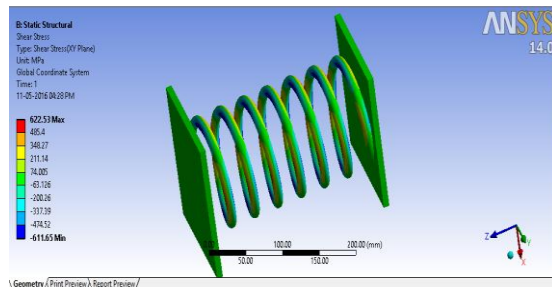


Fig.7: Shows Maximum Shear Stress

5.3 For Mini Suv

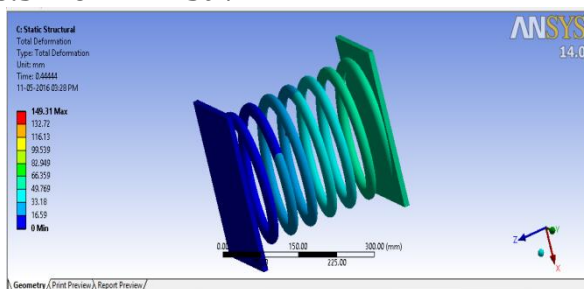


Fig.8: Shows total deformation

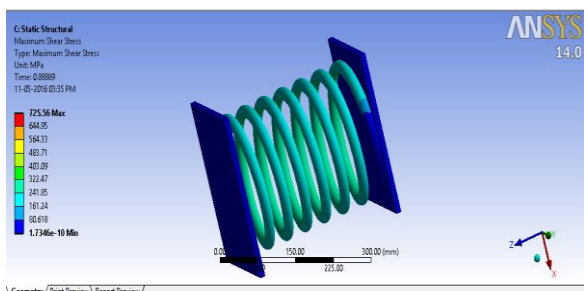


Fig. 9: Shows Maximum Shear Stress

6. ANALYTICAL VALUES

S.no	Car Segment	Load (N)	Maximum shear stress (τ) MPa
1	Hatchback	3212.7	738.8
2	Sedan	3691	622.5
3	Mini SUV	4169	725.56

7. CONCLUSION

In the present work helical compression spring is modelled and static analysis carried out by using ANSYS V14.0, it is observed that maximum shear stress is developed at the inner side of the coil and total deformation is also comes to be less. The induced shear stress found is less than permissible shear stress in all the cases and thereby shows that the spring which we designed is safe for the given load and it is good for ride. In this analysis our main focus is to keep the spring material good so that it can withstand the load and keep the diameter as small as possible so it will reduce the cost.

8. REFERENCES

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