Design of Helical Compression Spring For Front Bumper

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Abstract- *Helical compression springs are used as an integral part of many mechanical systems. Helical spring is also used in several industrial applications like balancing, brakes, vehicles suspensions in order to satisfy required functions. It applies forces, store or absorb energy, provide the mechanical system with the flexibility and maintain a force or a pressure*

Keywords- helical compression spring, calculations, forces, mass, materials.

I. INTRODUCTION

A spring is defined as an elastic body, whose function is to compress when loaded and to recover its original shape when the load is removed. A spring is a flexible element used to exert a force or a torque and, at the same time, to store energy. The force can be a linear push or pull, or it can be radial. The torque can be used to cause a rotation. Springs can be classified according to the direction and the nature of the force exerted by the spring when it is deflected. Helical compression springs are typically made from round wire, wrapped into a straight, cylindrical form with a constant pitch between adjacent coils.

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. In other words it is also termed as a resilient member.

II. LITERATURE REVIEW

Anderson [1] has discussed that to increase crash performance in automotive vehicles it is necessary to use new techniques such as use of energy absorber and materials. Components linked to crash safety should transmit or absorb energy. The energy absorbing capability of a specific component is a combination of geometry and material properties.

Evans D and Morgan[2] have studied that as vehicle manufacturers continue to become more aggressive with the styling of new vehicles, bumper system technologies will be required to find new solutions that fit into the reduced package spaces while continuing to meet the vehicle performance and cost requirements. It was suggested to introduce new and innovative Expanded Polypropylene (EPP) foam technologies and techniques.

L.DelLiano Vizcaya [3] studied the manufacturing process of mechanical spring and observed that tensile residual stresses induces on the inner coil surface while compressive residual stresses were generated on outer coil surface which reduces considerably the spring strength and service life. These unfavourable stresses partially eliminated by heat treatment.

Youli Zhu, Yanli Wang et al.[4] analyzed why a compressive coil spring fractured at the transition position from the bearing coil to the first active coil in service. While the nominal stress should always much less than at the insides coil position of a fully active coil. Visual observation indicated that a wear scar was formed on the first active coil. Scanning electron microscopy examination showed crescent shaped region and bench marks. Zn phosphate layer and painting around the contact zone were worn out due to contract and friction and Resulted into corrosion.

R. Puff et al. [5] investigated the effect of the presence of non-metallic inclusions in the early failure of a helical spring subjected to regular design loads during its operation. To understanding the reduction in fatigue strength, an analytical model was used.

K. Michalczyk [6] The analysis of elastomeric coating influence on dynamic resonant stresses values in springs presented in this paper. The appropriate equations determining the effectiveness of dynamic stress reduction in resonant conditions as a function of coating parameters were derived. It was proved that rubber coating will not perform in satisfactory manner due to its low modulus of elasticity in shear

III. SPECIFICATIONS OF HELICAL COMPRESSION SPRING

w = weight of car

f = force acted on car

τ = shear stress

kw = whar'l factor

d = wire diameter

D = coil diameter

C = spring index K

= stiffness

n = no of coils

n^1 = no of active coils

Ls = solid length of spring

Lf = free length of spring

P = pitch

IV. DESIGN OF HELICAL COMPRESSION SPRING

[1] Helical compression spring for Scorpio car at speed of 100 km/hr

W= 2610 kg

$F=1/2\,MV^2$

τ =686 N/mm^2

V= $\underline{100\times10}$ =28 m/s

m = w/g = 2610/9.81 = 267 Kg

$F = 1/2 \times 267\times28^2$

= 104664N

686 = 1.31(8×52332×5/
2
πd) d = 36 mm

C = D/d

D = 180 mm

K = F/δ =52332/30= 1744.4 N/mm

L_f = 177 mm

P = 52 mm

n = 2

n' = 2+2 = 4

L_s = 144 mm

[2] Helical compression spring for Scorpio car at speed of 80 km/hr

W= 2610 kg

$F=1/2\,MV^2$

τ =686 N/mm^2

V= $\underline{80\times10}$ =22.22 m/s

m = w/g = 2610/9.81 = 267 Kg
2

= 65912.7414 N

F' = 32956.37 N (on one spring)

Kw = 1.31

τ = Kw $(8FC/\pi d^2)$

686 = 1.31(8×32956×5/
2

C = D/d

D = 141.5 mm

K = F/δ =32956/30= 1098.53 N/mm

L_f = 175 mm

P = 39.46 mm

n = 3

n' = 2+3 = 5

L_s = 141.5mm

[3] Helical compression spring for Scorpio car at speed of 120 km/hr

W= 2610 kg

$F=1/2\,MV^2$

τ =686 N/mm^2

V= $\underline{120\times10}$ =33.33 m/s

m = w/g = 2610/9.81 = 267 Kg
2

= 148303.66N

F' = 74151.83 N (on one spring)

Kw = 1.31

τ = Kw $(8FC/\pi d^2)$

686 = 1.31(8×74151.83×5/
2

C = D/d

D = 212.3 mm

K = F/δ =74151.83/30= 2471.72 N/mm

L_f = 203 mm

P = 60 mm

n = 2

n' = 2+2 = 4

L_s = 170 mm

V. CONCLUSION

Springs produce a large deflection and used for a number of applications. Most springs are made of steel. Stress and deflection in coil springs was derived. Springs can be connected in series and parallel. There are a number of other spring configurations used in engineering.

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