DESIGN, FABRICATION AND ANALYSIS OF HELICAL COMPRESSION SPRING

[1]Yogesh Gaikwad, [2]Maheshwar Badgujar, [3]Suraj Bhange, [4]Swapnil Raut.
[5] Prof. Nilesh Dhumal
[1]Student of BE Mechanical [2] Student of BE Mechanical[3] Student of BE Mechanical[4] Student of BE Mechanical
[5] Assistant Professor, Mechanical Engineering Department, SRTTC, Kamshet

Abstract - Bumpers are structural components installed to reduce physical damage to the front and rear ends of a light/ heavy motor vehicle from Low-speed collisions. Damage and protection assessments are the commonly used design criteria in bumper design. For damage assessment, the relative displacements representing stiffness performance are examined and crash test will be done. The purpose of a crash analysis is to see how the car will behave in a frontal or rear collision. In this paper, impacts and collisions involving a car bumper beam model are simulated and analyzed using Hyper works software. The bumper should support the mechanical components and the body.
It must also withstand static and dynamic loads without undue deflection or distortion. The given model is tested under frontal collision conditions and the resultant deformation and stresses are determined using hyper works software. The crash analysis simulation and results can be used to assess both the crashworthiness of current bumper and to investigate ways to improve the design. This type of simulation is an integral part of the design cycle and can reduce the need for costly destructive testing program.

KEYWORDS: Helical compression spring, Bumper, Mass, Acceleration, Forces

I.INTRODUCTION

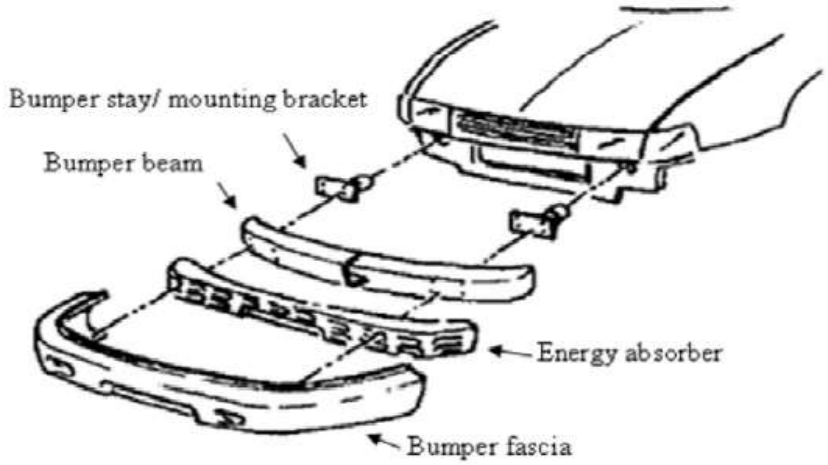


Figure 1: Bumper system [6]

Car accidents are happening every day. Most drivers are convinced that they can avoid such troublesome situations. Nevertheless, we must take into account the statistics ten thousand dead and hundreds of thousands to million wounded each year. These numbers call for the necessity to improve the safety of automobiles during accidents. Automotive bumper beam is one of the key systems in passenger cars. Bumper beam designed to prevent or reduce physical damage to the front or rear ends of passenger motor vehicles in collision condition. They protect the hood, trunk, grill, fuel, exhaust and cooling system as well as safety related equipment such as parking lights, headlamps and taillights, etc

The Car accidents are happening every day. Most drivers are convinced that they can avoid such troublesome situations. However the statistics shows that ten thousand dead and hundreds of thousands of million wounded each year. Hence, improvement in the safety of automobiles is prerequisite to decrease the numbers of accidents. Automobile bumper is a structural component of an automobile vehicle which contributes to vehicle crashworthiness or occupant protection during front or rear collisions. The bumper system also protects the hood, trunk, fuel, exhaust and cooling system as well as safety related equipment. Bumper beams are usually made of steel, aluminium, plastic, or composite material. Bumper beams are also the backbone of the energy absorbing systems located at both front and rear on automobiles. This energy absorber which looks like a shock absorber, functions as a connecting member between a bumper and front cross member for the purpose of damping load and the shock load during a low speed collision between the motor vehicle and an obstacle. Under the bumper impact situation these energy absorbers are loaded in compression or tension as well as the bumper moves from a designed outer position toward the vehicle body and are operative to absorb the energy of the impact. After impact, these energy absorbers recover at various rates to return associated with bumper assembly toward its original pre-impact position.

Two absorbers are located between the front cross member and the front bumper reinforcement. During a front end impact, the energy absorbers shorten, just like a telescope type shock absorber. Following the impact, if the impact is not beyond the designed limits of the energy absorbers, they return to their original length. This actionof forces hydraulic fluid to flow around the metering pin and through the orifices

in the end of the piston tube. As the piston tube continues to move the flow of hydraulic fluid into the piston tube pushes the floating piston to the left. This compresses the oil in the piston tube automotive bumper plays a very important role in absorbing impact energy for original purpose of safety and styling stand point/aesthetic purpose. Now days, automotive industry concentrates on optimization of weight and safety.

II. LITERATURE SURVEY

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

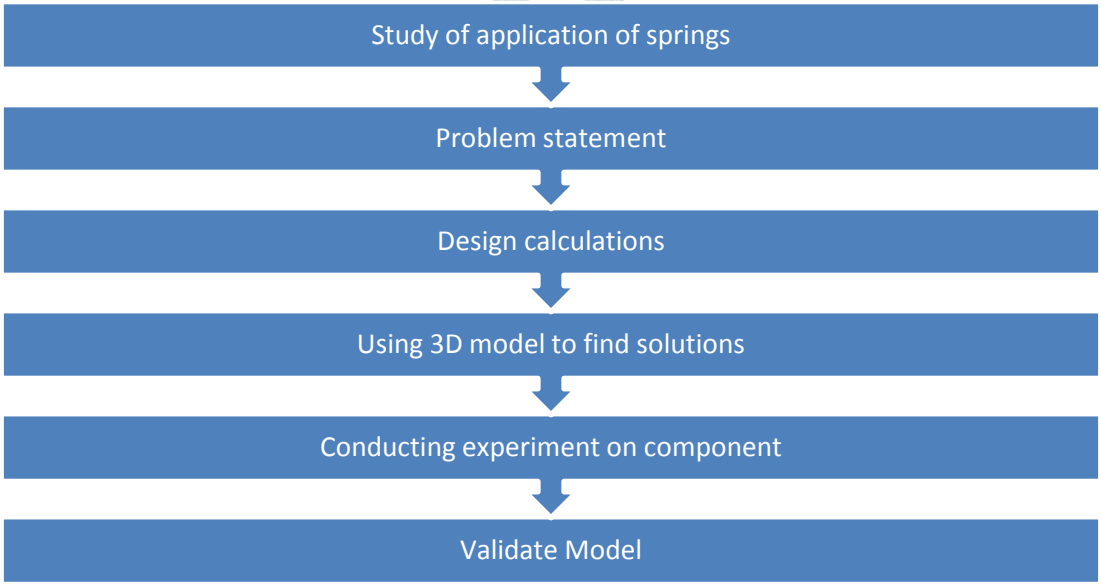
Touhid Zarrin-Ghalami, Ali Fatemi [7] Elastomeric components have wide usage in many industries. The typical service loading for most of these components is variable amplitude and multiracial. In this study a general methodology for life prediction of elastomeric components under these typical loading conditions was developed and illustrated for a passenger vehicle cradle mount. Crack initiation life prediction was performed using different damage criteria.

Sid Ali Kaoua a, KamelTaibi [8] This paper presents a 3D geometric modelling of a twin helical spring and its finite element analysis to study the spring mechanical behaviour under tensile axial loading. The spiralled shape graphic design is achieved through the use of Computer Aided Design (CAD) tools, of which a finite element model is generated. Thus, a 3D 18-dof pentaedric elements are employed to discrete the complex ‘‘wired-shape” of the spring, allowing the analysis of the mechanical response of the twin spiralled helical spring under an axial load.

Stefanie Stanzl- Tschegg [9] Ever since high-strength steels were found to fail below the traditional when loaded with more than 108 cycles, the investigation of metals’ and alloys’ very high cycle fatigue properties has received increased attention. A lot of research was invested in developing methods and machinery to reduce testing times. This overview outlines the principles and testing procedures of very high cycle fatigue tests and reports findings in the areas of crack formation, non-propagating small cracks, long crack propagation and thresholds. Furthermore, superimposed and variable amplitude loading as well as frequency effects are reported.

A.González Rodríguez, J.M. Chacón, [10] An adjustable-stiffness actuator composed of two antagonistic non-linear springs is proposed in this paper. The elastic device consists of two pairs of leaf springs working in bending conditions under large displacements. Owing to this geometric non-linearity, the global stiffness of the actuator can be adjusted by modifying the shape of the leaf springs. A mathematical model has been developed in order to predict the mechanical behaviour of our proposal.

III.METHODOLOGY



Most modern cars use a reinforced thermoplastic bumper, as they are making cheap to manufacture, easy to fit and absorb less energy during a crash. A majority of car bumpers are custom made for a specific model. However, many companies now offer alternative designs in thermoplastic, with a range of fittings designed for different models.

Steel Bumper Originally plated steel was use for the entire body of a car including the bumper.This material worked well, as it was very strong in a crash, but it was very heavy and dented performance. As car engine design has improved, steel bumper have pretty much disappeared for anything except classic cars. Replacing one involves a lot of searching for scrap cars or having one specially made. Improving passenger car damageability and repair ability.

CONCLUSION

Design changes in vehicles and the location of engine block have been the results of evolution of crash testing. Therefore in future, crash testing could suggest many more design changes, which could further minimize the probability of damage during a crash.

Shock absorber at the front of frame improves the safety of the vehicle as well as occupants inside the vehicle. From the above work, it can be concluded that the bumper is an important member of an automobile from the safety point Vehicle collisions are occurred in different possible modes. It may be head-on collision, rear end collision, and side collision and roll over's. Of these modes, head-on collision is mostly occurred one and causes severe damage to both vehicle and passengers.

We cannot totally avoid these types of vehicle collisions. Instead of preventing these accidents which is not possible, collision effects can be reduced by providing Bumpers in the front side of vehicles. Thus in this project, effects of collision is much reduced by implementing the several units of Hydraulic Shock Absorber with spring in bumper of vehicles. From the study of passenger it is clear that if bumper is safe for with passenger then it is definitely safe for without passenger.

REFERENCES

[1] Supriya Burgul : Literature Review On Design, Analysis And Fatigue life Of A Mechanical Spring [International Journal Of Research In Aeronautical And Mechanical Engineering]

[2] Dhiraj V. Shevale, Niranjan. D. Khaire : Review On Failure Analysis Of Helical Compression Spring : [International Journal Of Science, Engineering And Technology Research (IJSETR)]

[3] Gajanan S. Rao, Prof. R. R. Deshmukh : Art Of Fatigue Analysis Of Helical Compression Spring : [International Journal Of Mechanical Engineering And Technology (Ijmet)]

[4] Dr. Dhananjay. R. Dolas ,Kuldeep. K. Jagtap : Analysis Of Coil Spring Used In Shock Absorber Using CAE : [International Journal Of Engineering Research]

[5] Niranjan Singh General Review Of Mechanical Springs Used In Automobiles Suspension System : [Singh International Journal Of Advanced Engineering Research And Studies]

[6] Shaikh tauseef , P.Ravikantraju : Design And Analysis Of Compression Spring Used In Automotives : [International Journal Of Engineering Sciences & Research Technology]

[7] Mr. Anirudh M. Shende1, Prof. Shirish N. Gandhare, Dr. S. P. Untawale : Failure Analysis Of Helical Coil Spring In Automobile System : [International Journal Of Research In Science & Engineering Using Finite Element Method]

[8] Chandrakant chavan, G.M.Kakandikar, Swapnil S. Kulkarni: Analysis For Suspension Spring To Determine And Improve Its Fatigue Life : [International Journal Of Scientific Research And Management Studies]

[9] Akshat Jain, Arun Jindal, Prateek Lakhiani, Sheelam Mishra : Mathematical Approach To Helical Spring used In Suspension System : [International Journal Of Mechanical And Production Engineering]