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RUBBER COMPOSITE (VIBRATION MOUNT) DESIGN OPTIMIZATION USING FEA

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ABSTRACT

In this study give the vibration analysis of Vibration rubber mount. This analysis must be caried out by using FEA tool.FEA is a powerful tool for analysis the rubber components.FEA is a exallent tool for design engineering to improve the performance of the devices. , It is faster product development tool. It can be used for any phase of the product life styles. It will be provide a best stage to develop an optimum product. Rubber is a very unique material. During processing and shaping, it behaves mostly like a highly viscous fluid. The use of FEA can greatly improve the proces evaluation speed and the quality of product design or reduce the overall cost.In this study we have solve the geometry of object,shape and vibration proprties of rubber mount by using Gmsh and ANYSYS softwar and also reduce the overall material cost.This all analysis will be depend on Harmonic analysis and Equivalent stress.

Keyword: Gmsh, ANYSYS , Vibration rubber mount, Harmonic Response.

I. INTRODUCTION

The finite element method is a computer-aided engineering technique for obtaining approximate numerical solutions to boundary value problems which predict the response of physical systems subjected to external loads. It is based on the principle of virtual work. Finite element analysis in rubber is more difficult. A mostly Finite – element application to design is the determination of stresses and temperatures in rubber component.Many methodes are used to solve the FEA or many software also help to solve it.This analysis can also be diagnostic, also suporrt to solve it's failure prolem. The use of FEA can greatly improve the proces evaluation speed and the quality of product design or reduce the overall cost. Rubber is viscoelastic material. Rubber is a very unique material. During processing and shaping, it behaves mostly like a highly viscous fluid. After its polymer chains have been cross-linked by vulcanization (or by curing).Proper analysis of rubber components requires special material modeling and nonlinear finite element analysis tools that are quite different than those used for metallic parts. It can large deformations under load. Its load-extension behavior is nonlinear. Because it is viscoelastic, It's behavior is time and temperature dependent.

II. MATERIAL BEHAVIOOUR

This section discusses the issues central to the description of material modeling of elastomers. Any material behavior must be determined experimentally, and the wide variety of rubber compounds make this experimental determination even more important. The function of an isolator is to reduce the magnitude of motion transmitted from a vibrating foundation to the equipment, or to reduce the magnitude of force transmitted from the equipment to its foundation. The nature and degree of vibration isolation is influenced markedly by the characteristics of the damper. The performance is usualy given in terms of transmissibility. Transmissibility is defined as the ratio of the transmitted amplitude to the imposed amplitude of vibration or the ratio of the transmitted force to the externally imposed force.

It is expressed in decibels and usually based on the consideration of a single degree of freedom spring/mass system. In this simple model K is a stiffness and C is a damping coefficient. K and C are constants and independent of frequency. From the differential equation of motion the transmissibility can be computed and is given for a steady state sinusoidal excitation by

$$T = \frac{\text{output}}{\text{input}} = \sqrt{\frac{1+(2ur)^2}{(1-(r)^2)^2+2(ur)^2}}$$

Where r is the frequency ratio (=f/fn) and u is the damping ratio (= C/Cc), with f_n the natural frequency and C is the critical damping coefficient.

III. MODEL DESCRIPTION AND RESULT

In the analysis of an vibration mount, it is often important to model small-amplitude vibrations superimposed upon a large initial deformation. The static and dynamic characteristics of the rubber mounts for vibration isolation in automotive powertrains and other dynamic systems should be predicted during their design and development stage. Now A days the mounting system is playing a more and more important role in automotive noise, vibration and harshness control because of popular applications of smaller engines and lighter materials in automobiles and higher requirements

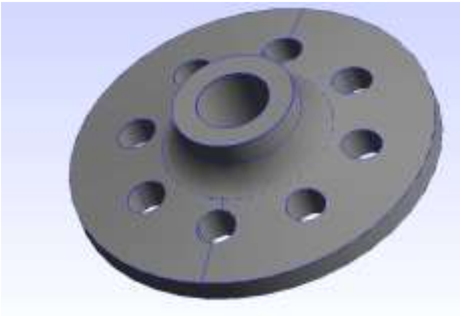
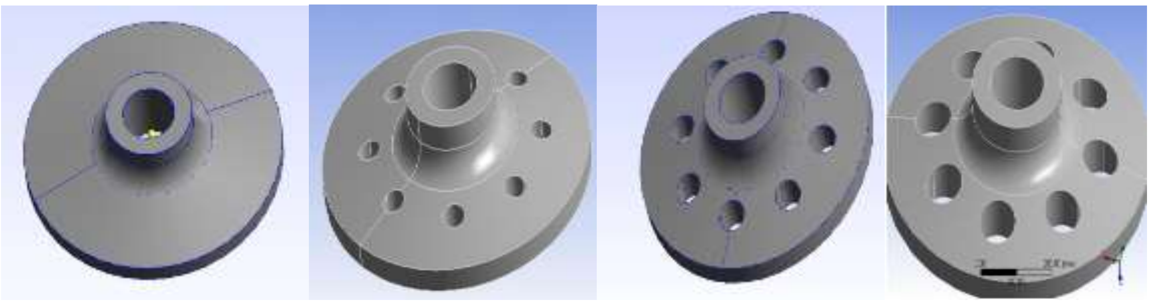


Fig. 1The Schematic diagram of model

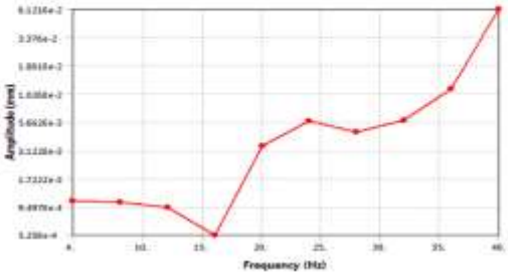
for car ride comfort and quietness. So, In this paper, the simulation of a rubber mount is performed using the finite element Analysis. The modeling and simulation methods for a large deformation rubber spring represented by axisymmetric, quarter-symmetric and three-dimensional finite element models are investigated by using finite element analysis software Gmsh for meshing and ANYSYS for computations. Show the Schematic diagram of model in figure 1. The static strain–stress analysis of the rubber part shows that the von Mises stress can be adopted as a stress measure for the rubber material and also measure the vibration properties. The modeling methods for the large deformation rubber mount are determined with numerical tests of elastic characteristics. The research results will help engineers and researchers to perform engineering design and analysis of rubber mounts and other vibration reduction rubber components using the finite element simulation method. In this simulation define the different geometry of the object at different dimensions. Show In figure core model and with hollow model at 60, 80 and 100 mm size of hole.



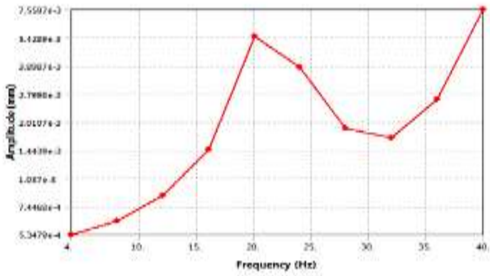
(a) (b) (c) (d)

Fig. 2 (a) Core model (b, c, d) With hollow at 60,80,100 mm size of hole.

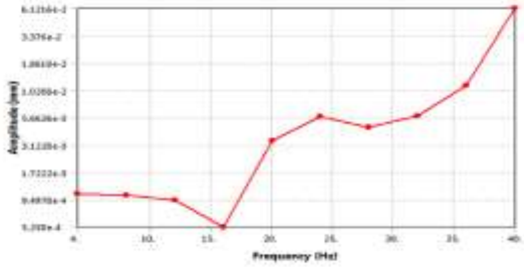
First of all set the all parameter of model. After that set all the material details in tool. In this analysis use the young modulus of Neoprene (Chloroprene) rubber as 7e5 and density of material is 1230 kg/mm^3, Poisson ratio is 0.49 at that condition. And find the properties of at 30, 50, 80,100 ˚C temperature. Shown the total deformation in below graph is as follows:



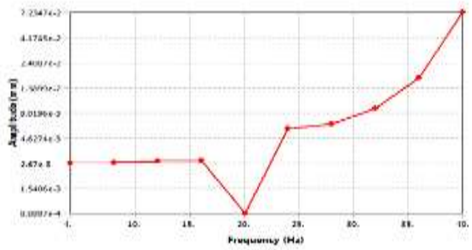
(a)



(b)



(C)



(d)

Fig. 3 Total deformation of material for all model.

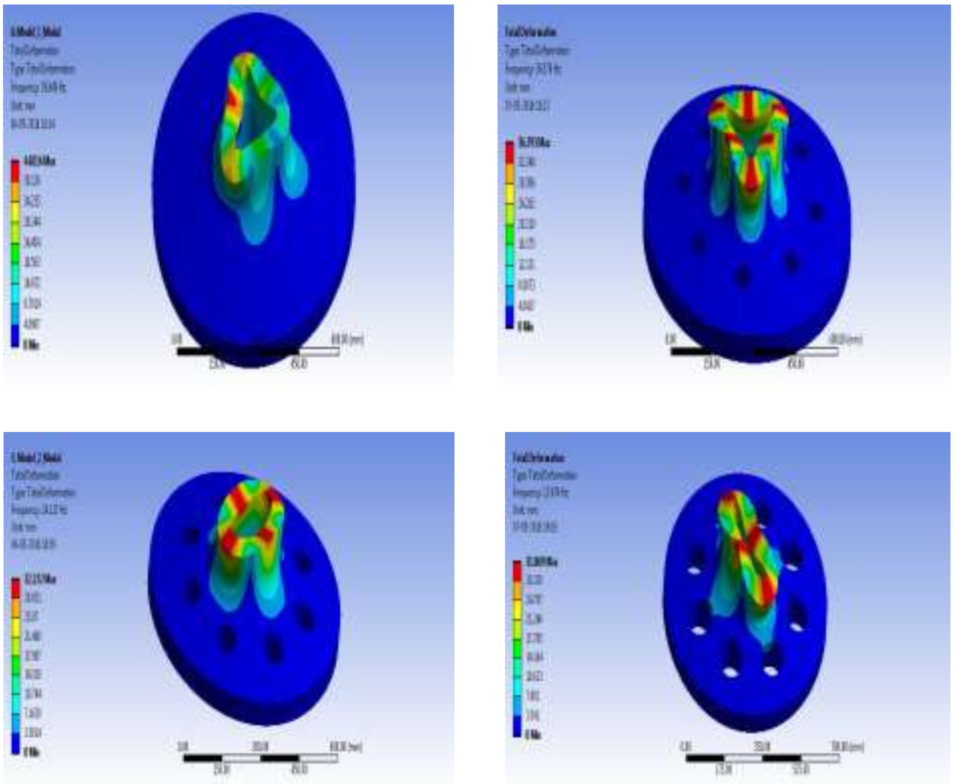


Fig. 4

Also define the equivalent stress of material at different frequency. Shown the stress analysis of object shown in figure 5.By this Analysis we should be define the shock absorption properties of rubber material. In rubber industries FEA analysis is more difficult as compare to other material.

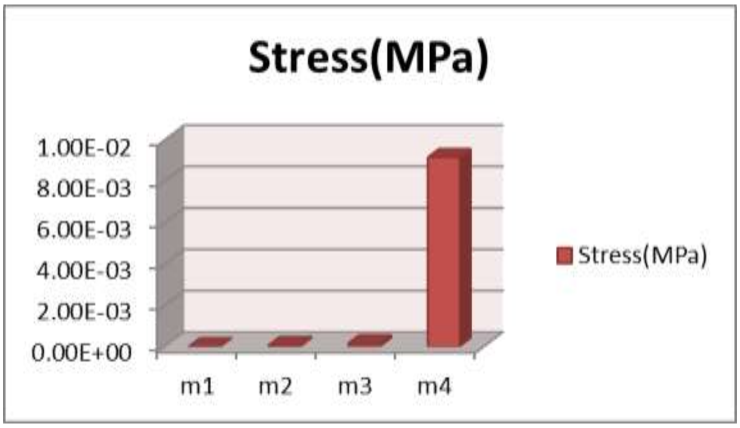


Fig. 5 Result of Stress analysis

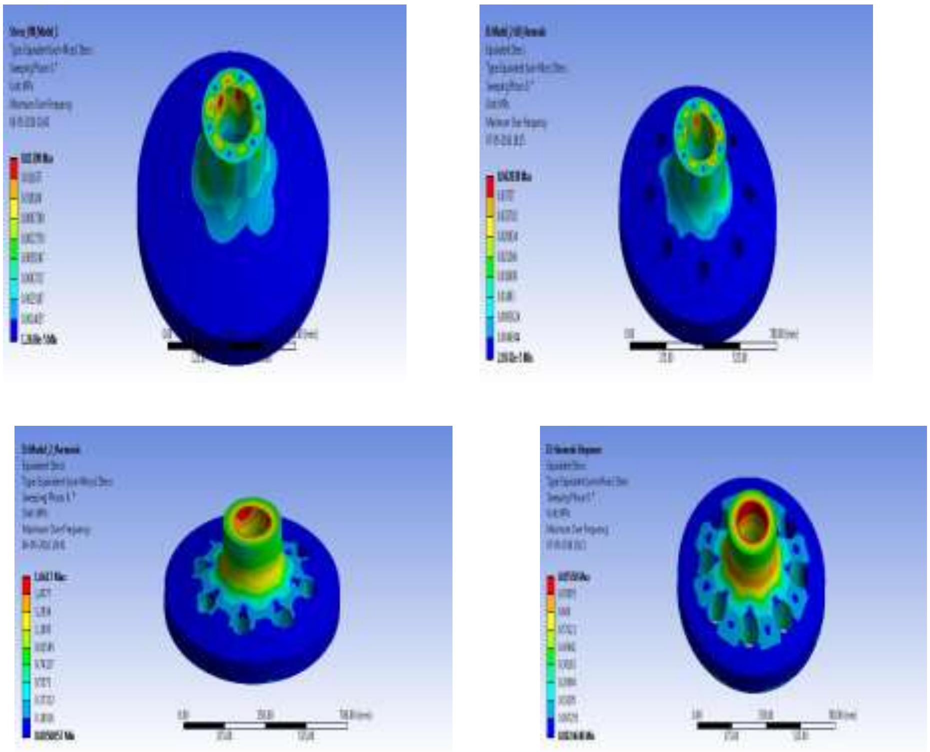


Fig. 6

So, cost of material is most important factor for production. The mass analysis is given in figure 7. In this case material mass must be decreased. So, reduce the material cost for product.

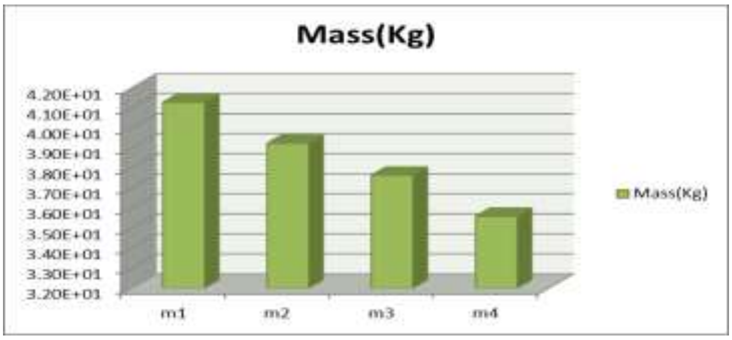


Fig. 7 Mass reduction chart

IV. CONCLUSION

The FEA can be used to obtain the valuable information for the vibration isolation design of rubber mount. Rubber material was obtained by test of material properties and the stress distribution of the rubber mount was obtained by FEA method. The proposed Harmonic response can shorten the product design cycle, decrease the design and product cost remarkably with change of geometry and improve the quality of the rubber mount and getting the final complete model without use of any kind of man power, materials, and machines.

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