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A Review on Modeling and Analysis of Leaf Spring Using Composite Materials in Ansys

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ABSTRACT

Leaf spring are the most important for suspension system in automobile industries every automobile company has been working on increasing the efficiency with reducing the weight without having any load carrying capacity This research paper describes the weight of the leaf spring is reduced by replacing convention steel material by various types of composite materials with the help of solidwork2020 and ansys18.1. Modeling and analysis is done to find stress and deflection. leaf spring withe different types of composite materials & compare with the different types of materials and find the best material for leaf spring with the help of solidwork2020 and ansys18.1 software.

The research paper main is to found that the newly proposed material is more economical and has less weight when compared to conventional material for leaf spring.

Keywords— leaf spring, composites, solidwork2020, ANSYS18.1, suspension system.

1. INTRODUCTION

Leaf springs are primarily utilized in suspension frameworks to ingest stun stacks in autos like light engine vehicles, substantial trucks and in rail frameworks. It conveys sidelong loads, brake torque, driving torque notwithstanding stun retaining. The upside of leaf spring over helical spring is that the parts of the bargains might be guided along a distinct way as it diverts to go about as an auxiliary part notwithstanding vitality retaining gadget. As per the investigations made a material with greatest quality and least modulus of versatility the longitudinal way is the most reasonable material for a leaf spring.

To address the issue of regular assets preservation, car producers are endeavouring to decrease the heaviness of vehicles as of late. Weight decrease can be accomplished fundamentally by the presentation of better material, plan improvement and better assembling forms. The suspension leaf spring is one of the potential things for weight decrease in vehicles un-sprung weight. This accomplishes the vehicle with more eco-friendliness and improved riding characteristics.

For weight decrease in vehicles as it prompts the decrease of un-sprung weight of car. The components whose weight isn't transmitted to the suspension spring are known as the unsprung components of the car. This incorporates wheel get together, axles, and part of the heaviness of suspension spring and safeguards. The leaf spring represents 10–20% 0f the unsprung weight. The composite materials made it conceivable to decrease the heaviness of machine component with no decrease of the heap conveying limit. On account of composite material's high flexible strain vitality stockpiling limit and high solidarity to-weight proportion contrasted and those of steel. FRP springs additionally have incredible exhaustion opposition and solidness. Yet, the weight decrease of the leaf spring is accomplished by material substitution as well as by structure enhancement.

Weight decrease has been the primary focal point of vehicle makers in the current situation. The supplanting of steel with ideally structured composite leaf spring can give 92% weight decrease. Also the composite leaf spring has lower stresses contrasted with steel spring. All these will bring about fuel sparing which will make nations vitality free since fuel spared is fuel delivered.

2. Literature survey

Leaf springs designing have involved engineering calculations, finite element simulations with extensive fatigue tests in reliability labs. During this section research papers are discussed associated with this work.

K. Krishnamurthy, P. Ravichandran **[1]** have worked on Modeling and structural analysis of leaf spring using composite materials. In this proposed work, the weight of the leaf spring is reduced by replacing conventional steel material by various composite materials. Its parameters were evaluated experimentally, Using ANSYS. The leaf spring is designed using modeling software and FEA is done to find stress and deflection. Values are also

compared both experimentally and numerically. From this, it is found that the newly proposed material is more economical and has less weight when compared to conventional material.

Pradip Kumar **[2]** have worked on this research describes the work carried out on a mono parabolic leaf spring of a mini loader truck (Tata Ace) with a GVW (gross vehicle weight) of 1550 kg. A leaf spring is simple form of spring, pervasively used for the suspension in automotives. In this paper analysis is done for leaf spring whose thickness varies from the centre to outer end in parabolic nature followed by mathematical equation of a parabola, hence it is named as parabolic leaf spring (PLS). The modeling and analysis of the leaf spring has done in CATIA V5 R20 and ANSYS 15. The finite element analysis of the leaf spring has been carried out by initially discretising the model and then applying the relevant boundary conditions under the static loading conditions. The results from FEA indicated that the red area close to shackle was undergoing maximum value of stress which may lead to failure of mono parabolic leaf spring. A comparison between the different materials of leaf spring has also been performed to study the influence of mechanical properties of different material of PLS, in order to find out the amount of maximum stress for different material. During the analysis of all the materials boundary condition and applied load are same.

O. Fatoba **[3]** have worked on this research optimize the design of the steel leaf spring by replacing it with composite materials for an extended application in automotive industry. The economic advantage and enhanced mechanical properties of composite materials like carbon epoxy, bamboo polyester, E-glass/epoxy and graphite epoxy made them choicy materials to be compared with the conventional steel leaf. CATIAVR9 and ANSYS software were both used for the model and the numerical analyses of the composite materials and the steel leaf. The results showed that all the four composite materials exhibited weight reduction compared to the conventional steel leaf. The Von Misses stresses of the composite materials were also compared with the conventional steel leaf and the results corroborated. Bamboo polyester showed maximum displacement of 1.5726 mm and followed by Carbon epoxy with deflection of 1.5469 mm. E-glass/epoxy showed the lowest displacement of 1.5172 mm as compared to conventional steel leaf with displacement of 1.2144 mm.

D. Lydia Mahanthi **[4]** have studied in this research The suspension leaf spring is one of the potential entities for weight reduction in automobiles as it results in large unstrung mass. The introduction of fiber reinforced plastics (FRP) is used to reduce the weight of the product without any reduction on load carrying capacity and spring rate. As the materials high strain energy storage capacity and high strength-toweight ratio compared to steel, multi-leaf springs are being replaced by mono-leaf FRP spring. FRP springs also have excellent fatigue resistance and durability.

Automobile world demands research of reducing weight and increasing strength of products, composite material should be up to the mark of satisfying these demands. As leaf spring contributes considerable amount of weight to the vehicle and needs to be strong enough, we introducing Kevlar material which is least in weight and bears more load with less deformation when compared to other materials.

The results of static analysis of both steel and composite leaf springs like EN47, KEVLAR, S-Glass Epoxy & E-Glass Epoxy are discussed in this chapter. Thus by comparing the above results we can say that Kevlar material is better than conventional steel, E-Glass/Epoxy, S-Glass Epoxy and the other composite materials. The total deformation and the Equivalent stresses for the Kevlar

K.S. Ashraff Ali **[5]** have worked on this research work reveals the modeling and investigation of composite leaf spring delivered utilizing polymers strengthened with glass fiber. The plan and investigation of composite leaf spring created utilizing polymers reinforced with glass fiber. The modeling constraints are strains, stresses and deflection. Measurements of the present standard steel leaf spring of a light commercial vehicle. Using E-Glass/Epoxy unidirectional covers, indistinguishable measurements from customary leaf spring are used to make a composite multi leaf spring. The 3-D model of traditional leaf spring is also dynamically analyzed using ANSYS 12 Workbench s we are using this software for analysis, we are able get exact results. The design can be made and load (forces) are applied to make the deformation depends on the load and to make the structure more effective and analyzing the shear stress, deformation, normal stress, and so on. Here we have conducted mess analysis, shear stress, equivalent stress and strain, normal force which make the entire requirement we needed. the design and comparative analysis made in the ansys software. As the result obtained is more likely effective and the values are tabulated for the results. the results obtained at the respective analysis.

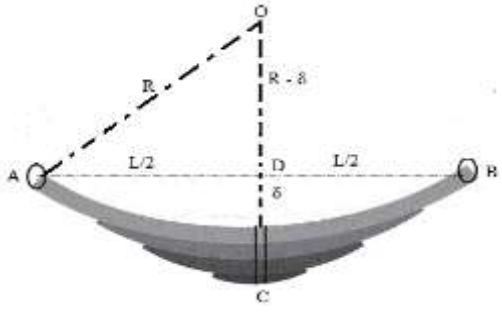

Figure 1 A leaf spring

3. FINITE ELEMENT ANALYSIS OF LEAF SPRING

3.1 Finite Element Analysis

Finite element analysis is a numerical approach that is described by partial differential equations to investigate and solve problems to arrive at their approximate exact solution. Solving engineering problems involving complex structures is a good characteristic of solid SolidWorks. ANSYS is a Catia

software package that generates equations that solve and control the behavior of elements. Geometry is first defined depending on the nature of the analysis to be performed

4. SHAPE OPTIMIZATION

Failure of all or part of the system will lead to risks of death and financial loss. Just as in the human context, when the human body does a lot of work, it becomes tired and sick, and eventually a nervous breakdown may occur. Also, in an engineering structure, failure may occur when the structure is subjected to a great deal of stress. The amount of stress in the geometric model that occurs when exposed to an external force or load is called a stress, which indicates that the applied load is a function of the amount of stress. The designer uses Von-Mises stress analysis to ascertain the failure of his design structure. Failure is inevitable when the strength of the material used is less than the maximum pressure value. The safety factor calculation includes the yield strength; therefore, it becomes necessary to declare this parameter before simulation in material properties

Figure 2 A 3D leaf spring

Figure 3 A 3D main leaf

5. CONCLUSION

The main objective of the analysis is to reduce the weight and cost with the leaf spring loading range. The leaf spring under static load condition is studied and experimental results like stresses and deflection are obtained with the help of ANSYS. The comparative results of all the materials are presented in from the analysis of the different composite materials used for producing leaf spring.

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