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Paper Authors
E. Sammaiah, Purna Avinash Goud, Sai Varun Gullapally, V. Racharla sai Prashanth

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EXPERIMENTAL EVALUATION AND FINITE ELEMENT ANALYSIS OF COMPOSITE LEAF SPRING

E. Sammaiah[1], Purna Avinash Goud[2], Sai Varun Gullapally[3]. V. Racharla sai prashanth[4]
[1]Assistant Professor, Department of Mechanical Engineering, CMR College of Engineering & Technology, Hyderabad, India
[2,3,4] Student, Department of Mechanical Engineering, CMR College of Engineering & Technology, Hyderabad,
India

ABSTRACT

A leaf spring is a simple form of spring, generally employed for the suspension in automotives. It is one of the important forms of springing techniques. It looks like a slender arc-shaped spring steel of rectangular cross-section. Axle beam is located at the center of the arc, at the end are the while tie holes which are employed for attaching to the vehicle body. The automobile industryhas showed a great interest in the replacement of steel springs by fibre glass reinforced composite leaf springs.Therefore,the aim of this research work istopresentageneralstudyontheanalysis,designandfabricationofcompositesprings.Asingleleaf,variablethicknessspringofglassfibrereinforced plastic (GFRP) with similar mechanical and geometrical properties to the multiyearsteel spring, was designed. This research work is based on a complete study and design of leafspring. Here Finite element models been deployed to optimize and improve the material withcomplete geometry of the composite elliptical spring based on the spring rate, long life and shearstress. The influence of elasticity ratio on performance of composit eelliptical springs was investigated computationally.

Key words: Laminated semi elliptical leaf spring, Composite materials, Finite element analysis,GlassFibre, ReinforcedPlastic.

INTRODUCTION

A leaf spring is a long, flat, thin, and flexible piece of spring steel or composite materi-al that resists bending. The basic principles of leaf spring design and assembly are relative-lysimple,andleaveshavebeenusedinvarious capacitiessincemedievaltimes.Mostheavydutyvehiclestodayusetwosetsofleafspringspersolidaxle,mountedperpendicu-larlytothe axle and supporting the vehicle's weight. This system requires that each leaf setact asboth a spring and a horizontally stable link. Because leaf sets lack rigidity, such a dual-roleisonlysuitedforapplicationswhereload-bearingcapabilityismoreimportantthanprecision in suspension response. Older transverse leaf spring arrangements mounted the asingleleafsetrunningparalleltoaliveaxle,butuseditbothasasuspensionlinkandaspringelement in a similar manner to the traditional arrangement. In vehicles with inde-pendentsuspensionandatransverseleafspringarrangementtheleafisnotusedtocontrolthe wheel'slocation and acts only as a spring element. In this arrangement double wish-bones act tolocate the wheel, while a single leaf or leaf set connected to the front or rear sub-frame inthemiddleofthevehicleandthelowerwishboneon eachsideprovidesthespringelement.In some applications two transverse leaf springs are used on a single axle with eachproviding separate springing action to each wheel. In the past most transverse leaf springsarrangements used multiple steel elements in a set similar to their traditional longitudinalcounterparts, but most modern applications use a composite (generally fiber- glass) monoleafelement.

ConstructionofLeafSpring

A leaf spring commonly used in automobiles is of semi-elliptical form. It is builtupofanumberofplates (knownasleaves).Theleavesareusuallygiven aninitialcurva-ture or cambered so that they will tend to straighten under the load. The leaves are heldtogetherbymeansofabandshrunkaround thematthecentreorbyaboltpassingthroughthecentre.Sincethebandexertsstiffeningandstrengtheningeffect,thereforetheeffectivelength of the spring for bending will be overall length of the spring minus width of band.Incaseofacentrebolt,two-thirddistancebetweencentersofU-boltshouldbesubtractedfrom the overall length of the spring in order to find effective length. The spring isclampedto theaxlehousing by means of U-bolts.

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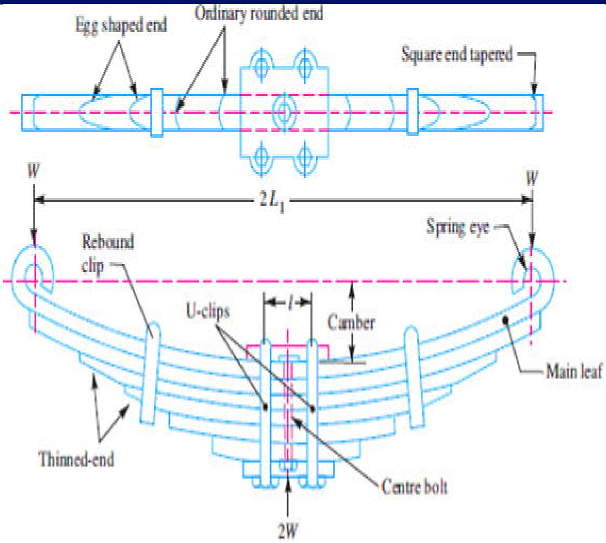

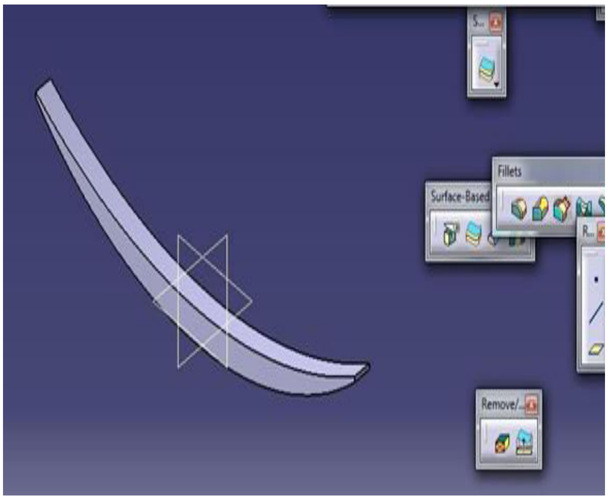

Fig EquivalentStress2000(N).

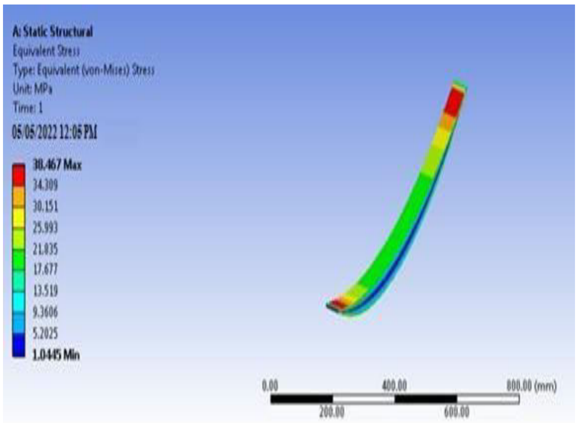

Fig. EquivalentStress3000(N).

CONCLUSIONS

The 3-D modeling of both steel and composite leaf spring is done and analyzed A comparativestudy has been made between composite and steel leaf spring with respect to Deflection , strainenergyand stresses.From theresults.

1. Thisresearchworkprovidesoptimumvaluesfordesignvariables(leafspringthicknessandwidth)ofhybridcompositeleafspringbyusingfiniteelementAnalysis.
2. Weight can be reduced by 55% if steel leaf spring is replaced by Jute/E-Glass/Epoxyhybrid composite leaf spring. Weight reduction reduces the fuel consumption of thevehicle.
3. At various loading conditions, hybrid composite leaf spring is found to have lesserstressesanddeflectionsascomparedtoconventionalsteelleafspring.
4. Jute/E-glass/Epoxyhybridcompositehashigherelasticstrainenergystoragecapacity than both steel and E-glass/Epoxy composite because it has lower young'smodulus and lower density as compared to both. Hence hybrid composite leaf springcanabsorbmoreenergywhichleadstogoodcomfortableriding.
5. Jute/E-glass/Epoxyhybridcompositeleafspringisfoundtobemoreeconomicalthan E-glass/Epoxycompositeleafspringasthecostofjutefiberisverymuchlessascomparedto E-glassfiberanditisabundantlyavailableinnature.

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