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Mono Composite Leaf Spring for Light-Weight Automobiles

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Abstract: ***The foremost aspire of this mission is to ease overall mass of the vehicle by replacing steel leaf spring in its place of mono composite leaf spring which enhance overall vehcile concert.weight diminution can be achieved principally by preamble of better stuff, creation and well mechanized process,not only lessening of the credence as to tighten your belt energy and save up natural resources. Composite fabric has accompanying elastic strain energy store power. Composite resources provides for more generous burden economy load carrying capacity and stiffness.In this analysis carbon fiber reinforced polymer is used which is enormously strong and it is light fiber reinforced plastic which contains carbon fibers which has good decomposition properties***.

Keywords: Composite, Ansys 18.1, Catia V5.

I. INTRODUCTION

Amalgamated fabrics are now replaced by metal parts and are widely used in automotive industries. The spring are the shelving segment of the cars needed to make light of sensations, shocks and impacts due to street problems and facilitate transportation. Advantage of the leaf springs that act as an energy absorption device. One of the majority valuable justufication in view of mono fused sheet instead of multiple steel sheet is its weight fall. Other important characteristics of the compounds that make them excellent for the sheet are a greater strength / weight ratio, fatigue resistance and "guaranteed". The automotive industries makes use of the expertise of amalgamated resources for the edifice of structural works in order to achieve burden fall without compromising the eminence and steadfastness of the vehicle.

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In the current circumstances, the foremost goal of automotive industries is to reduce weight as well as save energy, conserve and maximize natural resources. The fused merchandise can be pooled and premeditated in view of precise load capacities, offering at the same occasion a sequence of compensation in next of kin to time-honored resources, such as chemical opposition, high fatigue strength and high impact fight, etc. Today, heaviness drop is the main goal of the automotive production. Mass depletion achieves oil effectiveness and superior riding traits. The composite material is used to reduce weight without reducing rigidity and load capacity. The compound stuff must have a high potency / heaviness ratio and a high capacity to store the elastic twist energy. The composite material offers a considerable effort to save weight in terms of load capacity and rigidity. The deferment of the leaf spring is one of the possible elements for weight lessening in the automotive industry, since it represents 10 to 20 percent of the weight. This helps to reach a vehicle with improved driving qualities. The springs are especially premeditated to absorb, accumulate and release energy. Therefore, the deformation capacity of the spring material becomes an amazing factor in the spring design.

II. LITERATURE SURVEY

Sushil B. Chopade et al. [1] In their research work Design and analysis of E-Glass / EpoxySingle leaf composite spring for light vehicles, the design considerations are stress and the deviation that shows or expires on the suspension, the efficiency of the vehicle with the load capacity, to withstand vibrations and shocks during its operation and the The objective is to reduce the vehicle's weight by providing a good suspension system and leaf spring loading capacity using monocomposites. consumption . **Akshay A. Khedekar et al. [2]** In the design and analysis of composite paper for mono leaf springs for light vehicles, the material used is the glass fiber for the composite lamina used for light vehicle applications, here they compared the composite lamina with the leaf of springs Steel sheet to reduce weight, in general, the selection of the design is based on mass production, according to the results, the composite sheet steel has more resistance and is more reliable than the steel sheet spring, since the maximum displacement is in steel compared to steel compared to strength and weight. **Syambabu Nutalapati [4]** in the document, Design and analysis of leaf spring by using composite material for light vehicles, describes composite materials with the reduction of mass and maintenance of resistance of products currently running in the modern world and the solution to these old problems . He choosed a rear leaf spring for the commander model 650 DI mahindra to compare and study tensions, displacements and massive decline.

III. MATERIAL USED

A composite fabric also called concert or shortened as a compound, and is composed of two or more constituent goods with palpably altered physical
or chemical properties which, combined, produce objects with different characteristics of the individual components. Materials with an unusual combination of materials that cannot be satisfied by conventional materials such as metal alloys, polymers, etc. Therefore, compounds play a vital role in overcoming the deficits offered by conventional materials. Joint production has been widely divided into different methodologies and processes. The compound offers the possibility of lower production costs and more complex forms than traditional methods. This analysis uses an exceptionally resistant substance and a lightweight fiber-reinforced plastic containing carbon fibers. CFRPs can be pricey to fabricate but are universally used where high strength mass-rijidity ratio is required and provides first-class strength.[4,5]

3.1 Objective of the work

To design, analyze and intend a E-Glass/Epoxy mono composite leaf spring for automobile suspension system.

To barter conventional steel leaf springs with E-glass/Epoxy composite mono-leaf spring with superior ride eminence.

To achieve ample weight lessening in the suspension system.

IV. METHODOLOGY

Conventional steel spring uses plain carbon having 0.90 to 1.0% of carbon but the composites leafs are up to five times more durable than steel spring The universally used fibers are glass or carbon. The focal lead of glass fiber is cut-price, high strength and excellent insulating property. In this scrutiny mono leaf is modelled using shell 181 which is appropriate for composite modeling.[6] Material used is CFRP with different volume fraction consideration such as 0.4,0.6 , model is fashioned using CATIA V5 later the geometry is done with FE modeling using HYPERMESH were the section properties were created and assinged to the components,as the number of varaible thickness was more hence it was some difficult to create the layers , so angle orientation maintained as '0'.The solution is obtained using ANSYS 18.1 with good factor of safety.

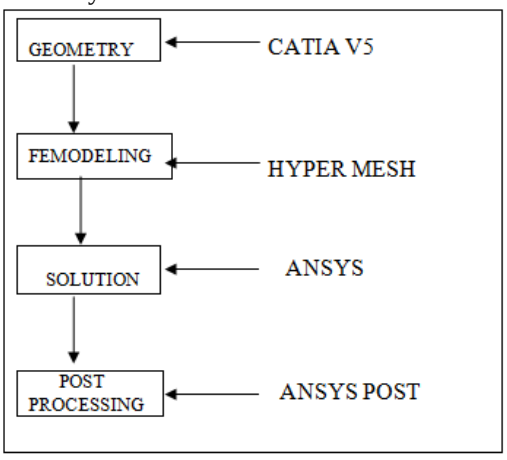

Figure 4.1: Design methodology

V. DESIGN AND FE MODELING

Design carried out using Catia V5, and imported geometry in Hypermesh and mid surface of leaf was been constructed,later then global element size was decided as 10 and selected element as E-type shell 181 and FE model was done. FE modeling by using Hypermesh.

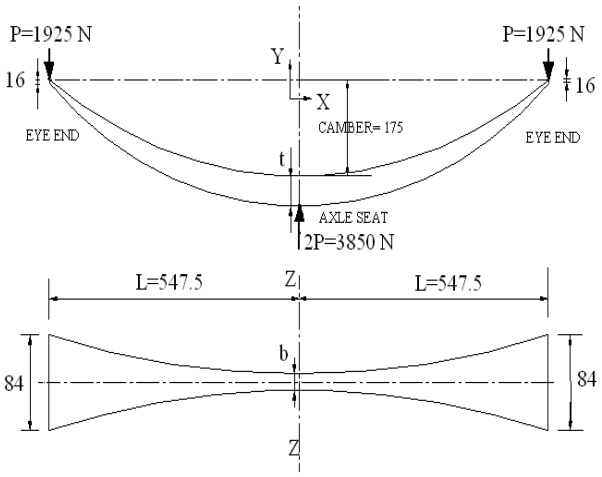

Figure 5.1: Full section of leaf spring

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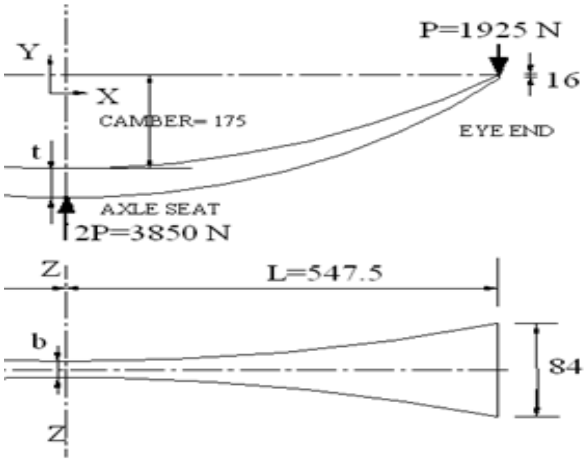

Figure 5.2: Mono section of leaf spring

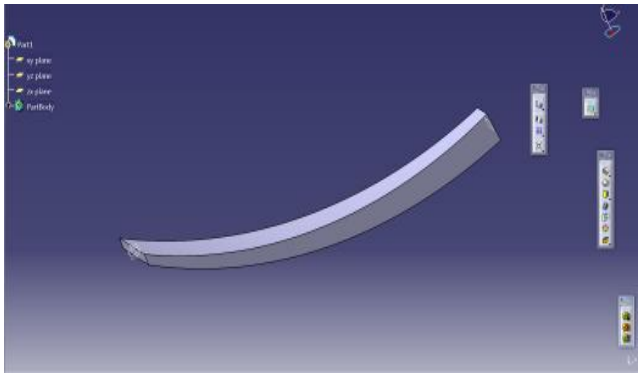

Figure 5.3: CATIA Model

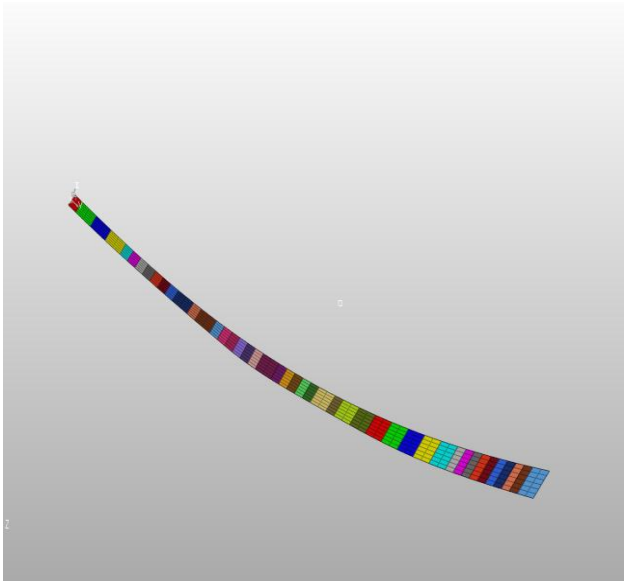

Figure 5.4: Leaf model with variable thickness

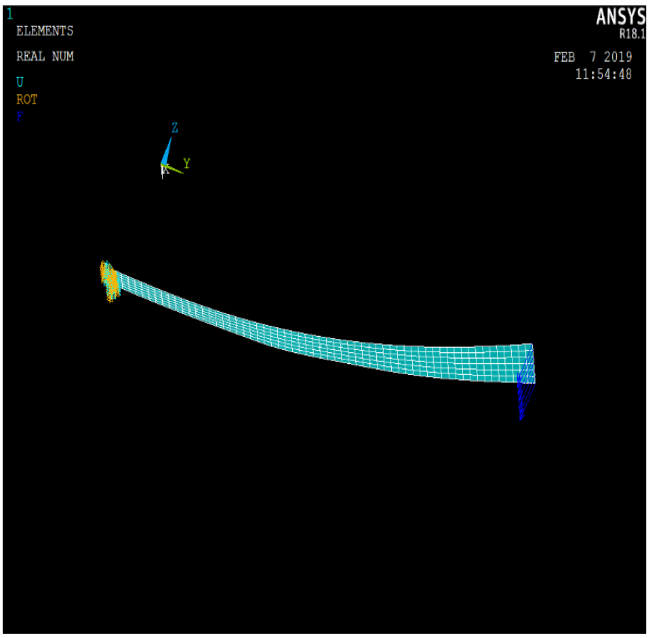

Figure 5.5: Boundary conditions

To represent the geometry properly then created a material property and assingend the same, and the boundary condition and loads are applied. In design each component were created i.e, six layers and orientation was maintained as "0" angle because of variable thickness and no of layers was more. Hence "0" angle was used,and design was carried out using Ansys 18.1.

VI. MERITS & DEMERITS

1. Mass diminution of the system.
2. Good vehicle recital.
3. No corrosion inconvenience.

1. Steel leaf spring lower damping competence.
2. Major downside is mechanized cost is more.
3. Its decomposition conflict is a smaller amount

VII. RESULT AND DISCUSSION

A. DISPLACEMENT:

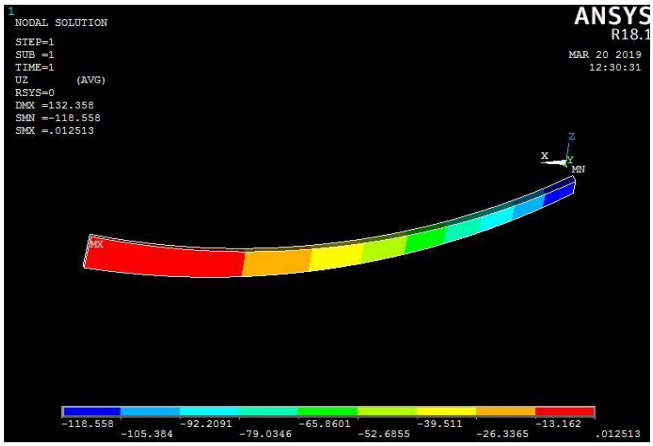

FIGURE 7.1. Displacement of steel

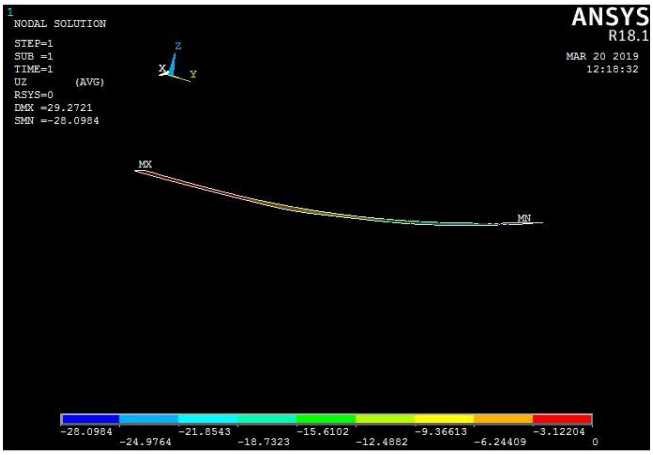

FIGURE 7.2. Displacement of Mono composite

B. STRESS:

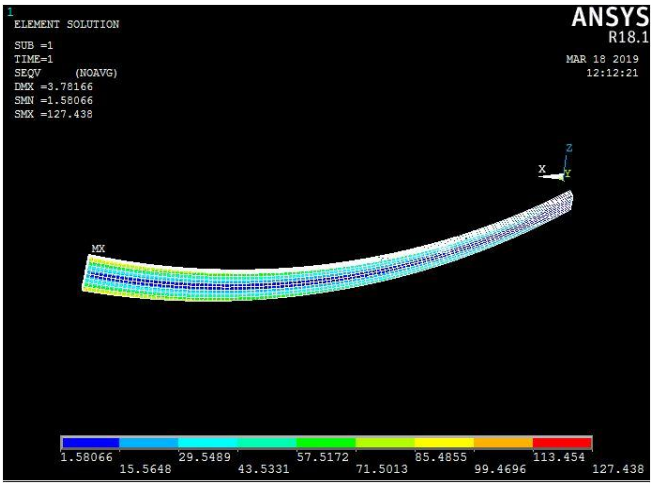

FIGURE 7.3. Stress for steel

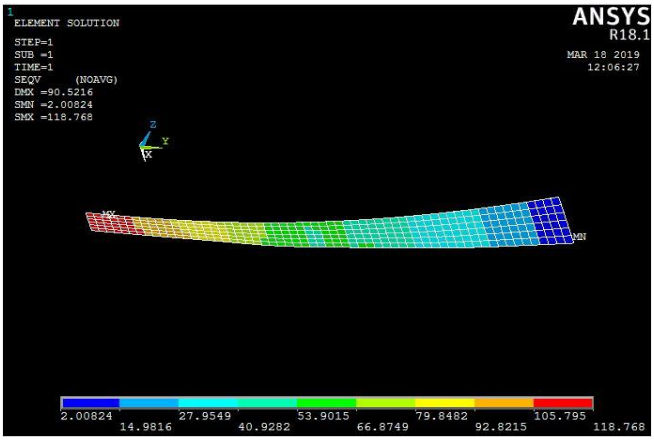

FIGURE 7.4. Stress for Mono composite

In the figure 7.1 & 7.2 displacement is compared for both steel and mono composite, where , for given load of 1925(n) steel has more displacement and mono composite has less displacement ,where as in figure 7.3 & 7.4 stresses for steel and mono composite stress is more in steel and is composite has less stress and hence provides better weight lessening is possible. By this we can monitor that volume fraction 0.6(60%) which is having superior result with respect to displacement, stress, failure criteria all fall within the predictable range .Hence we conclude that Mono leaf spring is safe within the restrictions.

Table 1 Result Table

Material	Load(n)	Displacement (mm)	Stress (Mpa)
Steel	1925	132.358	127.428
Composite	1925	29.271	118.768

VIII. CONCLUSION

1. In this above design we compared with conventional leaf spring vs Mono leaf spring ,as a result mono leaf spring has good suspension system without corrosion and is less expensive compared to conventional leaf spring.
2. The mono leaf spring is less weight and hence the overall efficiency of the vehicle can be enhanced and rider quality is superior.
3. From this design, nearly 60% of the mass decline can be done which will be very helpful and useful to each and every vehicles.

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