Stress Analysis of Epoxy carbon fiber composite material for leaf spring by using FEA software

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Abstract— In recent trends in automobile sector weight carrying important role. And in research point of view highly important is reducing weight & maintain quality. The composite material is attractive area to maintain research works. In this paper we describe design of epoxy carbon composite material using FEA software. In this research paper we studied analysis of epoxy carbon fiber material in different loading conditions, also studied different stress values for particular loading conditions. Also comparing composite material stress values & steel material stress values. Recent automobile sectors more interest in reducing weight that is strength to weight ratio, good corrosion resistance etc. the leaf spring model is draw in AUTO CAD 2011 software, and this one is import in ANSYS simulation software.

Key words: Epoxy carbon, FEA, Leaf spring, Simulation, stress etc

I. INTRODUCTION

Analyze the epoxy carbon fiber composite leaf spring by using FEA software. Generally FEA software is compurized method for finding how product react in real world, in that study different forces acting on material, vibrations, heat, fluid flows and physical defects etc. FEA software generally works two ways first one for when a study of product will break, wear out is called as simulation. And second one is product is designed in particular design software and applying some external forces. FEA software generally helps the behavior of products affected by many physical effects, including Mechanical stress, Mechanical vibration, Fatigue, Motion, Heat transfer, Fluid flow, Electrostatics, Plastic injection molding etc. In this research paper leaf spring model is draw in catia software & this one is import in ANSYS for loading, boundary conditions etc.

Weight reduction in automobiles as it leads to the reduction of un-sprung weight of automobile. The elements whose weight is not transmitted to the suspension spring are called the un-sprung elements of the automobile and leaf spring.

II. SCOPE OF THE WORK

In this research paper studied total theoretical study of epoxy carbon fiber leaf spring & steel leaf spring. Also study releated to design, FEA analysis etc. also we get exact weight reduction as compare to steel leaf spring.

A. *Problem definition*

Analysis of Epoxy carbon fiber composite material for leaf spring by using FEA software.

III. DESIGN & DEVELOPMENT PROCEDURE

1) Find stress value by using UTM testing.
2) Draw one leaf spring model in CATIA software.
3) Import same model in ANSYS software.
4) Put the value of poissions ratio during material selection in ANSYS.

Poisson's Ratio= 0.3.

5) Put youngs modulus value in ANSYS, the value from UTM testing. That is

E= (stress \ strain)
E = 380000 Mpa.

A. *FEA Analysis of Composite material leaf spring*

Size of specimen: - 15x25x395mm.
Manufacturing method: - Machine press mould.
Deflection measurement at predefined loading conditions.
Selection of load on leaf sprig :- Maruti car load 500 kg + 60 kg each person x 5ppl=800kg/4 wheels=200kg on each wheel.

Fig. 1: Actual composite material specimen

IV. PROCEDURE

1) Create solid model in CATIA V5.
2) Bulding clean geometry.

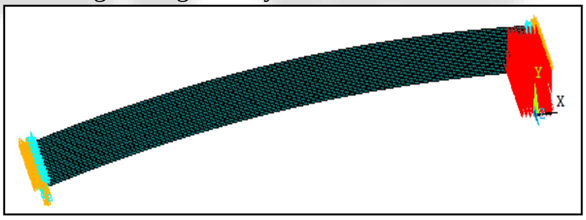

Fig. 2: solid model in CATIA V5.

3) Selection of element type in ANSYS (Shell 63).
4) Shell 63 input data provide.
5) Shell 63 output data provide.
6) Shell 63 stress output.
7) Meshing.
   In meshing includes following data.
   Controlling Smart Sizing levels.
   Setting element size controls.
   Specifying element shape.
   Specifying meshing type (free or mapped).
   Meshing solid model entities.
   Clearing meshes.
   Refining meshes.
8) Element shape control.
   Quadritral shape control.
   Tranigular shape controller.
9) Element size control.

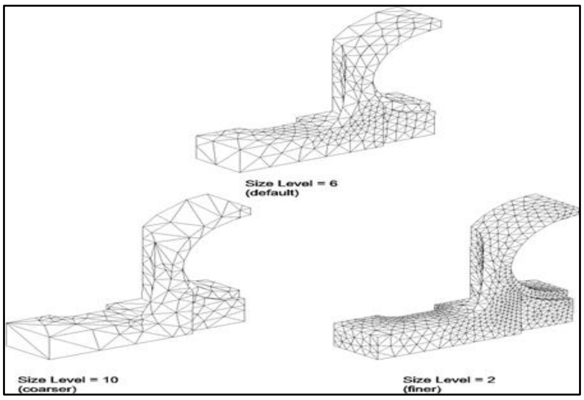

Fig. 3: Element size control

10) Boundary conditions apply.

FE Modeling and Boundary Conditions

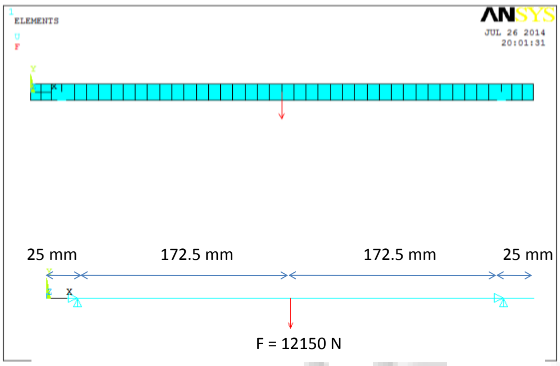

Fig. 4: sample boundary conditions on FEA modeling

A. *Simulation of composite material leaf spring*

Simulation

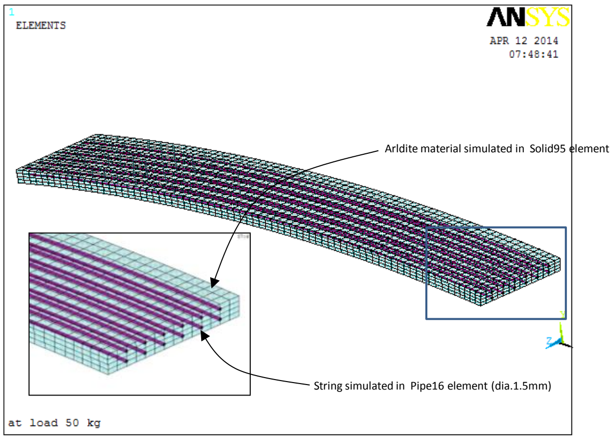

Fig. 5: simulation of composite material leaf spring

Boundary conditions.

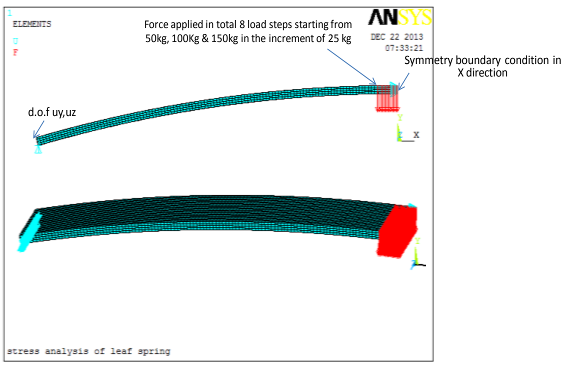

Fig. 6: Boundary conditions showing on composite material leaf spring

Maximum displacement in vertical direction at 50 kg load.

Max. disp in vertical direction UY is 9.660 mm @ load of 50 Kg.

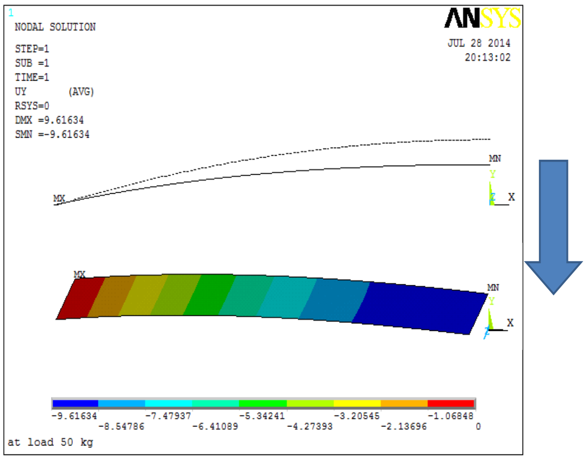

Fig. 7: Max. displacement in UY

Maximum displacement in Horizontal direction at 50 kg load.

Max. disp in horizontal direction Ux i1.5967 mm @ load of 50 Kg.

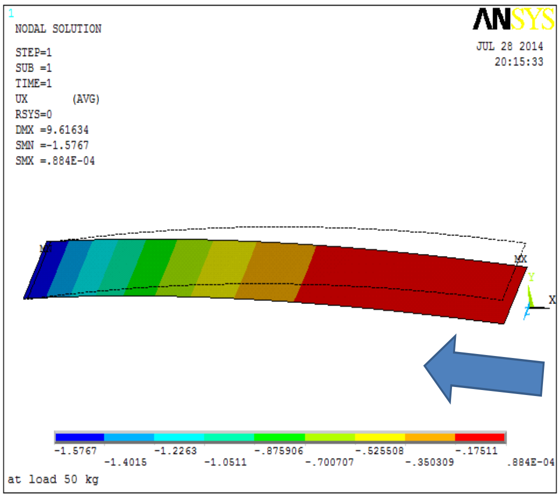

Fig. 8: Max. displacement in UX

Maximum von-misses stress at 50 kg load.

Max. eqv stress or von-misses stress 118.217 MPa @ load of 50 Kg.

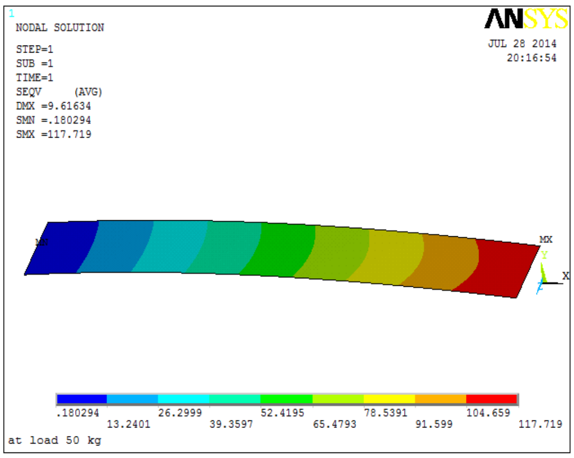

Fig. 9: Max. Von-misses stress

B. Design analysis of carbon fiber epoxy composite material leaf spring through ANSYS

Sr No	Load in Kg	Maximum displacement (Uy) in mm	Maximum displacement (Ux) in mm	Von-misses stress In Mpa
1	50	9.660	1.5967	118.217
2	100	21.15	3.2540	237.440
3	150	31.7	4.996	355.127
4	200	38.4654	6.9869	471.120

Table.1: Maximum vertical displacement for composite material leaf spring

V. CONCLUSIONS

1) Stress level is also shows 9 % difference in both the springs of steel & carbon leaf.
2) Due to reduction in 75 % mass of carbon fiber leaf, suspension performance will be greater than leaf spring.
3) This carbon leaf spring will be corrosion free hence friction noise problem will be no more and no need of greasing the leaf springs as in steel leaf case.
4) Loading deflection - ANSYS results of steel leaf & carbon fiber leaf are compared and found similar with 9% of acceptable range of difference.

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