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ANALYSIS OF VEHICLE CHASSIS FRAME MADE OF DIFFERENT COMPOSITE MATERIALS

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Abstract: The chassis frame forms the backbone of a vehicle; its principal performance is to soundly carry the most load for all designed operational conditions. This paper describes the planning and analysis of auto chassis. Weight reduction is currently the most issue within the industry. during this paper, the size of AN existing vehicle chassis frame of a Eicher truck eleven.0 is taken for modeling and analysis of a vehicle chassis frame with 3 completely different composite materials specifically, Carbon/Epoxy, E-glass/Epoxy, and S-glass /Epoxy subjected to identical pressure as that of a steel chassis frame. the planning constraints were stresses and deflections. The 3 completely different composite vehicle chassis frames are sculpturesque by considering C cross-sections. For validation, the planning is finished by applying the vertical masses functioning on the horizontal completely different cross-sections. the software package used for this work is Solid works for modeling, ANSYS workbench for analysis.

***Index Terms* - Chassis frame, Composite Material, Carbon/Epoxy, E Glass/Epoxy, S Glass Epoxy, SOLIDWORKS, ANSYS**

I. INTRODUCTION

Chassis could be a French term and used to denote the frame elements or Basic Structure of the vehicle. A vehicle while not a body is termed Chassis. The elements of the vehicle just like the powerhouse, transmission consisting of the clutch gear case, propellor shaft and rear shaft, Wheels, Suspension, and dominant Systems like Braking, steering, etc., and electrical system elements are mounted on the Chassis frame. So, it's conjointly known as a Carrying Unit. Chassis of Automotive helps to stay AN automobile rigid, stiff, and rigid. Automobile chassis ensures less noise, vibrations, and harshness throughout the car. beside the strength, a very important thought within the chassis style is to extend the stiffness (bending and torsion) characteristics. within the standard style procedure, the look is predicated on strength, and stress is then given to extend the stiffness of the chassis, with little thought to the burden of the chassis.

One such style procedure involves the adding of structural cross member to the prevailing chassis to extend its torsion stiffness. As a result, the burden of the chassis will increase. This increase in weight reduces the fuel potency and will increase the value thanks to further material. the look of the Chassis with adequate stiffness and strength is important.

All most all component's weight is engaged on the chassis frame, so the chassis subjected to static, dynamic, and cyclic loading conditions on the road. Static stress analysis is vital to illustrate essential (highest stress) regions within the frame. These essential regions might cause fatigue failures. during this study, a ladder-type chassis frame is analyzed. The Chassis consists of aspect members hooked up with a series of cross members to complete the ladder-like structure, so its name. The FEM could be a common tool for stress analysis. FEM with needed boundary conditions was wont to confirm essential regions within the chassis frame. Static structural analysis is performed to spot essential regions and supported the results obtained style modification has been done.

II. BASIC DETAILS OF CHASSIS FRAME

Model No. = 11.10 (Eicher E2)
Side bar of the chassis are made from "C" Channels with 210mm x 76 mm x 6 mm
Front Overhang (a) = 935 mm
Rear Overhang (c) = 1620 mm
Wheel Base (b) = 3800 mm
Material of the chassis is St 52
E = 2.10 x 105 N/mm^2
Poisson Ratio = 0.31

Radius of Gyration R = $\frac{210}{2}$ = 105 mm

Capacity of Truck = 8 ton

= 8000 kg

= 78480 N

Capacity of Truck with 1.25% = 98100 NWeight of the body and engine = 2 ton

= 2000 kg

= 19620 N

Total load acting on chassis = Capacity of the Chassis + Weight of body andengine

= 98100 + 19620

= 117720 N

Chassis has two beams. So, load acting on each beamis half of the Total load acting on the chassis.

Load acting on the single frame = $\frac{117720}{2}$ = 58860 N/beam

III. COMPOSITE MATERIALS

A material is sometimes created from a minimum of 2 materials out of that one is that the binding material, conjointly referred to as matrix and also the alternative is that the reinforcement material. Composite materials that comprise robust load carrying material (known as reinforcement) imbedded in weaker material (known as matrix) with physically severable phases. Reinforcement provides strength and rigidity, serving to support structural load. The matrix or binder maintains the position and orientation of the reinforcement. considerably, constituents of the composites retain their individual, physical and chemical properties however along they turn out a mix of qualities that individual constituents would be incapable of manufacturing alone. The reinforcement could also be platelets, particles or fibers and sometimes further to boost mechanical properties like stiffness, strength and toughness of the matrix material.

3.1 Material Properties

Table 3.1: Properties of materials

Properties	E-Glass	Carbon Epoxy	S-Glass Epoxy	Stainless steel
Young's modulus (GPA)	72.5	388	85	193
Poisson's Ratio	0.28	0.358	0.22	0.31
Density (kg/m3)	2580	1600	2490	7750
Tensile strength (GPA)	3.45	4.1	4.6	3.2

IV. MODELING OF CHASSIS FRAME

SOLIDWORKS-17 is used to modeled the chassis frame of Eicher11.10 E2 model of the chassis frame.

Figure 4.1: C-section Chassis frame

V. MESHING OF CHASSIS FRAME

The finite component methodology (FEM) could be a numerical technique for locating approximate solutions to boundary price issues FEM subdivides an oversized drawback into smaller, simpler, parts, known as finite components Meshing of chassis frame is completed in Ansys R nineteen.1, and methodology used for meshing is tetrahedrons surface meshes. the dimensions of components is unbroken as minimum as potential to induce correct results and at some points, the finer meshing is additionally done to induce higher results.

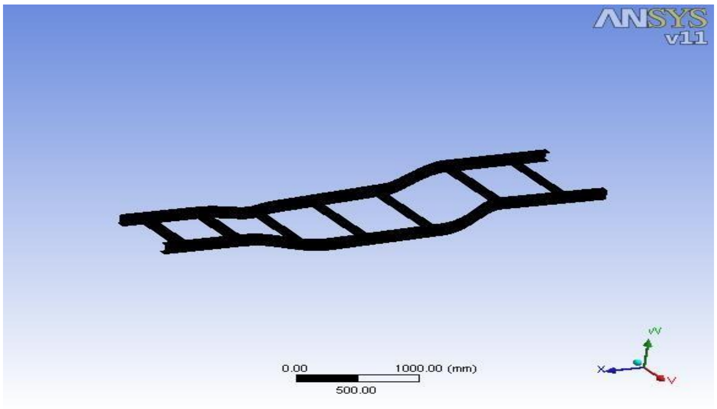

Figure 5.1: Mesh generation of C-section chassis frame

VI. BOUNDARY CONDITIONS

While doing software-based analysis there is need to apply boundary conditions.

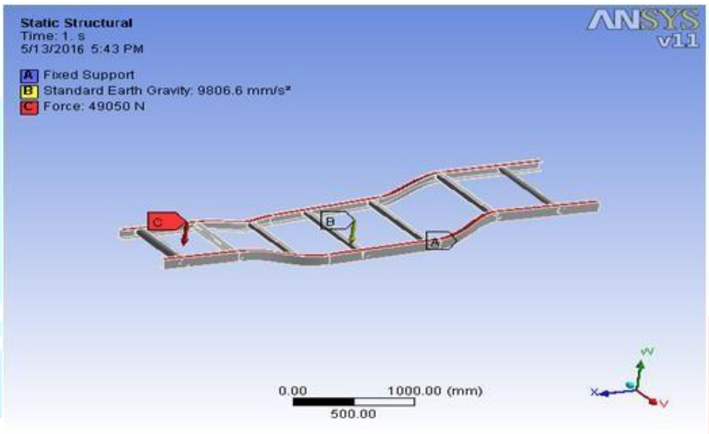

Figure 6.1: Fixed support and force application on chassis frame

VII. STRUCTURAL ANALYSIS

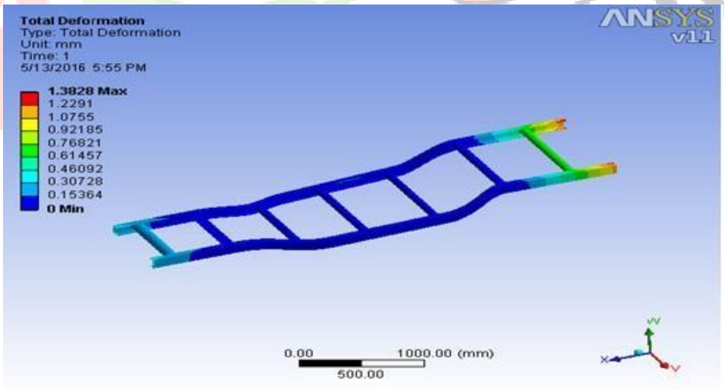

Figure 7.1: Total deformation for Carbon Epoxy chassis frame

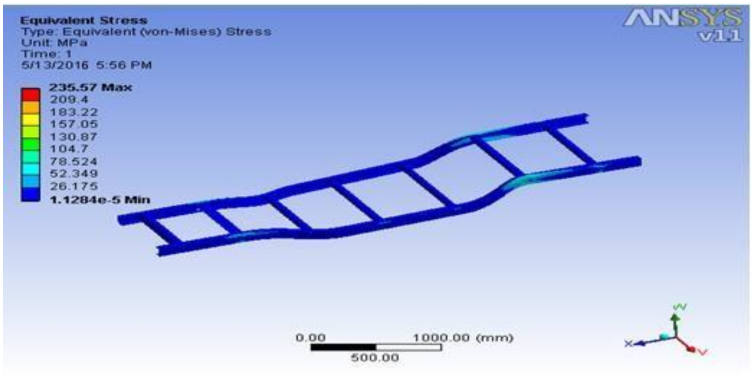

Figure 7.2: Equivalent stress for Carbon Epoxy chassis frame

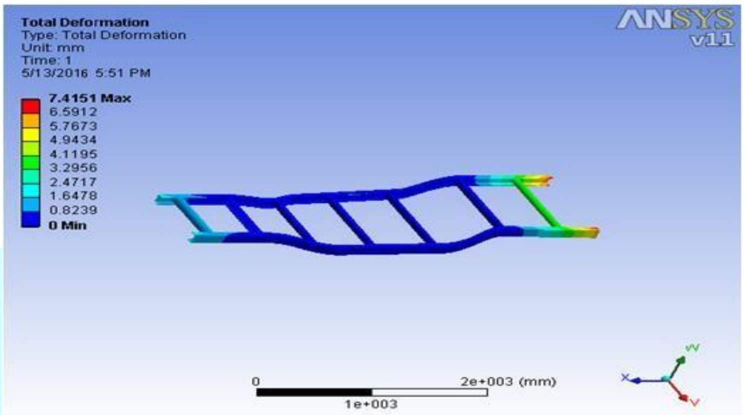

Figure 7.3: Total deformation for E-Glass fiber chassis frame

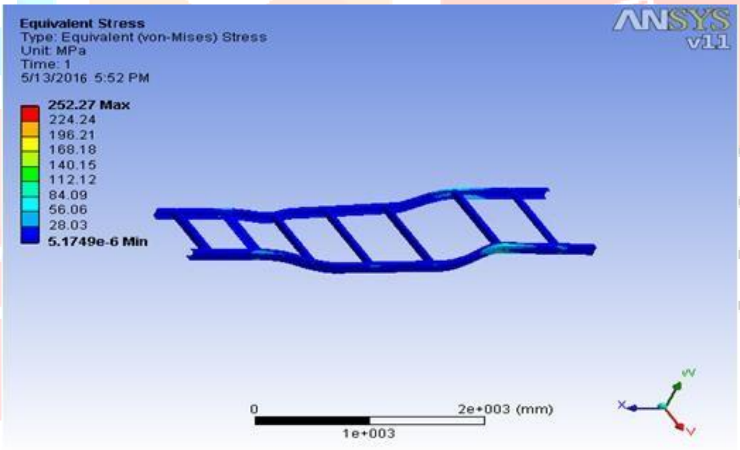

Figure 7.4: Equivalent stress for E- Glass fiber chassis frame

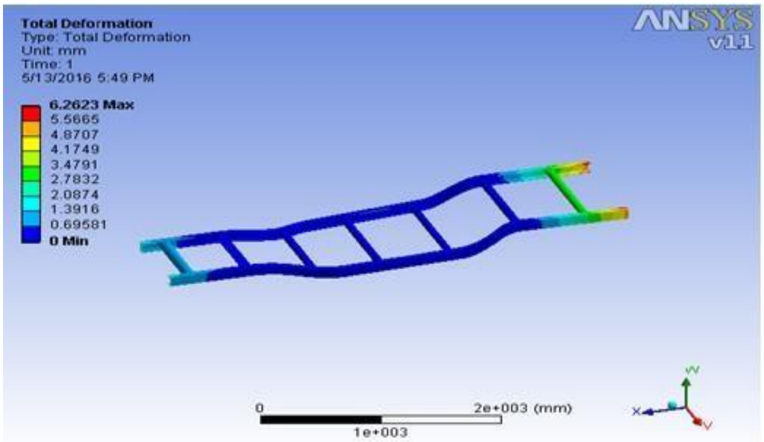

Figure 7.5: Total deformation for S-glass fiber chassis frame

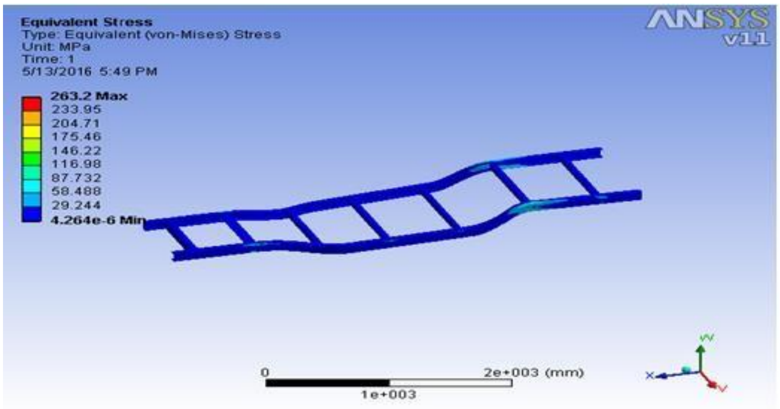

Figure 7.6: Equivalent stress for S-glass fiber chassis frame

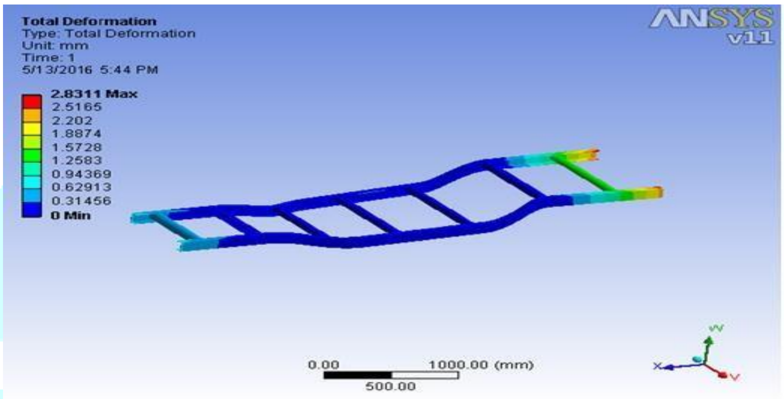

Figure 7.7: Total deformation for Stainless Steel chassis frame

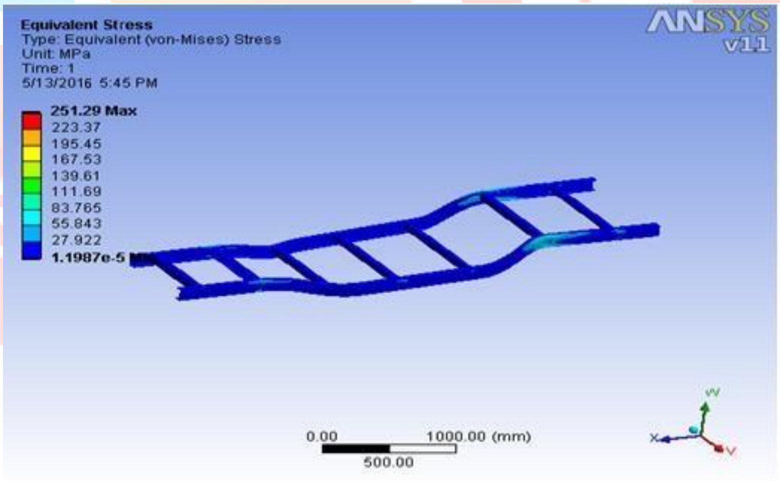

Figure 7.8: Equivalent stress for Stainless Steel chassis frame

VIII. RESULT AND DISCUSSION

Table 8.1: Result from Analysis

Material	Total Deformation (mm)	Equivalent stress (MPa)
Carbon Epoxy	1.3828	235.27
E-glass fiber	7.4151	232.27
S-glass fiber	6.2623	233.2
Stainless steel	2.8311	251.29

Composite materials show less Von-misses stress, but maximum deformation occur onto the chassis frame as compare to stainless steel and also the density of the composite materialis very less which helps to drop down the weight of chassis frame and assist in increasing the efficiency of the automobile.

IX. Conclusion

From the structural Analysis and Considering polymeric composites Carbon/Epoxy, E- glass/Epoxy and S-glass /Epoxy for chassis material, based on the results it was inferred that carbon/epoxy polymeric composite vehicle chassis has superior strength and stiffness and lesser in weight compared to steel and other polymeric composite materials mentioned. The Epoxy Glass Fiber have shown a little bit higher deformation than steel its due to lowstiffness but if the thickness of the epoxy glass chassis frame is increases than deformation will be less. Composite material is very costly as compare to other metal used in automobile chassis frame which incur some extra cost on the consumer when cost will not be the factor the best alternative for the automobile and chassis frame is composite materials.

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