DESIGN AND ANALYSIS OF AUTOMOTIVE BUMPER USING POLYMER COMPOSITES

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Abstract- Automobile bumper subsystem is a frontal and rear structures of the vehicle that has the purpose of energy absorption during low velocity impact. The bumper beam is the main structure for absorbing the energy of collisions. Automotive bumper beam is one of the key system in car. Bumper beam design to prevent or reduce physical damage to front or rear end of the Motor vehicle in collision conditions they protect the hood, trunk, grill, fuel, exhaust and cooling system as well as safety related equipment such as the parking light, head lamp and tail light etc. A good design of the car bumper must provide safety for passengers and should have low weight.

***Key Words*:-** Automotive Bumper, Composite Material,3D Modelling, ANSYS, Stress Analysis, Total Deformation.

I. INTRODUCTION

Car accidents are happening every day. Most drivers are convinced that they can avoid such troublesome Situations. Nevertheless, we must take into account the statistics – ten thousand dead and hundreds of thousands to million wounded each year . These numbers call for the necessity to improve the safety of automobiles during accidents. Automobile bumper subsystem is a frontal and rear structures of the vehicle that has the purpose of energy absorption during low velocity impact. The bumper beam is the main structure for absorbing the energy of collisions. Automotive bumper beam is one of the key system in car. Bumpers beam design to prevent or reduce physical damage to front or rear end of the Motor vehicle in collision conditions they protect the hood, trunk, grill, fuel, exhaust and cooling system as well as safety related equipment such as the parking light, head lamp and tail light etc. A good design of the car bumper must provide safety for passengers and should have low weight.

II. BUMPER DETAILS

Effective length- 18cm

Total length-60cm

Thickness-5cm

Effective breath-12cm

Profile- c type

III. Material Properties

There are two main reasons why materials selection is required: firstly, to design an existing product for better performance, lower cost, increasing reliability and reduced weight and secondly, to select a material for a new product. Materials selection is a main product design consideration because product's overall performance is mainly affected and determined by materials selection process.

Table.1-Material Properties

SL.No.	Properties	Units	Structural Steel	Carbon Fibre	E-Glass Epoxy Fibre
1	Density	Kg/m3	7850	1500	1983
2	Young's Modulus	N/mm	2×1011	1.55×1011	7.8×1011
3	Poisson Ratio	-	0.3	0.38	0.27
4	Ultimate tensile strength	Mpa	520	600	490

IV. Analysis of Bumper

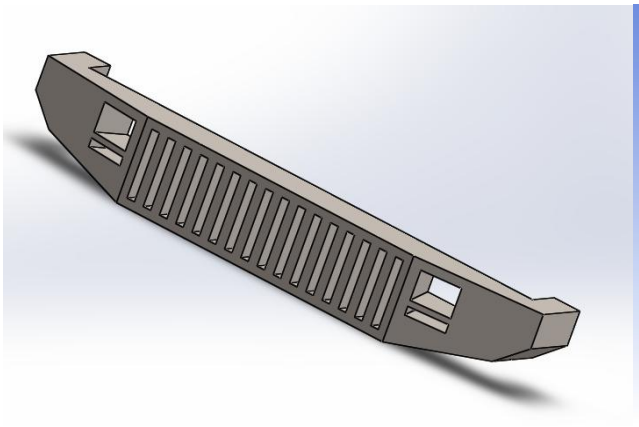

Figure.1- Isometric View

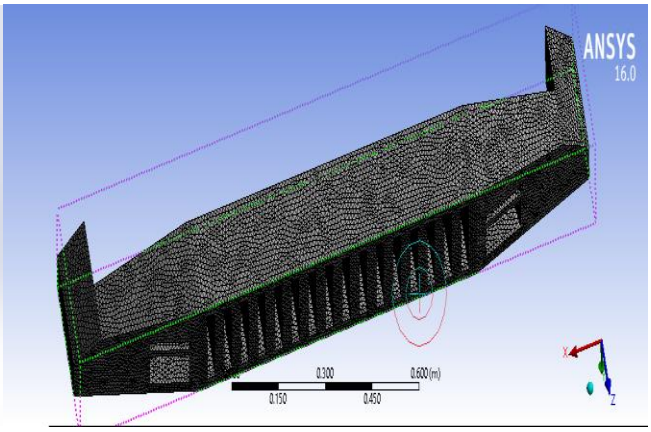

Figure.2- Meshing Of Bumper

Table.1

Properties	Structural Steel	Carbon Fibre Epoxy	Epoxy E-Glass
Total Deformation(mm)	3.6208e-002	0.33103	0.31762
Equivalent (von-Mises) Stress(MPa)	7.7084	6.8483	6.7131
Shear Stress(Mpa)	1.4853	1.719	1.4655
Normal Stress(MPa)	3.004	5.9594	4.8162
Equivalent Elastic Strain(mm/mm)	4.5187e-005	8.5151e-004	7.219e-004

Structural steel:-

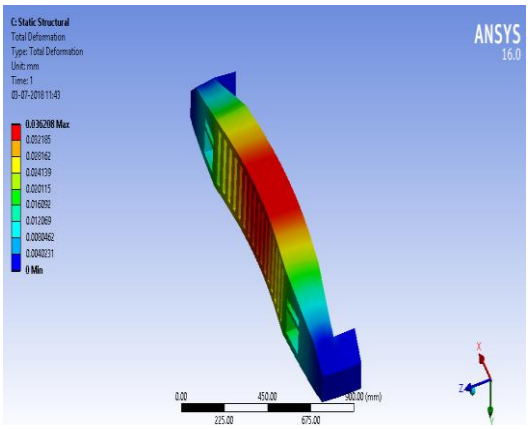

Figure.3-Total Deformation In Steel

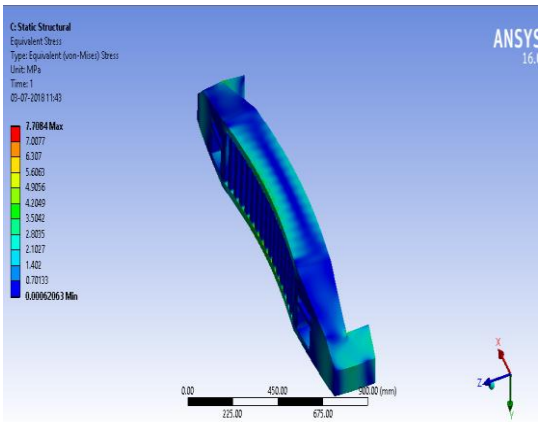

Figure.4-Equivalent Stress(Von-Mises)

Epoxy Carbon Fibre:

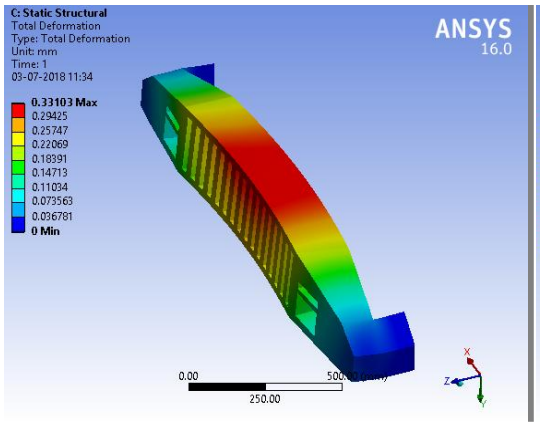

Figure.5-Total Deformation

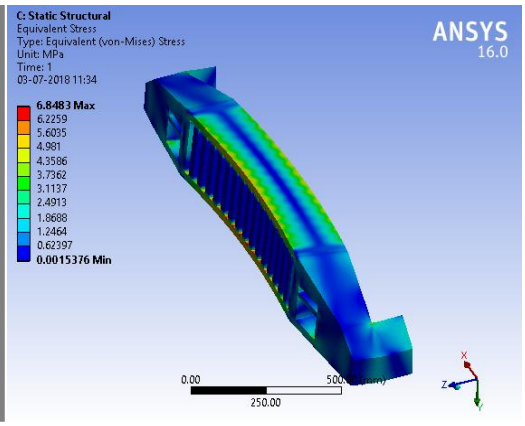

Figure.6-Equivalent Stress(Von-Mises)

Epoxy E-Glass Fibre:-

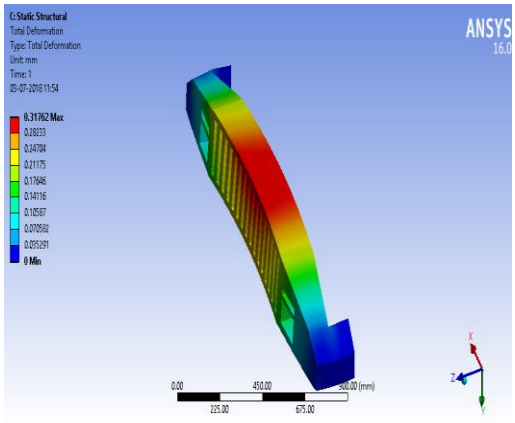

Figure.7-Total Deformation

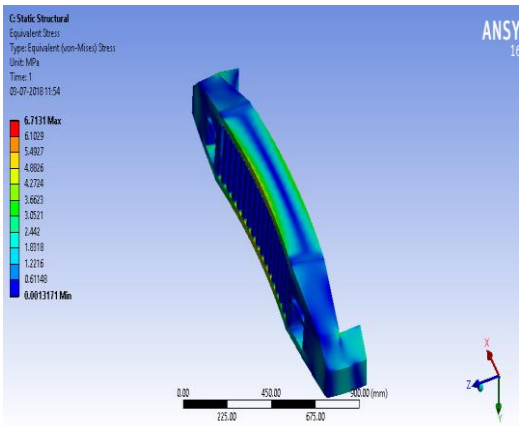

Figure.8-Equivalent Stress.

V. Conclusion

From above the results it was analysed that which composite material is best to replace the metallic/ conventional bumpers it was found that both the composite materials are safe to replace with heavy metallic bumpers. Carbon Fibre epoxy performed very well in the analysis but this composite material is very costly as compare to other metal used in auto vehicle chassis frame which incur some extra cost on the consumer when cost will not be the factor. And E-Glass Epoxy fibre also showed well results rather than steel. The results of the analysis give a clear indication that the maximum stress induced is in steel and minimum stress induced is in composite material. And the cost of the bumper beams can be reduced by more than 50%.

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