CRASH ANALYSIS OF BUMPER USING PHYSICAL AND ANALYTICAL TECHNIQUES

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ABSTRACT: An automobile's bumper is the front-most or rear-most part, designed to allow the car to sustain an impact without damage to the vehicle's safety systems. They are not capable of reducing injury to vehicle occupants in high-speed impact. In this paper, review of the most important variables like material, structures, shapes and impact conditions are studied for analysis of the bumper beam in order to improve the crashworthiness during collision. More emphasis is given on selection of bumper material.

I.INTODUCTION

Automotive industry is a very huge ground and research is still evolving. From this safety and comfortness of passenger car is very important. Hence the researchers have to be focused on safety and comfortness. In tune with this improvement in the design of a bumper is very important. This will increase the performance of the bumper, improve absorbing capacity during impact load and increase the protection of the front car component. A bumper is a structure attached to or integrated with the front and rear ends of a motor vehicle, to absorb impact in a minor collision, ideally minimizing repair costs. Bumper systems are designed to prevent or reduce physical damage to the front or rear ends of passenger motor vehicles in collision condition. It protects the hood, trunk, grill, fuel, exhaust and cooling system as well as safety related equipment such as parking lights, headlamps and taillights. A good design of car bumper must provide safety for passengers and should have low weight. Different countries have different performance standards for bumpers.

II. LITERATURE REVIEW

UNITED NATIONS AGREEMENT [UNITED NATIONS AGREEMENT, Uniform Provisions concerning the Approval of Vehicles with regards to their Front and Rear Protective Devices (Bumpers, etc.), E.C.E., 1994. Three main design factors for this structure: shape, material and impact condition are studied and the results are compared with conventional metals like steel and aluminum. Finally the aforementioned factors are characterized by proposing a high strength SMC bumper instead of the current GMT. In this paper, Marzbanrad JM discussed the most important parameters including material, thickness, shape and impact condition are studied for design and analysis of an automotive front bumper beam to improve the crashworthiness design in low-velocity impact.

III. OBJECTIVE OF PROJECT

The aim of this work is to study front bumper of one of the existing passenger cars in Indian market and suggest design improvement in front bumper of a passenger car in terms of material selection using Impact Analysis.

1. To analyze the mechanical properties on front part (fascia) of car bumper by comparative speed impact analysis.
2. To analyze on mechanical properties focus on stress analysis
3. To modeling the actual dimension of the car bumper into the Solid Work or PRO-e software and analyze by using impact loading.

IV. COMPOSITE BUMPER

Composite materials or simply composites are combinations of materials. They are made up of combining two or more materials in such a way that the resulting materials have certain design properties or improved properties. The automotive industry has advanced a great deal and composite materials have played a large role in this revolution. The composite materials have the following properties.

- High specific strength
- High specific stiffness
- More thermal stability

IV.1 COMPOSITE MATERIAL USED

IV.1.1 Aluminum Alloy

Aluminum alloys are alloys in which aluminum (Al) is the predominant metal. The typical alloying elements are copper, magnesium, manganese, silicon, tin and zinc. Properties of Aluminum Alloy have light in weight, better strength to weight ratio, ductile and soft, good corrosion resistance, high electrical, thermal conductivity.

Density	2.77e-006 kg mm^-3
Coefficient of Thermal Expansion	2.3e-005 C^-1
Specific Heat	8.75e+005 mJ kg^-1 C^-1
Compressive Yield Strength MPa	280
Tensile Yield Strength MPa	280
Tensile Ultimate Strength MPa	310

Table 1. Aluminum Properties

IV.1.2 Carbon Fiber

Carbon fibers are fibers about 5 10 micrometers in diameter and composed mostly of carbon atoms. Carbon fibers have several advantages including high stiffness, high tensile strength, low weight, high chemical resistance, high

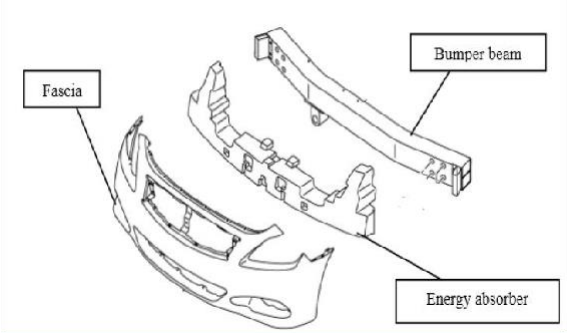
temperature tolerance and low thermal expansion.

Density	1.6e-006 kg mm^-3
Coefficient of Thermal Expansion	1.4e-005 C^-1
Specific Heat	7.8e+005 mJ kg^-1 C^-1
Compressive Yield Strength MPa	41
Tensile Yield Strength MPa	0
Tensile Ultimate Strength MPa	5

Table 2. Carbon Fiber Properties

V. MODEL DESCRIPTION

The modelling and analysis is an accurate and time saving measure to analyses a product and interpret the results. Modelling of the bumper is done according to the drawing of the bumper, which is then used as an input for analysis.



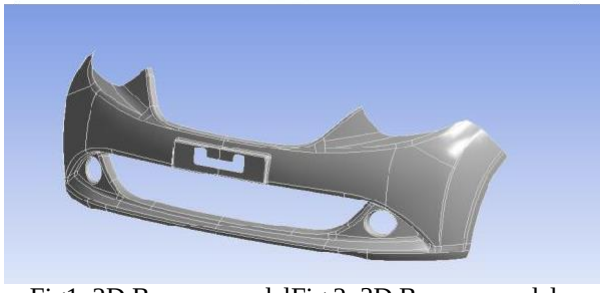


Fig1. 2D Bumper modelFig 2. 3D Bumper model

VI. IMPACT ANALYSIS

This analysis is done for the designed front car bumper model.When Velocity of 5m/s is applied on the fascia so as to mimic the collision at low speed, which is according to the standards. Finally the displacement vector of the bumper for Z-axis (i.e. vertical movement) is kept as Zero as we are not considering the bumper to get detached and get thrown in the vertical direction.

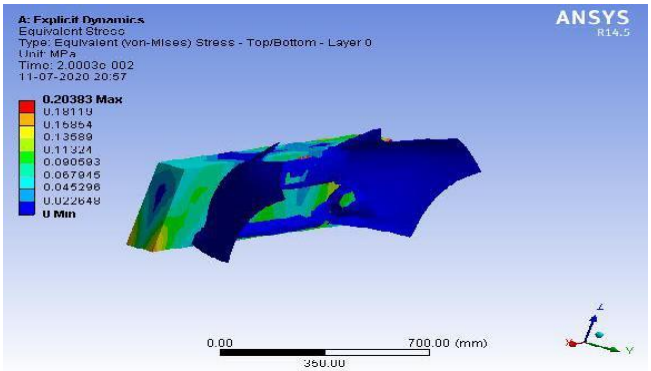


Fig3. Displacement of the component

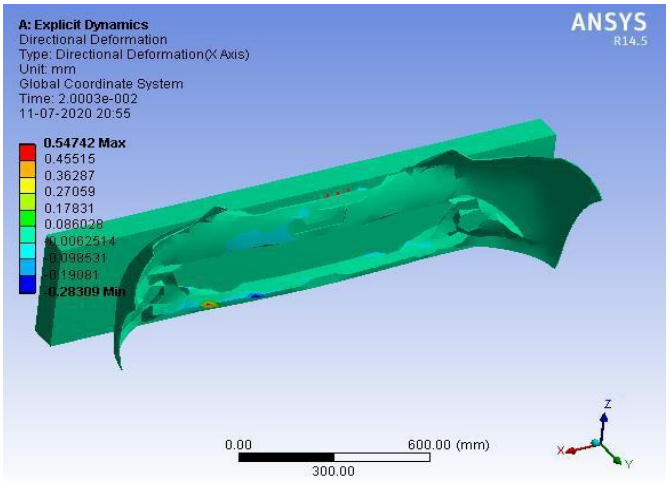


Fig4. Displacement of the compone

REFRENCES

[1] Dubem Ezekwem had studied and analyzed about the use of composite materials in frontal car bumper. Loughborough University Aug.2016.

[2] Bhavesh A. Bohra, Prof. D. B. Pawar discussed about the comparative analysis of frontal car bumper during impact. Dept. Of Mechanical Engineering, Gawai Institute of Engineering and Technology, Darapur, Maharashtra, India. Vol.3, Issue 12, December 2014.

[3] S Seenu as, N Nagendran, N Gayathri, T V B Babu, R Manjunathan had studied about the energy absorption analysis in front bumper of a car. Dept. of mechanical engineering, Vel Tech High Tech Dr. Rangarajan Dr. Shakunthala Engineering college Chennai- 600062.

[4] Mr. Nitin S motgi, Prof. S.B. Naik, Prof. P.R. Kulkarni had studied about the Impact Analysis of Front Bumper. Walchand Institute of Technology, Solapur, India.Vol. 6 no.5 December 2013.

[5] Mahesh Kumar v. Dange, Dr. Rajesh B. Buktal, Dr. Nilesh R. Raykai has proposed about the design and analysis of an automotive front bumper. Dept. Of Mechanical Engineering, Sardar Patel College of Engineering/Mumbai University, India Apr.2015.

[6] Arun Basil Jacob, Arun kumar O. N emphasized that improving crashworthiness of an automobile bumper. Dept. Of Mechanical Engineering, SNGCE, Kolenchery, Kerala.

[7] Alen john and Nidhi M B studied about the analysis of an automotive bumper used for a low passenger vehicle. P.G. scholar, Dept. of mechanical engineering, Mar Baselios college of Engineering and technology. Trivandrum, India.

[8] Lingam Ramyashree, D Venkataramaniah, G Naveen Kumar discussed about the impact analysis of frontal car bumper using long fiber reinforced thermoplastics. Balaji Institute of Engineering and Science, Warangal, Telangana, India. Vol.5 no.3 june 2015.

[9] Pradeep Kumar Uddandapu studied on impact analysis on car bumper by varying speeds using materials ABS plastic and poly ether imide by FEM. Assistant professor, Dept. of Mechanical Engineering, K.S.R.M College of Engineering. Kadapa. Andhra Pradesh, India. Vol-3 issue 1, jan-feb 2013.

