

Design and Analysis of Automobile Bumper

G.V.R.Seshagiri Rao, Vадnala Priyanka, V V S H Prasad



Abstract: An automobile's bumper is the front-most or rear-most part, ostensibly 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 impacts, but are increasingly being designed to mitigate injury to pedestrians struck by cars. The automobile bumper weight is reduced by the utilization of composite and high-strength gilded sheet of a skinny material. Once the motor vehicle is hit from the front or behind, the bumper beam collapses. The impact force is transmitted to the left and right front frames on the bumper beam and bumper stays. The impact energy created throughout the crash is absorbed by plastic deformation on the bumper beam and bumper stays that square measure the specified elements of bumper. For characteristic the foremost effective material, varied analysis like static analysis, impact or crash analysis, dynamic and modal analysis area unit required the target of the work is to counsel the foremost effective material for bumper that is ready to ensure rider safety, with high strength to weight quantitative relation through the static and dynamic analysis.

Keywords: Bumper, dynamic and modal analysis,

I. INTRODUCTION

An automobile's bumper is that the front-most or rear-most 0.5, apparently designed to permit the automotive to sustain an impression whereas not hurt to the vehicle's safety systems. They're ineffective of reducing injury to vehicle occupants in high-speed impacts, however unit of measurement a lot of and a lot of being designed to mitigate injury to pedestrians suffering from cars. Front and rear bumpers became ancient instrumentation on all cars in 1925. What were then straightforward metal beams connected to the front and rear of a automotive have evolved into advanced, designed elements that unit of measurement integral to the protection of the vehicle in low-speed collisions. Today's plastic wheeled vehicle bumpers and tissue system unit of measurement esthetically pleasing, whereas giving blessings to each designers and drivers. the bulk of up so far plastic automotive bumper system fascias unit of measurement product of thermoplastic olefins (TPOs), polycarbonates, polyesters, plastic,

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polyurethanes, polyamides, or blends of those with, as associate example, glass fibers, for strength and structural rigidity. In the FE simulations, the FE mesh of the bumper System is coupled to a simplified model of the car. Presents different models for simulation of frontal and side vehicle impacts with more complexity and less simplifications as the design process progresses. The way that the car is modeled is normally based on experience from former similar car models to the one that is under development and the specific crash load case that is to be simulated. Before delivery, the bumper candidate performance is normally verified by physical crash tests with a Universal Test Vehicle (UTV) that serves as a test rig for the bumper. They shield the hood, trunk, grill, gasoline, exhaust and cooling system in addition to protection associated equipment which includes parking lights, headlamps and backlights. An excellent style of automobile bumper has to be compelled to supply safety for passengers and should have low weight. Completely different nations have extraordinary performance standards for bumpers.

II. LITERATURE REVIEW

“RM Hosseinzadeh” and et.al [1] studied that bumper beams square measure one among the most constructions of traveller cars that defend them from front and rear collisions. In their paper, an advertisement the front bumper beam manufactured from glass mat thermoplastic (GMT) is studied and characterized by means that of have an impression on modeling mistreatment LS-DYNA ANSYS”

“Marzbanrad JM et.al [2] during this analysis, a front bumper beam made from 3materials: atomic number 13, GMT and high-strength SMC is studied by impact modeling to build out the deflection, impact force, stress distribution and absorption of energy-behavior.”

“The mentioned characteristics are compared to every different to search out most suitable option of fabric, form and thickness originally developed as European requirements and now adopted by using many countries car's safety structures have to never the less function normally after a straighten pendulum or moving-barrier have an effect on of 4km/h to the front and to the rear corners.”[3].

“Mohapatra S [4] discusses that car improvement cycles are getting shorter by way of the day. With increasing opposition in the marketplace, the OEM's and supplier's essential venture is to come up with time environment friendly graph solutions.” Some bumpers use electricity absorbers or brackets and others are made with a foam cushioning material. [5].” Andersson R et.Al[6] disclosed is a bumper gadget which include a bumper cover, an power absorber shaped of a artificial resin fabric thru a foam moulding system, an effect beam for supporting the strength absorber, the impact beam being fashioned of a glass mat thermoplastic sand having a "C"-formed phase.



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Butler M et.al.[7] focuses that to boom crash overall performance in automobile vehicles it's necessary to use new ways and materials. Elements associated with crash protection have to be compelled to transmit or absorb power. Carley ME et.al [8] observes is to layout inexperienced epoxy structural foam reinforcements to boost the energy absorption of the front and rear automotive bumper beams. 3 bumper structural overall performance criteria had been studied. Evans D and Morgan T[9] as car manufacturers maintain to emerge as more aggressive with the styling of latest motors, bumper gadget technologies .

III. IMPACT MECHANISM

“This kind of analysis on impact tests, the necessary purpose to be noted is that the form of impact that we tend to get elastic or plastic impact. Negligible amount of energy are going to be losing in elastic impact in between to impacting bodies. Impact between to table game balls are often thought-about as associate example. Appreciable quantity of energy dissipation are going to be going down in plastic impact. Impact between two automotive vehicles or at least between a rigid body and an automotive vehicle in which the vehicle gets crumple on an impact. It is also an example of an elasto-plastic impact.”

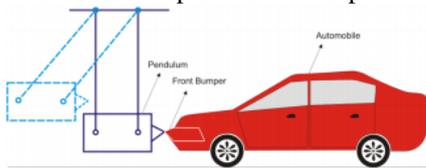


Fig 1: Low speed impact test

In the elastic impact, energy conservation principle is considered here; kinetic energy is conserved before the impact and again converted to elastic energy. Kinetic energy of automobile and the impact or during its maximum deflection can be expressed as follows:

IV. EXPLICIT DYNAMICS ANALYSIS OF ORIGINAL MODEL

$$\frac{1}{2} m_1 v_1^2 = \frac{1}{2} K_{eq} \delta_{max}^2 + \frac{1}{2} m_1 v_o^2 + \frac{1}{2} m_2 v_o^2$$

where v_1 is the velocity of impact or before the impact and v_o is the final velocity at maximum deflection point of the vehicle and the impact or, m_1 is the impact or mass and m_2 is the vehicle mass and K_{eq} is the equivalent stiffness of the automobile bumper beam which can be obtained from the relationship of reaction forces and displacement from analysis of beam.

Another important consideration in the case of momentum is that it can neither be created nor destroyed. Therefore, the momentum before the impact is as same as after impact. Principle of momentum conservation at the moment of its maximum deflection before and after the impact can also be expressed as follows:

$$m_1 v_1 = (m_1 + v_1) v_o$$

$$\delta_{max}^2 = \frac{1}{K_{eq}} \frac{m_1 m_2}{m_1 + m_2} v_1^2$$

V. EXPLICIT DYNAMICS ANALYSIS OF ORIGINAL MODEL

Material – Abs Plastic

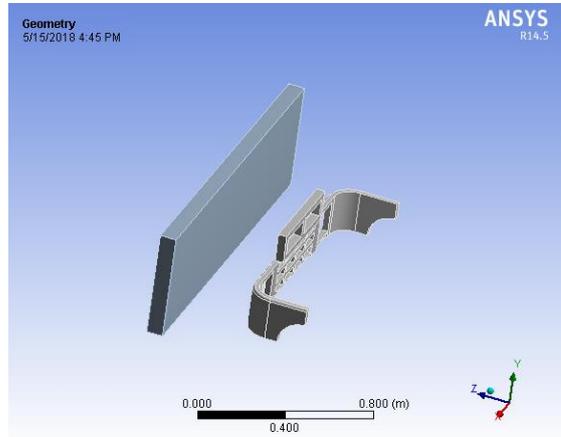


Fig 2: Cad Model of Bumper

MATERIAL PROPERTIES OF ABS PLASTIC

Density : 1400 kg/m³
 Young's modulus : 2000Mpa
 Passions ratio : 0.33

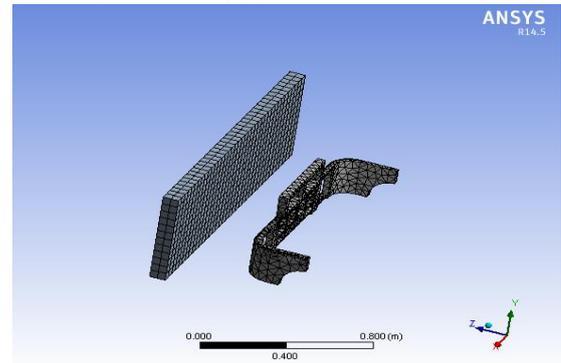


Fig 3: Mesh Model Of Bumper

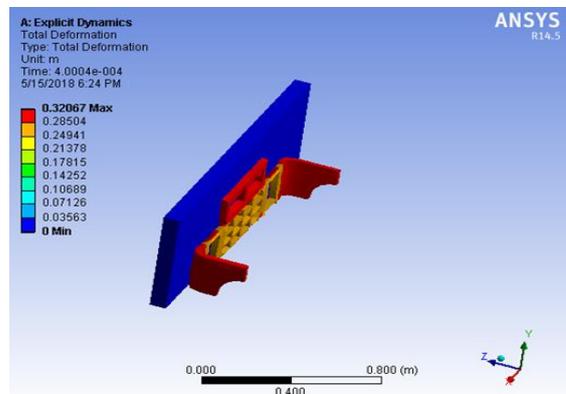


Fig 4: Total Deformation

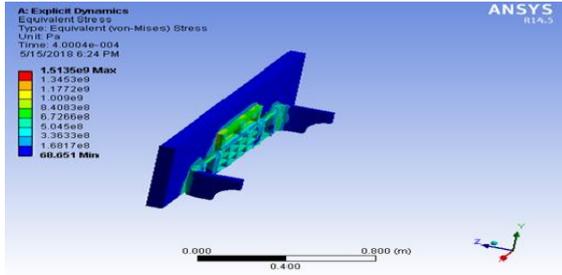


Fig 5: Equivalent Stress

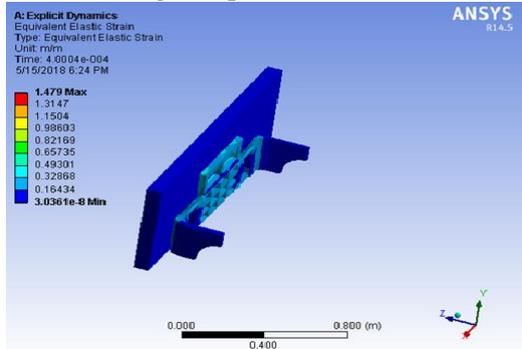


Fig 6: Equivalent Elastic strain

MATERIAL- POLYETHERIMIDE
MATERIAL PROPERTIES OF POLYETHERIMIDE

Density : 1270kg/m3
Young's modulus : 3040Mpa
Poissons ratio : 0.4

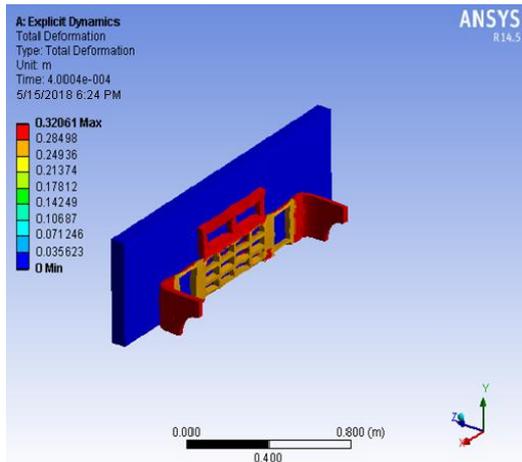


Fig 7: Total Deformation

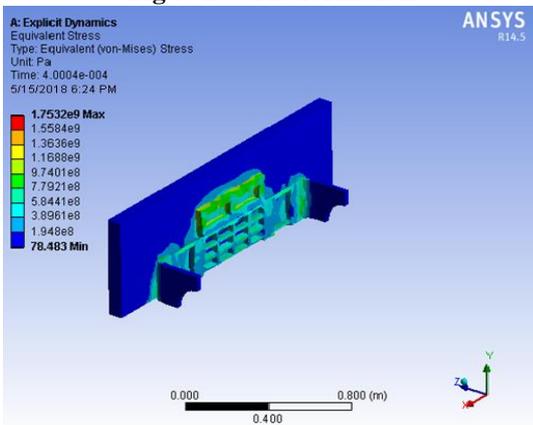


Fig 8: Equivalent stress

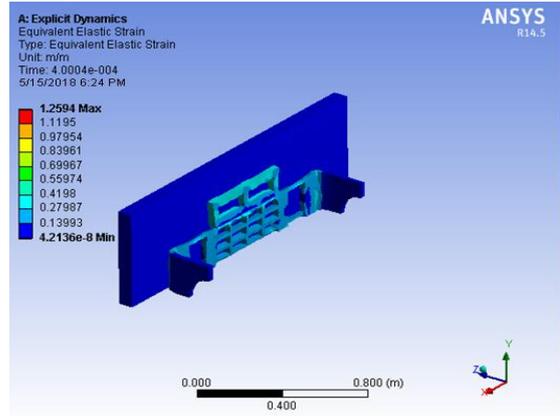


Fig 9: Equivalent elastic Strain

MATERIAL- S2-fiber Glass
MATERIAL PROPERTIES OF S2FIBER GLASS

Density : 2460kg/m3
Young's modulus : 85000Mpa
poissons ratio : 0.23

TOTAL DEFORMATION
Equivalent stress

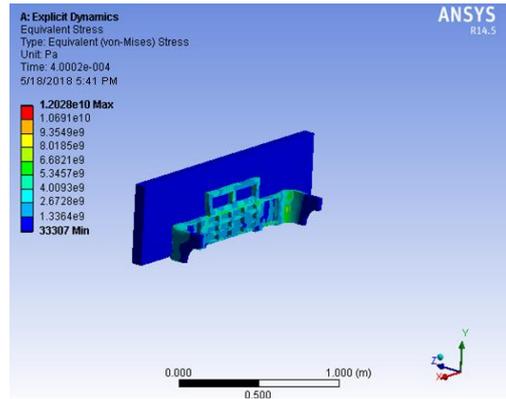


Fig 10: Equivalent elastic Stress

Equivalent elastic Strain

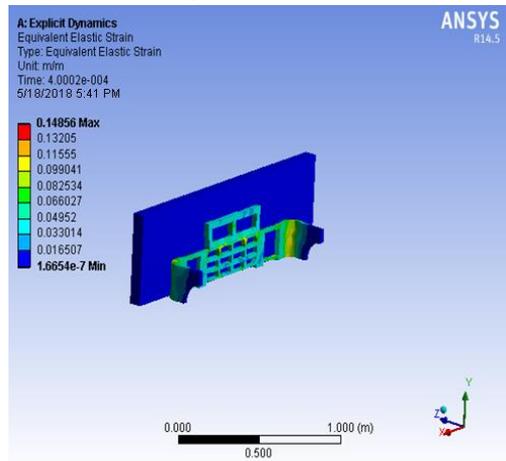


Fig 11: Equivalent elastic Strain

Directional Deformation

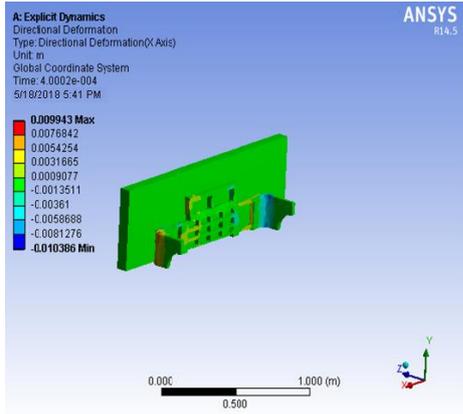


Fig 12: Deformation

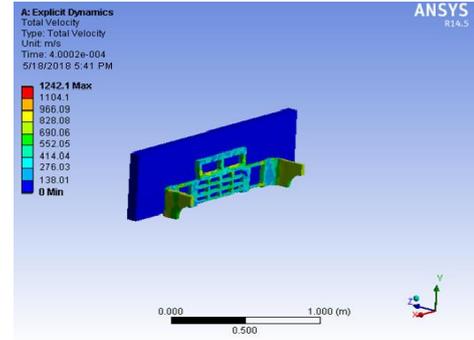


Fig 13: Total velocity

VI. RESULTS

	Original Model				Existing Model			
	ABS Plastic	Polyetherimide	S2 Glass	Glass fiber	ABS Plastic	Polyetherimide	S2 Glass	Glass fiber
Total Deformation	0.32067	0.32061	0.31996	21.729	0.31992	0.31789	0.26661	6.2398
Stress	1.51E+09	1.75E+09	1.20E+10	1.46E+11	1.38E+09	1.85E+09	1.16E+10	8.57E+10
Strain	1.479	1.594	0.14856	1.7854	1.5741	1.505	0.16533	1.8058
Directional Deformation	0.008137	0.009631	0.009943	0.003361	0.031562	0.03471	0.043199	3.8416
Total Velocity	1291.7	1347.9	1242.1	8974.8	2164	1475	1482.4	5696.6

VII. CONCLUSION

Modeling of a automobile bumper is completed mistreatment 3D modeling software system Catia. Impact analysis is completed on the automobile bumper for various speeds. The analysis is additionally automobilieried on the car bumper for various materials plastic, Polyetherimide, S2 glass and fiber composites. Now a days the fabric used for automobile bumper is steel. Steel is substitution with plastic, Polyetherimide, S2 glass and fiber composite. The density of plastic, Polyetherimide, S2 glass and fiber composes is a smaller amount than that of steel. By observing the Impact Analysis results like Stress, Displacement and strain values. By comparing Original modal and existing modal these results of ABS Plastic, Polyetherimide, S2 glass and glass fiber composites, the stress values are less for S2glass than ABS Plastic, Polyetherimide and Glass fiber composite . S2glass is better Material. Glass fiber Deformation less than other materials.

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