Dynamic Analysis of Bumper Beam

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Abstract - *Now a days automobile accidents are increasing each year, The main reason is being the lack of proper safety system in the vehicle. In case of automobiles we can see that the 60% of accidents caused due to frontal impact of the automobile and the bumper beam is generally used to protect the automobile components from the impact. The bumper playing key roll in automobile as well as human safety purpose. An automotive bumper beam is structural component with intended absorb kinetic energy during vehicle collision. this paper throws light on materials, structure and safety impact condition included for analysis of bumper beam in order to improve crashworthiness during collision.*

Key Words: (bumper, analysis, deformation, stress)

1. Introduction

Presently days Car crashes expanding every year the greater part of risk circumstances are jumped out at driver that they can not be keep away from. As indicated by overview that 60% mishaps are happened front of vehicle and this effects are most usually observed, unintentional circumstances on street. .This gives most elevated bit of death .The main reason of this being lack of proper safety system in vehicle. In automobile vehicle bumper beam is a primary component which plays a very important role. Which takes entire damage and transfer all forces to structure. As well as bumper beam is used to absorb accidental kinetic energy by deflection low speed impact and by deformation in high speed impact. Stiffness and energy absorption are essential criteria in design of bumper beam. The new bumper design must be very flexible to reduce passenger and occupant injury and stay in impact in low speed impact. The reinforcement beam play very important role in safety it must be validate to finite element analysis. Aim of this study improving the crashworthiness and energy absorbing capacity of bumper beam and selecting the best suitable material which gives the best result under the deformation .figure shows of basic component of bumper, bumper system is made up of four main parts a bumper fascia, energy absorber, reinforcing beam, bumper stay. Bumper fascia is outside covering of bumper as shown in figure. Energy absorber is usually made up of foam material that is design to absorb impact energy.This study is done on CATIA and Ansys software.

Basic components of Bumper:

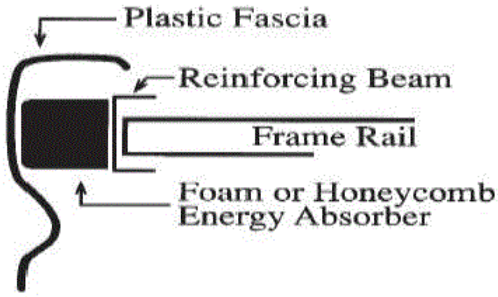


Fig. Basic components of Bumper

1.1 Literature Review

1."Crashworthiness Analysis of a Composite and Thermoplastic Foam Structure For Automotive Bumper Subsystem"

Giovanni Belingardi, Ermias Gebrekidan Koricho, Alem Tekalign Beyene, Brunetto Martorana , Mangino Enrico

In the study, the re-design of a front bumper subsystem has been developed finalised to Light weight. Alternative solutions have been considered by substituting the used steel with other suitable materials. The bumper beam solutions, based on these alternative materials, have been developed on the bases of equal thickness and equal stiffness criteria. Comparison of the obtained FE simulation results illustrates how the choice of material can significantly affects the performance of bumper subsystem. The introductions of local reinforcements at the stress concentration point enhance the composite bumper beam performance by redistributing the stress and preventing local failures. However the PA66 solution, even if reinforced with short glass fibres, does not reach comparable result with respect to the CFRP solution. Looking at the results from another point of view, the polyamide with 30% glass solution leads to better results in term of possible material recycling at the end of life, while CFRP has still problematic perspective.

2."Improving The Crashworthiness Of An Automobile Bumper"

Arun Basil Jacob1, Arunkumar O.N

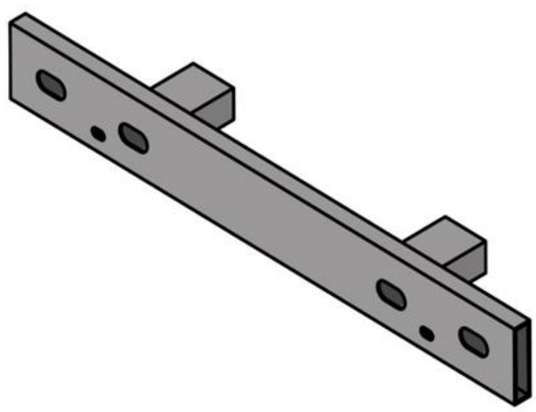
This paper compares newly designed bumper with existing steel bumper of a Toyota Camry automobile. The crash tests were executed in a software environment. All the simulations were executed using LS-DYNA. The material models used for the study included MAT_PIECEWISE_LINEAR_PLASTICITY (MAT24), MAT_RIGID (MAT20), MAT_CRUSHABLE_FOAM (MAT63). The proposed model of honeycomb and also foam models have shown better impact absorption capacity than the already existing model. The existing steel bumper model absorbed 46,000 Joules of energy of the total 71,212 Joules. The honeycomb model absorbs a total of 54,000 Joules where 7800 Joules is absorbed by the honeycomb structure and the remaining by the steel bumper. In the honeycomb model the increased energy absorption capacity is 11.26 % compared to the existing steel bumper. The foam model absorbs a total of 50,000 Joules in which the foam absorbs 4000 Joules. Compared to the existing steel bumper the foam has an increased energy absorption capacity of 6%.

3."Design and Crash Analysis of Passenger Car Frontal Bumper Beam Using Hypermesh and Radioss"

P. Ravinder Reddy, 2Thota Harish

In 1994, the National Safety Council estimated that 20 million vehicle crashes occurred on roads in the United States, resulting in 43,000 fatalities and 2.1 million injuries requiring hospitalization. From a public health perspective, motor vehicle crashes are the fourth leading cause of death after heart disease, cancer and stroke. Today, transportation safety efforts focus on crashworthiness, crash avoidance, driver performance, and highway construction. Over the past decade automakers have added many features to help the driver avoid a crash, such as anti-lock braking systems, traction control devices and daytime running lamps. Vehicles also include many crashworthiness features such as rigid steel occupant-cells surrounded by strategically placed, energy absorbing components. In addition,

1.2 CAD Model Of Bumper Beam TOYOTO INNOVA:



Model No.	Model type	Iteration No.	Material used
Model 1	Without coating	1.1	Aluminum
		1.2	Magnesium
		1.3	Carbon fiber
Model 2	With coating	2.1	Aluminum
		2.2	Magnesium
		2.3	Carbon fiber

2. PARAMETERS FOR STUDY

Table 1 - Fixed and variable parameters

Sr. No.	Fixed parameters	Variable parameters
1	Basic design of the beam bumper	Material of beam bumper
2	Velocity of the beam bumper	A coating on the outer of the beam bumper
3	Fix support given to wall	

Table 2 - Fixed parameter values

Sr. No.	Fixed parameters	Values
1	Length of the beam bumper	1000 mm
2	Width of the beam bumper	120 mm
3	Thickness of the beam bumper	30 mm
4	Velocity of the beam bumper	22.22 m/sec

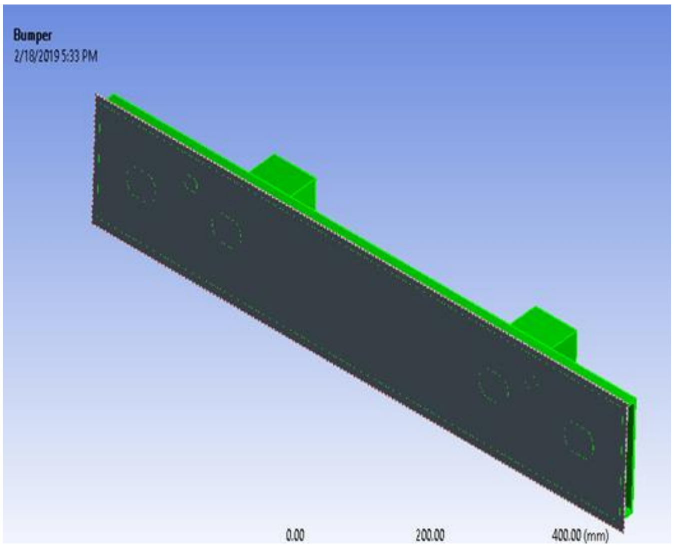
2.1 MATERIAL USED FOR BUMPER BEAM

Magnesium

Steel

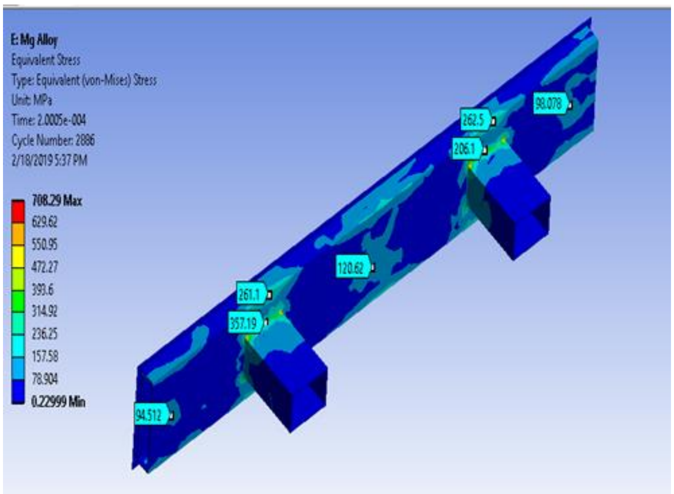
2.2 Performing Explicit Dynamic Of Models By Using Ansys

First the analysis of the beam bumper without coating was performed for all the three material that was followed by the analysis of the beam bumper with the coating material.

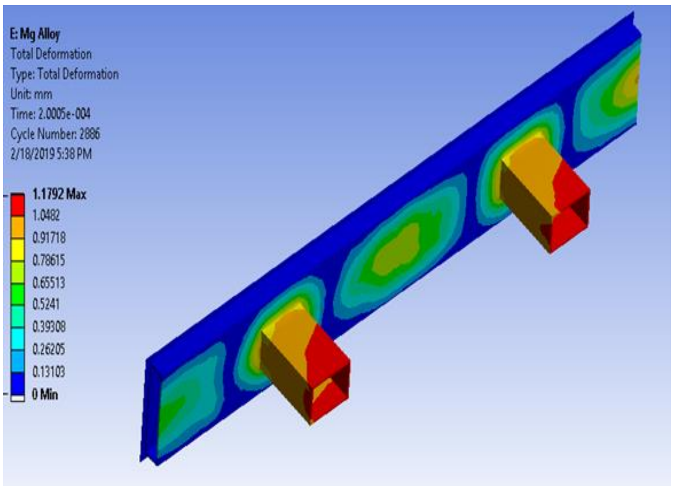


2.3Dynamic analysis for magnesium alloy without coating

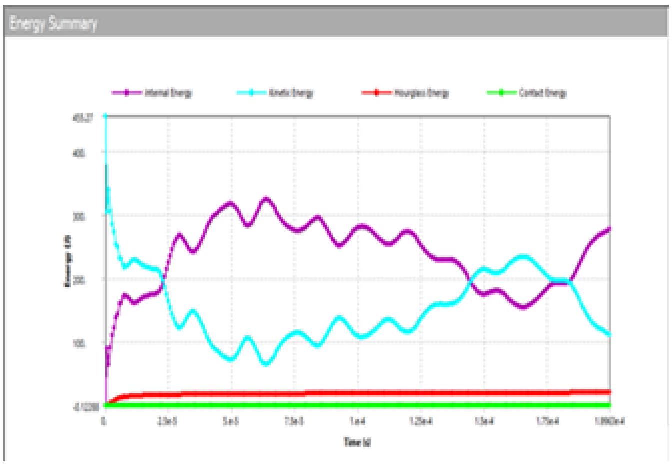
stress



Deformation



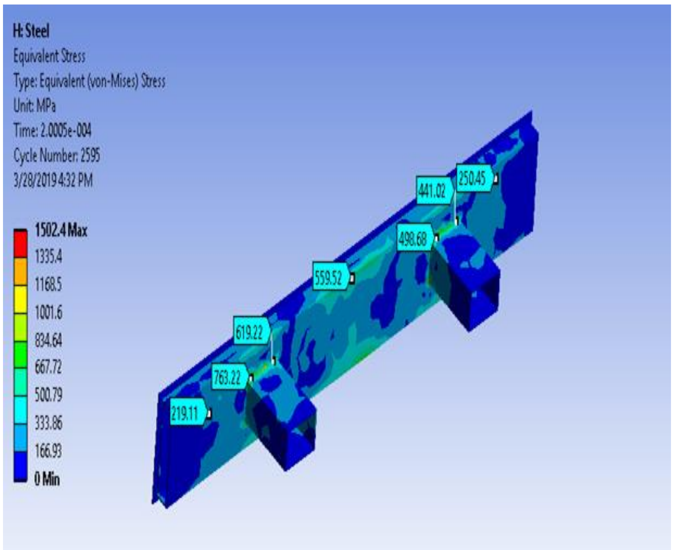
Results



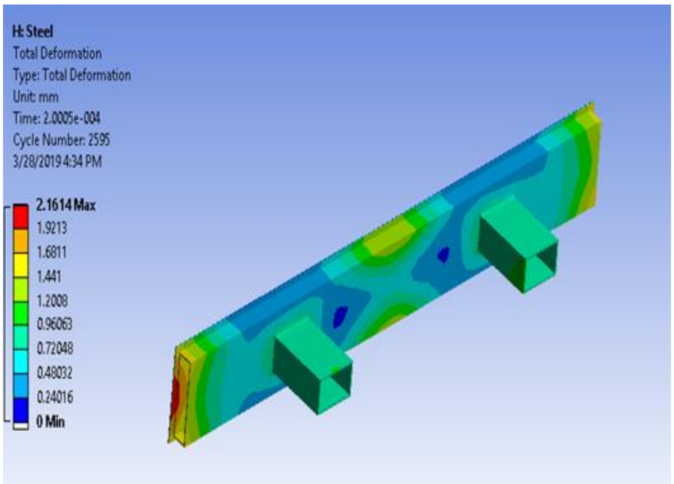
Sr. No.	Stress value (MPa)
1	94
2	261
3	357
4	120
5	206
6	262
7	98
Avg. Value	199.71

2.4 Dynamic analysis for steel without coating

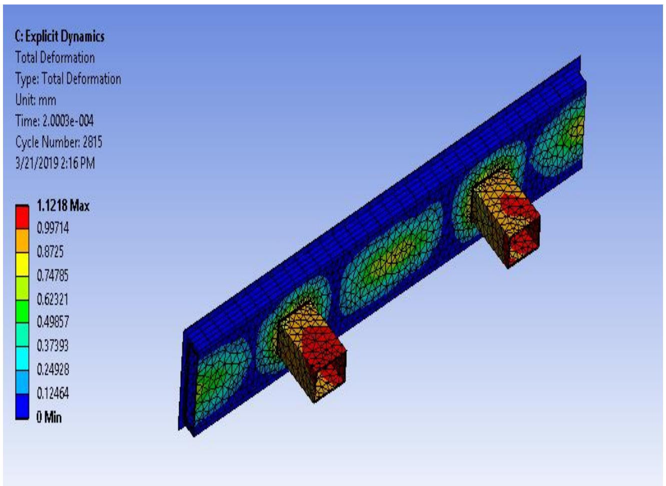
Stress



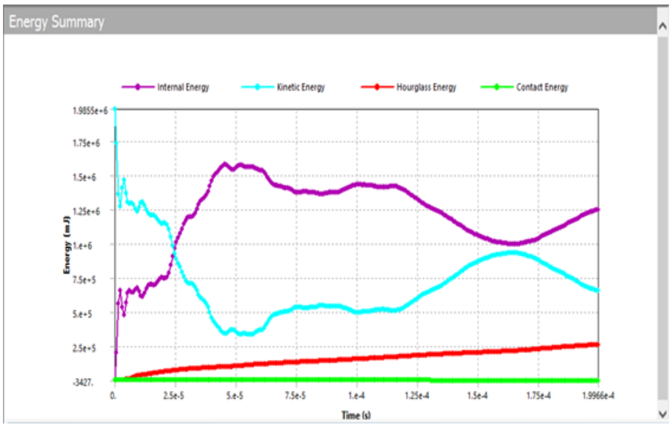
Deformation



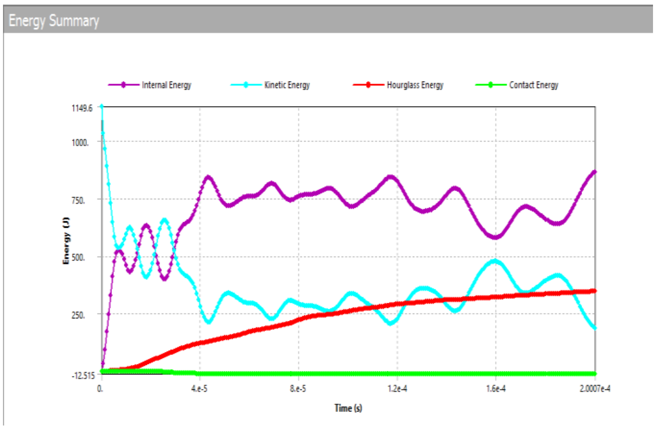
Deformation



Results



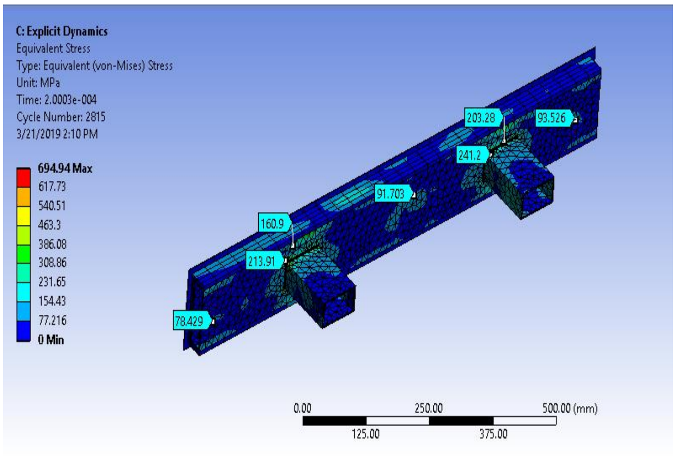
Results



Sr. No.	Stress value (MPa)
1	219
2	763
3	619
4	559
5	498
6	441
7	250
Avg. Value	478.42

2.5 Dynamic Analysis For magnesium With Coating

Stress

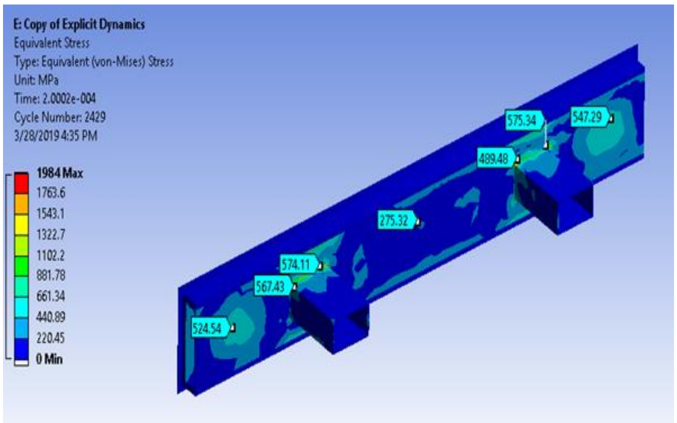


Sr. No.	Stress value (MPa)
1	78
2	214
3	161

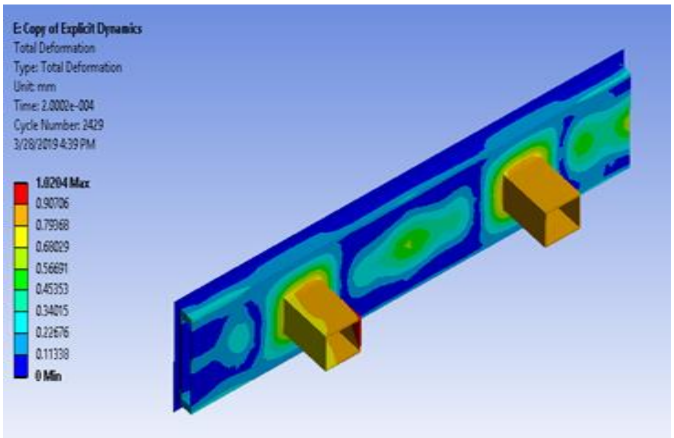
4	92
5	241
6	204
7	94
Avg. Value	154.85

2.6 Dynamic analysis for steel with coating

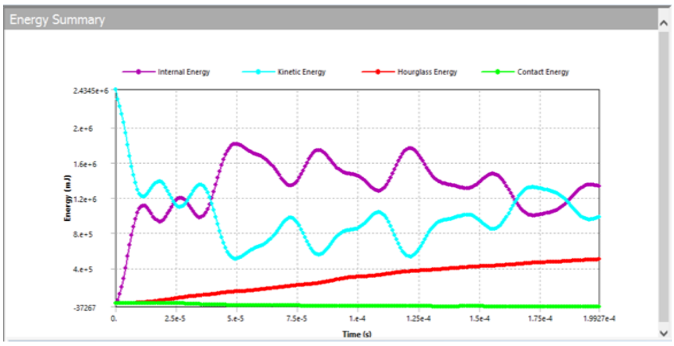
Stress



Deformation



Results



Sr. No.	Stress value (MPa)
1	524
2	567
3	574
4	275
5	489
6	575
7	547
Avg. Value	507.28

3 Stress and deformation values without coating

Sr.No	Material	Avg. Stress (Mpa)	Deformation (mm)
1	Magnesium	199.71	1.18
2	Steel	478.42	2.16

3.1 Stress and deformation values with coating

Sr.No	Material	Avg. Stress (Mpa)	Deformation (mm)
1	Magnesium	158.85	1.12
2	Steel	507.28	1.02

3.2 Percentage change for with and without coating

Sr.No	Material	Model 1 stress	Model 2 stress	% change
1	Magnesium	199.71	158.85	20.459
2	Steel	478.42	507.28	- 6.032

4. CONCLUSION

We performed the crash analysis on the designed beam bumper for various materials and studied the stress and deformation of the same. As mentioned in the literature review steel is now a day's least preferred material that is used for the bumper as the stress developed in the steel is maximum that damages life and property therefore it is important to have a material that is safe for life and property. From the results table we conclude that stress generated for the magnesium was least. Also further more to enhanced the effect of the safe bumper we introduced a coating material i.e. epoxy resin that showed a very positive results as the stress and deformation value was reduced and had a significant change in results. Among the above iteration that we performed the combination of magnesium and epoxy resin is the most satisfactory.

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