CRASH WORTHINESS ANALYSIS OF AUTOMOTIVE BY A BUMPER-WALL COLLISION

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ABSTRACT: Crash simulation is a virtual recreation of a destructive crash test of a bumper by using computer simulation software in order to test the level of safety of the car and it's components. Automotive bumper beam is one of the key system in car. Bumper is beam design to prevent or reduce physical damage to front or rear end of the Motor vehicle in collision conditions they protect to hood, trunk, grill, fuel, exhaust and cooling system as well as safety related equipment such as the parking light, head lamps, tail light etc. Finite element model of a vehicle was developed in solidworks and it was solved for full frontal impact in ANSYS using explicit dynamics.

Keywords: Computer Simulation, Crashworthiness, Explicit Dynamics Code, Impact Energy, Automobile Bumper, Composite Material, Ansys.

INTRODUCTION

Today's automobile Manufactures are increasingly using lightweight materials to reduce the weight. As we know Car accidents are happening Everyday .Most of the drivers thinks that they can avoid such troublesome simulations. Automobile bumper subsystem is a frontal & rear structure of vehicle that has the purpose of energy absorption during low velocity impact.

- The structure have to preserve at least minimum space of survival to keep Injury and fatality level as low as possible.
- A good structure or automobile bumper have to provide safety for passenger.

GEOMATRIC MODLING AND MESHING

Solidworks software is use in designing of body panel. A set of equally spaced cross section are generated along the entire length of the body panel. Synchronous modelling feature of solid work is used in developing of the body panel. 225mm*70mm is the dimension of the model. The body panel act as a protective layer for occupants of the vehicle. The body panel structure work as a crumpling zone which absorbs. The energy of impact during crash or accident. So, the body is the main concern. The projection area of the body panel on X-Z plane is The model is imported to ANSYS workbench 16 design modulor. The wall against which the Bumpur is subjected to a crash is modelled in ANSYS workbench 16 Design modeller. The wall is modelled at a distance to 80.121mm from the start of the body panel. The wall diameter and height is considered to be 256.79mm x 21.5mm x 200mm, which accounts for 26% of the body panel's projected area. The meshing of model is done by using ANSYS mesh feature in ANSYS workbench 16 Mechanical. The element has 12 degrees of freedom at each node: Translation, Acceleration and Velocities in node x,y,z directions.

Boundary Conditions:

The stiffness behaviour of the wall is set as a Rigid. The stiffness behaviour of the model is set as a flexible. The simulation is done to analyse the high velocity crash test.

Material Properties:

MATERIAL	Resin_Polyester	AL 6061-T6	Stainless Steel	Resin_Epoxy	Concrete
Density	1200	2703	7750	1160	2300
Coefficient of the Thermal Expansion	4.5*23	2.32*10	4.62	4.5*293	3.8055
Specific heat	120	885	480	140	780
Poisson's Ratio	0.316	0.33	0.31	0.35	0.18

Assumptions:

The following assumptions are made in the simulation of a crash-

- The body panel is approximated to be the bumper.
- The wall is assumed to be a rigid support.
- The panel is subjected to an initial velocity and constant acceleration.

Bumper & Wall Meshing:

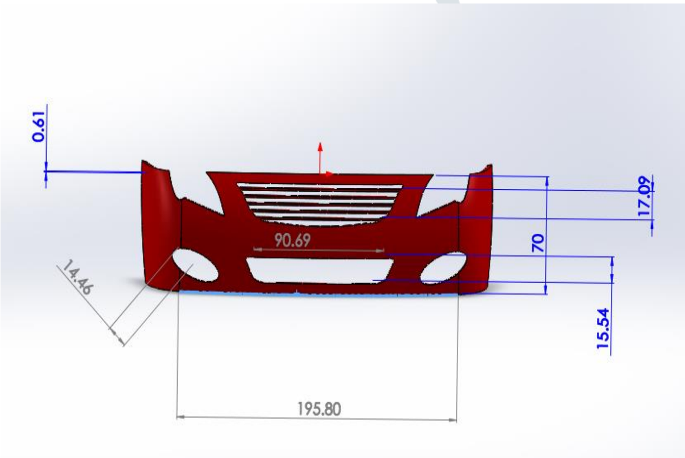

Fig.1 Dimension

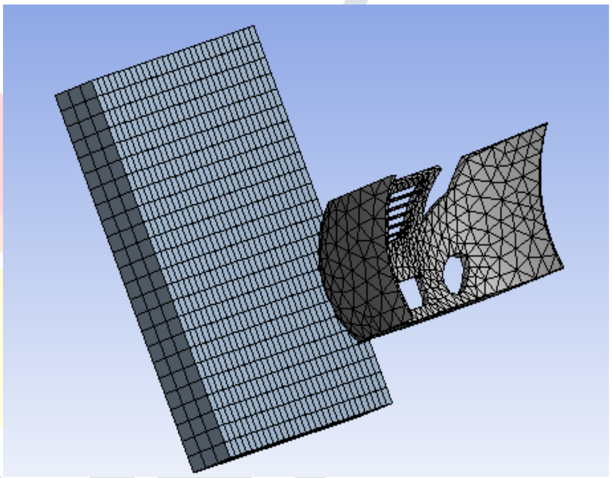

Fig.2 Meshing

Result:

Crashworthiness:

	Resin Polyester	Al 6061-T6	Stainless steel	Resin Epoxy
Total Deformation Maximum	6.2299e-002 m	6.9368e-002m	0.12216m	6.2304e-002 m
Directional Maximum	6.0846e-002 m	6.9366-002m	1.1719e-002m	6.085e-002 m
Total Velocity Maximum	67973 m/s	14290m/s	9294.4m/s	41073 m/s
Equivalent Maximum	3.0945e+009 Pa	7.9416e+00.9Pa	1.5644e++011Pa	3.1663e+009 Pa

RESIN POLYESTER

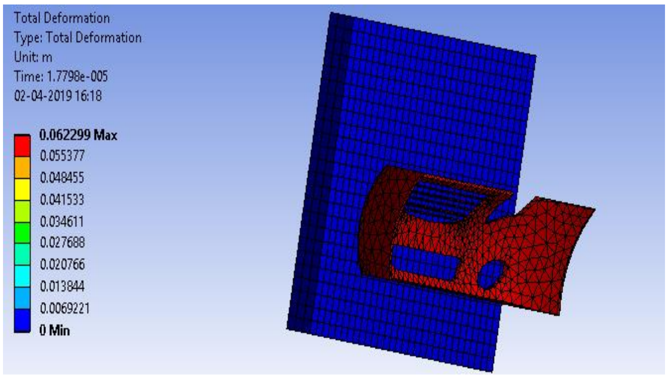

Fig.3 Total Deformation

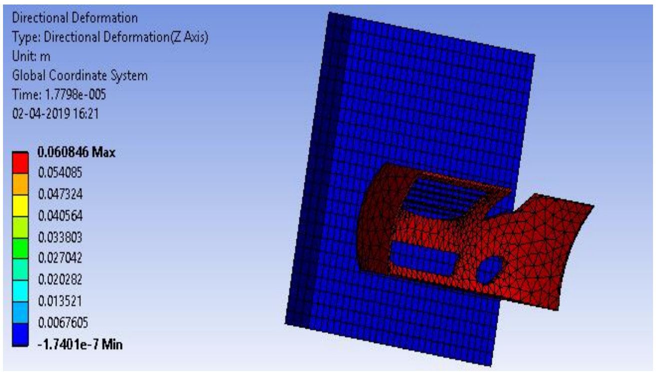

Fig.4 Directional Deformation

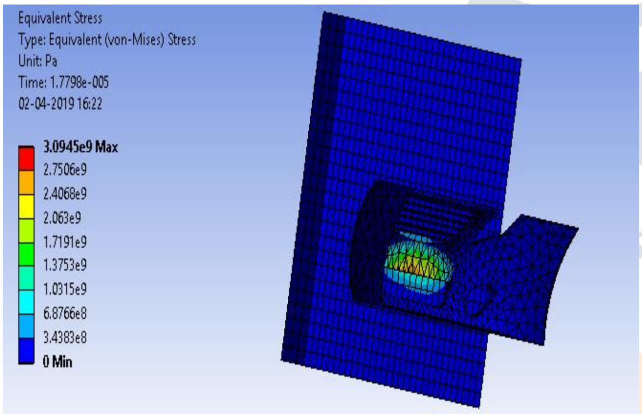

Fig.5 Equivalent stress

Al 6061-T6:

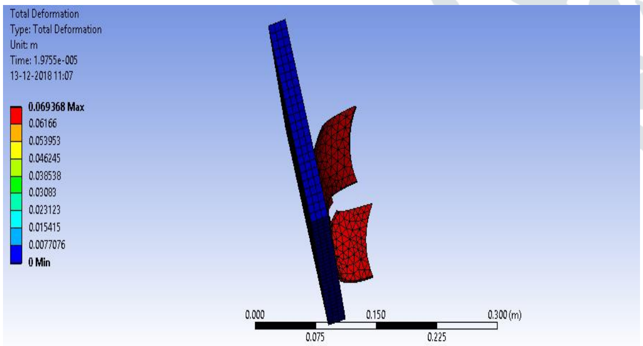

Fig.6 Total Deformation

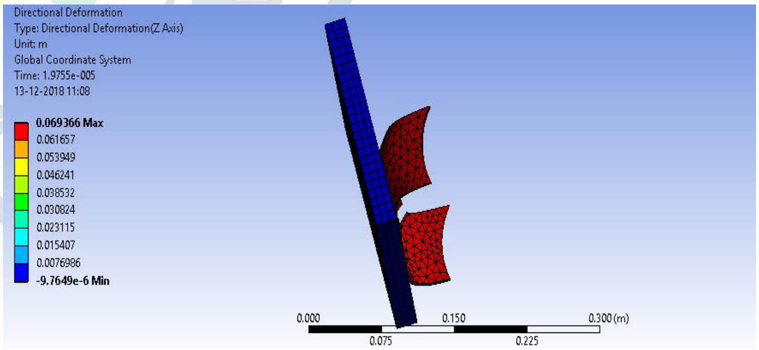

Fig.7 Directional Deformation

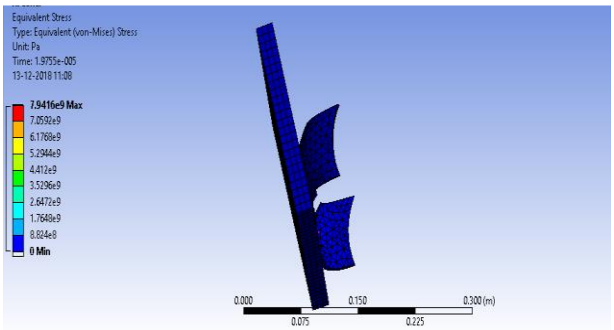

Fig.8 Equivalent stress

Stainless steel:

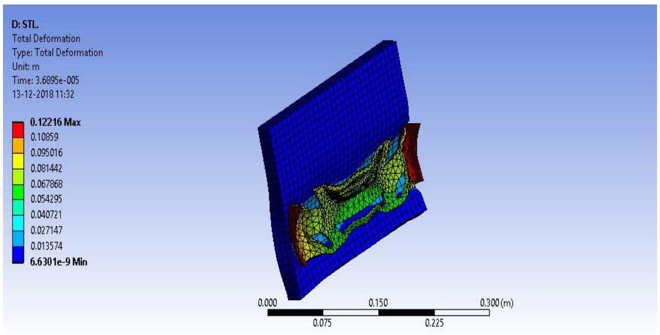

Fig.9 Total Deformation

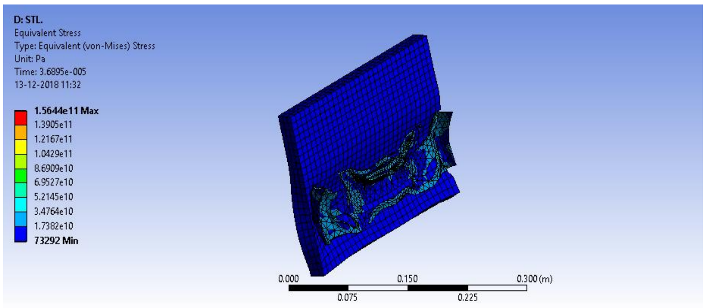

Fig.10 Equivalent stress

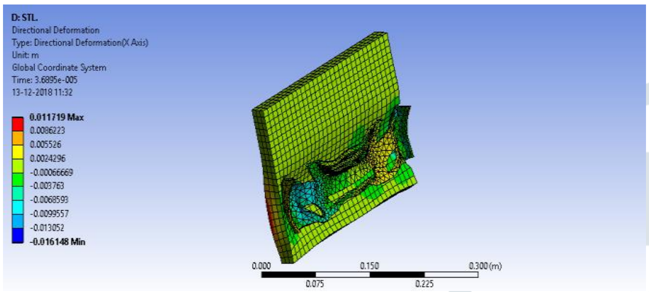

Fig.11 Directional Deformation

Resin Epoxy :

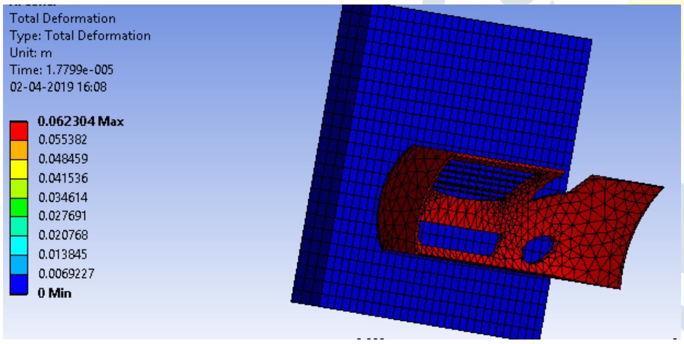

Fig.12 Total Deformation

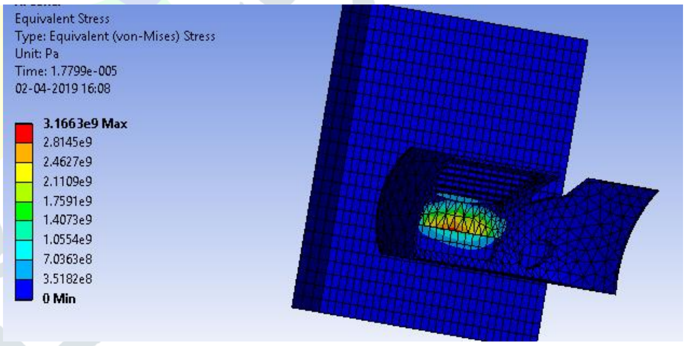

Fig.13 Equivalent stress

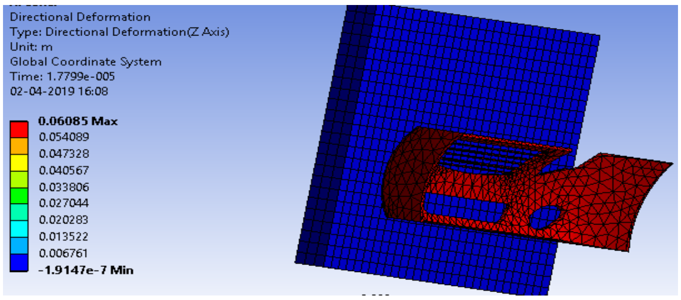

Fig. 14 Directional deformation

Conclusion-

The overall objective of the paper was to simulate a full bumper crash of a bumper with wall. Simulation was performed using ANSYS 16.0

- The bumper absorbs must of the energy as it is subjected to maximum deformation.
- Generally, the minimum deformation was seen at the points was the contact region of the shell with the wall.
- Among the metallic structures, Resin polyster is the best crashworthy material. However, Resin polyster proved to be a better crashworthy material than any other metallic structure. Specific energy absorption was the common figure of merit for comparing crashworthiness of different materials.
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