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Design Analysis of Automatic Pneumatic Bumpers for 4-Wheelers Subjected To Dynamic Analysis

Duguta Rajashekar[1], Mr.Pedamuthevi Vijayanand[2]

1M.Tech(Machine Design) Student, Department of Mechanical Engineering, Holy Mary Institute of Technology and Science, Hyderabad

2Associate Professor, Department of Mechanical Engineering, Holy Mary Institute of Technology and Science, Hyderabad

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ABSTRACT

The technology of pneumatics plays a major role in the field of automation and modern machine shops and space robots.. The aim is to design and develop a control system based intelligent electronically controlled automotive bumper activation and automatic braking system is called Automatic Pneumatic Bumper and Break Actuation before Collision. This project consists of IR transmitter and Receiver circuit, Control Unit, Pneumatic bumper system and pneumatic braking system. The IR sensor senses the obstacle. There is any obstacle closer to the vehicle (within 3-4 feet), the control signal is given to the bumper activation system and also pneumatic braking system simultaneously. The pneumatic bumper and braking system is used to product the man and vehicle. This bumper and braking activation system is only activated the vehicle speed above 30-40 km per hour. This vehicle speed is sensed by the proximity sensor and this signal is given to the control unit and pneumatic bumper and braking activation system.

INTRODUCTION

Increase in number of accidental deaths has made vehicle safety as one of the major areas of research in the automotive sector. New stringent legislations and growing concern of people support this research. Thin-walled metallic tubes used in the vehicles are of increasing interest with reference to safety and crashworthiness of vehicles. These thin walled structures are most conventional devices for absorbing impact energy effectively. The extensive research on the structural response of these tubes is going on continuously to improve the passenger safety.

1.1 Road Accidents in India

Highest number of accidents takes place in India. Having more than 1,30,000 deaths every year, the country has surpassed China and now has become the country having worst road traffic accident rate in the world. This was revealed by World Health

Organization (WHO) in the first Global Status Report on Road Safety.

1.2.1 Bumpers

Bumper is a part of an automotive designed that had at a vehicle. Bumper comprised an elongated support which can be attached to the front and rear of the vehicle body and which spans the width of the vehicle body, a shock absorber extending along the support part and extending towards the front and rear of the vehicle body in a substantially convex manner, and an elastic exterior shell which can be connected to the support part and which encompasses the front and rear of the vehicle in an approximate U shape, covering the side of the support part opposite the side facing the front and rear of the vehicle body where in the support part has a middle section that can be firmly supported on the vehicle body.

Figure: Bumper

LITERATURE REVIEW

Bumper system including a bumper cover, an energy absorber formed of a synthetic resin material through a foam molding process, an impact beam for supporting the energy absorber, the impact beam being formed of a glass mat thermoplastic and having a U-shaped section, and a stay for connecting the impact beam to a vehicle body. Tips are formed on front upper and lower portions of the impact beam, and a web portion is formed on the impact beam between the tips. Tip insertion grooves in which the tips are inserted are formed on an inner surface of the energy absorber, and a pressure receiving surface corresponding to the web portion is formed on the inner surface of the energy absorber. (Choi, W.J. et al., 2003).

METHODOLOGY

Modeling and simulation (M&S) refers to using models physical, mathematical, or otherwise logical representation of a system, entity, phenomenon, or process as a basis for simulations methods for implementing a model (either statically or) over time to develop data as a basis for managerial or technical decision making. Modeling & Simulation supports analysis, experimentation, and training. As such, M&S can facilitate understanding a system's behavior without actually testing the system in the real world. For instance, to determine which type of spoiler would improve traction the most while designing a race car, a computer simulation of the car could be used to estimate the effect of

different spoiler shapes on the coefficient of friction in a turn. Useful insights about different decisions in the design could be gleaned without actually building the car. In addition, simulation can support experimentation that occurs totally in software, or in human in the loop environments where simulation represents systems or generates data needed to meet experiment objectives. Furthermore, simulation can be used to train persons using a virtual environment that would otherwise be difficult or expensive to produce.

3.4 3D CAD Models

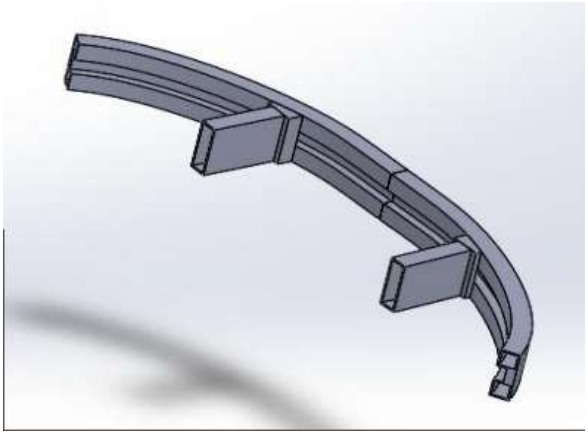

Figure: Metal Bumper beam

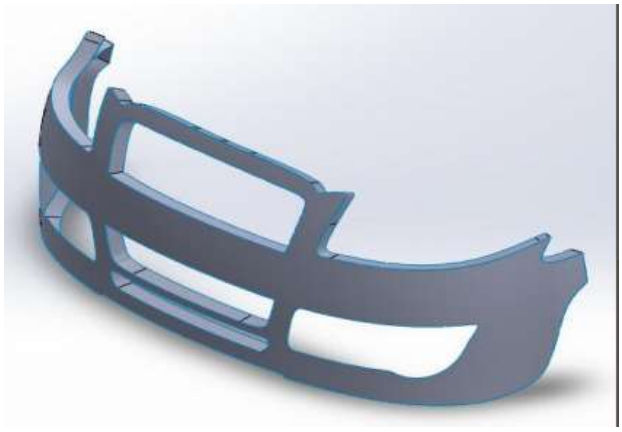

Figure:Fascia Model

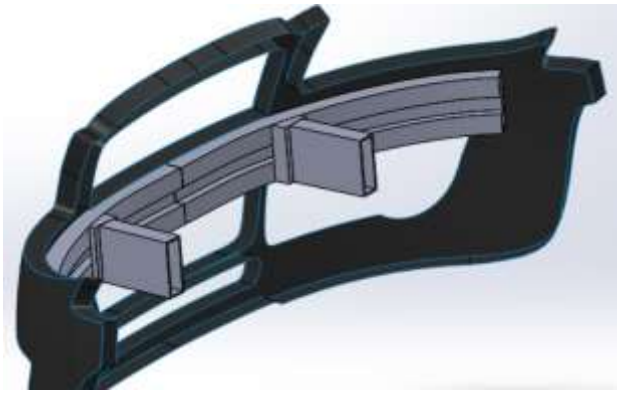

Figure:Complete Assembly of CAR Bumper

3.5 PROCEDURE FOR ANALYSIS

- Engineering Data
- Geometry
- Meshing

1) Types of Element

2) Meshing methods

3) Meshing sizing

Imported geometry in ANSYS

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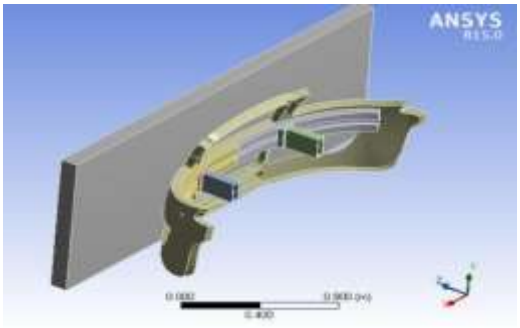

Figure: ANSYS Geometry window

3.6 MESHING

Meshing is discrete representation of the geometry that is involved in the problem. Essentially, it partitions space into elements (or cells or Zones) over which the equation can be approximated. Zone boundaries can be Free to create computationally best shaped zones, or they can be fixed to represent internal or external boundaries within a model.

1) Triangular 2) Quadrilateral 3) Quad-triangular 4) Tetrahedron 5) Pyramid 6) Triangular 7) prism 8) hexahedron

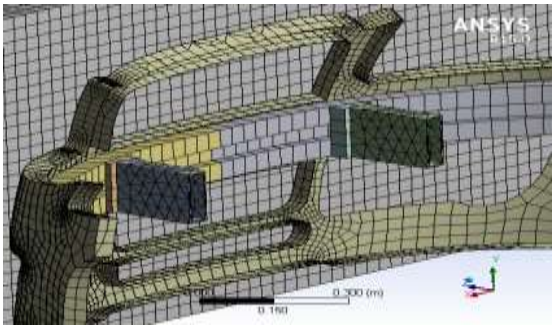

Figure: Meshed Model

Table 1: Mesh Details

Object Name	Mesh
Sizing	
Use Advanced Size Function	On: Curvature
Smoothing	High
Transition	Slow
Span Angle Centre	Coarse
Minimum Edge Length	1.6146e-002 m
Nodes	13369
Elements	11013

RESULTS AND DISCUSSION

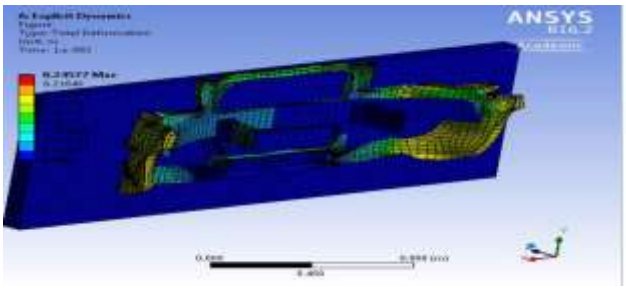

Figure: Deformation of Bumper:

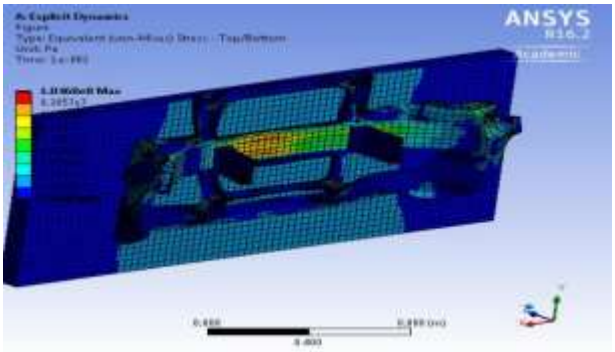

Figure: Von-Misses stress in bumper

CONCLUSION

In Explicit Dynamic Analysis energy absorption the maximum percentage of energy is absorbed by mild steel which is failed in equivalent stress and after mild steel it comes aluminum which absorbs about 46.69% energy that is higher than magnesium. So till now aluminum with appears to be best combination. In the Normal bumper Design.

In case of Pneumatic bumper Explicit dynamic analysis shows the maximum energy absorption observed in Mild steel but mild steel failed in equivalent stress so it comes aluminum which absorbs 57.02% energy.

When we compare both the analysis of normal bumper and pneumatic analysis in case of pneumatic bumper the energy absorption is increased almost 12% from the above result we conclude the pneumatic bumper is safe with aluminum bumper.

After considering all required criteria's and comparing all the results, we concluded that the best suitable material is aluminum. This is the final proposed solution of this project.

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