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Fabrication of Replacement Material for Car Bumper with FEA Analysis

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ABSTRACT: The current pace of technological advancement forces us to seek for new materials to replace old ones. In order to keep the impact energy from being passed to the car and its occupants, bumpers are crucial. At various speeds (50 to 150 km/hr), this bumper either transmits the impact energy perpendicular to the path of impact or absorbs it through deformation. To ascertain the deformation and stress of the automobile bumper, static and impact analysis is used. To ascertain the natural frequency and deformation for mode forms, modal analysis is used. In low-speed collisions, bumpers are designed to lessen or completely avoid physical harm to the front and back of the car. The hood, trunk, grille, gasoline, exhaust, and cooling systems are all protected by bumpers by design. A bumper is a type of shield that is often constructed of rubber, plastic, steel, or aluminium.

KEYWORDS: Car bumper, Creo, Ansys, Static and Impact Analysis.

I. INTRODUCTION

This chapter provides an overview of the current work, including its definition, problem description, objectives, and scopes. This chapter also includes a brief summary of the actions taken to launch the current research project. Our current technological advancement forces us to discover and create new materials to replace old ones. In order to keep the impact energy from being passed to the car and its occupants, bumpers are crucial. At various speeds (50 to 150 km/h), this bumper either transmits the impact energy perpendicular to the path of impact or absorbs it through deformation. To ascertain the deformation and stress of the automobile bumper, static and impact analysis is used. To ascertain the natural frequency and deformation for mode forms, modal analysis is used.

II. RELATED WORK

Dr. Chethan K N et.al, Conceptual design and an analysis of a car bumper using finite element method Due to intrinsic or extrinsic conditions, the number of car accidents has increased currently across the globe. Drivers must be assured that they can avoid these problematic conditions. According to the statistics, about 10,000 are dead, and more than a million people are wounded each year in India. Hence, improvement in the safety of vehicles is of utmost importance to shoot down the number of accidents. The automotive bumper beam is one of the essential components in passenger cars. Bumper beams reduce or minimize the extent of impact caused at the front and rear ends during a collision in passenger vehicles. It absorbs the impact energy. The important physical parameters in the bumper beams such as material, size, and design to improve the extent of crashworthiness are studied and discussed in this current work. Comparative analysis between 2 mm thickness and 4 mm thickness bumper with honeycomb structure is studied. An ideal design composition is considered. This helps in advanced safety precautions.

Gandla Pradeep, P. Chandra kumar et.al, design and experimental analysis on car bumper with composite materials. the main criteria of the project is to minimize the cost & increase the strength of the bumper by using composite materials. design should be under attention of safety of the passenger meanwhile with low weight. in point of safety, efficiency & emission gas regulation are very important in recent years that enforce the manufacturer to reduce the weight of passenger cars. for the design & analysis of a bumper chosen with composite material of carbon fibre & jute fibre with low cost and good strength. study done by using software solid works & ansys. tests done on bumper is tensile strength and impact analysis.



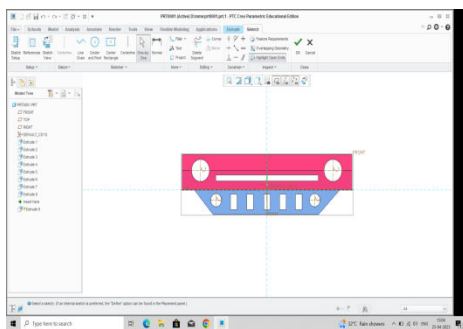
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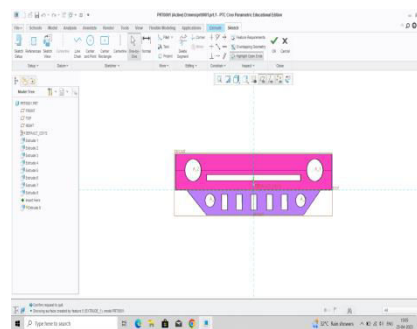
Dasari. kusuma kumara, badugu kataiahetal, design and analysis of an automotive bumper used for low passenger vehicle. In this work, a bumper used for low passenger vehicle, Benz car. This bumper either absorbs the impact energy with its deformation or transfers it perpendicular to the impact direction at different speeds (40, 60, 75& 80 km/hr).The materials used for these analyses are Aluminum B390 alloy, Chromium coated mild steel, and Glass Mat Thermoplastic (GMT) materials. 3D modeled by using the software Pro-Engineer and analysis done in COSMOS software. In this thesis, the static and impact analysis to determine the stress, strain and deformation, modal analysis to determine the frequency and deformation for Aluminum B390 alloy, Chromium coated mild steel, Glass Mat Thermoplastic (GMT) materials.

III. METHODOLOGY

1. We study the different journals on car bumper.
2. Car bumper design process using the CREO software after part file convert in to the IGES file.
3. Perform the static and modal analysis using the ANSYS software
4. Analysis using the various material like AL , stainless steel, silicon.
5. Finally find out the which material is the suitable material based on the static and impact, modal Analysis results, Deformation, shear stress, Strain.



a) Front view



b) back view

IV. EXPERIMENTAL RESULTS

Component	Density	Young’s Modulus	Poisson’s Ratio
Aluminium	2.7 g/cm	70Gpa	0.33
Stainless steel	7.9g/cm ³	109Gpa	0.265
Silicon	2.33 g/cm ³	40Gpa	0.265

Metals, polymers, and composites can all experience deformation, which Ansys can model. Finite element analysis (FEA) is a technique used in the software to decompose large structures into simpler, easier-to-manage components. The structure's deformation under various conditions is then calculated by applying loads and boundary conditions to these elements.

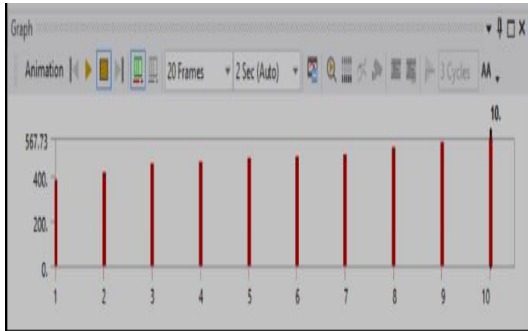
Stress and strain distributions, displacement profiles, and deformation modes can all be produced via Ansys simulations of deformation. These findings can be utilised to optimise the design of buildings and their parts, increase their toughness and dependability, and lower the possibility of failure or damage.

Ansys is a strong tool for engineering applications when it comes to simulating deformation and other mechanical behaviours. Its capacity to precisely forecast the behaviour of complex systems can assist engineers in making knowledgeable design choices and enhancing product performance.



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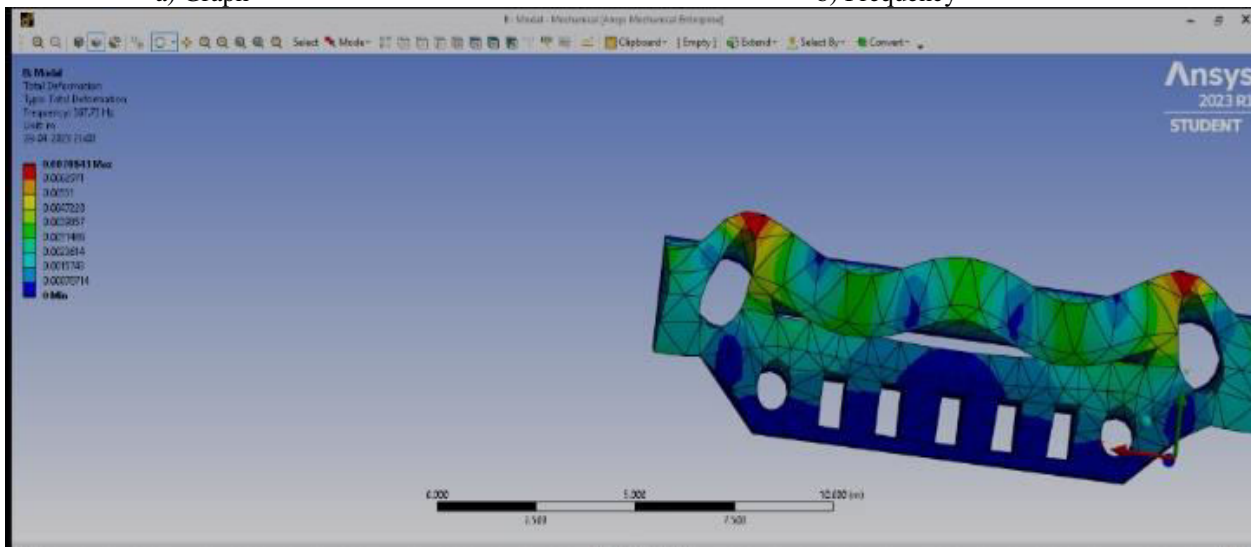
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a) Graph

Mode	Frequency [Hz]
1	383.76
2	415.12
3	452.69
4	461.37
5	476.84
6	491.66
7	498.15
8	524.94
9	549.21

b) Frequency



c) deformation

V. CONCLUSION

In this piece, a bumper for a low-slung passenger automobile is employed. This bumper either transmits the impact energy perpendicular to the direction of impact at varying speeds (50, 75, 100, 125, or 150 km/hr) or absorbs it through deformation. Aluminium B390 alloy, chromium-coated stainless steel, and advanced silicon are the components employed in these studies. By raising the car's speed while maintaining low stress and high deformation, the static analysis shows that the deformation and stresses rise. When compared to stainless steel and aluminium alloy B 390, silicon material is used. By looking at the modal analysis, it can be shown that glass mat thermoplastic material has a lower deformation value than mild steel and aluminium alloy B390. In this piece, a bumper for a low-slung passenger automobile is employed. The impact energy is either absorbed by this bumper's deformation or perpendicular transfers. According to the model study, the deformation and stresses grow as the car's speed rises, and the material develops high deformation and low frequency when compared to aluminium alloy B390 and stainless steel. According to all of these analyses, bumpers made of silica that can deflect impacts perform better.

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