



Safety and Reliability Enhancement of Car Front Bumper for Different Materials Using Ansys

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ABSTRACT

In this dissertation, we attempted to improve the crash safety of a leading Indian Economic car bumper through impact assessment while also focusing on some other important parameters such as bumper price and weight. As a result, it was always kept in mind that different materials should be lighter in weight and less expensive, with continued to improve crash safety, which was the main goal of the dissertation. For testing bumpers, various safety standards are developed. Using CreO software, we created a model of an existing bumper for this dissertation. Ansys software was used for meshing and analysis. For analysis and comparison with existing materials, Federal Motor Vehicle Safety Standards (FMVSS) standard speeds of 13.37 m/sec (48 kmph) and Insurance Institute of Highway Safety Standards (IIHS) standard speeds of 17.78 m/sec (64 kmph) are used. At the conclusion of the research study, we concluded that we can replace the existing bumper with a new proposed material bumper to achieve better performance, improved safety and reliability, and lower cost and weight.

Keywords-Safety, Cost, Bumper, collision, Ansys, Reliability, Impact

INTRODUCTION

A front bumper is a shield made of metal, aluminium, rubber, or a composite material that is installed on the front and rear of a passenger vehicle. When a high-speed collision occurs, the bumper machine absorbs the impact to protect or reduce harm to the occupants. Some bumpers have strength absorbers or brackets, while others are made of foam cushioning cloth. The front bumper is designed to protect or reduce physical harm to the vehicle. Aside from the engine, it is also designed to protect the hood, trunk, grille, gasoline, exhaust, and cooling device. It is not a safety feature designed to prevent or mitigate injury to passengers in passenger vehicles. Automobile bumpers are designed so that cars can collide without putting the riders in danger. Each car has a large rubber bumper all around it, which prolongs the effect and disperses the force of the collision. Bumpers are structural elements installed to reduce physical harm to the front and rear ends of a passenger vehicle from low-speed collisions. The most commonly used criterion in bumper style is harm and protection assessments. The relative displacements representing stiffness performance area unit outlined and examined for harm assessment. Finite component (FE) analysis is commonly used in the early stages of a replacement automotive to predict the strength of a bumper. However, typical bumper analysis using FEM produces a continuous stiffness, albeit with some distribution due to uncertainties. The uncertainties are assumed to be the thickness tolerances. Under this uncertain condition, the stiffness displacements are calculated using approximate statistics and worst-case analysis.

2. OBJECTIVES

The main objectives in this research work are

1. To emphasize alternate bumper materials in order to increase the impact strength of the bumper fascia. Our research's primary goal is to strengthen the bumper fascia.
2. To improve the shock absorbing capacity of bumper by material optimizing.
3. By replacing the existing bumper material, the weight of the existing bumper will be reduced. Which measures also help to increase fuel efficiency.
4. To lower the cost of the bumper without compromising performance or while enhancing performance.

5. To increase the Elastic Strain of bumper by material optimization.

3. MODELLING OF BUMPER

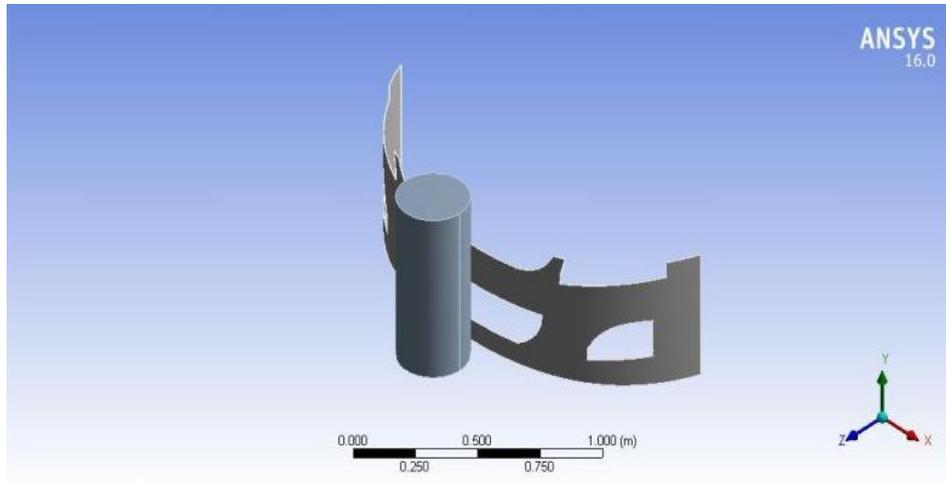


Figure 3.1 Modelling of Front Bumper with Pole

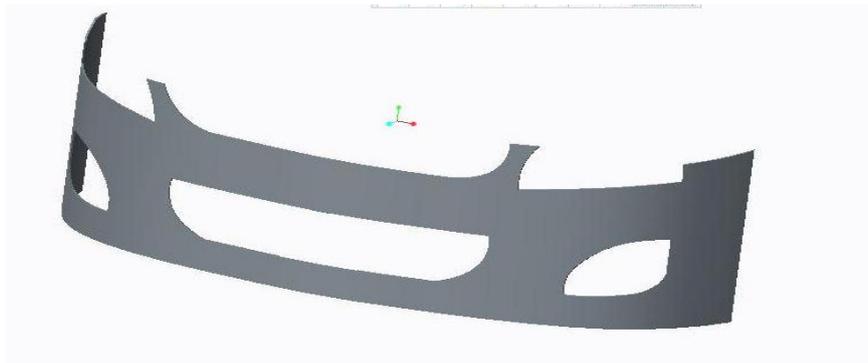


Figure 3.2 Model of Front Bumper

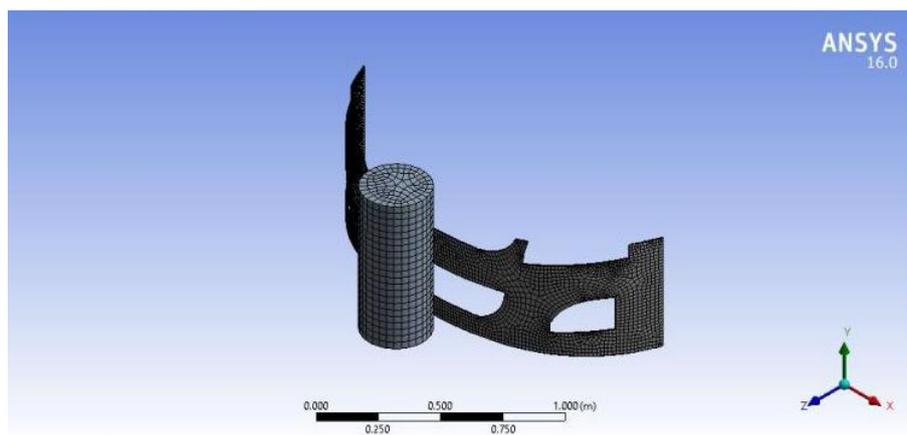


Figure 3.3 Meshing of Front Bumper

4. RESULT AND ANALYSIS

The weight comparison of the various bumpers shown above clearly demonstrates that ABS Plastic is the lightest bumper material when compared to

all other comparable materials. By lowering the overall weight of the car, the use of lightweight materials during the production process could increase efficiency.

Mass of Different Bumpers in Kg

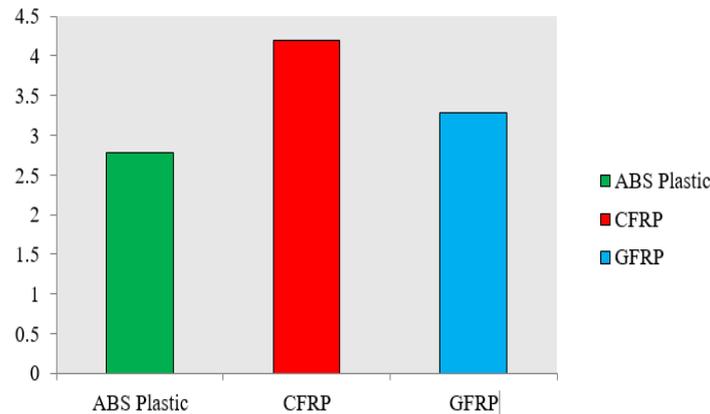


Figure4.1 Comparison of Mass of Different Bumpers

The weight comparison of the various bumpers shown above clearly demonstrates that ABS Plastic is the lightest bumper material when compared to all other comparable materials. By lowering the overall weight of the car, the use of lightweight materials during the production process could increase efficiency.

Price of Different Material Bumpers in INR

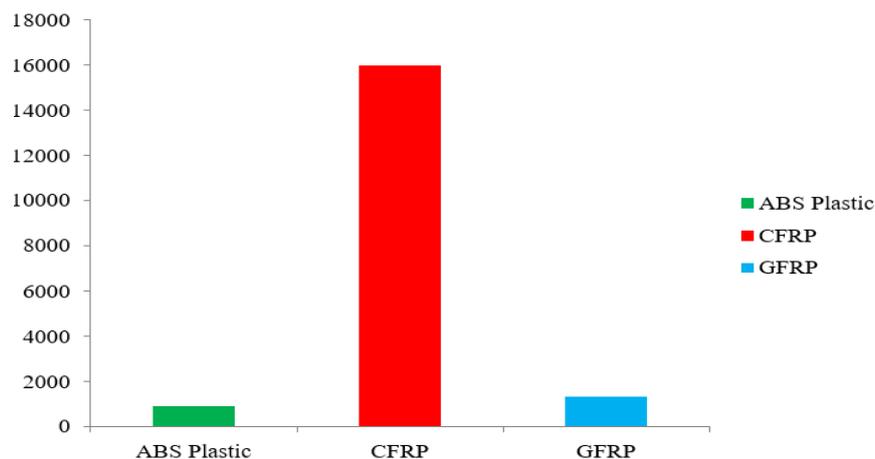


Figure4.2 Comparison of Cost of Different Bumpers

5. CONCLUSION AND FUTURE SCOPE

From the current investigation, the following findings can be drawn: -

- 1) In comparison to other bumper materials, the ABS plastic bumper exhibits the most promising performance at the time of stress analysis. It demonstrated minimal stress during impact study and theoretical calculation as well. To absorb shock after a collision and lessen the amount of energy transferred toward the occupants, these characteristics are most desired when making car front bumpers. Therefore, we may swap out the GFRP front bumper on the Mitsubishi Swift Desire for one made of ABS Plastic.
- 2) When analyzed, ABS Plastic shows the greatest deformation when compared to other bumper materials, demonstrating its ability to withstand significant impact without breaking.
- 3) It has been noted that ABS Plastic bumpers are remarkably lightweight when compared to other materials currently in use. ABS Plastic is a composite material with a low density. And the weight of the bumper might be reduced by 30%.
- 4) As opposed to the currently used GFRP material, ABS plastic bumpers are less expensive.

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