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Safety and Reliability Enhancement of Car Front Bumper

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ABSTRACT

A bumper is a small part of an automobile vehicle that plays an important role in terms of safety. The primary function of a bumper is to absorb the impact of a collision and reduce the intensity of the impact by deforming themselves. It is necessary for the bumper to absorb more energy in order to overcome vehicle damage. Every vehicle manufacturer used a different type of bumper. However, because the safety of occupants and pedestrians is the primary goal of automobile designers, it is critical that every component of the vehicle be designed in such a way that it not only performs efficiently but is also safe.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.

Keywords-Bumper, Collision, Safety, Ansys, Reliability, Impact

1.INTRODUCTION

A bumper is a protective structure made of steel, aluminium, rubber, or plastic that is installed at the front and rear of a passenger vehicle. When a low-speed collision occurs, the bumper absorbs the impact to save or reduce damage to the vehicle. Weight reduction has been the primary criteria of car manufacturers in recent times. Less weight, more efficient use of natural resources is the primary concern of vehicle manufacturers today. The preceding can be accomplished by introducing superior layout concept, superior fabric, and a powerful manufacturing technique. Metal bumpers have numerous advantages in addition to precise load carrying capacity. Despite its advantages, it has a low electricity-to-weight ratio. It is claimed that weight reduction combined with acceptable improvement in mechanical properties has made composites a variable replacement material for traditional metal. The metallic bumper used in passenger cars is replaced in the gift paintings by a composite bumper made of carbon composites.

2.PROBLEM IDENTIFICATION

We have seen that accidents are frequent in now days and cause damage to a vehicle's body and became threat to human life also. Hence crashworthiness of automobile bumper is very essential. Also the cost for replacing bumper is quite expensive especially if surrounding area or part also damaged. Customer also blame to the manufacture that the bumper easily gets damaged although the collision was slow. The material of the bumper should be analyzed to find the alternative material that can improve the crash worthiness, toughness in a cost effective way and should be lighter in weight also

3.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.

4.RESULTS AND ANALYSIS

Table 4.1 -Comparison of results for Numerical Impact Stress and ANSYS Impact Stress

Velocity m/sec	Material	Numerical Impact Stress Mpa	Ansys Impact Stress (von misses stress) Mpa	Percentage Error
13.43	ABS Plastic	47.66	47.45	0.31
	CFRP Material	368.39	335.40	8.93
	GFRP Material	203.71	219.25	-7.63
17.74	ABS Plastic	63.32	64.12	0.28
	CFRP Material	489.82	471.40	3.75
	GFRP Material	270.91	271.41	-1.73

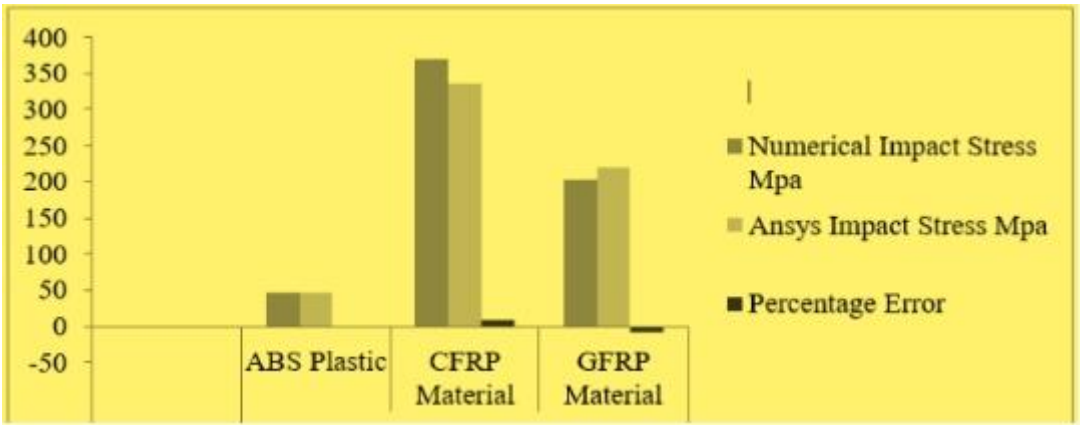

Figure 4.1- Validation of Results at velocity 13.43 m/sec

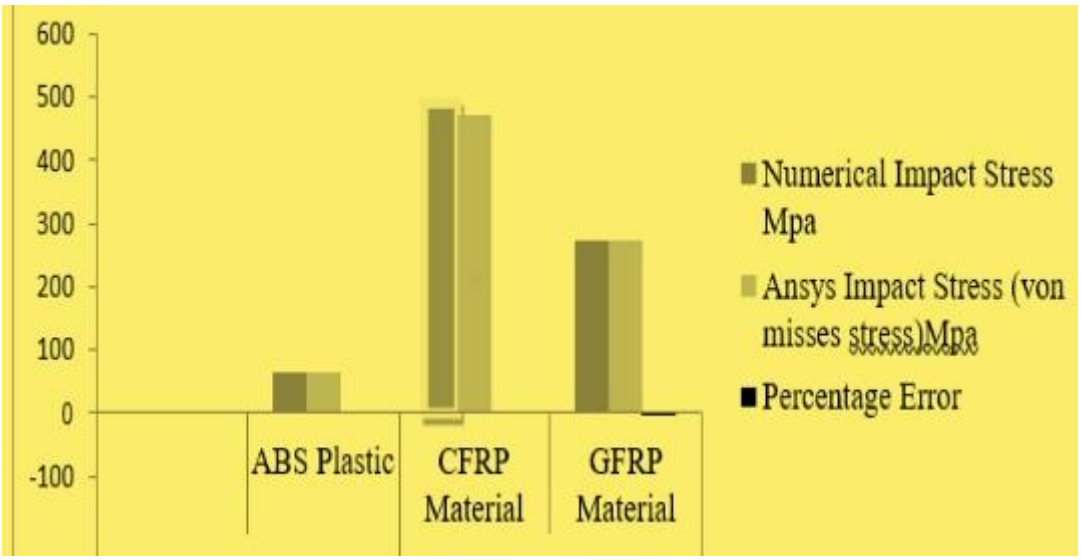

Figure 7.2- Validation of Results at velocity 17.74 m/sec

CONCLUSION

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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