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DESIGN AND DYNAMIC IMPACT ANALYSIS OF FRONT FRAME BUMPER

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ABSTRACT:

In this paper, the modification of an existing front inner bumper of a passenger automobile is described in this study. Scanning the generated bumper with the ATOS-GOM three-dimensional scanner yielded the CAD cloud geometrical data. IMPACT, a dynamic explicit time stepping algorithm program, was used to conduct the impact study. The program was initially tested against known experimental findings of a beam impacting at a low velocity. With a fluctuation of 1.6 to 9.5 percent, the simulated and experimental findings of the deflected beam were substantially close. The genuine bumper was then subjected to two impact simulations: a 40 percent offset collision and a complete frontal collision. Collisions were attempted at speeds of 48 km/h, 64 km/h, and 110 km/h. The data was used as a benchmarking tool to improve the bumper's performance. Two different design modifications were attempted. Internal energy adsorbed increases significantly in both design A and B. Despite the fact that both designs absorb more energy, design B is superior in every manner.

KEYWORDS: IMPACT, STATIC, BUMPER, COLLISIONS, CAD

1. Introduction

Car accidents may be terrible, yet they happen all the time. The majority of drivers believe they can avoid such perilous circumstances. Every year, Millions of people, on the other hand, are killed or injured in automobile accidents. Automobile design is one of the variables that contributes to the probability of accident damage. As a result, enhancing the design is critical. Bumpers are meant to protect motor vehicles from physical harm in the case of a collision. The study will concentrate on the front area of a typical four-wheel automobile, specifically the front inner bumper, because the majority of the outer bumpers perform no crash-worthiness function. To perform the simulation, a few key characteristics in order to improve crash-worthiness, material, thickness, shape, and impact condition are explored for the design and analysis of a car front bumper beam. However, the study will concentrate on a three-stage velocity to replicate impact at low, middle, and high speeds. The bumper construction on contemporary vehicles is now designed to consist of a plastic cover over a steel, aluminum, fiberglass composite, or plastic reinforcing bar. Most current automotive bumpers are constructed of PC/ABS, a composite of polycarbonate (PC) and acrylonitrile buta-diene styrene (ABS).

The objectives of this Research are

- To create a composite automobile bumper with the help of CAD CATIA or AutoCAD.
- To perform an impact analysis of composite car bumper by using CFD Software.
- To suggest a good composite material for an automobile bumper.

2. Methodology

The type of material used has a significant impact on the condition of the front automobile bumper after a collision. Aluminium alloy is preferable in terms of high strength and lightweight; yet, automobile manufacturers disregard this sort of material due to its high cost. In summary, this research looked at the material types that would be optimal for a composite automobile bumper in terms of strength, weight, and impact absorption. There were two parts to this study. The first step was to test and validate the IMPACT software. After the test and validation yielded satisfactory findings that were equivalent to those obtained in the experiments, the simulation of the real bumper model was carried out. The simulation study' results were used as the starting point for deciding on an alternate design for the inner front bumper. The CAD data for the bumper was obtained by scanning an existing one.The plastic-strain during a transverse impact changes depending on the impact position, and the severity of dynamic buckling during loading will increase owing to flaws on the model's surface. The capacity of the vehicle's structure to absorb the energy created determines the survival of the vehicle's occupants after a collision. The bio mechanics of the human body following a crash may be examined via simulation. However, if the occupant's head did not travel at a speed more than 57.6 G, the entire

extent of probable damage to the passengers would not be incurred. The vehicle frame material and geometric form also have an impact on the amount of kinetic energy absorbed during a collision.

3. Working and Construction

The front inner bumper functions as an energy absorber to simplify the model of a front inner bumper. These energies, also known as crash energies, are formed when the starting circumstances are abruptly changed, such as after a collision, when the relative velocity changes abruptly, causing the energies to convert and focus at the point of impact.

Figure 1: -Front Bumper

There are several tests to assess the intensity and severity of the collision in order to identify where the loading is focused during the impact. Frontal offset models and a complete barrier test of a family vehicle are the impact tests covered in this study. Furthermore, because of its inertia, the relative low speed of impact is ignored, whereas other materials respond differently during impact and may change substantially depending on the speed of impact and the site of impact.

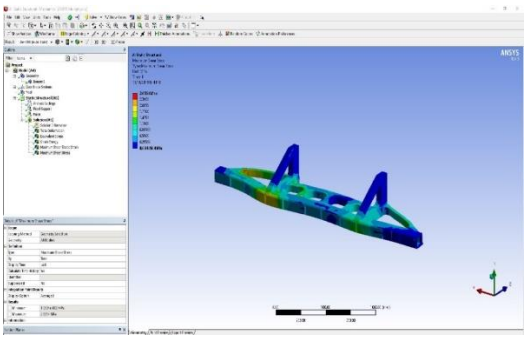
4. Design problems

The types of material play a big role to influence the front car bumper condition after crashing. In term of high strength and lightweight, aluminium alloy is preferable; however, because of expensive price of aluminium alloy, car's manufactures ignore this type of material. In short, this study discussed material type that best suit to be a composite car bumper in order to fulfil the aspect of strength, lightweight, and impact absorption. By using light weight materials only low number of passengers can travel and safety is more important where there should be no injuries for the passengers in the vehicle. So we can use different materials which has high efficiency and better safety for preventing injuries and damages. The main aim of the bumper is to increase the bumper efficiency and passenger safety which is more important in an impact analysis.

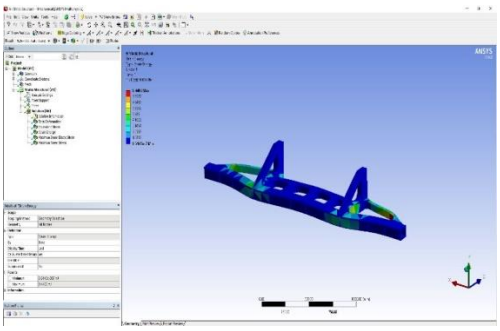
5. Design

AL-ALLOY

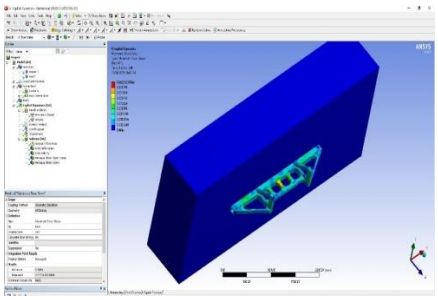
LOAD 20 N



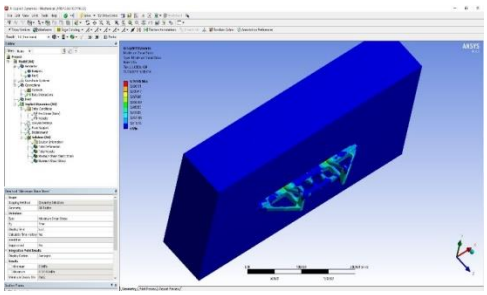
LOAD 50 N



VELOCITY 10 M/S

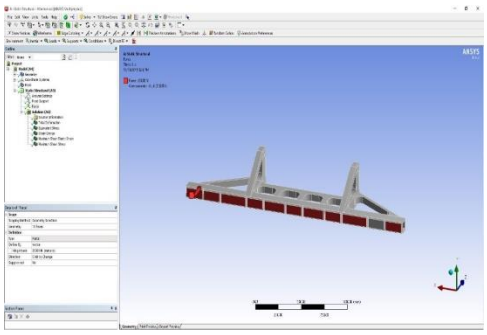


VELOCITY 20 M/S

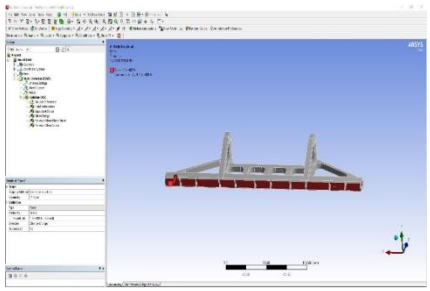


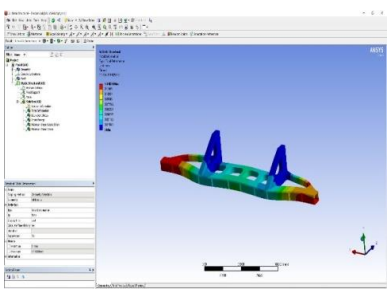
STAINLESS STEEL

LOAD 20 N



LOAD 130 N





6. Conclusion

This paper discusses the findings of the IMPACT benchmarking test, as well as a novel alternative design for a car's inner front bumper that considers impact collisions. By examining the time for deformation of each simulated scenario and category, modifications were made to lengthen the duration of impact. The time for yield stress rose significantly as the impact time of the modified bumper beam designs A and B increased. Model B, on the other hand, performs better. According to the simulation results, there are critical parts of the front inner bumper beam that demand urgent revision. Physically, the bumper beam has the potential to indicate that it was made using a cold pressed process or a metal sheet stamped on a die.

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