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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 thegenerated bumper with the ATOS-GOM three-dimensional scanner yielded the CAD cloud geometrical data. IMPACT, a dynamicexplicit time stepping algorithm program, was used to conduct the impact study. The program was initially tested against knownexperimental findings of a beam impacting at a low velocity.With a fluctuation of 1.6 to9.5 percent, the simulated andexperimental findings of the deflected beam were substantially close. The genuine bumper was then subjected to two impactsimulations: a 40 percent offset collision and a complete frontal collision. Collisions were attempted at speeds of 48 km/h, 64km/h, and 110 km/h. The data was used as a benchmarking tool to improve the bumper's performance. Two different designmodifications were attempted. Internal energy adsorbed increases significantly in both design A and B. Despite the fact that bothdesignsabsorbmoreenergy,designBis superiorineverymanner.
KEYWORDS:IMPACT,STATIC,BUMPER,COLLISIONS,CAD

I. INTRODUCTION

Car accidentsmay be terrible,yet they happen all the time. Themajority of drivers believe they can avoid such perilouscircumstances. Every year, Millions of people, on the other hand, are killed or injured in automobile accidents. Automobile designis one of the variables that contributes to the probability of accident damage. As a result, enhancing the design is critical. Bumpersare meant to protect motor vehicles from physical harm in the case of a collision. The study will concentrate on the front area of atypical four-wheel automobile, specifically the front inner bumper, because the majority of the outer bumpers perform no crash-worthinessfunction.Toperform thesimulation,afewkeycharacteristicsinordertoimprovecrash-worthiness,material,thickness, shape, and impact condition are explored for the design and analysis of a car front bumper beam. However, the studywill concentrate on a three-stage velocity to replicate impact at low, middle, and high speeds.The bumper construction oncontemporary vehicles is now designed to consist of a plastic cover over a steel, aluminum, fiberglass composite, or plasticreinforcingbar.MostcurrentautomotivebumpersareconstructedofPC/ABS,acompositeofpolycarbonate(PC) andacrylonitrilebuta-dienestyrene(ABS).

The objectives ofthis Researchare

- Tocreateacompositeautomobilebumper withthehelpofCADCATIAor AutoCAD.
- Toperformanimpactanalysisofcompositecarbumper byusingCFDSoftware.
- Tosuggestagoodcompositematerialfor anautomobilebumper.

II. METHODOLOGY

The type of material used has a significant impact on the condition of the front automobile bumper after a collision. Aluminiumalloy is preferable in terms of high strength and lightweight; yet, automobile manufacturers disregard this sort of materialdue toits high cost. In summary, this research looked at the material types that would be optimal for a composite automobile bumper interms of strength, weight, and impact absorption. There were two parts to this study. The first step was to test and validate theIMPACT software. After the test and validation yielded satisfactory findings thatwere equivalent to those obtained in theexperiments, the simulation of the real bumper model was carried out. The simulation study' results were used as the starting pointfor deciding on an alternate design for the inner front bumper. The CAD data for the bumper was obtained by scanning an existingone.The plastic-strain during a transverse impact changes depending on the impact position, and the severity of dynamic bucklingduring loading will increase owing to flaws on the model's surface. The capacity of the vehicle's structure to absorb the energycreated determines the survival of the vehicle's occupants after a collision. The biomechanics of the human body following acrashmaybeexaminedviasimulation.However,iftheoccupant'sheaddidnottravelataspeedmorethan57.6G,theentire

extent of probable damage to the passengers would not be incurred. The vehicle frame material and geometric form also have animpactontheamountofkineticenergyabsorbedduring acollision.

III. WORKING AND CONSTRUCTION

The front inner bumperfunctions as an energy absorber to simplify the model of a front inner bumper. These energies, alsoknown as crash energies, are formed when the starting circumstances are abruptly changed, such as after a collision, when therelative velocitychanges abruptly,causing theenergiestoconvertandfocus atthe pointofimpact.

Figure1:-Front Bumper

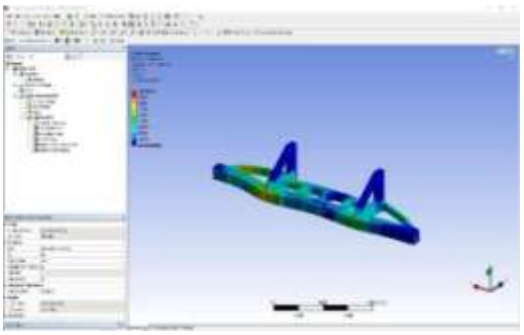
There are several tests to assess the intensity and severity of the collision in order to identify where the loading is focused duringthe impact. Frontal offset models and a complete barrier test of a family vehicle are the impact tests covered in this study.Furthermore, because of its inertia, the relative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

IV. DESIGN PROBLEMS

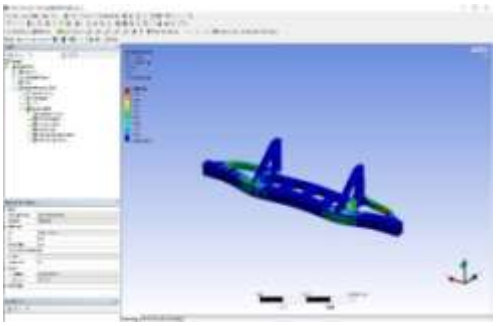
The types of material play a big role to influence the front car bumper condition after crashing. In term of high strength andlightweight,aluminium alloy is preferable; however,because of expensive price of aluminium alloy,car'smanufacturesignorethis type of material. In short, this study discussed material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

V. DESIGN

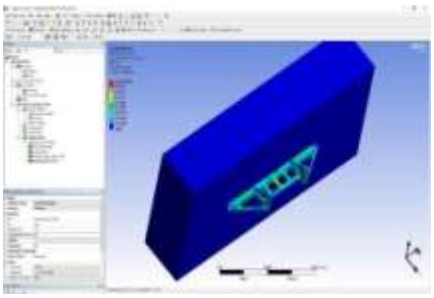
AL-ALLOYLOAD 20 N



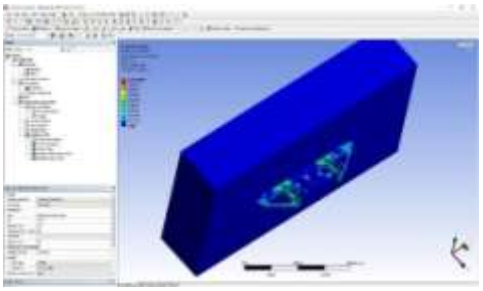
LOAD50 N



VELOCITY 10 M/S

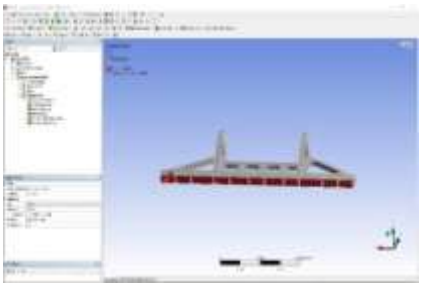


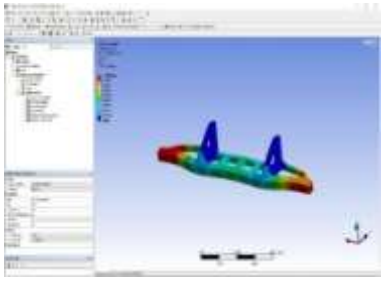
VELOCITY 20 M/S



STAINLESS STEELLOAD 20N

LOAD130 N





VI. CONCLUSION

This paper discusses the findings of the IMPACT benchmarking test, as well as a novel alternative design for a car's inner frontbumper that considersimpactcollisions. By examining the timefor deformation of each simulated scenarioand category,modifications were made to lengthen the duration of impact. The time for yield stress rose significantly as the impact time of themodified bumper beam designs A and B increased. Model B, on the other hand, performs better. According to the simulationresults, there are critical parts of the front inner bumper beam that demand urgent revision. Physically, the bumper beam has thepotentialtoindicatethatitwasmade using a coldpressed processorametalsheetstamped ona die.

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