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Comparative Evaluation of Impact Test & Its Analysis of Impact Barrier of Vehicle

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ABSTRACT

Now-a-days, Automobile industry is the fastest growing industry & human safety is most important factor in automobile field. To accomplish the need to design a moderate car, the structural engineer will need to use imaginative concepts. The demands on the automobile designer increased and changed rapidly, 1st to meet new safety requirements & later to reduce weight in order to satisfy fuel economy requirements. When vehicle impact occurs, force acts on vehicle bumper. But sometimes the traditional bumper may fail to absorb all impact energy & passenger may get injured. The main motivation for using Honeycomb structures as front barriers for four wheelers is to improve the safety of the vehicle occupants. Composite honeycomb structures are light weight compared to metal barriers; they are capable of absorbing more initial impact shocks than metal barriers and transfer minimal shocks to vehicle. This helps in less damage to vehicle occupants. The thesis gives an overall view of Honeycomb Structures in vehicles The aim is to find out an alternative geometric structure for hexagonal honeycomb structure, which can be used to replace the present day hexagonal type aluminium impact barriers.

Keywords— ***Human Safety, Honeycomb Structures, Impact Shocks, Metal Barriers.***

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I. INTRODUCTION

a After years of steady, predictable model changes, the automobile industry is in the midst of the most intense product changeover in its history. To accomplish the need to design a moderate car, the structural engineer will need to use imaginative concepts. The demands on the automobile designer increased and changed rapidly, first to meet new safety requirements and later to reduce weight in order to satisfy fuel economy requirements. Experience could not be extended to new vehicle sizes, and performance data was not available on the new criteria. Mathematical modeling was therefore a logical avenue to explore. Most recently, the finite element method, a computer dependent numerical technique, has opened up a new approach to vehicle design.

II. RELATED WORK

a **Xiaozhou Gong** presented a paper on Cellular solids such as sandwich panels have been used as advanced materials in aerospace, automobile and marine industries for decades due to their unique combination of properties derived from their cellular structures. Scientists and engineers have paid more and more attentions to cellular solids since new techniques for making ceramic and metallic foams have widened the range of man-made materials and the diversity of their applications. Textile reinforced honeycomb composite can be regarded as a kind of cellular solid due to its hollow core structure and as an innovative product, much interests have been drawn on it to find out its mechanical performance under various loading conditions.This part presents a literature review on cellular solids including textile honeycomb composites in the following aspects, which are (1) classification, applications, mechanical and non-mechanical features of cellular solids (2) honeycomb structure manufacturing techniques (3) the mechanical performances of cellular solids under various impact conditions (4) the energy absorption analysis of cellular solids (5) the basic concept of three-dimensional (3D) fabrics and structural parameters for textile honeycomb composite (6) the application of 3D honeycomb fabrics on personal protection equipment (PPE).

Thomas Jost et.al in their thesis Using Finite Element (FEM) it is possible to show and predict the behavior of the vehicles structure during a crash test. To ensure good simulation results compared to the reality it is not only necessary to carryout built up the FE-model of the vehicle, but to simulate the real behavior of the crash barrier too.

To meet this demand a new method for modeling and simulating crash barrier has been developed.

This method is based on discrete beam elements to model the Aluminum honeycomb structure. The major advantage of this method is the possibility to show realistic local and global deformation behavior of honeycomb structures that include all characteristics deformation models.

To ensure high quality crash barrier models an effort was done on testing and validating. Over all, the results of the validation work shows a good accordance of the acceleration, the force results and of the deformation behavior of all structures.

Brian Walker ARUP in his paper the offset deformable barrio (ODB) has been used by Euro NCAP and most of leading car manufacturers worldwide. This deformable barrier is used for frontal offset impact while the specifications developed by EEVC WGII. This paper represents the methodology to create the advanced FE Model of cell bonds OBD barrier and certification through experimental test data. LS-Dyna was used to analyze the FE Model and a number of static compressive tests performed at different angles to construct Aluminium honeycomb material cards. The strain-rate factor curves are also defined to simulate stiffening in the Aluminium honeycomb during the analysis. Adhesive properties are obtained using climbing Drum, T-Peel, Tensile and Plate shear test results. The initial component test generated a good correlation with FE output and to validate the barrio model, similar impact test were performed in LS-Dyna environment respecting of four. In all assessments the barriers were mounted on a rigid wall and were tested at certain impact speeds. The final comparison on overall results represents a good correlation between that data and CAE results for all tests.

Z.Q. Chenga et.al presented a paper on, The experiences encountered during the development, modification, and refinement of a finite element model of a four-door sedan are described. A single model is developed that can be successfully used in computational simulations of full frontal, offset frontal, side, and oblique car-to-car impacts. The simulation results are validated with test data of actual vehicles.

The validation and computational simulations using the model show it to be computationally stable, reliable, repeatable, and useful as a crash partner for other vehicles.

T. J. Stevenson in his paper the literature on vehicle crash reconstruction provides a number of empirical or classical theoretical models for the distance pedestrians are thrown in impacts with various types of vehicles and impact speeds.

The aim of this research was to compare the predictions offered by computer simulation to those obtained using the empirical and classical theoretical models traditionally utilized in vehicle-pedestrian accident reconstruction. Particular attention was paid to the pedestrian throw distance versus vehicle impact speed relationship and the determination of pedestrian injury patterns and associated severity.

It was discovered that computer simulation offered improved pedestrian kinematic prediction in comparison to traditional vehicle-pedestrian accident reconstruction techniques. The superior kinematic prediction was found to result in a more reliable pedestrian throw distance versus vehicle impact speed relationship, particularly in regard to varying vehicle and pedestrian parameters such as shape, size and orientation. The pedestrian injury prediction capability of computer simulation was found to be very good for head and lower extremity injury determination. Such injury prediction capabilities were noted to be useful in providing additional correlation of vehicle impact speed predictions, whether these predictions were made using computer simulation, traditional vehicle-pedestrian accident reconstruction methods or a combination of both.

A generalized approach to the use of computer simulation for the reconstruction of vehicle-pedestrian accidents was also offered. It is hoped that this approach is developed and improved by other researchers so that over time guidelines for a standardized approach to the simulation of vehicle-pedestrian accidents might evolve.

Thoracic injury prediction, particularly for frontal impacts, was found to be less than ideal.

It is suspected that the relatively poor thoracic bio-fidelity stems from the development of pedestrian mathematical models from occupant mathematical models, which were in turn developed from cadaver and dummy tests. **A.B.Doyum [6] et.al,** in their thesis, effectiveness and sensitivity of ultrasonic through transmission C-scan and X-ray radiography methods for the characterization and classification of defects unique to honeycomb structures were analyzed. The specimens with built-in defects were fabricated and tested by Automated Ultrasonic Scanning System (AUSS) and X-ray film radiography. AUSS provides significant information which can be used to identify and size most of the defects such as planar voids, core damages and water/hydraulic fluid intrusion into the core. X-ray radiography was found to be a reliable NDI technique for defects such as core damages, water/hydraulic fluid intrusion into core and air gaps that might occur in filler adhesive. When used together, these two techniques were found sufficient for the detection and characterization of most defects encountered in honeycomb structures.

Thomas R. Hay presented a paper on Guided wave inspection of composite skin-honeycomb core structures is an efficient and sensitive alternative to other common inspection methods. This paper shows that sweeping experimentally through the dispersion curves is an effective way to experimentally locate guided wave modes sensitive to skin-core delamination.

Composite skin-Nomex honeycomb core specimens were developed with simulated delaminated areas. The delaminated areas were detected with guided waves and confirmed with conventional ultrasonic testing methods. Calculated phase velocity dispersion curves are given to define the practical phase velocity and frequency ranges. Example wave structures in this range are given to illustrate the change in sensitivity as frequency is swept for a given mode.

III. PRESENT THEORIES

a Presently, most of the vehicles are using sheet metal or solid type of impact barriers which offer good resistance for primary impact, but most of the forces during impact are transferred on the vehicle which can cause considerable damage to the occupants of the vehicle.

IV. PROBLEM STATEMENT

I. a Most of the vehicles are using sheet metal or solid type of impact barriers which offer good resistance for primary impact, but most of the forces during impact are transferred on the vehicle which can cause considerable damage to the occupants of the vehicle. To avoid this Impact barriers are attached to the front of the bumper. Presently the impact barriers are made with hexagonal honeycomb textile structures.

V. SCOPE OF THE FEM ANALYSIS STUDY

The inputs from the Design department in the form of geometry and material properties for the component shall be taken up for further research work. This would involve building a `finite element model' with this data using discretization techniques for pre-processing followed by solving, using suitable CAE software. The results for the benchmark analysis shall be studied for identifying the significant parameters affecting the objectives of the research work. A plan for tweaking the values of these parameters and assigning the same to the new geometry or the changed boundary conditions shall be evolved for further analysis.

VI. FINITE ELEMENT ANALYSIS

The finite element analysis (FEA) is a computational technique which is used to obtain approximate solutions of boundary value problems in engineering. In simple words, a boundary value problem is a mathematical problem in which one or more dependent variables must satisfy a differential equation everywhere within a known domain of independent variables and satisfy specific conditions on the boundary of domain

VII. OBJECTIVE

- Study the existing component design and its function for identifying potential areas for modification
- Secure geometry and import the same over the pre-processor for Discretization
- Solve the Model for securing the results
- Evolve a Test plan for validating the F.E. Methodology
- Revise the values for any of the significant parameter/s for noting its effect on the objective
- Recommend the new design for implementation

VIII. TYPES OF MATERIALS USED

Below mentioned are the materials used for different types structures for conducting crash test analysis to get a best suited alternative geometry for traditionally used hexagonal structure and to eliminate or to reduce the delamination problem in impact barriers.

- **Aluminium Alloy**
- **S2- Glass Fiber**
- **E - Glass Fiber**

IX. MODELLING

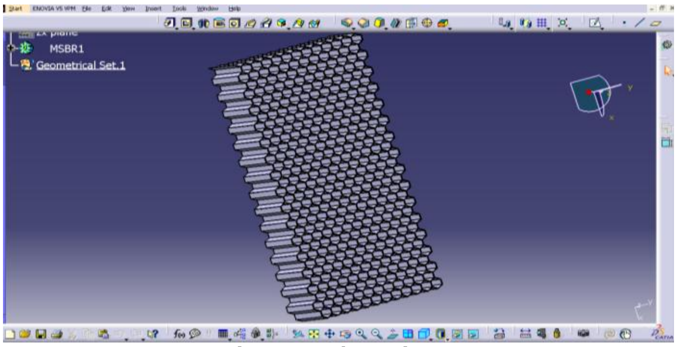

Fig.1 Hexagonal Honeycomb Textile Structure

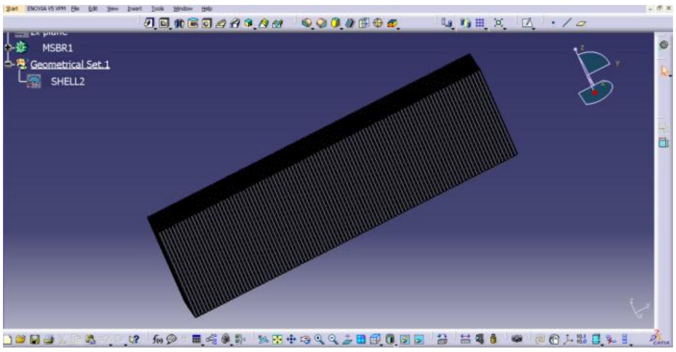

Fig.2 Square Honeycomb Textile Structure

X. RESULT

TABLE I

Name	Material	Von Misses Stress In(N/mm^2)	Displacement in mm	Strain
Hexagonal	Aluminium	3510.11	0.972037	0.0111524
	S2 Glass	817.45	0.533675	0.00331992
Square	Aluminium	128.675	0.188824	0.0014245
	S2 Glass	277.386	0.0397982	0.00024713

XI. CONCLUSION

This project gives brief explanation about impact barriers and composite textile technology. There was a delaminating problem in honeycomb textile impact barriers. In this thesis different different composite specimens are validated to overcome the same problem. Steps in project was 1st literature survey, then 3D modelling of the specimen are prepared to carry out the analysis test. Impact test is carried out to evaluate the results.

As per analytical results obtained from analysis square type S2 Glass with Von Misses Stress 277.386, Displacement 0.0397982 is the best option for replacement for traditional Hexagonal Honeycomb Structure.

REFRENCES

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[2]**"Rapid Inspection of Composite Skin-honeycomb Core Structures with Ultrasonic Guide Waves"** by Thomas R. hay, Lou Wei and Joseph L. Rose, Engineering Science and Mechanical Department, The Pennsylvania State University.

[3]**"A New Method of Model Aluminium Honeycomb Based Crash barriers in Lateral and Front Load Cases"** By Thomas Jost, Thomas Heubrandtner, Charistian Ruff, Bernhard Fellner, Kompetenzzentrum-Das Virtuelle Fahrzeug Forschugsgesellschaft mbH,Graz,Austria.

[4]**"Defect Characterization of Composite Honeycomb planes by Non-Destructive Inspection Methods"** by A.B.doyum,M.Durer Department of Mechanical Engineering, Middle East Technical University, Ankara(TR).

