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Analysis of Crash Box using Structural Analysis and Compression Testing

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ABSTRACT: During a light-weight collision between two vehicles or a vehicle and an obstacle, the car's interior structure is irrecoverably damaged. A crash box may be a separate component in the vehicle which is mounted in between the mainframe of the car and the front bumper. The structure of the crash box provides luxury to the passenger at the time of impact force. It works as a secure guard for the expensive components behind the bumper like the engine hood and cooling system. In present research different shape crash box is designed in CATIA software namely circular, square, and rectangle. Explicit dynamics analysis has been performed to obtained optimum shape crash box under existing boundary conditions to determine maximum energy-absorbing structure and calculation of deformation, force reaction, and stresses at the respective crash box. An experimental test is to be performed on a UTM machine. After, that the comparative analysis is going to be administered between the experimental and analysis results, and then the result & conclusion are going to be drawn

KEYWORDS: Crash Box, Analysis, UTM Test, Comparision of different shapes

I. INTRODUCTION

Crash box (vehicle collision), is an energy-absorbing device installed to reduce repair costs in low-speed vehicle collisions. Vehicle collisions frequently happen at a low speed. Insurance companies and the Research Council for Automobile Repairs both require reduction of repair costs and improvement in occupant safety in a low-speed crash. To reduce repair costs, an energy-absorbing device such as the crash box is usually installed. The crash box is a thin-walled structure attached between the vehicle bumper structure and the side rail. The determination of the crash box geometry is quite important to absorb the impact energy since the installation space of the crash box is not very large.

The equivalent static load method for nonlinear static response structural optimization is employed to solve the formulated topology optimization problems. The cross-sections of the crash box are determined from the results of the conceptual design. In the second step, the detailed design processes are performed by using discrete design with an orthogonal array for the models that are selected in the first step.

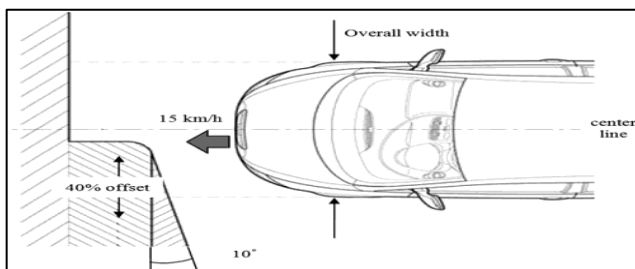


Fig.1 R-CAR Test

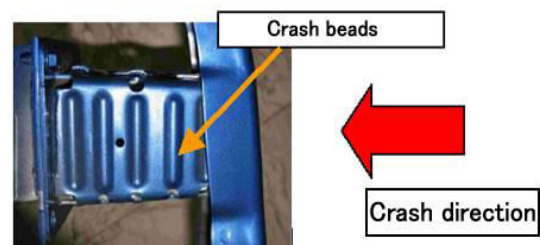


Fig.2 Crash Box

II. RELATED WORK

In automobile design, crash and structural analysis are the two most important engineering processes in developing a high-quality vehicle. Computer simulation technologies have greatly enhanced the safety, reliability, and comfort of today's automobiles. rectangular cross-section Crash box was modeled in CATIA V5R14, meshed in HYPER MESH-9, and simulated in LS DYNA. The result is post-processed to determine the displacement levels and energy absorption



characteristics for different material models, various velocities and different wall thicknesses for the particular material models in the crash box, and energy management during the event.

A crash box is a separate component in the vehicle which is mounted in between the mainframe of the car and the front bumper. At the time of the accident, it deforms axially and absorbs accidental energy. The crash box structure provides comfort to the passenger at the time of impact. It works as a safeguard for the costly components behind the bumper like the engine hood and cooling system. In this report plane, crash box geometry is studied for energy absorption

III. METHODOLOGY

Project Stage- 1

- Initially research paper relevant to the topic is gathered and after going through research papers, the conventional design of Energy Absorption crash boxes was examined.
- A 3-D CAD model will be prepared by studying the conventional design of different cross-section shape crash box specimen
- Prepared 3-D model will be transferred to ANSYS software and proper meshing will be created on the model for further analysis.
- For determining the impact energy explicit dynamic analysis will be performed on ANSYS.

Project Stage- 2

- A prototype of the model will be manufactured.
- UTM compression test will be performed on the prototype.
- Comparison of ANSYS and UTM results will be carried out.

IV. EXPERIMENTAL RESULTS

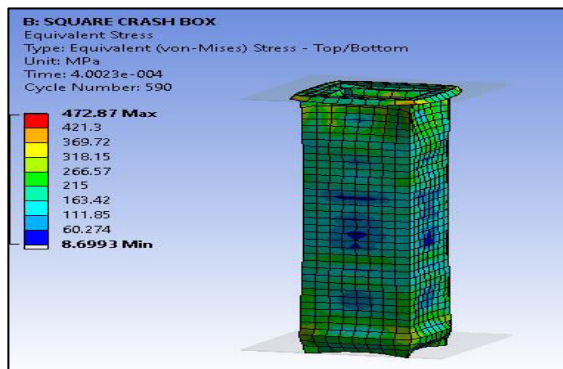


Fig.3 Best Shape According Stress Analysis

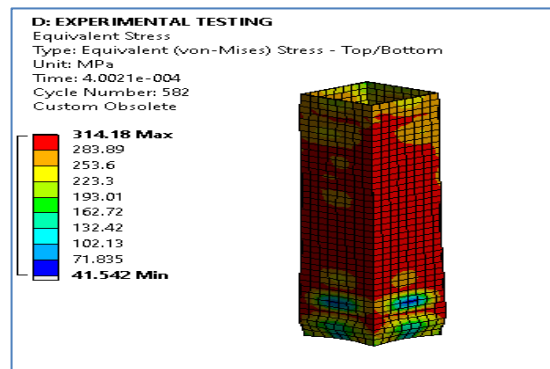


Fig.4 Experimental Testing

PARAMETERS	ANSYS	EXPERIMENTAL TESTING
DISPLACEMENT	40MM	40MM
STRESS	318 Mpa	314 a



IV. CONCLUSION

- In the present study three different structures namely circular, square and rectangular structure shapes are studied during the crash test with 100 m/s velocity, it is observed from the results that the force reaction of square structure is more than circular shape and rectangular.
- So, it is beneficial to use a square frame structure in the chassis structure of the crash box.
- Experimental testing is performed for an optimum shape that is the square crash box, it required **40.6 KN** force for complete failure
- Both Readings of Ansys & Experimental Testing matches that show our analysis is correct

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