DESIGN AND WEIGHT OPTIMIZATION OF 4 WHEELER ROCKER PANEL USING FEA AND THREE-POINT BENDING TEST

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Abstract: Vehicle aspect crash could be a crucial crash event wherever the vehicle is crashed by a movable automobile or vehicle could hit a tree or pole. Minimizing the intrusion into the inhabitant area is vital to guard the inhabitant. In an aspect pole crash, vehicle rocker still plays a crucial role in resisting the load because of the crash. The target is to review the useful performance and potential mass reduction within the vehicle sill/rocker space by use of Glass fiber reinforced polymer (GFRP). This project investigates the behaviour of GFRP square section rocker panel in a three-point quasi-static bending as compared to traditional rocker panel finite element methodology. Design and analysis of existing Rocker Panel specimens are going to be done by victimization CATIA R5V20 and ANSYS nineteen software. New design & weight optimization of rocker panel specimens are going to be done victimization GFRP. Experimental investigations are going to be done by three-point bending check on UTM.

Keyword: Rocker Panel, Design optimization, 3 Point bending test, UTM.

I. INTRODUCTION

In the 21st century, individuals are additionally headed toward vehicles with higher fuel economy and reduced emission levels. At constant time, because of a rise in awareness on safety and rigorous crash check rules, the automotive makers are heading towards a smarter and a wiser design of the inhabitant space by use of high strength materials for better crashworthiness. The term crashworthiness signifies the power of the structure to guard the inhabitant in a crash situation. Crash performance necessities are centered on inhabitant injury parameters and structural deformation measurements like intrusion, acceleration and speed of the deforming structure. Protecting individuals within a crash is difficult as a result of the edges of vehicles having comparatively very little space to soak up energy and defend occupants, in contrast to the front and rear, that have substantial crumple zones.

II. LITERATURE REVIEW

Hongshen SSZhang, Gan Huang and Dali Yu. et.al[1]. In this examination, the casing construction of a van-type electric truck was taken as an exploration object. Stress, strain, and modular examinations of this edge structure were performed utilizing Abaqus, a limited component programming, to confirm the sanity and wellbeing of the underlying model. The casing structure was streamlined by mathematical examination. The fourth shaft was pushed 524 mm ahead between the establishment points of the force battery pack and the back lifting drag of the front leaf spring. Results showed that the upgraded outline bowing, the full-load slowing down condition, and the full-load torsional working condition stresses diminished by 44.499%, 23.364%, and 31.303%, individually. The twisting solidness of a streamlined edge expanded by 4.026%, while the front and back torsional stiffnesses expanded by 4.442% and 4.092%, individually.
III. PROBLEM STATEMENT

In order to meet the challenges of making a lighter vehicle to achieve fuel economy and good structure in crashworthiness, use of the carbon fiber reinforced polymer (CFRP) materials can be one of the solutions.

IV. OBJECTIVES

- To study and perform static analysis on 4-wheeler rocker panel specimen under loading condition.
- To propose an optimized model this will have better or same performance and reduced weight.
- CAD modelling of 4-wheeler rocker panel specimen in Catia VSR20 software.
- To perform static structural analysis of optimized 4-wheeler rocker panel specimen in ANSYS 19 workbench.
- Experimental investigation of GFRP rocker panel specimen will be done by three-point bending test on UTM.
- Comparative analysis between Experimental & Analysis results.

V. METHODOLOGY:

Find out literature survey. Gathered research papers

Learned about the causes of failure of rocker panel.

Describe literature gap, identify need of project

Finalizing concept 3D model and drafting will be done

Structural simulation of rocker panel will be done with the help of ANSYS.
DESIGN AND ANALYSIS OF ROCKER PANEL USING REVERSE ENGINEERING METHOD

Fig. rocker panel

Fig. Meshing of existing rocker panel

Fig. rocker arm material properties

Fig. Meshing details

Fig. drafting of rocker panel

Fig. Boundary condition of existing rocker panel

Total deformation

ANALYSIS OF EXISTING ROCKER PANEL USING PLASTIC MATERIAL

Fig. Geometry of existing rocker panel

Mesh

Fig. Total deformation of existing rocker panel
ANALYSIS OF OPTIMIZED ROCKER PANEL USING PLASTIC AND GLASS FIBER COMPOSITE MATERIAL

Equivalent stress

Fig. Equivalent stress of existing rocker panel

Fig. Geometry of rocker panel with glass fiber

Equivalent elastic strain of existing rocker panel

Fig. Material properties of glass fiber

Fig. Layered selection for composite material

Fig. Force reaction of existing rocker panel

Mesh
Fig. Meshing details of rocker panel with glass fiber boundary condition

Fig. Equivalent stress of rocker panel with glass fiber

Fig. Rocker panel boundary condition

Total deformation

Fig. Equivalent elastic strain

Fig. Total deformation of rocker panel with glass fiber

Equivalent stress

EXPERIMENTAL VALIDATION:

A Universal Testing Machine (UTM) is used to test both the tensile and compressive strength of materials. Universal Testing Machines are named as such because they can perform many different varieties of tests on an equally diverse range of materials, components, and structures. Universal Testing Machines can accommodate many kinds of materials, ranging from hard samples, such as metals and concrete, to flexible samples, such as rubber and textiles. This diversity makes the Universal Testing Machine equally applicable to virtually any manufacturing industry. The UTM is a versatile and valuable piece of testing equipment that can evaluate materials properties such as tensile strength, elasticity, compression, yield strength, elastic and plastic deformation, bend compression, and strain hardening. Different models of Universal Testing Machines have different load capacities, some as low as 5kN and others as high as 2,000kN.

SPECIFICATION OF UTM

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Value</th>
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<tbody>
<tr>
<td>1</td>
<td>Max Capacity</td>
<td>400KN</td>
</tr>
<tr>
<td>2</td>
<td>Measuring range</td>
<td>0-400KN</td>
</tr>
<tr>
<td>3</td>
<td>Least Count</td>
<td>0.04KN</td>
</tr>
<tr>
<td>4</td>
<td>Clearance for Tensile Test</td>
<td>50-700 mm</td>
</tr>
<tr>
<td>5</td>
<td>Clearance for Compression Test</td>
<td>0-700 mm</td>
</tr>
<tr>
<td>6</td>
<td>Clearance Between column</td>
<td>500 mm</td>
</tr>
<tr>
<td>7</td>
<td>Ram stroke</td>
<td>200 mm</td>
</tr>
<tr>
<td>8</td>
<td>Power supply</td>
<td>3 Phase, 440Volts, 50 cycle, A.C.</td>
</tr>
<tr>
<td>9</td>
<td>Overall dimension of machine (L<em>W</em>H)</td>
<td>2100<em>800</em>2060</td>
</tr>
<tr>
<td>10</td>
<td>Weight</td>
<td>2300Kg</td>
</tr>
</tbody>
</table>

**RESULT AND DISCUSSION**

The rocker panel used to protect a vehicle from external damage. The material used for rocker panel is plastic. To increase the strength of rocker panel without increasing the glass fiber material is selected. Applied the glass fiber layer on the rocker panel using hand layup method. As per result the reaction force of rocker panel using composite material is increased.

<table>
<thead>
<tr>
<th>S</th>
<th>R</th>
<th>O COMPO</th>
<th>NENT</th>
<th>TOTAL DEFORMATION (mm)</th>
<th>EQUIVALENT STRESS (MPa)</th>
<th>WEIGHT (kg)</th>
<th>REACTION FORCE (N)</th>
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<td>EXISTING MODEL</td>
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<td>9</td>
<td>0.989</td>
<td>1234</td>
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<td>2</td>
<td>OPTIMIZED MODEL</td>
<td>5.5</td>
<td>15.29</td>
<td>0.92</td>
<td>4899</td>
<td></td>
<td></td>
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</tbody>
</table>

**CONCLUSION**

**CASE STUDY**

In this project we have performed the structural analysis of Rocker panel made of steel and plotted the result of total deflection and Force reaction of Rocker panel. After the optimization of rocker panel by reducing the thickness of steel plate and layering of carbon fiber the overall weight of the optimized rocker panel is observed. The optimized rocker panel is also gone through the process of structural analysis and from the plots it is concluded that the optimized rocker panel has best reaction force than the original one. As the reaction force for the original rocker panel is having force reaction of 9754.4 N and the optimized model has the force reaction of 9969.2 N.

**ROCKER PANEL**

Perform static analysis using ANSYS software and find out optimized model for the rocker panel. The material used for rocker panel for existing material is plastic. The equivalent stress and reaction force generated by the existing rocker panel is 9.00 MPa and 1234 N.
For optimized model layer of glass fiber used for improving strength of model. The equivalent stress and reaction force generated in optimized model is 15.29 MPa and 4899 N. As per analysis result the optimized model perform better in three point bending test.

The weight of existing rocker panel is 0.98 kg and weight of optimized model with glass fiber reinforcement is 0.92 kg. Hence total weight optimized in rocker panel is 6.97%.

Fig. Force reaction comparison

Fig. Weight optimization

Fig. Comparison between FEA and experimental results

REFERENCES


6. Aleksandr Cherniaev, Clifford Butcher, John Montesano “Predicting the axial crush response of CFRP tubes using three damage-based constitutive models”.
