Design and FEA Analysis of 3-Wheeler EV for E-Commerce Delivery

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Abstract— With the rising demand for sustainable transportation solutions, electric vehicles (EVs) have gained significant attention. In the context of e-commerce, the need for efficient and eco-friendly delivery options has led to the exploration of three-wheeler electric vehicles. This research paper aims to explore the design and simulation aspects of three-wheeler EVs tailored for e-commerce delivery applications. The study encompasses various parameters, including performance, energy efficiency, and operational considerations, to provide insights into the viability and effectiveness of such vehicles in the e-commerce sector.

Index Terms- EV, Design Optimization, Material Utilization, Manufacturing, BTMS, FEA, Pre-Processing, Post Processing, Meshing.

I. INTRODUCTION

- Electrical vehicles are increasing very rapidly due to their economic benefits. On other hand with consideration of E-commerce industry it is also increasing extremely fast and to fulfil their requirements they need a vehicle which is convenient and cost effective. We consider this and start our research work.
- Highlight the surge in e-commerce activities and the associated demand for efficient delivery solutions.

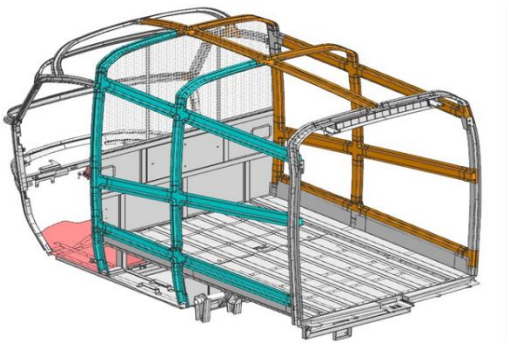

Fig1: CAD 3D model of 3-wheeler EV.

II. OBJECTIVES

- Explore the design considerations specific to three-wheeler electric vehicles.
- Investigate the potential benefits and challenges of integrating these vehicles into e-commerce delivery fleets.
- Utilize simulation tools to evaluate the performance and energy efficiency of the proposed three-wheeler EV design.

III. LITERATURE REVIEW

We have read multiple research papers on 3-wheeler EV development.

- Satyendra Nath Saxena worked on Revolution in growth of three-wheeler electric vehicles in India: Providing job opportunities to semi-skilled and unskilled people, he focuses on recent developments in last 2 decades.
- Tamer Nabil 1, Basem E. El-Naghi 2, Mahmoud Saeed worked mainly on BTMS (Battery thermal management system) they used Ansys software for their work. Aravind Harikumar, Anand RM, Himani Jain given exposure towards Indian EV transitions.
- Bharati Parmar1, Sachin Rajput 2, Pankaj Sanap3 worked on Design of a Three-Wheeler Electric Vehicle, and they compared various fuel form including LPG and CNG for automobiles. After going through various research paper, we initiated our work with cad design and then Design Optimization with the help of NX software.

IV. METHODOLOGY

5.1 Vehicle Architecture:

We Developed the model first from sketch design.

- Discuss the unique design features of three-wheeler electric vehicles.

- Considerations for load-carrying capacity and manoeuvrability in urban environments.
- Explore battery technologies suitable for three-wheeler EVs.
- Discuss the powertrain design for optimal performance and energy efficiency.

5.2 Aerodynamics and Lightweight Materials:

- Investigate the role of aerodynamics in improving efficiency.
- Explore the use of lightweight materials for enhancing range and payload capacity.

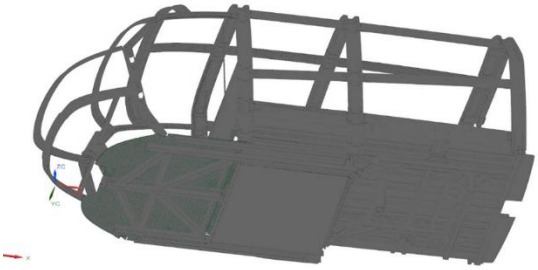

Fig 2: Meshed model of EV.

5.1 Simulation Methodology:

- Model Creation: A 3D model of the three-wheeler electric vehicle (EV) was developed using Simcenter 3D, ensuring that all design specifications were accurately incorporated.
- Material Selection: Appropriate material properties were assigned to each component, with steel and aluminium chosen for structural elements and lightweight materials selected for the body to enhance efficiency.
- Mesh Generation: A finite element mesh was generated for the model, refined in critical areas to ensure accuracy while maintaining computational efficiency.
- Boundary Conditions and Loads: Boundary conditions were defined to simulate real-world operating conditions, and relevant loads were applied, including dynamic forces encountered during e-commerce deliveries.
- Simulation Setup: Simulation parameters were configured for static and dynamic analysis, and the finite element analysis was executed to evaluate the vehicle's performance.
- Results Analysis: Stress distribution, deformation, and safety factors were assessed through the post-processing of simulation results to identify areas requiring attention.
- Optimization: Based on the analysis findings, the design was refined, and further simulations were conducted to validate improvements in performance and efficiency.

5.2 Modelling and Simulation Tools:

- Choose appropriate simulation tools for evaluating the proposed three-wheeler EV design.
- Discuss the parameters considered in the simulation process.
- We have used SS-310 grade material on whole body for simulation purposes.

V. RESULTS AND ANALYSIS

- Present simulation results and analyse the performance of the designed three-wheeler EV.
- Discuss the implications of the findings on e-commerce delivery operations.

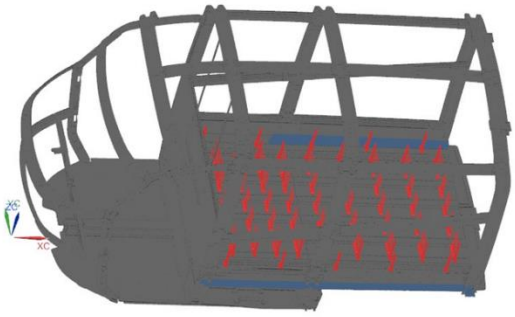

Fig 3: Boundary condition application.

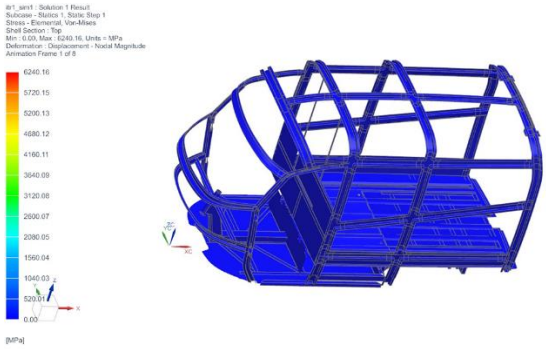

Fig 4: Displacement analysis result on EV 3-wheeler.

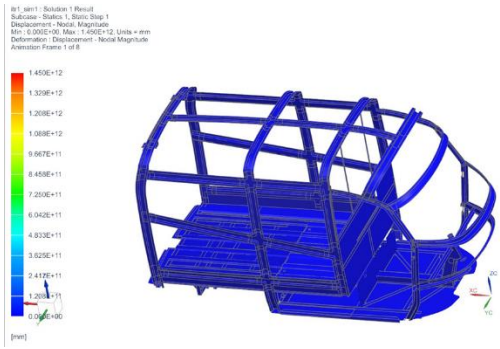

Fig 5: Deformation analysis results on EV 3-wheeler model.

CONCLUSION

A summary of the research findings, highlighting the significance of scrap flow simulation in advancing sheet metal forming processes and its potential impact on the broader manufacturing industry.

Note: This is a general outline, and the content of each section may need to be tailored based on specific research findings and objectives.

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