International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 07 Issue: 03 | March - 2023 Impact Factor: 7.185 ISSN: 2582-3930

Review on Modeling and Optimization of Electric Vehicle Alloy Wheel

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Abstract - The need for vehicle production now is an increase in vehicle demand at a lower rate. Customers' expectations in terms of longevity, effectiveness, and affordability are increasing tremendously. Automobile wheels constructed of an alloy of aluminium or magnesium metals, or occasionally a combination of the two alloys, are known as alloy wheels. Because they are lighter than steel wheels, alloy wheels are superior to steel wheels for motorcycle driving and handling. Overdesigned vehicle load components increase weight and decrease efficiency. The suspension system supports all of the wheels, which can be changed and adjusted to reduce weight and expense. All of the wheels carry the vehicle's sprung mass. There were already existing alloy components in the reverse-engineered and CAD modelled using CATIA V5 software.

Key Words: Composite material, Alloy wheels, Magnesium alloy, Design optimization, weight optimization, stress analysis,

1.INTRODUCTION

To meet the desire of course enthusiasts who were constantly looking for a position in performance and design, alloy wheels were first produced in the late 1960s. The wheel is a component that makes it possible for an object to be moved over a surface effectively even when there is a force forcing it against the surface. After the engine, the spoke wheel rim assembly adds the most weight to the motorbike. Aluminum alloy is the best alloy material when compared to all other alloy materials. In order to develop more fuel-efficient automobiles, the automotive industry is under growing pressure to maximise performance while decreasing weight and expense.

Increased demand led to fresh stylistic developments and a wide range of designs. The commonly accepted process for carriage wheel production in the fatigue life analysis of aluminum wheel design is to pass two durability tests, specifically the radial fatigue test and the cornering fatigue test. A great amount of attention must be taken to ensure the longevity of wheels because they are crucial to the vehicle's protection. Wheels need to have a moment applied to them about their axes, either by gravity or by the application of another external force. A steering wheel and other circular rotating or turning devices are also included in the term's more generic usage.

Alloy is a superior heat conductor, the risk of brake failure is decreased through better heat dissipation from the brakes. Wheels for motorbikes today are constructed of aluminum alloys. In this study, composite materials and other alloys are compared to aluminum alloy. In this research paper, an existing model is used to create a parametric model for an alloy wheel used in two-wheelers. The vehicle wheel rim experiences static and fatigue loads since it travels on numerous highways. As a result, the rim experiences significant stresses, making it crucial to identify the important stress point and shear stress.

2.MODELLING OF TWO-WHEELER ALLOY WHEEL

Die cast aluminum is the substance used. In this alloy, silicon, copper, magnesium, iron, manganese, and zinc are used as components.

3. MESHING

A multipurpose, intelligent, automated, high-performance product is meshing. It creates the best mesh possible for precise, effective multiphasic solutions. For any component of a model, a mesh that is best suited for a particular study can be created with a single mouse click. For the professional user who wishes to fine-tune the mesh, full control over the options utilised to generate it is provided. Your wait time for mesh generation is decreased automatically by utilising the capabilities of parallel computing. Engineering simulations are built upon the best suitable mesh being created. ANSYS Meshing contains the necessary criteria to produce the best-suited mesh and is aware of the kinds of solutions that will be employed in the project. ANSYS Meshing is integrated automatically.

4. BOUNDARY CONDITION

The basic loading types that can be used in FEA are force, pressure, and temperature. They may be used on points, surfaces, edges, nodes, and other elements, or they may be distantly offset from a feature. Alloy wheels on 2-wheelers have fixed outer hub rims since they are stationary. The inner circumference is loaded as described before, and tyre pressure is applied to the rim. At edge support, fixed support is used. A pressure of 0.206 mpa, or roughly 30 psi, is applied to the tyre. Given that the bike weighs approximately 110 kg, each wheel's weight is 55 kg..

5. ANALYSIS OF TWO-WHEELER ALLOY WHEEL

Complete distortion Regardless of the program being utilized, the terms "total deformation" and "directed deformation" are general concepts in finite element methods. The displacement of the system in a certain axis or user-defined direction is referred to as directional deformation. The vector sum of each system's directional displacements represents the total deformation. On application of the boundary condition specified in the previous section, a maximum deformation of 0.0134 mm is seen with the material that is already there..

With the present material, the maximum equivalent stress is measured at 7.45 MPa when the boundary condition described in the previous section is applied. It has been found that the design is safe because the stress does not exceed the material's yield strength, which for aluminum alloy is roughly 280 MPa and ultimate strength is 310 MPa.

6. TOPOLOGY OPTIMIZATION TECHNIQUE

The grid perturbation approach is used in the research presented in this publication. Recent research has employed topology for optimization more frequently to identify potential, and occasionally wholly novel, structure arrangements that satisfy pre-determined criteria (i.e., objective function and constraints).

In ANSYS, the topology optimization module links static structural analysis with optimization results and boundary conditions. The blue area is initially shown as the design space, and the red area is an exclusion zone that takes into account the boundary conditions of pressure, load, and fixed support.

Red regions represent material removal areas, along with marginal and maintain regions, after topology optimization has been completed in order to prevent material removal from such areas. Material is removed from the red zone with the right shape and defined dimension geometry, and an optimized design is then reanalyzed to assess the component's stress levels. In an area that has been optimized for topology, holes with diameters of 10 mm, 8 mm, and 6 mm as well as 22 mm center holes are bored..

7. CONCLUSIONS

While comparing the results we concluded that aluminum alloy is the suitable material for this commercial vehicle for the respective design. Aluminum alloy is an appropriate material. In comparison to other alloy materials with superior deformation factors and stress, aluminum alloy has better sustainable properties. Because it has excellent equivalent elastic strain and deformation coefficient, aluminum alloy is widely used today. However, due to its lightweight, low deformation factor, and high-stress managing capabilities, composite material outperforms aluminum and magnesium alloy material.

ACKNOWLEDGEMENT

The author would like to thank the faculty at Priyadarshini College of Engineering in Nagpur for their assistance in carrying out this research experiment.

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