

Optimization Of Design And Analysis Of An Alloy Wheel Used In Heavy Vehicles

Anusha Battiprolu¹, Rajesh Chinthanippula², Abhishek D³
Mechanical Department^{1,2,3}, Andhra University^{1,2,3}

Email: anushabattiprolu@yahoo.co.in¹ chrajesh369@gmail.com²

Abstract- The purpose of the car wheel rim provides a firm base on which it is to fit on the tire. Its shape and dimensions should be suitable to adequately accommodate the particular tire required for the vehicle. This Project deals with the design of alloy wheel for automobile application which is carried out for paying special reference to optimization of the mass of the wheel. The Finite Element analysis shows that the optimized mass of the wheel rim could be reduced upto 50% as compared to the existing solid disc type. The FE analysis shows that the stress generated in the optimized component is well below the actual yield stress of the Al alloy.

Index Terms-Alloy wheel, design Optimization, CATIA, ANSYS.

1. INTRODUCTION

Alloy wheels are mainly used in heavy vehicles which are made from an alloy of magnesium or aluminium. This Alloys are mixtures of metal and other elements. Generally they provide greater strength over pure metals, which are usually more ductile and much softer. Alloys of this magnesium or aluminium are typically lighter for the same strength, provide better heat conduction, and often produce improved fair and clear appearance over steel wheels. Although steel, the most common material used in wheel production, is an alloy of iron and carbon, the term "alloy wheel" is usually reserved for wheels made from non-ferrous alloys.

2. TYPES OF WHEELS/RIM

Few major types of alloy wheels are mainly

2.1. Wire spoke wheel

This wire spoke wheel is still used on classic vehicles. Light alloy wheels have developing in recently, a design to give emphasis to this wire spoke effect is given to fulfill users fashion requirements.

2.2 Steel disc wheel

This steel disc wheel is a rim which practices the steel-made rim and the wheel into one by welding, and it is used mainly for passenger vehicles mainly original equipment tires.

2.3 Light alloy wheel

These light alloy wheels are based on the use of light weight metals, such as magnesium and aluminium has come to be popular in the market.

2.4 Composite material wheel

The composite material wheel is different from the above wheel type, and it is developed mainly for low weight. However this wheel has inadequate consistency against heat and for best strength.

2.5. Structural steel

Structural steel is steel construction material, a profile, formed with a specific shape or cross section and certain standards of chemical composition and mechanical properties. Structural steel shape, size, composition, strength, storage, etc., is regulated in most industrialized countries.

2.6. Aluminum alloy

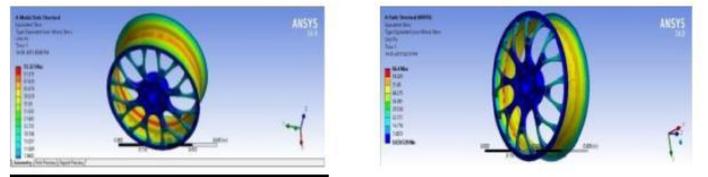
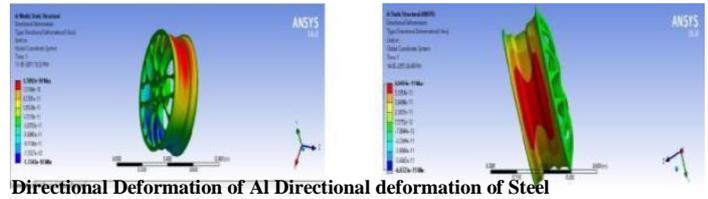
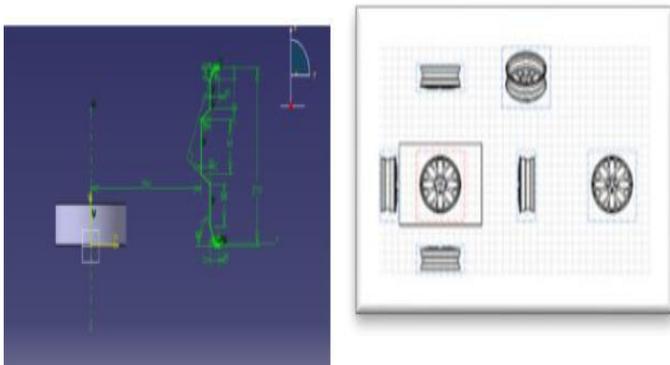
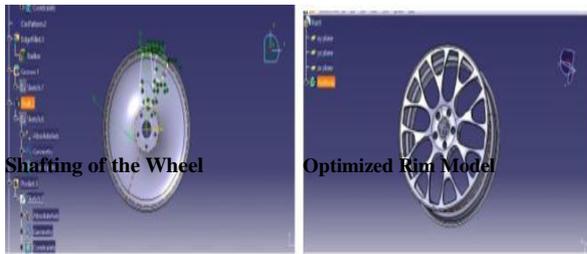
The alloying elements mostly copper, silicon, magnesium, tin, manganese and zinc. There are two classifications generally, they are casting alloys and wrought alloys, both of which are further subdivided into the categories heat non-treatable and heat-treatable. Almost 85% of aluminium is used for wrought products, for example foils, rolled plate and extrusions. Cast Al alloys yield cost-effective products due to the low melting point, though they have lower tensile strength than wrought alloys. The important cast Al alloy system is Al-Si. where the high levels of silicon (4.0–13%) yields to give good casting properties. Al alloys are widely used in engineering components and structures where light weight or corrosion resistance is required.

3. INTRODUCTION TO CAD

Basically **CAD** includes many techniques that use computers in the design process including designing, stress analysis, drafting, simulation and motion analysis. **Computer Aided Design** program software is an electronic tool that enables you to make quick and accurate design and drawings with the use of a computer. it involves both design and analysis. So far the softwares such as CATIA, Pro-E, ANSYS, CFD, NASTRAN, FLUENT belongs to this computer aided design(CAD).

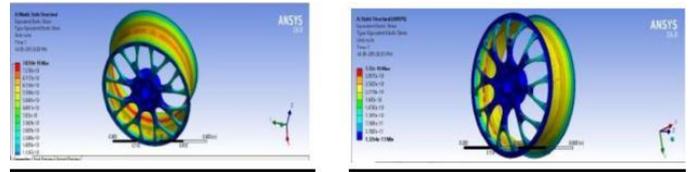
3.1 CATIA

CATIA (COMPUTER AIDED THREE DIMENSIONAL INTRACTIVE APPLICATION) IT enables greatly with the creation of 3D parts, from 2D sketches, molded, forged or tooling part, composites, weldings, up to the definition of mechanical assemblies. This software provides technologies which are more advanced for mechanical surfacing. CATIA provides tools to complete definitions of products, including kinematic definition as well as functional tolerances. It provides a wide range of applications for tooling design, for both mold & die and generic tooling. In the case of Aerospace engineering an additional module named the aerospace sheetmetal design offers the user to combine the capabilities of generative surface design and generative sheetmetal design. By using CATIA here the model is designed and optimized with the required dimensions.



Equivalent stress on Al

Equivalent stress on Steel



Equivalent Elastic Strain on Al

Equivalent strain on Steel

3.3 GRAPHS

Based on the values and analysis the Pressure Vs Equivalent stress and strains along with Directional Deformations are calculated.

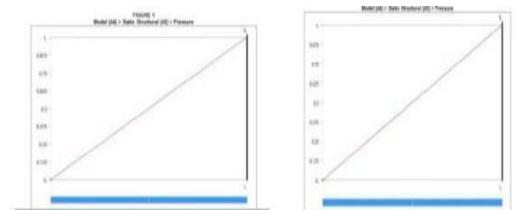


Pressure Vs Equivalent Stress On Al

Pressure Vs Equivalent Stress on Steel

Dimensions of the Wheel

Drafted Views of the Wheel



- Slip Angle on Fatigue Life of Wheel Rim of Passenger Car by Using Radial Fatigue Testing” in International Journal of Innovative Research in Science Engineering
- [8] Jaimon Dennis Quadros, Suhas, Vaishak N.L “ Study of vibration and its effects on health of a two wheeler rider”, International Journal of Research in Engineering and Technology eISSN: 2319-1163 | pISSN: 2321-7308
- [9] T. Siva Prasad, T. Krishnaiah, J. Md. Iliyas, M. Jayapal Reddy “A Review on Modeling and Analysis of Car Wheel Rim using CATIA & ANSYS” International Journal of Innovative Science and Modern Engineering (IJISME) ISSN: 2319-6386, Volume-2, Issue-6, May 2014(A.1)
- [10] “Topology Optimization of Alloy Wheel” in 2013 Altair conference India 2013.
- [11] Rajarethinam P, Periasamy K. “ Modification of Design and Analysis of Motor Cycle Wheel Spokes”, International Journal of modern Engineering research
- [12] P. Meghashyam, S. Girivardhan Naidu and N. Sayed Baba, “Design and Analysis of Wheel Rim using CATIA & ANSYS” International Journal of Application or Innovation in Engineering & Management Volume 2, Issue 8, August 2013
- [13] Shivakumara BS, , in “Study of vibration and its effect on health of the motorcycle rider” in Online Journal of Health and Allied Sciences Volume 9, Issue 2; Apr-Jun 2010