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"DESIGN MODIFICATION AND STRUCTURAL ANALYSIS OF CAR WHEEL RIM"

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ABSTRACT

The truth is that "rims" are actually just one part of the wheel. It is the outer edge of the wheel which holds the tire. It is the outer circular design and surrounds the decorative area of the wheel's hub and spokes. Design is an important industrial activity which influences the quality of the product. The present work focuses on the design of wheel rim and to analyze for optimum shape and dimensions. The design of the rim will carried out using ANSYS software and solver mode is used to analyze the design and calculate the stresses, deflections, bending moments and their relations etc. This dissertation presents design modification and structural analysis of car wheel rim. The simulation results shows that the proposed approach gives the significant good results in term of calculated parameters during analysis. Simulation is performed using the ANSYS software. The Structural analysis o titanium and aluminum is done over the ANSYS. Here exiting material for making alloy wheel rim was used Alumium alloy so here find out more buckling and stresses value at 4500 N boundary condition of load compared to new material Titanium alloy So here suggested Titanium alloy is best material compared to Aluminum alloy material for car rim manufacturing.

Keyword*: Titanium alloy , Aluminum alloy Rim, wheel. NX, ANSYS.*

I. INTRODUCTION

The "outside edge of a wheel, retaining the tyre" is known as the rim. On wheels placed on autos and other vehicles, it makes up the outside circular pattern of the wheel. For instance, the rim of a bicycle wheel is a sizable hoop that is fastened to the wheel's spokes' outside edges and contains the tyre and tube. The rim forms a "U" shape in cross-section, supporting the bead of the tyre casing, and is deep in the middle and shallow at the corners. Chariots' wooden wheels were given an iron rim in the first millennium BC to increase durability on unforgiving terrain. on a single-piece alloy wheel, a scratched rim. The tire's placement on the "safety profile" rim is still marked by the black residue.
The early bicycle pneumatic tyres were just tubes that were glued to the wooden wheel's outside circumference with a concave surface and pressed against by air pressure. The tyre occasionally came off the rims because the surface for accepting the tube was not particularly secure. Thomas B. Jeffery (1897), a bicycle maker and inventor, created a better tyre with a wire implanted in the rubber that could be fastened onto the rim and in 1882 innovation served as the prototype for all clincher tyres, the kind used on contemporary bicycles and automobiles. In order to keep the tyre in place when it is completely inflated, modern clincher tyres feature wires implanted on both beads of the tyre. These wires fit within the borders of the rim.

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Diameter- Measured in the plane of the rim and across the axis of the hub that is or will be joined to, or which is integrated with the rim, diameter is the distance between the bead seats (for the tyre).
Width- A width is the space between opposing rim flanges. A rim's flange-to-flange width needs to be at least three-quarters of the width of the tyre section. Additionally, the maximum rim width needs to match the tread width of the tyre.

TYPE OF RIM

There are several rim profiles and different rim component counts; it depends on the kind of vehicle and tyre. One-piece rims with a "safety" rim shape are frequently used with tubeless tyres and modern passenger automobiles. The safety feature has two safety humps that extend inwards of the rim toward the other tyre bead seat from an outside contoured surface of the rim. This helps maintain the tyre bead secured to the rim when the circumstances are bad.. A replaceable multi-piece rim assembly made up of a base that attaches to the wheel and axle may be seen on various trucks and heavy vehicles. A side ring or a side and lock ring combination is then available to them. For tyre installation, these components may be removed from one side, while the flange on the side that is connected to the base is fixed on the other side.
A beadlock is used in low tyre pressure scenarios like off-roading and drag racing to physically clamp or fasten the tire's bead to the wheel rim. This lessens the possibility that the tyre may come loose from the rim and suddenly deflates.

Material

The rim may be made of a variety of metals. Alloy (magnesium and aluminium), mag (magnesium), aluminium, and chrome are often observed. Sometimes Teflon coatings are also used as an additional layer of security.

Vehicle performance

The size of the rims affects a vehicle's handling qualities since the rim is where the tyre sits on the wheel and supports the tyre form.
The sidewalls of the tyre don't have enough curvature to flex correctly over bumpy roads, therefore excessively broad rims in comparison to the tyre width for a specific automobile may produce greater vibration and a less pleasant ride. The tyre might rub against the body or suspension parts when the vehicle turns if the rims are too large. Poor handling might result from rims that are too thin compared to the tyre width because the tyre may deform sideways while cornering quickly. A thin rim will change the tyre profile on
motorcycles, causing the contact patch to be smaller while braking and concentrating tyre wear in a relatively small area during cornering [9]. The ideal tyre width for bicycles is around 1.5 times the exterior width of the rim or twice the internal width of the rim (for example, a 35 mm tyre on an ETRTO 17 mm internal width rim). However, extremely broad tyres on a narrow rim may overstress the rim and harm the tyre sidewalls, while very narrow tyres on a wide rim provide a harsh ride and increase the risk of a high- pressure tyre blowing off. Considerable fluctuation outside of this range is safe.

Production

A tubeless tyre may vibrate as a result of rim damage and lose its ability to maintain pressure. Rectangular sheet metal is used to create an average steel wheel rim for an automobile. The metal plate is bent into a cylindrical sleeve, and the sleeve's two free edges are then joined together by welding. To achieve the appropriate thickness profile of the sleeve—as well as the necessary angle of inclination in relation to the axial direction in the zone for the outer seat—at least one cylindrical flow spinning operation is performed. Then, the sleeve is fashioned to produce the rims on each side with an outside seat zone with a radially inner cylindrical wall and an outer seat zone with a radially frustoconical wall inclined at an angle matching the standard inclination of the rim seats. Next, the rim is calibrated.
The cylindrical rim construction is supported by a disc that is created by stamping a metal plate. It must have the proper holes for the lug nuts and central hub. The wheel disk's radial outer surface has a cylindrical shape that fits within the rim. The outside seat of the rim is used to fit the rim and wheel disc together before they are welded together. The disc is welded into position such that the hub's and the wheel's centres are identical. The "offset" is the distance, which may

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be positive, negative, or zero, between the mounting plane of the wheel and the centerline of the rim [11]. treatment techniques shield magnesium rims from corrosion and greatly increase their typical lifetime.

Production Methods

Forging- One or more steps may be used to forge a variety of magnesium alloys, most often AZ80 and ZK60 (MA14 in Russia). Although they are substantially more expensive, wheels made using this process often have better hardness and ductility than wheels made of aluminium [8]. Forging is a difficult procedure that includes rolling, exerting high pressure, heating, hammering, and/or combining these operations [9]. The alloy's crystal structure changes as a consequence and as a result the material gains strength and lightness.

Assembly- Forged wheels come in one-, two-, and three-piece assemblies. Each component starts off as an alloy billet and then either becomes a wheel, in the case of one-piece forged wheels, or a wheel portion, in the case of multi-piece wheels.

High pressure die casting- A big machine with a strong closing force is used in the high pressure die casting process to clamp the die closed. A filler tube known as a shot sleeve is filled with molten magnesium. High-pressure and speed pistons force the metal into the die, where it hardens into magnesium. The die is then opened, releasing the wheel. Due to the nature of high pressure die casting, wheels made using this technology are less ductile and have lesser strength, but they may also provide price savings and increases in corrosion resistance.

Low pressure die casting: In this method, a steel die is often used, and it is positioned over a crucible containing molten magnesium. Most often, the crucible is sealed against the die, and molten metal is forced into the die via a straw-like filler tube by use of a pressured air/cover gas mixture. Low pressure die casting wheels may give gains in ductility over magnesium wheels and any cast aluminum wheels when treated using appropriate practices, although they remain less ductile than forged magnesium.

II. LITERATURE REVIEW

The methodology of the present research work is discussed through the flow chart and sub module explanation which is as followings-

The main contribution of the proposed research work is as followings-

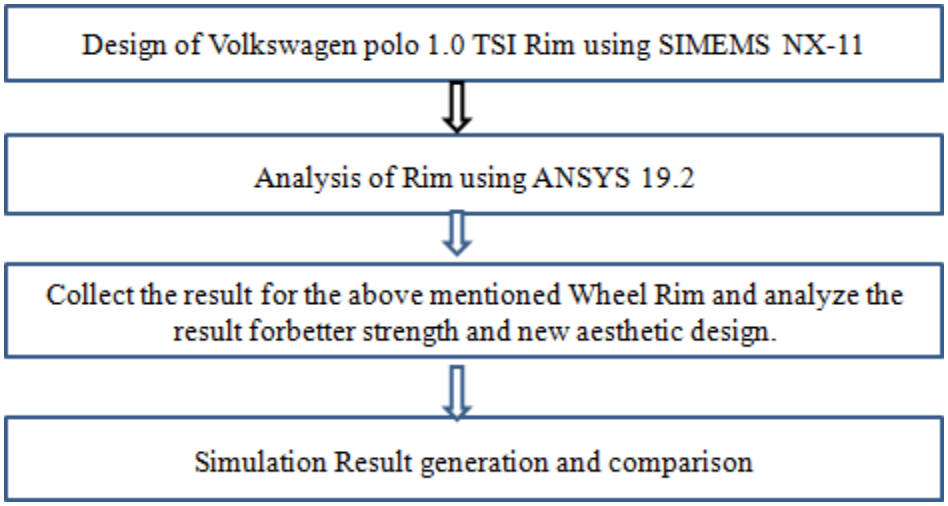

Figure 1: Work flow chart

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III. RESULT

SIMULATION SOFTWARE

The execution and entertainment of the proposed model estimation is done over Ansys 19.2 programming. The workbench has different decision of the assessment like static development, fluid examination, CFD, warm, etc Ansys, Inc. is an American association arranged in Canonsburg, Pennsylvania. It makes and promotes PC supported plan/CAM and multiphysics planning amusement programming for thing setup, testing and action and offers its things and organizations to clients all over the planet. Ansys was laid out in 1970 by John Swanson who offered his benefit in the association to monetary examiners in 1993. Ansys opened up to the world on NASDAQ in 1996. During the 2000s, the association obtained different other planning plan associations, getting additional advancement for fluid components, devices plan, and material science examination. Ansys transformed into a piece of the NASDAQ-100 record.

Ansys makes and promotes planning entertainment programming for use across the thing life cycle. Ansys Mechanical restricted part examination writing computer programs is used to imitate PC models of developments, devices, or machine parts for analyzing strength, solidness, adaptability, temperature scattering, electromagnetism, fluid stream, and various characteristics. Ansys is used to conclude how a thing will function with different specifics, without building test things or driving mishap tests. For example, Ansys programming could replicate how a platform will hold up following a long time of traffic, how to best deal with salmon in a cannery to diminish waste, or how to design a slide that uses less material without relinquishing security.

DESIGN AND RESULT ANALYSIS

Aluminum Alloy Analysis

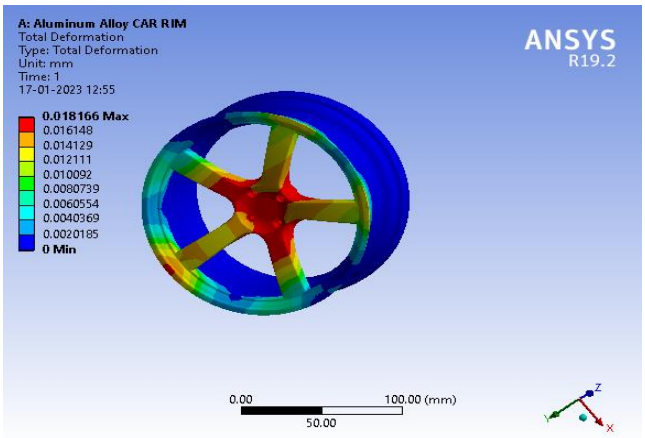

Figure 2: Static structural total deformation

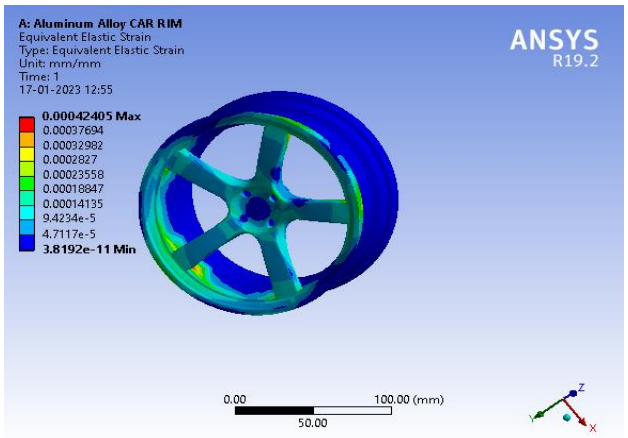

Figure 3: Static structural equivalent elastic strain

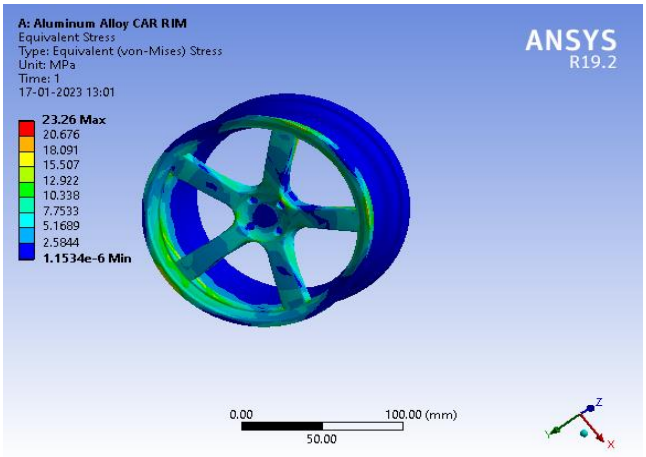

Figure 4: Static structural equivalent stress

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Titanium Alloy Analysis

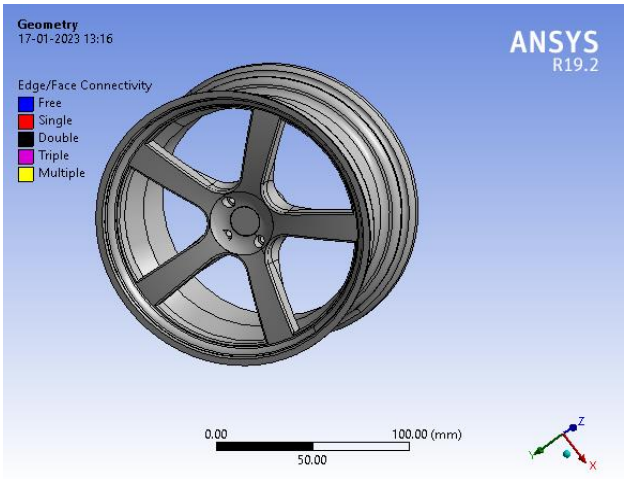

Figure 5: Static structural Scorpio

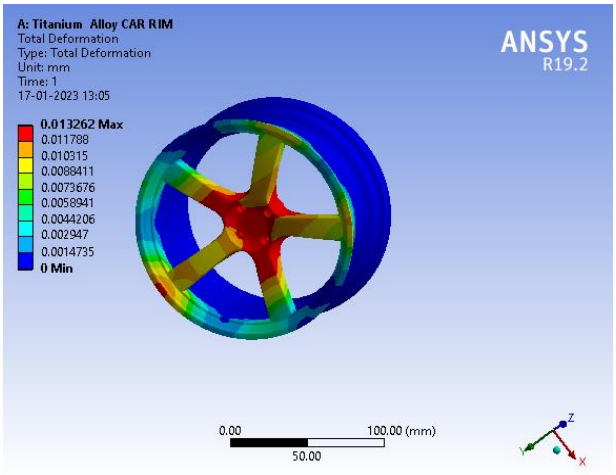

Figure 6: Static structural total deformation

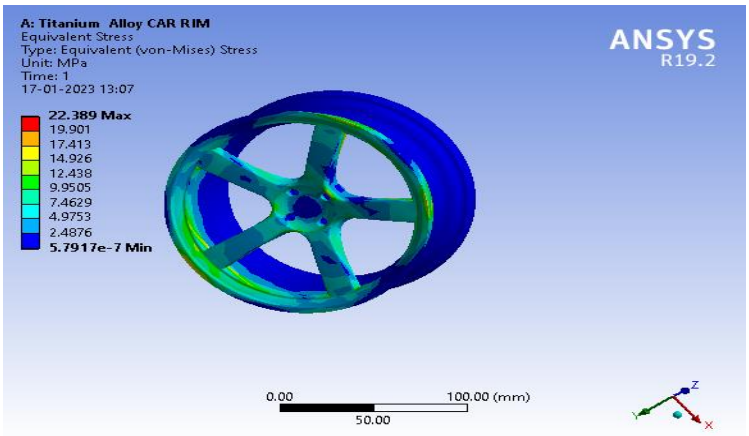

Figure 7: Static structural equivalent von misses stresses

IV. CONCLUSIONS

The basic function of your wheel rims is to provide leverage as well as a solid base to mount your tires. A good rim makes a difference in friction reduction and handling as well as gas mileage. Rims do more than make the vehicle look cool. A quality set of rims will enhance the performance and give a smoother ride. That rim must fit the vehicle, though; otherwise, it will worsen the performance of the vehicle. They must also be suitable for your driving style and where you do most of your driving. The rim is a cylindrical wheel outer edge holding the tire on the wheel. Main function of the rim is supporting and sealing the tire to the wheel. The rim ensures proper fitting between tire and rim and retaining the air inside the tubeless tire.

Car presently available in two different variants, they are Trendline, Comfortline, Highline and Highline Plus. Scorpiotyre size for Trendline model measures 175/70 R14 and comes with radial tubeless technology while the Comfortline and Highline variants are equipped with 185/60 R15 radial tubeless tyres. The top-end trim Highline Plus, on the other hand, features 195/55 R16 radial tubeless tyres. In terms of wheel covers, Trendline, the base model has been shod with steel wheels with full covers. Moreover, the Comfortline trim gets steel wheels. Scorpiocar tyres of Highline trim has been bestowed with stylish TOSA alloy wheels whereas the top-end trim Highline Plus features PORTAGO alloy wheels.

Car an elegant hatchback and since launch, it has been competing against hot hatches with similar fortitudes such as

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Maruti Swift, Ford Figo, Honda Jazz, Maruti Baleno and Hyundai Elite i20.The rim is the "outer edge of a wheel, holding the tire". It makes up the outer circular design of the wheel on which the inside edge of the tire is mounted on vehicles such as automobiles.

Table 6.1 Overall Results Comparison

Results	Aluminum Alloy RIM	Titanium Alloy RIM
Stresses	23.26	22.3
Deformation	0.018	0.013

Here exiting material for making alloy wheel rim was used Alumium alloy so here find out more buckling and stresses value at 4500 N boundary condition of load compared to new material Titanium alloy So here suggested Titanium alloy is best material compared to Aluminum alloy material for car rim manufacturing.

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