

# Review of Wheel Rim Design Strategy and Analysis

Trapti Manker, Dr. S L Ahirwar  
M.Tech Scholar, Professor  
Department of Mechanical Engineering  
Oriental Institute of Science and Technology, Bhopal, India

**Abstract—** 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. The main difference between wheel and rim is that rim is not the whole wheel but only a part of the wheel. Key parts of the wheel are rim and disc. The hub may be also considered as a part of the wheel. There are various design and shape of the wheel rim. This paper presents the review of wheel rim design strategy and analysis.

**Keywords—**Wheel, RIM, Disc, Tire, Optimazation, Design.

## I. INTRODUCTION

The wheel rim is an important part of the locomotive operation which carries the weight of entire vehicle. The conventional phased array inspection method for wheel rim is poor efficiency and has poor resolution for some special angle defects. The wheel has developed from an oversized bearing to a fully integral part of any modern transportation vehicle.

The modern motor vehicles are produced according to very strict rules to ensure the safety of passengers. Materials to produce these wheels have become has sophisticated as a design and material can range from steel to non ferrous alloys like magnesium and aluminium. Automotive wheels have evolved over the decades from early spoke design of wood and steel. Today's modern vehicles are uses the stamped metal configuration and modern cast and forged aluminium alloys rims. Since the 1970's several innovative methods of testing well aided with experimental stress measurement have been initiated [1]. In recent years, the procedures have been improved by a variety of experimental and analytical methods for structural analysis (finite element method).

Within the past 10 years, durability analysis (fatigue life predication) and reliability method for dealing with variations inherent in engineering structure have been applied to the automotive wheel Braking performance shows effect on the wheel rim parameters: size, weight, design and materials. The size of the wheel rim governs how much space there is between the rim and brake rotor. If the diameter of the wheel rim is higher there will be more scope for air flow around the brakes and therefore better cooling. The weight of the wheel rim is also an important issue. The handling of a vehicle is always improved with light weight. The rotational inertia is also obvious factor goes up with more weights as well, causing even more work for the brakes. Another factor in handling has to do with wheel strength and flex. A more rigid wheel will reduce wheel flex. This is essentially important with low aspect ratio, high performance tires that can be generate high cornering forces. Car wheels are classified in to two main groups, steel wheels and alloy wheels. Alloy wheels are frequently fitted typical during the manufacturing of modern vehicles. All steel wheels to be made up of two pressed components, the rim and the wheel disc, which are welded together.

The tire works as a wheel only after it is set up on the rim and is inflated therefore: the tire and wheels assembly affects the function and performance of the vehicle. The tire is designed and manufactured to suit a usual rim and once installed on correct rim the tire will perform up to the preferred level [1]



Figure 1: Wheel-Rim

## Rim Nomenclature-

1. Wheel: Wheel is generally constitute of rim and disc
2. Rim: This is a part where the tire is installed
3. Disc: This is a part of the rim where it is fixed to the axle hub
4. Offset: This is a space between wheel mounting surface where it is bolted to hub and centre of the line.
5. Flange: The flange is a part of rim which holds the both beds of the tire
6. Bead Seat: Bead seat approaches in contact with the bead face and it is a part of rim which holds the tire in a radial direction
7. Hump: It is a bump what was put on the bed seat for the bead to prevent the tire from sliding off the rim while the vehicle is moving
8. Well: This is a part of rim with depth and width to facilitate tire mounting and removal from the rim

## II. LITERATURE SURVEY

E. Graser et al.,[1] make progress towards a route objective position, that wheel would should be hauled. To moderate the gamble of harming a link racing to a wheels drive actuator, the unconstrained piece of a wheel could be decisively shed by performing driving moves on a resolute stone. What might stay after wheel shedding is a rimmed wheel (the external 1/3 of the wheel). We concentrated on the possibility of somewhat instructing the meanderer to play out the shed move on one of its front wheels. To illuminate

the decision about whether to shed the wheels, we tried the exhibition of driving on at least one rimmed wheels in flight. This prompted a two-month test crusade in the Fly Impetus Lab (JPL) Mars Yard utilizing the Scarecrow testbed meanderer. Driving and guiding execution was portrayed on an assortment of landscape types and slants in a most pessimistic scenario rimmed wheeled setup. Test results show that assuming wheel shedding could be effectively executed in flight, Interest could keep on driving endlessly on rimmed wheels.

B. Venkat et al.,[2] the vehicle wheel rim is to give a firm base to fit the tire. Its aspects and shape ought to be reasonable to enough oblige the specific tire expected for the vehicle. Configuration is a significant modern action which impacts the nature of the item. The current work centers around the plan of wheel rim and to break down for ideal shape and aspects. The plan of the rim will completed utilizing CREO (displaying programming) and ANSYS solver mode is utilized to dissect the plan and ascertain the burdens, redirections, bowing minutes and their relations. Likewise static primary examination has been done and the presentation of the rim has been really taken a look at in unique examination.

X. Zhang et al.,[3] further developing the landscape flexibility of wheeled robots, a changeable wheel that accomplishes multimodal velocity by utilizing a deformable wheel rim is proposed. The deformable wheel rim is made of four indistinguishable bend rim sections, which joints end by end to make it foldable. By the collapsing or unfurling of the deformable rim, the changeable wheel can change its movement mode among wheeled mode, followed mode and legged mode. The setup properties of the changeable, including the foldable rim track wheel sets are itemized planned in this work. The change property of the foldable rim during the mode switch process is likewise broke down. The possibility of which is confirmed by model test on progress and velocity experiments of various modes.

C. Y. Loi et al.,[4] The Wheel rim is a huge part of a vehicle. It should be made flawlessly to give a

smoother ride and better execution of the vehicle. In this work, there are 3 plans of spokes wheel will be created to go through exhaustion examination. The material of the wheel rim utilized is aluminum 6061-T6 on the grounds that it's lightweight and better intensity guide. The size of the wheel rim fixed at 250 mm width and 450 mm measurement. The boundary aspect of wheel rim that picked is Volkswagen Passat, car and its check weight is 1550 kg. In this work, three dimensional wheel rims are planned by involving SolidWorks and reenactment by involving ANSYS for outspread perseverance test weakness examination. Recreation results like same (Von-Mises) stress, disfigurement, security component and life cycles being produced.

W. HUANG et al.,[5] a recurrence space manufactured opening calculation in light of virtual source innovation is proposed to take care of issues referenced previously. To start with, the focal point of staged exhibit is engaged as curve inside the wheel rim shaping numerous virtual sources. Then, high-goal lines are blended utilized the defer rule with the A-filter information. At last, the B filter is drawn in light of the stage shift relocation strategy in round and hollow directions. Through reproduction and experiment, the outcomes could show that the enhancement calculation proposed in this work takes full advantage of the pillar diversion and centering of the staged cluster which works on the nature of the picture, further develops the recognition capacity of the far field, and expands the identification goal of extraordinary points. The calculation could productively diminish the hour of the imaging exploiting the recurrence space imaging.

C. - H. Chao et al.,[6] plan and equipment acknowledgment of wheel-shape objects naming and quality assessment digital actual framework is introduced. The proposed digital actual framework comprises of three frameworks (1) the name activity framework, (2) the wheel activity stage, and (3) the vision-based input and quality investigation framework. The human-finished naming interaction is supposed to be supplanted by coordinating the

previously mentioned frameworks. The planned digital actual framework is applied to the marking system of bicycle rim to approve the plan and present the outcomes.

F. Zhou et al.,[7] Search and save missions require robots have high velocity and productivity on both even and harsh landscapes. Hybrid robots that join the benefits of various motion instruments are created to tackle this issue. However the plan of past examination is typically muddled in light of the fact that they have separate wheels, tracks and legs. In this work, a clever wheel-track-leg hybrid robot that has straightforward morphology is introduced. By using a changeable rim, the robot wheels can change to tracks or legs as per various grounds. We cut the wheel rim into a few portions and joint the finishes, which makes the rim foldable. Mode-switch is accomplished by the collapsing or unfurling of the changeable rim, so that no different wheel, track, or leg is required.

Z. Han et al.,[8] We present the calculated plan of a wheel-track hybrid versatile robot. Contrasting with most hybrid stages which have separate components of wheels and tracks, this robot is executed with a change instrument which straightforwardly changes the morphology of wheels (for example rim is a round trip) into quadrangle tracks (for example rim is a "∞"). The change standard, headway strategy, and the underlying experimental trial of the robot are additionally detailed.

M. S. A. Karim et al.,[9] research project is directed to track down ways of making robotization at configuration stage in the illumination of decreasing chance to plan inside a PC Supported Plan (computer aided design) bundle. As latest thing of item improvement is toward mass customizations, it is tracked down that perhaps the best method for executing robotization in plan is via computerizing the part-dreary advances that should be done each time the part is made. This venture zeroed in on fostering a method for mechanizing the dreary advances and a contextual analysis on a wheel rim configuration is embraced. From writing explores, found in wheel planning process, the creator rehash the means of

making the computer aided design information for the rim of the wheel which has standard estimating of its significant profiles. The two driving aspects in making a wheel are the measurement of the wheel and the width which both have standard sizes.

A. Zuska et al.,[10] presents the test consequences of vibrational solace of two traveler vehicles, in which a characterized and a variable unbalance of a front wheel was set. The vehicles were in a decent specialized condition and had a place with the C-section and D-portion. Every vehicle was furnished with steel wheel rims and tires of a similar size (185/65 R15). The wheels were placed into unbalance by introducing extra loads of various mass inside steel wheel rims. The vibrations, recorded for different driving rates, of the components of suspension, controlling, floor, and driver's seat (lower part) were first dissected in the time space and afterward followed by spectroanalysis. The vibrational solace was evaluated through the r.m.s. coefficient. It was the premise to show that the vibrations of the seat and floor plates of the tried vehicles, actuated by critical wheel unbalance, don't cause distress during the drive.

F. Zhou et al.,[11] presents a novel multimodal hybrid robot that comprises of a robot frame and four changeable wheels. Contrasted with most robot wheels that have an inflexible round rim, the changeable wheel with a foldable rim can change to follow mode for higher effectiveness velocity on damp landscape or leg mode for better over-deterrent capacity on rough street. Exhaustively, the wheel rim of this robot is sliced into four start to finish bend rims to make it fit for collapsing or unfurling between a roundabout ring with a stretched ring (very much like "O" and "<∞>") to change the contact type between changeable wheels with the ground. The itemized structure plan and change standards between various velocity modes are made sense of.

E. Lazarescu et al.,[12] present way of behaving of a radio wire utilized inside a vehicle TiS (Tire Data Framework) module and to track down a way for future potential upgrades. We will introduce a few reenactments of the circle receiving wire coordinated

inside the TIS module. We will take in thought three unique circumstances: the independent reproduction for that module, the circumstance when the module is mounted on the rim, and the other one, when the module is recreated gathered with the rim and the tire. The situation of the module on the rim as well as the impacts delivered by the actual tire, are examined in view of the recreations and assessments of the impedance and the radiation proficiency. A few common aspects are considered for the rim and the tire.

### III. CHALLENGES

There are some challenges to design and use of the wheel rim.

#### 1. Vibration and Shakiness When Steering

One of the most obvious signs of a bent rim is shakiness and vibration that gets transmitted up the steering column. When a rim is bent and damaged, it will cause your tire to make uneven contact with the surface of the road.

In turn, this leads to “shakiness” and vibration when you’re driving. Shakiness in the front, such as the steering column, is a sign that your front rim is bent, while vibration in your seat or farther behind your vehicle may indicate that your rear rim has been damaged and bent.

#### 2. Car Isn't Handling The Way It Used To

A bent rim can lead to issues with your tire pressure and other problems, and significantly impact the steering and performance of your vehicle. If your car feels “slushy” or like you cannot control it properly, you may have a bent rim. Do a quick visual inspection, or bring your car to the Ride Time service centre to have it checked out as soon as possible.

#### 3. There Is Visible Damage to Your Wheel

Wheel damage is usually obvious, but if you have large metal or plastic hubcaps, you may not be able to easily detect damage to your wheel. It should be quite easy to remove your hubcaps, and



examine your tire and wheel to see if there is any damage.

Once the hubcap has been removed, look all around each one of your tires, to see if there are any areas where there is obvious damage or deformation to your wheel. If there is, it needs to be repaired and straightened, or replaced if there is serious damage.

#### 4. Tire Keeps Deflating

Your wheel is designed to fit flush against your tire. When the wheel is bent and pulls away from the tire, it can cause air leaks, or even press against the rubber and cause a flat.

If your tire is deflating quickly, and you find yourself filling it up every few days or weeks, you may have some tire damage that is causing a slow leak. If you continue driving on this tire, you could be at risk of a serious blowout, so you should get it fixed right away.

- Vibration in the steering wheel or seats, depending on which wheel is affected.
- Uneven tire tread wear.
- Increased road noise (such as droning or thumping heard in your vehicle cabin)
- Decreased fuel efficiency.
- Poor handling.

#### IV. CONCLUSION

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. This paper review of various previous works on the wheel rim design strategy and analysis. In future, make a advance design of the wheel rim for optimized using the ANSYS software. The simulation result will be calculated and compare with the existing designs.

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