DESIGN AND ANALYSIS OF ALLOY WHEEL

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Abstract
This project deals with the design of alloy wheel for automobile application which is carried out for optimization of the mass of alloy wheel. Alloy wheels are wheels that are made from an alloy of aluminum or magnesium. They are typically lighter for the same strength and provide better heat conduction. Lighter wheels can improve handling by reducing unsprung masses, allowing suspension to follow more closely to improve grip. Reduction in overall vehicle mass can also help to reduce fuel consumption and alloy wheels are non corrosive and can resist the vibrations. However not all alloy wheels are lighter than their steel equivalents.

In this project is to generate the alloy wheel of lightweight alloy materials like magnesium alloy, aluminum alloys, aluminum metal matrix, aluminum silicon magnesium alloy and stainless steel and perform the structural analysis by applying load is studied. For design Catia v15 software is used and for analysis ansys 14.5 workbench is used.

Introduction:
The wheel is a device that enables efficient movement of an object across a surface where there is a force pressing the object to the surface. Early wheels were simple wooden disks with a hole for the axle. Because of the structure of wood a horizontal slice of a trunk is not suitable, as it does not have the structural strength to support weight without collapsing; rounded pieces of longitudinal boards are required. The spoke wheel was invented more recently, and allowed the construction of lighter and swifter vehicles. Alloy wheels are automobile wheels which are made from an alloy of aluminum or magnesium metals (or sometimes a mixture of both). Alloy wheels differ from normal steel wheels because of their lighter weight, which improves the steering and the speed of the car, however some alloy wheels are heavier than the equivalent size steel wheel. Alloy wheels are also better heat conductors than steel wheels, improving heat dissipation from the brakes, which reduces the chance of brake failure in more demanding driving conditions. Over the years, achieving success in mechanical design has been made possible only after years of experience coupled with rigorous field testing. Recently the procedures have significantly improved with the emergence of innovative method on experimental and analytical analysis. Alloy wheels intended for normal use on passenger cars have to pass three tests before going...
into production: the dynamic cornering fatigue test, the dynamic radial fatigue test, and the impact test. Many alloy wheels manufacturing company had done numerous amount of testing of their product but their method on simulation test on alloy wheel information often kept limited. Historically, successful designs was arrived after years of experience well aided worth extensive field -testing. Since the 1970's several innovative methods of testing and experimental stress measurements have been initiated. In more recent years, the procedures have significantly improved by the emergence of a variety of experimental and analytical methods for structural analysis. Durability analysis, that is: fatigue life prediction and reliability methods, for dealing with various inherent in engineering structures has been used for the study of automotive rims. In its basic form a wheel is a transfer element between the tire and the vehicle. The main requirements of an automobile wheel are; It should be as light as possible so that unsprung weight is least. It should be strong enough to perform the above functions. It should be balanced statically as well as dynamically. It should be possible to remove or mount the wheel easily. It material should not deteriorate with weathering and age. In case, the material is suspected to corrosion, it must be given suitable protective treatment.

Alloy wheels are wheels that are made from an alloy of aluminum or magnesium. Alloys are mixtures of metal and other elements. They generally provide greater strength over pure metals, which are usually much softer and more ductile. Alloys of aluminum or magnesium are typically lighter for the same strength, provide better heat conduction and often produce improved cosmetic appearance over steel wheels. Although steel is also an alloy, consisting of iron and carbon, it is the most common material used in wheel production. The term "alloy wheel" is usually reserved for wheels made from nonferrous alloys.

LITERATURE SURVEY

Carvalho et al [1] Wheels are components working under cyclic loading and different load spectrum considering the load amplitude and frequency. Based on the different manufacturing process on evaluation of fatigue life prediction can take account using tests. The flow-forming process help the hardness improvement on the disc material and the results is the improvement on fatigue life. A wheel works under a load spectrum where the load amplitude and frequency can change depend on the vehicle characteristics, road, tire used. Wheel designation & nomenclature specification some norms exist at TRA, ETRTO, and ALAPA.

Akbulut et al [2] Rims are the most vital elements in a vehicle, they must be designed carefully. The rim type examined in this study has same trouble when touching any curb or entering a sharp curve. The rims manufactured by various methods are made of either steel or cast aluminum alloys. By doing FE analysis of elasto plastic tress strain the optimization of car rim takes place.
Ramamurty Raju et al [3] In the fatigue life evaluation of aluminum wheel design, the commonly accepted procedure for passenger car wheel manufacturing is to pass two durability tests, namely the radial fatigue test and cornering fatigue test. There are different loading methodologies for simulation of radial fatigue test. The dynamic nature of the tests is simulated using equivalent static load in the form of cyclic nature. The present work deals with estimating the fatigue life of aluminum alloy wheel by conducting the tests under radial fatigue load and comparison of the same with that of finite element analysis. Fatigue life prediction using the stress approach is mostly based on local stress, because it is not possible to determine nominal stress for the individual critical areas. The necessary material data for fatigue life prediction with the stress concept is the well known S–N curve. Fig3: S–N curve of A356.2 material.

**Characteristics of alloy wheel:**
Lighter wheels can improve handling by reducing unsprung masses, allowing suspension to follow the terrain more closely and thus improve grip, however not all alloy wheels are lighter than their steel equivalents. Reduction in overall vehicle mass can also help to reduce fuel consumption. Better heat conduction can help dissipate heat from the brakes, which improves braking performance in more demanding driving conditions and reduces the chance of reduced brake performance or even failure due to overheating.

An aluminum alloy wheel designed to recall the crossed spokes of a wire wheel

Fig: aluminum alloy wheel design

Alloy wheels are also purchased for cosmetic purposes although the alloys used are not corrosion-resistant. Alloys allow the use of attractive bare-metal finishes, but these require to be sealed with paint or wheel covers. Even if so protected the wheels in use will eventually start to corrode after 3 to 5 years but refurbishment is now widely available at a cost. The manufacturing processes also allow intricate, bold designs. In contrast, steel wheels are usually pressed from sheet metal, and then welded together (often leaving unsightly bumps) and must be painted to avoid corrosion and/or hidden with wheel covers / hub caps.

Alloy wheels are more expensive to produce than standard steel wheels, and thus are often not included as standard equipment, instead being marketed as optional add-ons or as part of a more expensive trim package. However, alloy wheels have become considerably more common since 2000 now being offered on economy and subcompact cars, compared to a decade earlier where alloy wheels were often not factory options on inexpensive vehicles. Alloy wheels have long been included as standard equipment on higher-priced luxury or sports cars, with larger-sized or "exclusive" alloy wheels being options. The high cost of alloy wheels makes them attractive to thieves; to counter this, automakers and dealers often use locking wheel nuts which require a special key to remove.

Most alloy wheels are manufactured using casting, but some are forged. Forged wheels are usually lighter, stronger, but much more expensive than cast wheels.
The design phase of an alloy wheel, the following characteristics must be considered:

**Stiffness:** The structural stiffness is the basic engineering parameter to be examined when designing an aluminum wheel which offers at least the same vehicle performance as an equivalent steel wheel. The structural stiffness is determined by the final shape of the wheel; the material stiffness (Young’s modulus) is more or less given and little depending on alloy and temper.

**Static performance (strength):**
In order to avoid any deformation under maximal axial (accelerations and braking) and radial stresses (turning), the yield strength of the material must be considered. Misuse cases have to be evaluated in relation to the tensile strength. Yield tests under pressure are also conducted to check this behavior. An additional, important factor is the temperature resistance, i.e. the wheel must be able to tolerate Temporarily 200°C due to the proximity of the brakes and temperatures around 100°C over longer periods.

**Fatigue behavior:**
The fatigue performance is the most important parameter for wheel dimensioning. Numerical simulation methods are systematically used during design. Service stresses, including also multi-axial stresses are considered. Rotary bending and rim rolling tests are used to verify the calculations.

**Crash worthiness:**
Numerical simulation methods are more and more used for the design of wheels for crashworthiness. However, impact tests are still systematically carried out to check the resistance to accidental collisions, such as pavements impacts.

**Thermal aspects**

Whatever type of wheel (cast, forged, mixed wrought-cast…) is used, aluminum dissipates heat more quickly than steel. Furthermore, aluminum wheels act as a very efficient heat sink. This results in a significantly improved braking efficiency, and a reduced risk of tire overheating.

**Style and weight saving potential**
The reduction of the weight of the un sprung mass of vehicles is a key priority in any design consideration. On the other hand, styling aspects are generally a decisive factor for choosing an aluminum wheel. Thus, a compromise has to be accepted if the styling requirements dictate the selection of specific production technologies and therefore the realization of less than the maximum achievable weight reduction potential.

**Dimensional tolerances**
A perfect mass balance is a key parameter to avoid significant vibrations of the wheel. As a result, both cast and forged aluminum wheels are finally machined. Compared to steel wheels, the lower weight of aluminum sheet wheels also reduces the intensity of vibrations.

**Corrosion resistance:**
There are various surface treatment options for aluminum wheels offering different qualities and benefits. Wheel appearance, durability and maintenance requirements must be considered when choosing a wheel surface. More details can be found in the section “Surface treatment”. Galvanic corrosion effects present generally no problems. Even at the uncoated iron/aluminum hub interface, no significant corrosion has ever been noticed.

**Types of wheel and material:**
a) Wire spoke wheel:
Wire spoke wheel is an essential where the exterior edge part of the wheel (rim) and the axle mounting part are linked by numerous wires called spokes. Today’s automobiles with their high horsepower have made this type of wheel manufacture obsolete. This type of wheel is still used on classic vehicles. Light alloy wheels have developing in recent years, a design to give emphasis to this spoke effect to fulfill users fashion requirements.

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

c) Light alloy wheel:
These wheels are based on the use of light metals, such as aluminum and magnesium has come to be popular in the market. This wheel rapidly become standard for the original equipment vehicle in Europe in 1960’s and for the replacement tire in United States in 1970’s. The advantages of each light alloy wheel are explained as below.

Types of alloy wheels:
1. Aluminum alloy wheels
2. Magnesium alloy wheels
3. Titanium alloy wheels
4. Composite material wheels

1. Aluminum alloy wheels:
Aluminum is a metal with features of excellent lightness, thermal conductivity, rust confrontation, physical characteristics of casting, low heat, machine processing and reutilizing, etc. This metals main advantage is decreased weight, high precision and design choices of the wheel. This metal is useful for energy preservation because it is possible to re-cycle aluminum easily.

2. Magnesium alloy wheels:
Magnesium is about 30% lighter than aluminum and also admirable as for size stability and impact resistance. However, its use is mainly restricted to racing, which needs the features of weightlessness and high strength at the expense of weathering resistance and design choice, etc. Compared with aluminum.

Magnesium wheels were the first die-cast wheels produced, and were often referred to as simply "mag wheels." Magnesium wheels were originally used for racing, but their popularity during the 1960s led to the development of other die-cast wheels, particularly of aluminum alloys. The term "mag wheels" became synonymous with die-cast wheels made from any material, from modern aluminum alloy wheels to plastic and composite wheels used on items like bicycles, wheelchairs, and skateboards.

However, pure magnesium wheels are no longer produced, being found only on classic cars. Magnesium suffered from many problems. It is very susceptible to pitting, cracking and corrosion, and starts to break down in just a few months when exposed to moisture. Magnesium wheels require constant maintenance to keep polished. Alloy of magnesium were later developed to help alleviate some of these problems.

Magnesium in bulk is hard to ignite but can be ignited by a burning tire or by prolonged scraping of the wheel on the road surface following a puncture. Once lit, it is very hard to extinguish, being able to burn under water or in carbon dioxide which are common extinguishing materials.

The mass of a typical magnesium automotive wheel is about 5–9 kg (depending on size).

3. Titanium alloy wheels:
Titanium alloys are metals that contain a mixture of titanium and other chemical elements. Such alloys have very high tensile strength and toughness (even at extreme temperatures). They are light in weight, have extraordinary corrosion resistance and the ability to withstand extreme temperatures. However, the high cost of both raw materials and processing limit their use to military applications, air craft, space craft, medical devices, and highly stressed components such as connecting rods on expensive sport cars and some premium sport equipments and consumer electronics.

So that titanium alloys are high stable which can resist all mechanical loads and thermal heat loads.

4. Steel Wheels:
The weight of wheels, tires, brakes and rotors is specifically called “unsprung weight” because it is not being cushioned by the suspension springs. Unsprung weight has much more effect on how the car handles than an equivalent amount of weight above the springs, such that even a small change in weight can have large effects.

Steel wheels are heavier than aluminum, so when you put steel wheels on a car that has had alloy wheels, you tend to find that the extra weight dampens acceleration and agility, lowers the car’s center of gravity and in general makes it drive more like a tank. Obviously this can be undesirable for summer performance applications, but in the winter the effect can be a significant physical and psychological advantage. Heavier wheels will make tires bite the snow harder, and when driving in snow, having a car with dampened acceleration and agility, an artificially low center of gravity and a sense of solidity and heaviness can be a very good thing.

Steel wheels are significantly stronger than alloy wheels. It takes greater force to bend steel wheels, and it is almost impossible to crack them. Given their usual utilitarian look, purely cosmetic damage is not generally a major issue.

There are wheel covers that you can put on steels to make them look like alloy wheels; they often come on steels sold as OEM choices, and can be found online as well. Wheel covers are fragile, look kind of cheesy, and are most often held on by a spring steel friction grip that has a distressing tendency to come off at inconvenient times and roll away.

Steels are generally only made in 16” sizes or less. There are a very few 17” steels out there, but not a single 18” steel that I know of. I would imagine that an 18” steel would be ridiculously heavy. Consequently, putting on steels will often involve downsizing. Some high-performance cars will not accept downsized wheels because of oversized brake calipers or other suspension issues.

Steels are also usually 75-80% less expensive than alloy wheels, making them great for a second set, and inexpensive to replace if badly damaged.

Production methods for alloy wheels:

1. Forging process
2. High pressure die casting
3. Low pressure die casting
4. Gravity casting

Different aluminum casting technologies are suitable for wheel production. High productivity casting methods are primarily applied for the production of aluminum wheels to be used for factory production cars (supply to the OEM market). On the other hand, the aftermarket is looking for more versatile designs, but relatively small series, i.e. specialty casting processes are more useful. However, depending on
the applied casting process, also the quality of the cast aluminum wheels varies. The selection of the specific casting methods largely determines the quality of the as-cast microstructure (e.g. porosity) and influences the choice of the applicable types of alloys and heat treatments. Thus, it determines not only the strength and durability of the wheel, but also affects the quality level which can be achieved in the various surface preparation steps and thus the final appearance. Consequently, the selection of the optimum casting methods depends on many different factors.

The main casting processes used for the production of aluminum wheels are:

- low-pressure die casting (mainly)
- gravity permanent mould casting (less used)
- squeeze-casting process (marginally used)

In addition, a few other casting processes have been or are used:

- counter pressure die casting
- casting-forging (Cob press)
- Thixocasting.

In general, pressure casting, where the metal is pumped into the mould, is preferable to just pouring. However, gravity permanent mould casting is still a relevant casting process for aluminum wheels. Gravity casting offers reasonable production cost and is a good method for casting designs that are more visually oriented or when the reduction of the wheel weight is not a primary concern. Since the process relies only on gravity to fill the mould, the cast structure usually shows more defects (porosity, etc.) than that produced by some other casting processes. Consequently, gravity cast wheels will generally have a higher weight to achieve the required strength.

Catia: Catia mechanical design automation software that takes advantage of the familiar Microsoft Windows graphical user interface.

It is an easy-to-learn tool which makes it possible for mechanical designers to quickly sketch ideas, experiment with features and dimensions, and produce models and detailed drawings.

A catia model consists of parts, assemblies, and drawings.

- Typically, we begin with a sketch, create a base feature, and then add more features to the model. (One can also begin with an imported surface or solid geometry).
- We are free to refine our design by adding, changing, or reordering features.
- Associatively between parts, assemblies, and drawings assures that changes made to one view are automatically made to all other views.
- We can generate drawings or assemblies at any time in the design process.
- The catia software lets us customize functionality to suit our needs.

INTRODUCTION TO CATIA:

CATIA mechanical design automation software is a feature-based, parametric solid modeling design tool which advantage of the easy to learn windows™ graphical user interface. We can create fully associate 3-D solid models with or without while utilizing automatic or user defined relations to capture design intent.

- Parameters refer to constraints whose values determine the shape or geometry of the model or assembly. Parameters can be either numeric parameters, such as line lengths or circle diameters, or geometric parameters, such as tangent, parallel, concentric, horizontal or
vertical, etc. Numeric parameters can be associated with each other through the use of relations, which allow them to capture design intent.

- Design intent is how the creator of the part wants it to respond to changes and updates. For example, you would want the hole at the top of a beverage can to stay at the top surface, regardless of the height or size of the can. CATIA allows you to specify that the hole is a feature on the top surface, and will then honor your design intent no matter what the height you later gave to the can. Several factors contribute to how we capture design intent are Automatic relations, Equations, added relations and dimensioning.

- Features refer to the building blocks of the part. They are the shapes and operations that construct the part. Shape-based features typically begin with a 2D or 3D sketch of shapes such as bosses, holes, slots, etc. This shape is then extruded or cut to add or remove material from the part. Operation-based features are not sketch-based, and include features such as fillets, chamfers, shells, applying draft to the faces of a part, etc.

- Building a model in CATIA usually starts with a 2D sketch (although 3D sketches are available for power users). The sketch consists of geometry such as points, lines, arcs, conics (except the hyperbola), and spines. Dimensions are added to the sketch to define the size and location of the geometry. Relations are used to define attributes such as tangency, parallelism, perpendicularity, and concentricity. The parametric nature of CATIA means that the dimensions and relations drive the geometry, not the other way around. The dimensions in the sketch can be controlled independently, or by relationships to other parameters inside or outside of the sketch.

**Design procedure of alloy wheel**

For designing the alloy wheel the following procedure has to be follow

- 2 dimensional sketch of a alloy wheel

Revolve boss tool is used to create 3Dimensional alloy wheel

Extrude cut tool is used to cut the excess portion of the supporting spokes.
Finite Element Analysis

Introduction

Finite Element Analysis (FEA) is a computer-based numerical technique for calculating the strength and behavior of engineering structures. It can be used to calculate deflection, stress, vibration, buckling behavior and many other phenomena. It also can be used to analyze either small or large scale deflection under loading or applied displacement. It uses a numerical technique called the finite element method (FEM). In finite element method, the actual continuum is represented by the finite elements. These elements are considered to be joined at specified joints called nodes or nodal points. As the actual variation of the field variable (like displacement, temperature and pressure or velocity) inside the continuum is not known, the variation of the field variable inside a finite element is approximated by a simple function. The approximating functions are also called as interpolation models and are defined in terms of field variable at the nodes. When the equilibrium equations for the whole continuum are known, the unknowns will be the nodal values of the field variable.

Introduction to Simulation

Simulation is a design analysis system. Simulation provides simulation solutions for linear and nonlinear static, frequency, buckling, thermal, fatigue, pressure vessel, drop test, linear and nonlinear dynamic, and optimization analyses.

Powered by fast and accurate solvers, Simulation enables you to solve large problems intuitively while you design. Simulation comes in two bundles: Simulation Professional and Simulation Premium to satisfy your analysis needs. Simulation shortens time to market by saving time and effort in searching for the optimum design.

Figure: simulation example

Benefits of Simulation:

After building your model, you need to make sure that it performs efficiently in the field. In the absence of analysis tools, this task can only be answered by performing expensive and time-consuming product development cycles. A product development cycle typically includes the following steps:

1. Building your model.
2. Building a prototype of the design.
3. Testing the prototype in the field.
4. Evaluating the results of the field tests.
5. Modifying the design based on the field test results.

This process continues until a satisfactory solution is reached. Analysis can help you accomplish the following tasks:

- Reduce cost by simulating the testing of your model on the computer instead of expensive field tests.
- Reduce time to market by reducing the number of product development cycles.
- Improve products by quickly testing many concepts and scenarios before making a final
decision, giving you more time to think of new designs.

**Ansys**

**Introductions to Ansys**

ANSYS 14.5 delivers innovative, dramatic simulation technology advances in every major Physics discipline, along with improvements in computing speed and enhancements to enabling technologies such as geometry handling, meshing and post-processing. These advancements alone represent a major step ahead on the path forward in Simulation Driven Product Development. But ANSYS has reached even further by delivering all this technology in an innovative simulation framework, ANSYS Workbench14.5 The ANSYS Workbench environment is the glue that binds the simulation process; this has not changed with version 14.5 In the original ANSYS Workbench, the user interacted with the analysis as a whole using The platform’s project page: launching the various applications and tracking the resulting files employed in the process of creating an analysis. Tight integration between the component applications yielded unprecedented ease of use for setup and solution of even complex multi physics simulations.

In ANSYS 14.5, while the core applications may seem familiar, they are bound together via the innovative project page that introduces the concept of the project. This expands on the project page concept. Rather than offer a simple list of files, the project schematic presents a comprehensive view of the entire analysis project in flowchart form in which explicit data relationships are readily apparent. Building and interacting with these flowcharts is straightforward. A toolbox contains a selection of systems that form the building blocks of the project. To perform a typical simulation, such as static structural analysis, the user locates the appropriate analysis system in the toolbox and, using drag and drop, introduces it into the project schematic. That individual system consists of multiple cells, each of which represents a particular phase or step in the analysis. Working through the system from the top down, the user completes the analysis, starting with a parametric connection to the original CAD geometry and continuing through to post-processing of the analysis result. As each step is completed, progress is shown clearly at the project level. (A green check mark in a cell indicates that an analysis step has been completed.)

**Workbench:**

The ANSYS Workbench environment tracks dependencies among the various types of data in the project. If something changes in an upstream cell, the project schematic shows that downstream cells need to be updated to reflect these changes. A project level update mechanism allows these changes to be propagated through all dependent cells and downstream systems in batch mode, dramatically reducing the effort required to repeat variations on a previously completed analysis. Parameters are
managed at the project level, where it is possible to change CAD and geometry parameters, material properties and boundary condition values. Multiple parametric cases can be defined in advance and managed as a set of design points, summarized in tabular form on the ANSYS Workbench project page. Design Exploration systems can be connected to these same project-level parameters to drive automated design investigations, such as Design of Experiments, goal-driven optimization or Design for Six Sigma.

**Analysis Types**

The different type of analysis that can be performed in ANSYS:

1. Structural static analysis:
   - Structural dynamic analysis
   - Structural buckling analysis
     - Linear buckling
     - Non-linear buckling
   - Structural non linearity
2. Static and dynamic kinematics analysis
3. Thermal analysis
4. Electromagnetic field analysis
5. Electric field analysis
6. Fluid flow analysis
   - Computational fluid dynamics
   - Pipe flow
7. Coupled-field analysis

**Materials Used in Project and Their Properties:**

<table>
<thead>
<tr>
<th>Material</th>
<th>Density (kg/m^3)</th>
<th>Young’s modulus (GPa)</th>
<th>Poisson’s ratio</th>
<th>Shear modulus (GPa)</th>
<th>Bulk modulus (GPa)</th>
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</thead>
<tbody>
<tr>
<td>aluminum alloy</td>
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<td>71000</td>
<td>0.33</td>
<td>9900</td>
<td>26992</td>
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<td>0.33</td>
<td>67647</td>
<td>22590</td>
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</tbody>
</table>

**Analysis on alloy wheel**
Material: magnesium alloy

Material: stainless steel

Strain

Deformation

Shear stress

Stress

Strain
Deformation

Shear stress

Material: aluminum silicon magnesium alloy

Stress

Strain

Deformation
Shear stress

Results

At a load of 1.5 mpa pressure

<table>
<thead>
<tr>
<th>Material</th>
<th>Stress (mpa)</th>
<th>Deformation (mm)</th>
<th>strain</th>
<th>Shear (mps)</th>
<th>stress (mps)</th>
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</thead>
<tbody>
<tr>
<td>Aluminum alloy</td>
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<td>0.00074485</td>
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<tr>
<td>Aluminum silicon alloy</td>
<td>72.944</td>
<td>0.63408</td>
<td>0.0010579</td>
<td>32.844</td>
<td></td>
</tr>
</tbody>
</table>

Conclusion:

- Brief study about alloy wheel its construction, type, materials is done in this project.
- By using 3d modeling software CATIA V5 alloy wheel is modeled.
- Catia Model of alloy wheel is saved as IGES (neutral) file and transferred to ANSYS work bench 14.5 software.
- Static structural analysis is performed of alloy wheel by applying the pressure load of 1.5 MPA.
- Static structural analysis is performed on five different materials on same boundary condition.
- Analysis result is noted and tabulated.
- According to result table magnesium alloy showing least stress value compare to other four materials.
- Meanwhile magnesium alloy is also least dense material, i.e. its weight ratio is lowest than other four materials.

- So we can conclude that magnesium alloy is best material for alloy wheel compare to other four materials, because of its least weight and least stress value on load conditions.
- Design and analysis on alloy wheel is done.

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