MAPLE TREE PUBLISHING HOUSE (INDIA)
INTERNATIONAL RESEARCH JOURNAL OF AUTOMOTIVE TECHNOLOGY (IRJAT)
http://www.mapletreejournals.com/index.php/IRJAT
Received 6 April 2018 ISSN 2581-5865
Accepted 3 May 2018 2018; 1(3);33-37
Published online 30 May 2018

Analysis of Alloy Wheel Rim

P.Sathish Kumar[1*], M.Sivaraman[1],K.Maadesh Kumar[1], M.Venkatesh[2]

[1]Asst Professor, Dept of Mech Engg, Jansons Institute of Tech, Coimbatore, Tamilnadu, India.
[2]PG Student, Dept of Mech Engg, SBM College of Engg and Tech, Dindigul, Tamilnadu, India.

**Corresponding author E-Mail ID: kumarsathish0035@gmail.com, Mobile: 9698175302*

ABSTRACT

In this work we are doing the material optimization of two wheeler alloy wheel. This project we are designed the 3D model of the alloy wheel by using creo 1.0 software and the analysis taken by different materials of the alloy wheel and the analysis taken by the ansys software. This project we are analyzed the rotational velocity and force acting on the alloy wheel by the three materials. Presently the alloy wheels are made by the material of aluminum alloy and, this project we are testing the same load under the two materials. The materials are Magnesium alloy, Titanium alloy. Then the model is analyzed for the deflection, max stress induced and strain for all the above materials under same load

.Keywords: wheels,rim,creo,ansys

1. INTRODUCTION

A wheel is a circular device that is capable of rotating on its axis, facilitating movement or transportation while supporting a load (mass), or performing labor in machines. Common examples are found in transport applications. A wheel, together with an axle overcomes friction by facilitating motion by rolling. In order for wheels to rotate, a moment needs to be applied to the wheel about its axis, either by way of gravity, or by application of another external force. More generally the term is also used for other circular objects that rotate or turn, such as a ship's wheel, steering wheel and flywheel. Alloy wheels are automobile wheels which are made from an alloy of aluminum. Alloy wheels differ from normal steel wheels because of their lighter weight, which improves the steering and the speed of the vehicle, 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 1possible 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. Lighter wheels can improve handling by reducing unsprung mass , 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.

2. METHODOLOGY

2.1 Modeling

The bike alloy wheel model has been entirely modeled by PRO E software. First of all sketch command of the pro e is opened. Then by using 2d commands sketch is created. Then the 3D model of bike alloy wheel plates is created by extrude, revolve command in creo.

2.2 Transformation of model

Then the model is converted in to the IGES format which is most suitable and easy access for any other software's. Using the IGES format we can import the bike alloy wheel model from pro e to ANSYS. Now we can make static structural analysis.

2.3 Meshing

After the complete structure is modeled, bike alloy wheel is meshed. This has been done by using ansys workbench software. The last step to be completed before meshing the model is to set the meshing controls, i.e. the element shape, size, the number of divisions per line, etc. Selecting the various parts of the model, one by one finite element mesh is generated. The critical portions are plates with sharp corners, curvature etc. These areas can be remeshed with advance mesh control options. "Smart element sizing" is a meshing feature that creates initial element sizes for free meshing operation. Proper care has to be taken to have the control over the number of elements and hence the number of degrees of freedom associated with the structure. This is done to have a control over the solution time. However, no compromise is made on the accuracy of the results.

2.4 Loading

The types of loading that can be applied in a structural analysis include:

- Externally applied forces and pressures
- Steady-state inertial forces (such as gravity or rotational velocity)
- Imposed (nonzero) displacements

2.5 Analysis

A static structural analysis determines the displacements, stresses, strains, and forces in structures or components caused by loads that do not induce significant inertia and damping effects.

3. DESIGN AND CALCULATION

3.1 Calculation

Mass of Bike,
Dead Weight of Bike = 143kg
Other Loads = 20 Kg
Total Gross Weight = 143 + 20
= 163 Kg
= 163X 9.81 N
Tires and Suspension system reduced by 30% of Loads
W net = 163 X 9.81 X 0.7 N = 1119.32N
Reaction Forces On Bike = Nr = 1119.32N
Number of Wheels: 2
But by considering total Reaction Force on only one wheel
FT = 1119.32N
Rim surface area which is having 6 spokes:
A6 = 48299.69 mm2
(this can be obtained from selecting faces on rim by using measuring tool in solid works)
Stress on the each Rim = 0.02321 N/mm2
Rotation velocity = V/ r
For men accelerate motorcycle from 0 to 80km/hr
Rotation velocity = 22.22 / 250 = 88.88 rad/sec

3.2 Design

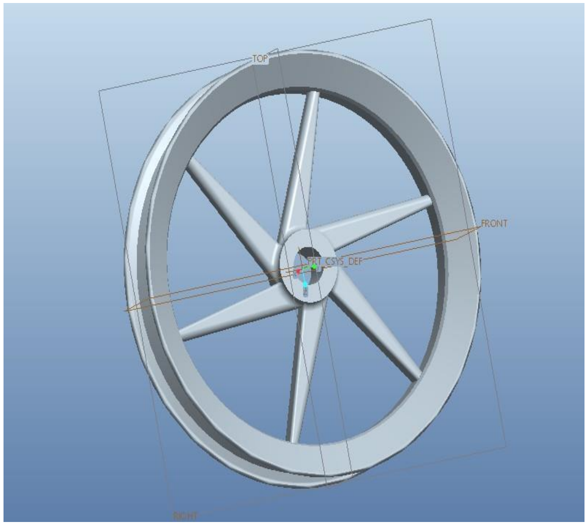

Fig 1

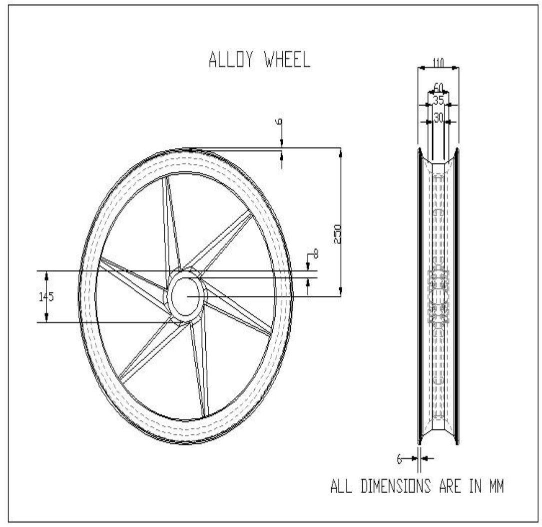

Fig 2

4. RESULT AND DISCUSSION

4.1 Result For Existing Material

Aluminium Alloy

Total Deformation

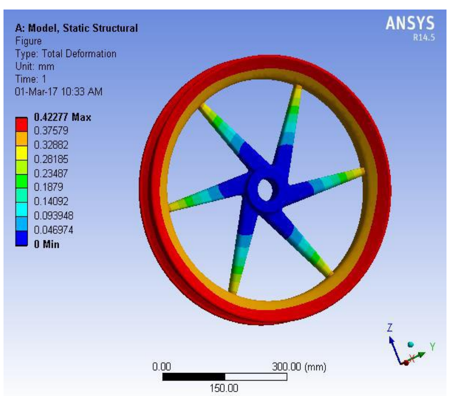

Fig 3

Equivalent Elastic Strain

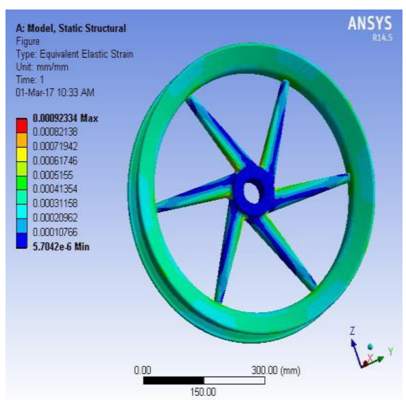

Fig 4

Equivalent Stress

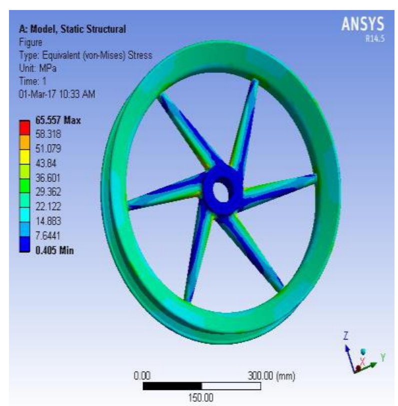

Fig 5

4.2 Result For Optimized Materials

Magnesium Alloy

Total Deformation | Equivalent Elastic Strain | Equivalent Stress

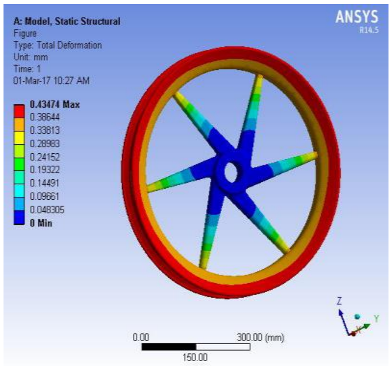

Fig 6

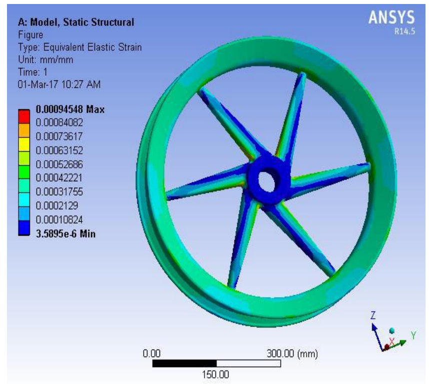

Fig 7

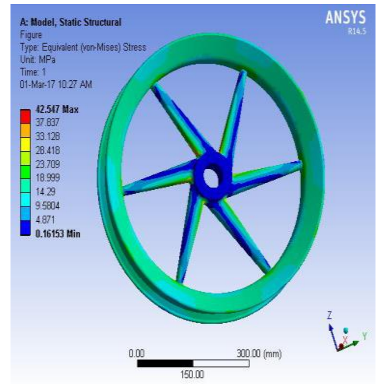

Fig 8

Titanium Alloy

Total Deformation | Equivalent Elastic Strain | Equivalent Stress

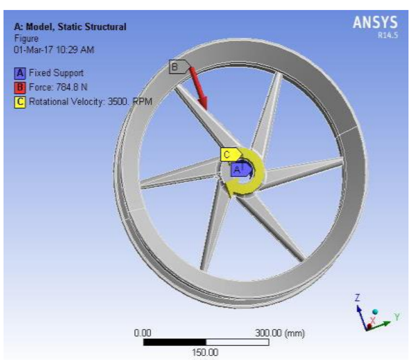

Fig 9

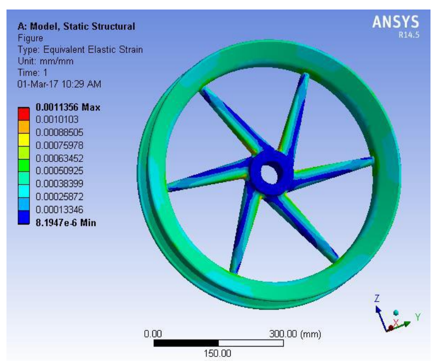

Fig 10

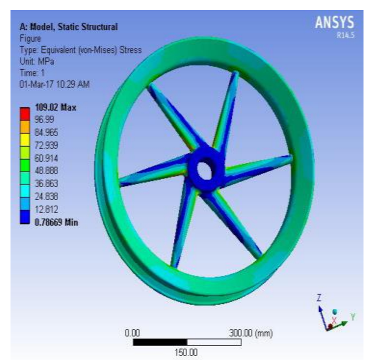

Fig 11

4.3 Comparison Of Results

Aluminium Alloy

DESCRIPTION	MINIMUM	MAXIMUM
Total deformation (mm)	0	0.4227
Equivalent elastic strain (mm/mm)	5.704e-6	9.23e-4
Equivalent stress MPa	0.405	65.557

Magnesium Alloy

DESCRIPTION	MINIMUM	MAXIMUM
Total deformation (mm)	0	0.4347
Equivalent elastic strain (mm/mm)	3.589e-6	9.4e-4
Equivalent stress MPa	0.16153	42.547

Titanium Alloy

DESCRIPTION	MINIMUM	MAXIMUM
Total deformation (mm)	0	0.52116
Equivalent elastic strain (mm/mm)	8.1947 e-6	0.0011354
Equivalent stress MPa	0.78669	109.02

5.CONCLUSION

Analysis results from testing the alloy wheel under static load containing the stresses and deflection are listed in the Table. The materials we analyze are Aluminium alloy, magnesium alloy, Titanium alloy. The analysis of alloy wheel we found that the magnesium alloy wheel have a good strength and it have a less deformation under the fixed support and force, than the other three material which are used for alloy wheels. So the existing aluminium alloy material can be replaced with optimized megnisium material because of its low deformation and elastic strain values. Compared to other optimized materials like Titanium alloy has low deformation value. So the suitable material for alloy wheel is Titanium alloy.

REFERENCES

1. M.Riesner and R. I. DeVries, ―Finite Element Analysis and Structural Optimization of Vehicle Wheels‖, in Proceedings of International Congress & Exposition - SAE, Detroit, MI, 1993.
2. Ch. P.V. Ravi Kumar, Prof. R. Satya Meher. "Topology Optimization of Aluminum Alloy Wheel". International Journal of Modern Engineering Research, Ruzanna Nadia Binti Nisah, Finite element Analysis of a Motorcycle Alloy Wheel. Generated by Foxit Creator.
3. Mohd Izzat Faliqfarhan and Bin Baharom (2008), "Simulation Test of Automotive Alloy Wheel Using Computer Aided Engineering Software", Eng. D. Thesis,
4. Liangmo Wang, Yufa Chen, Chenzhi Wang and Qingzheng Wang (2011), "Fatigue Life Analysis of Aluminum Wheels by Simulation of Rotary Fatigue Test", Strojniski Vestnik-Journal of Mechanical Engineering,University Malaysia, Pahang.
5. Si-Young Kwak, Jie Cheng and Jeong-Kil Choi (2011), "Impact Analysis of Casting Parts Considering Shrinkage Cavity Defect", China Foundry,
6. WenRu Wei, Liang Yu, Yanli Jiang, JunChuan Tan and Ru HongQiang (2011), "Fatigue Life Analysis of Aluminum HS6061- T6 Rims Using Finite Element Method", International Conference on Remote Sensing, Environment and Transportation Engineering.