DESIGN AND ANALYSIS OF ALLOY WHEEL FOR TWO WHEELER VEHICLE

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ABSTRACT:

Alloy wheel plays a major role in automotive industry. The main aim of our project is to design a new better lighter alloy wheel similar to the existing design. Alloy wheels are the wheels which are made in non ferrous alloy because there is no iron content.They are typically light weight and it has same strength and better heat condition. Aluminium alloy and the magnesium alloy are the common alloy wheels are used in the wheel industry.

In this project we have designed a wheel of bajaj platina to reduce the weight of the alloy the composition of the other non ferrous alloys which is mixed with aluminium to increase their strength and reduce their weight and cost. The design of the existing alloy is done in the solidworks 2015 x64 edition and it is analyzed in the ansys workbench 14.5 software.

Key words: Non Ferrous Alloy, Composition, Bajaj Platina.

I.INTRODUCTION:

Wheel is a circular device in order to rotate the wheel an external force needs to be applied to the axis. It is one of the most important parts in automobile. Wheels must be rigid enough to retain their shape under all operation condition. The design of the wheel should be such that the tyre can be fitted easily. Spoke wheel was the first wheel which was introduced in the wheel industry, but these can be easily corroded. To overcome this alloy wheel was introduced. The mixture of two or more metals is called alloys. Alloy wheel was introduced which provide greater stability at high speed. It has less number of spokes. The major difference between the spoke and alloy wheel, in the spoke wheel the tubeless tyre cannot be accommodated but in the alloy wheel the tubeless tyre can be easily accommodated.

1.1 Alloy wheels:

Alloy wheels are the automobile wheels which are made from an alloy of aluminium or magnesium metals. Alloy wheels are differs from normal steel because of light weight and better heat conductors. (1)

1.2Non Ferrous Alloys:

The metal which doesnot contain iron content such metal is called as non ferrous alloys. It is the alloy which is commonly used in the wheel industry. The Non Ferrous Metals are Aluminium, Magnesium, Copper, Titanium, Nickel, Silicon,etc……..(2)

1.2 Parameters of Alloy Wheels:

The Non ferrous metals has a several parameters like Style, Weight, Manufacturability and performance of the Design of the new wheel, The cost and weight of the Alloy wheel is less comparing to the spoke wheel. (3)

1.3 Aluminium Alloy:

Aluminium is the most common materials which is used in wheel industry. It is the metal which is considered as a good metal for the wheel industry. [3] discussed about a disclosure which is made regarding a driving alert system which is designed in the form of a neck cushion which has the capability to sense the posture of the drivers neck position so as to identify whether the driver is alert and if he is dozing of. The system is made intelligent to obtain data from the movement so as to produce triggers to alert the user and to keep him/her awake to avoid accidents. The system is also linked to a mobile computing device so as to provide a report of the analysis done. The drivers location can also be tracked using the same. It has less weight and low cost comparing to all the other metals.

1.4 Steels:

Steel is the first metal which is used in Alloy wheel. Steel is an alloy which is consists of iron and carbon. It has more strength but it is very hard and high cost. The weight of the steel is more high. (4)

1.5 Magnesium Alloy:

Magnesium Alloy is the metal which is used instead of Steel. It has several key properties that make us it is a attractive base metals for wheel. Magnesium Wheels are lighter weight comparing to steel. This wheel which give good milage for automobile because due to their less weight and easy to move. (5).

II. LITERATRE SURVEY

There are several Journal, Books and websites are referred for comprising the materials and two wheeler rim. Since there are no research work about a design and analysis for a commercial vehicle. This idea to analyze the commercial vehicle. A commercial vehicle BAJAJ PLATINA has been choosen for this project. The materials properties, design calculation and method of analyze has been taken from following base papers.

2.1 Base paper:

1. Daniel Antony C, Prince Jerome Christopher J, “Design and analyze of two wheeler alloy rim wheel using composite materials”, International Journal of Innovative Research in Science, Engineering and Technology, ISSN NO(online): 2319-8753, Volume 5, Number 5(May 2016), ISSN NO(print):2347-6710.

The above project is taken as the base project and the properties of aluminium and the calculation of the theoretical parts are referred and concluded that aluminum(AL7475-T7651) is the best alloy for the design of wheels.

2. Saran Thejal M, Vamsi Krishna M, “Structural and Fatique Analysis of Two Wheeler Lighter Weight Alloy Wheel”, IOSR Journal of Mechanical and Civil Engineering(IOSR-JMCE), e-ISSN: 2278-1684,p-ISSN:2320-334x, Volume 8, Issue 2 (Jul.-Aug. 2013), PP 35-45. From the above project the properties of Magnesium(MG alloy ZK60) and Aluminium(201.0_T43) Alloys and analyze part are referred.

III. DESIGN PROCEDURE FOR ALLOY WHEEL

3.1 Modeling of Alloy Wheel:

Fig.3.1.1 Modeling of Rim Wheel

Fig.3.1.2 Meshing of Rim Wheel

Fig.3.1.3 Part Model of Rim Wheel

3.2 Theoretical Calculations:

Applying Loads:

Mass of bike/Weight of bike = 110kg Other load = 15kg

Load 0 = Weight of bike + Other load = 110+15=125kg, 125*9.81 =1226.25N

Load 1 = 125+60 = 185*9.81 = 1814.85N (Rider); (average weight of man = 60kg)

Load 2 = 185+60 = 245*9.81 = 2403.45N (Rider + 1 person)

Load 3 = 245+60 = 305*9.81 = 2992.05N (Rider + 2 person)

Applying Pressure:

Number of Wheels: 2, Weight of Rim Wheel = 5.85kg`

Rim surface which is having 5 spokes: A5 = 369319.02mm^2. (This can be selecting by measuring tool in solid works software).

Tire and suspension generally reduced 30% of loads

W_{net} = 125*9.81*0.7N = 858.37N

Pressure on Load 0 = 858.37/369319.02 = 0.7285N/mm^2

~similarly

Pressure on Load 1 = 0.6756N/mm^2.

Pressure on Load 2 = 0.5102N/mm^2.

Pressure on Load 3 = 0.4198N/mm^2.

Tabulation of Loads Pressure for rim:

S.No	Loads	Values(N)	Pressure	Values(N/mm^2)
1.	Load 0	1226.25	Pressure 0	0.7285
2.	Load 1	1814.85	Pressure 1	0.6756
3.	Load 2	2403.45	Pressure 2	0.5102
4.	Load 3	2992.05	Pressure 3	0.4196

Table 1 Loads and Pressure

IV. Analysis

Materials Used: Al7475-T7651 (Aluminium Alloy)

4.1Analysis Data for Aluminum Alloy:

S.No	Properties	Values	Units
1.	Density	2810	Kg/m^3
2.	Young's Modulus	71700	Mpa
3.	Poisson's Ratio	0.33	--
4.	Tensile Yield Strength	462	Mpa
5.	Compressive Yield Strength	250	Mpa
6.	Tensile Ultimate Strength	531	Mpa
7.	Bulk Modulus	70294	Mpa
8.	Shear Modulus	26955	Mpa

Table 2 Mechanical Properties for Aluminium Alloy (Al7475-T7651)

4.2 Result Analysis for Aluminium Alloy:

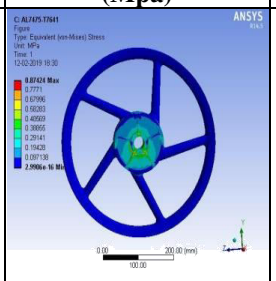
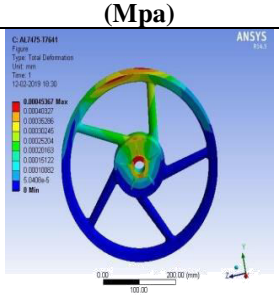
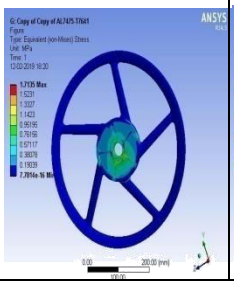
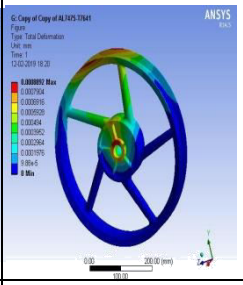
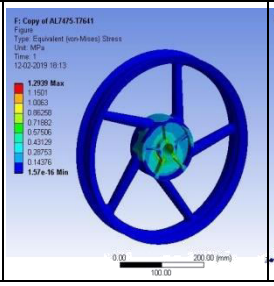
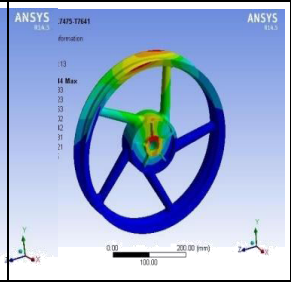
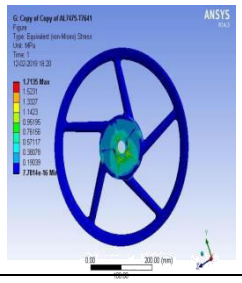
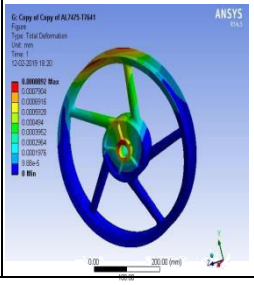
Load/ Pressure	Equivalent Stress (Mpa)	Total Deformation (Mpa)	Load/ Pressure	Equivalent Stress (Mpa)	Total Deformation (Mpa)
Load 0 & Pressure0			Load 2 & Pressure 2		
Load 1 & Pressure 1			Load 3 & Pressure 3		

Table 3 Analysis Result for Aluminium Alloy

From the above table the Deformation and Equivalent Stress for all the Loads and Pressure are Calculated, analyzed and tabulated for the Aluminium Alloy (Al7475-T7651). [5] discussed about a disclosure which is made regarding a gear blocking gear cover for the four wheeler vehicle where the protective cover has been with touch sensors and biometric sensors. Here in case of theft even if the car is started without a key the gear system is locked using biometric locks which can read the palm of the user to unlock the gear system thus protecting the vehicle against any form of theft. This device can be attached to any type of four wheeler vehicle.

Material Used: Mg alloy ZK60 (Magnesium Alloy)

4.3 Analysis Data for Magnesium Alloy:

S.No	Properties	Values	Units
1.	Density	1700	Kg/m^3
2.	Young's Modulus	45000	Mpa
3.	Poisson's Ratio	0.35	---
4.	Bulk Modulus	50000	Mpa
5.	Shear Modulus	16667	Mpa
6.	Yield Strength	425	Mpa
7.	Thermal Conductivity	160	W/(m/K)
8.	Specific Heat	1000	J(Kg/K)

Table 4 Mechanical Properties for Magnesium Alloy (Mg Alloy ZK60)

4.4 Analysis Result for Magnesium Alloy:

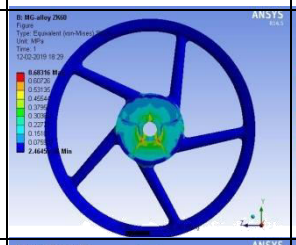
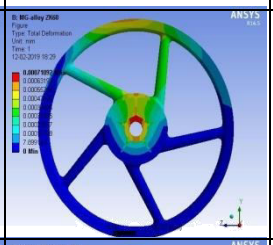
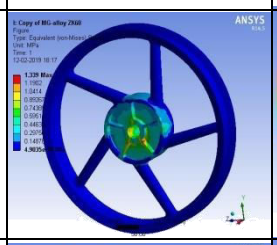
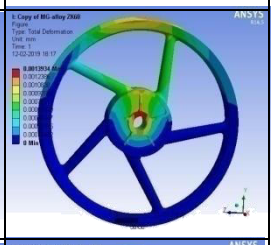
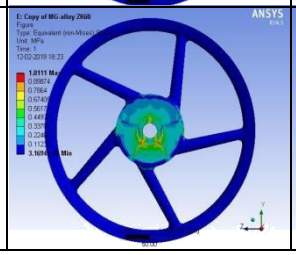
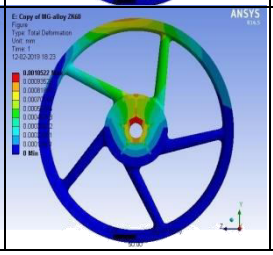
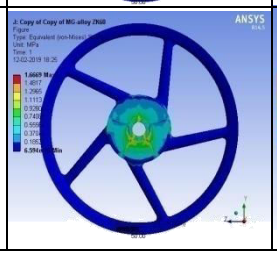
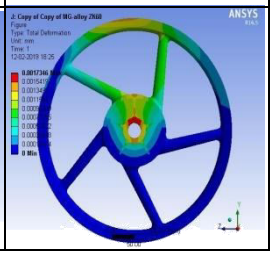
Load/ Pressure	Equivalent Stress (Mpa)	Total Deformation (Mpa)	Load/ Pressure	Equivalent Stress (Mpa)	Total Deformation (Mpa)
Load 0 & Pressure 0			**Load 2 & Pressure 2**		
Load 1 & Pressure 1			**Load 3 & Pressure 3**		

Table 5 Analysis Result for Magnesium Alloy

From the above table the Deformation and Equivalent Stress for all the Loads and Pressure are calculated, analyzed and tabulated for the Magnesium Alloy.

V. Comparison and Result

S. No	Loads/Pressure	Al7475-T7651	Mg alloy ZK60
1.	At 0	0.00045367	0.00071092
2.	At 1	0.00067144	0.0010522
3.	At 2	0.00088921	0.0013934
4.	At 3	0.001107	0.0017346

Table 6 Comparison of Total Deformation Results

From the above table by applying the different loads and conditions we have examined that the total deformation on Al7475-T7651 is lower than the Mg alloy ZK60.

S. No	Loads/Pressure	Al7475-T7651	Mg alloy ZK60
1.	At 0	0.87424	0.68316
2.	At 1	1.2939	1.0111
3.	At 2	1.7135	1.339
4.	At 3	2.1331	1.6669

Table 7 Comparison of Equivalent Stress Results

From the above table by applying the different loads and conditions we have examined that the total deformation on Al7475-T7651 is higher than the Mg alloy ZK60.

S. No	Loads/Pressure	Al7475-T7651	Mg alloy ZK60
1.	At 0	$1.231e^{-5}$	$1.542e^{-5}$
2.	At 1	$1.8218e^{-5}$	$2.822e^{-5}$
3.	At 2	$2.4127e^{-5}$	$3.0223e^{-5}$
4.	At 3	$3.0036e^{-5}$	$3.7625e^{-5}$

Table 8 Comparison of Equivalent Strain Results

From the above table by applying the different loads and conditions we have examined that the total deformation on Al7475-T7651 is higher than the Mg alloy ZK60.

V1. Conclusion

The original design of the wheel rim of a Commercial Vehicle of a BAJAJ PLATINA was presented. The Maximum value of Deformation, Equivalent Stress and Equivalent Strain of aluminium alloy (Al7475-T7641) and Magnesium alloy (Mg alloy ZK60) for a various types of Loads and pressure were analyzed and tabulated. While comparing the two results it is concluded that **Al7475-T7651** is the suitable material for the commercial vehicle comparing to Mg alloy ZK60 for the respective design. The Proposed Design is modeled by using Solid works 2015 X64 software and analyzed by using Ansys Workbench 14.5.

VII. Future Scope

In future the performance of this two wheeler rim will be checked and the current design of the wheel rim will be modify by reducing the number of spoke. The weight of the wheel can be reduced by reducing the part of rim wheel where the stress is does not act.

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