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Design and Analysis of α (Alpha) Wheels

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Abstract

A α-wheel is a part of suspension used to carry various loads acting on the suspension system of vehicles. α-wheel is subjected to various stresses like bending, torsion and shear stresses due to different loads acting on it. It will leads to sudden deformation and failure of material. Thisproject describes design and experimental analysis of anα-wheel and material Carbon fibre. Finite element analysis (FEA) is carried out at static condition of the loop wheel, sothat stress distribution can be observed for analysis of high stress zones. Solid works model is prepared in the analysis. The analysis is to compare the various loading condition and overall stress distribution zones have been studied.

Keywords:*Carbon Fibre Materials, Finite Element Method,StructuralAnalysis.*

1. INTRODUCTION

Anα-wheel is a simple form of spring used for the suspension in wheeled vehicles. The α-wheel is based on the theory of a beam ofuniform strength.α-wheel can serve locating and to some extent damping as well as springing functions.

In this present work, an attempt is made to replace the existing wheelswith α-wheel used in light vehicle, α-wheel is designed to analysis the behaviour of bending stress, deflection and stress at various loads is applied over. Weight reduction can achieve by the 60%. After using carbon fibre composite α-wheel. Increasing competition and innovations in automobile sector tends to modify the existing products or replacing old products by new and advanced material products. A suspension system of vehicle is also an area where these innovations are carriedout regularly. There is almost a direct proportionality between the weight of the vehicle and its fuel consumption. This paper is mainly focused on the implementation of composite materials and replacing steel in conventional wheel of a suspension system. Automobile-sector is showing an increased interest in the area the introduction of the paper shouldexplain the nature of the problem, previous work, purpose, and the contribution of the paper. The contents of each section may be provided to understand easily about the paper, of composite material- springs due to their high strength to weight ratio. Therefore analysis of composite material α-wheel has become essential in showing the comparative results with conventional suspension system.

2. PROBLEM DESCRIPTION

As weight plays an important role in deciding the efficiency of an automobile. The wheel rims used generally is made of steel which are quite bulky and one of the potential items for weight reduction in automobiles because it accounts 10-20% spring weight carried by its own. This work is mainly focused on the implementation of carbon fibre α-wheel by replacing the excising conventional steel wheel to reduce product weight, improving the safety, comfort and durability.

2.1Theoretical calculation

The specification of Royal Enfield is taken for calculating the stress created during maximum speed condition. The maximum deformation created will be found to find the deceleration to find the strength of the α-wheel.

2.2Suspension system

Suspension = spring + shock absorber + α-wheel. System = Assemblage or combinations of things or parts.Thus, Suspension system is a mechanical system which consists of springs and shock absorbers. The automobile chassis is mounted on the axles, not direct but some form of hub holding.

3. STATIC STRUCTURAL ANALYSIS

Analysis done while the structure is static using ANSYS Workbench 14.0. The specifications, material properties, modelling, meshing, element type of the analysis are given below.

3.1Specification Of The α-Wheel

The α-wheel input dimensions are followed by “universal wheel design”.

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Table 1 *Design Parameter for α-wheel*

Sl. No.	Parameters	Dimensions
1	Total Length (mm)	490
2	Width (mm)	490
3	Max. Load given on α-wheel (N)	1000,1500,2000
4	Weight (kg)	5.87

3.2Material For α- Wheel

Wheels are made of various fine grade alloy steel. The test wheel is used for experimentation purpose. Thewheel is used in the ROYAL ENFIELD vehicle, for front Suspension. Following are the parameters for the α-wheel.

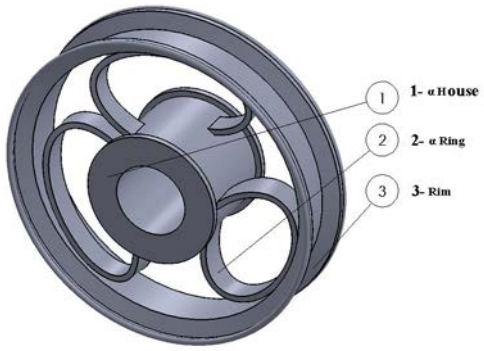
3.3Modelling

The modelling of the alpha wheel profile is done using solid works13. The dimensions are taken from Royal Enfield Classic 350 motor bike

Fig. 1 *Dimension is first modelled in SOLID WORKS 13*

3.4Element Type

Tetra element: SOLID185 is used for the 3-D modelling of solid structures. The element is defined by four nodes having three degrees of freedom at each node: translations in the nodal



x, y, and z directions.

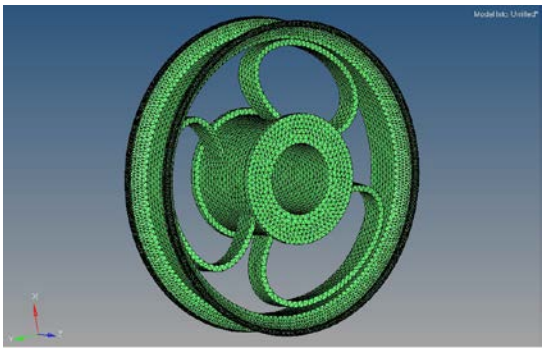
The element is defined by four nodes and the isotropic material properties. The default element coordinate system is along global directions. You may define an element coordinate system using ANSYS, which forms the basis for isotropic material directions.

3.5Meshing (Hyper Mesh12.0)

The meshing of the alpha wheel profile is done using hyper mesh12.The number of nodes 46385 and number of elements 168784 for the selected meshing statics.

Fig. 2 *Meshed view in the HYPER MESH12*

3.6Loads & Boundary Conditions



- The boundary conditions the alpha wheels are show in Figure3.
- The inner face of the hub is arrested in all degree of freedom
- The assembly is arrested to rotate in Uz.
- The static load is given as the magnitude of -1000N, -1500, -2000N in Uy separately

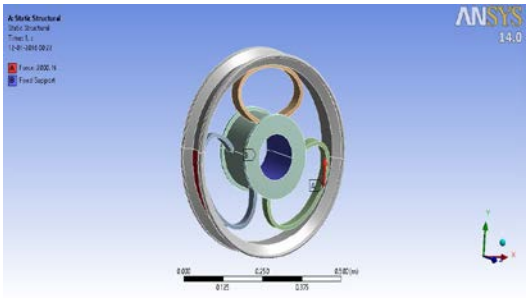


Fig.3*Loading conditions*

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3.7Analysis

Modelling is done by solidworks13 and meshing using hypermesh12 then Analysis is carried out by using ANSYS 14.0 software for better understanding. SOLID185 element is a higher order 3-D,4-node element.

4. RESULTS AND DISCUSSION

From the result of static analysis of α-wheel, it is seen that the maximum bending stress in α-wheel is86 N/mm^2 when 1500N load on wheel is applied as shown in figures. Thus α-wheel has a safe bending stress over normal wheel.

Fig. 4A *Von Mises Stress at load of 1000 N*

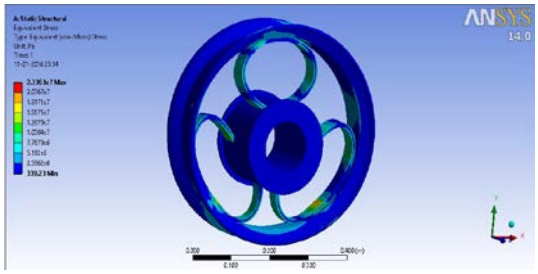


Fig. 4B *Load vs. Deflection for 1000N load*

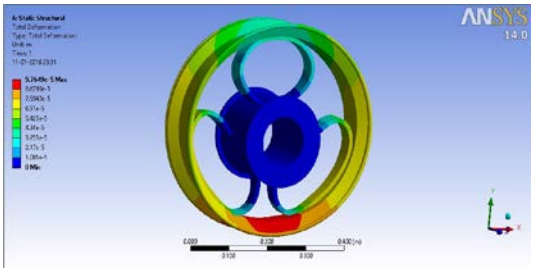


Fig. 4C *Shear Stress at load of 1000 N*

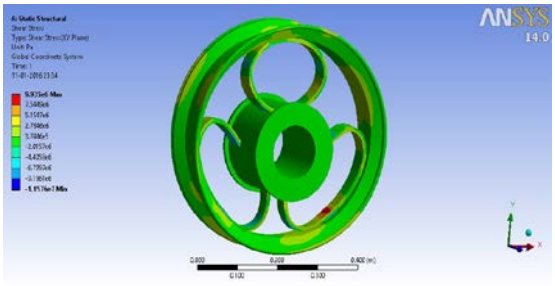


Fig.4.1A *Von Mises Stress at load of 1500 N*

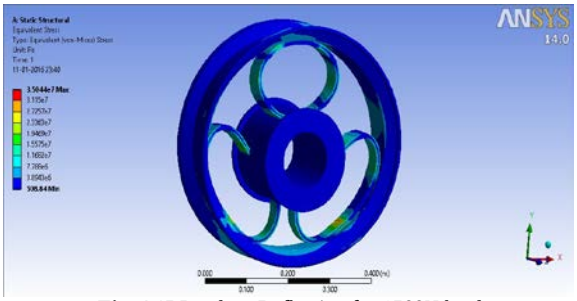


Fig. 4.1B*Load vs. Deflection for 1500N load*

Fig. 4.1C*Shear Stress at load of 1500 N*

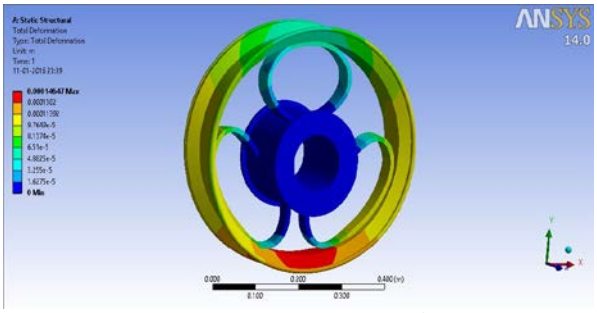


Fig. 4.2A*Von Mises Stress at load of 2000 N*

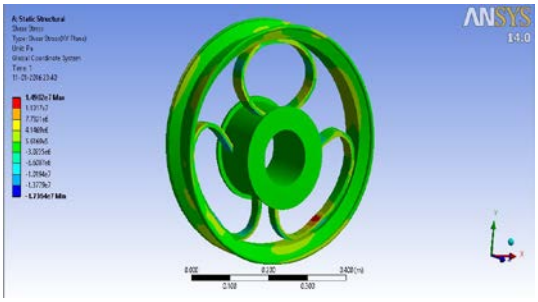
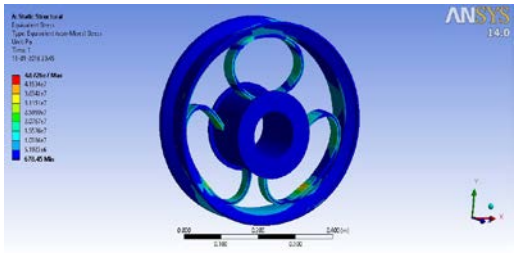


Fig.4.2B *Load vs. Deflection for 2000N load*



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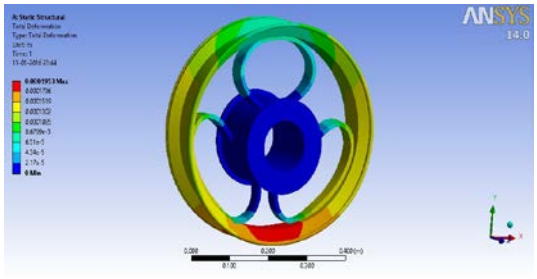
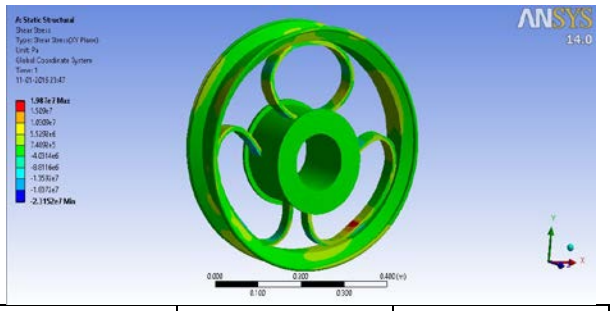


Fig. 4.2C *Shear Stress at load of 1500 N*

Table 2*FEA Results of materials*



PARAMETER	FEA RESULT OF α -WHEEL	FEA RESULT OF NORMAL WHEEL
Static Load (N)	**Bending Stress** (N/mm^2)	
1000	23	132
1500	35	144
2000	46	160
Deformation (mm)	0.34	0.42

5. CONCLUSION

- In this present work, the bending stress, deformation and deflection were analyzed for the wheel of ROYAL ENFIELD α-wheel.
- The Optimum bending stress value of α-wheel by analyzing is found to be 86 N/mm2, 95 N/mm2, and 112 N/mm2 which is lesser than Conventional wheel of 160 N/mm2. The lower bending stress results in increased life of the material carbon fibre as compared to existing material.
- The deflection value of conventional wheel and α-wheel is found to be 182mm and 160mm. The α-wheel subjected to lesser deflection, it indicates the better strength as comparing to existing.
- The Deformation of α-wheel is 0.34307mm whereas for conventional is found to be 0.4162mm.
- Therefore, the analyzed results indicate that α-wheel may be selected due to their lesser stress, deflection and deformation as compared to the existing.

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