



ISSN: 0976-3031

Available Online at <http://www.recentscientific.com>

International Journal of Recent Scientific Research
Vol. 7, Issue, 8, pp. 12921-12924, August, 2016

**International Journal of
Recent Scientific
Research**

Research Article

DESIGN AND ANALYSIS OF DRIVE SHAFT BY DIFFERENT REINFORCEMENT MATERIAL IN METAL MATRIX COMPOSITE

Kalaiyarasan A*¹ and Sankareswaran N²

¹Department of Mechanical Engineering, Muthayammal Engineering College, Rasipuram, Tamilnadu, India

²Department of Mechanical Engineering, Anna University Regional Campus Tirunelveli, Tirunelveli, Tamil Nadu, India

ARTICLE INFO

Article History:

Received 15th May, 2016

Received in revised form 25th June, 2016

Accepted 23rd July, 2016

Published online 28th August, 2016

Key Words:

Stir-casting; process; MMC;

Reinforcement; Alumina; drive shaft;

Static analysis; Nano composite

ABSTRACT

The composite material is mainly used to reduce the weight and increase the strength, stiffness etc... Stir casting process is mainly used to manufacturing of reinforced with metal matrix composite. The manufacturing of aluminum alloy based on stir casting method its used to one of the most economical method of processing MMC. The main project the operating parameter of the composite as its control the properties of the composite material. The drive shaft is increases the length of the shaft because to reduce the whirling vibration. This paper present overview of stir casting process, parameter & preparation of MMC study on mechanical behavior of metal matrix composite with varies composition of reinforcement particles of graphite or Nano particle Sic and Al₂O₃ composite produced by the stir casting technique. Different percentage of reinforcement is used. Tensile, Hardness properties and torsion analysis. The shaft is modeled using CERIO modeling and finite element analysis is done for same model utilizing ANSYS 15.0 software for Aluminum (Al-SiC) and the results were discussed.

Copyright © Kalaiyarasan A and Sankareswaran N., 2016, this is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution and reproduction in any medium, provided the original work is properly cited.

INTRODUCTION

Drive shaft is most important part contrasted with different parts in an automobile division. In recent papers a driveshaft is a rotating shaft that transmits power from the engine to the differential gear of a rear wheel drive vehicles Driveshaft must operate through constantly changing angles between the transmission and axle. High quality steel (Steel SM45) is a common material for construction. Steel drive shafts are usually manufactured in two pieces to increase the fundamental bending natural frequency because the bending natural frequency of a shaft is inversely proportional to the square of beam length and proportional to the square root of specific modulus. The two piece steel drive shaft consists of three universal joints, a center supporting bearing and a bracket, which increase the total weight of a vehicle. Power transmission can be improved through the reduction of inertial mass and light weight. Substituting composite structures for conventional metallic structures has many advantages because of higher specific stiffness and higher specific strength of composite materials. Composite materials can be tailored to efficiently meet the design requirements of strength, stiffness and composite drive shafts weight less than steel or aluminum

of similar strength. It is possible to manufacture one piece of composite. Drive shaft to eliminate all of the assembly connecting two piece steel drive shaft. Also, composite materials typically have a lower modulus of elasticity. As a result, when torque peaks occur in the driveline, the driveshaft can act as a shock absorber and decrease stress on part of the drive train extending life. Many researchers have been investigated about MMCs drive shafts and joining methods of the MMCs shafts to the yokes of universal joints.

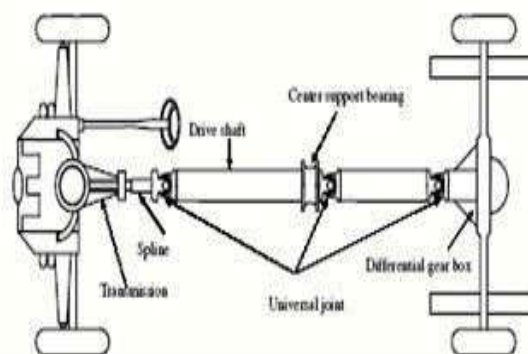


Fig1 schematic arrangement of underbody of an automobile

*Corresponding author: Kalaiyarasan A

Department of Mechanical Engineering, Muthayammal Engineering College, Rasipuram, Tamilnadu, India

Design of composite drive shaft

Identification of problem

- The passenger cars, trucks and vans should have the torque transmission capacity more than 3500Nm and the natural frequency must be higher than 6500 rpm to avoid whirling vibration.
- In that the critical speed of shaft is inversely proportional to the square of the length. so that the vibration problem could be solve by increasing the length of shaft but it's not permitted due to space limitations.
- So that it's only for manufacturers and manufacture the shaft in two pieces.

Assumptions

The shaft rotates at a constant speed about its longitudinal axis. The shaft has a uniform, circular cross section.

The shaft is perfectly balanced, all damping and nonlinear effects are excluded. The stress-strain relationship for composite material is linear and elastic; hence, Hook's law is applicable for composite materials. Since lamina is thin and no out-of-plane loads are applied, it is considered as under the plane stress.

Merits of Composite Drive Shaft

1. They have high specific modulus and strength.
2. Reduced weight.
3. Due to the weight reduction, fuel consumption will be reduced.
4. They have high damping capacity hence they produce less vibration and noise.
5. They have good corrosion resistance.
6. Greater torque capacity than steel or aluminum shaft.
7. Longer fatigue life than steel or aluminum shaft.

Theory

Composite Material: A material composed of two or more constituents is called composite material. Composites consist of two or more materials or material phases that are combined to produce a material that has superior properties to those of its individual constituents. The constituents are combined at a macroscopic level and or not soluble in each other. The main difference between composite and an alloy are constituent materials which are insoluble in each other and the individual constituents retain those properties in the case of composites, whereas in alloys, constituent materials are soluble in each other and forms a new material which has different properties from their constituents. Classification of Composites

- Polymer matrix composites
- Metal matrix composites
- Ceramic Matrix composites

Material Selections

(A6061)-LM6 Aluminum alloy having density of 2.72 gm/ and prominent properties like weight, toughness etc. was chosen as the base material due to its usage of drive shafts. The aim of increasing the wear resistance, strength, stiffness, hardness etc. of this drive shaft alloy, SiC particles of 23micron size was

selected as reinforcement. This SiC has higher density 3.22 gm/cm³, higher hardness relative to B4C, and the excellent chemical composition and to improve the wear performances of the alloy

Table 1 Aluminium alloy series

Alloy series	Features	Application
Al2024	Good corrosion resistance & High strength	High strength structural (aircraft), automotive parts, screws and rivets.
Al6061	Good formability, weld ability, corrosion resistance and strength.	Marine, aircraft's and automobile parts
Al7075	High strength alloy	Aircraft and structure, recreation equipment's.

RESULT AND DISCUSSION

Finite Element Analysis

Design Analysis

Finite element analysis is a computer based analysis technique for calculating the strength and behavior of structural engineering. In the structure is represented as finite element. These elements are jointed at particular points which are called as nodes. The FEA is used to calculate the deflection, stress, strain, buckling behavior of the member. In our project FEA is carried out by using ANSYS 15.0. Initially we don't know the displacement and other quantities like stress, strain, deflection which are the then calculated from nodal displacement.

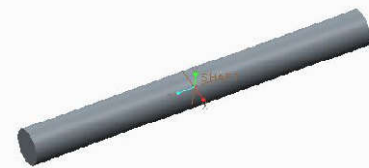


Fig 2 Cerio modeling

In present work we have used FEA for the structural analysis of Aluminium/SiC drive shaft. The CERIO software is used to prepare the drive shaft. After completing CERIO modeling, the model is saved in STP or IGES file then STP or IGES file is import to ANSYS 15.0 software for the finite element analysis.

Boundary Condition

The finite element model of Al-SiC shaft is shown in figure. One end is fixed and torque is applied at other end.

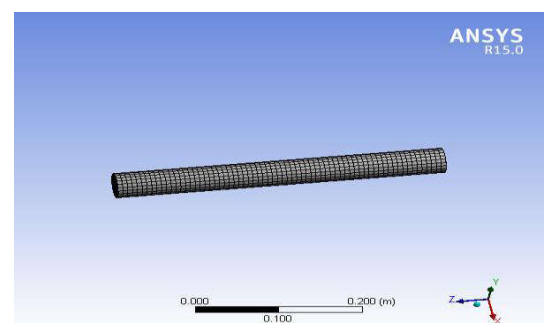


Fig 3 Finite element model of Al-SiC

Ansys Simulation

Static Analysis

A static analysis is used to determine the displacement, strain, von mises stress and force in structure or compounds caused by load that do not significant inertia and damping effects.

The static analysis of drive shaft is done by ANSYS software 15.0.

Static analysis of Aluminium alloy

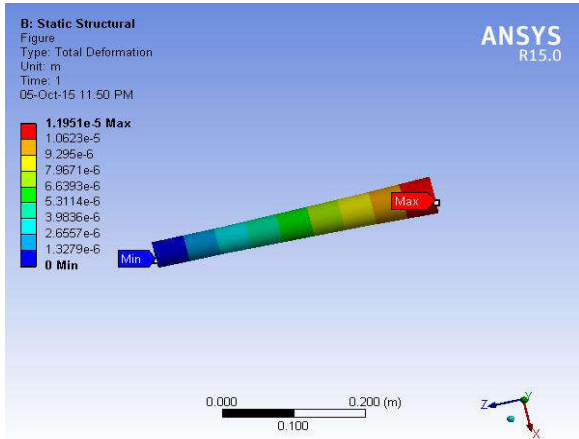


Fig 4 Total deformation of Aluminium alloy

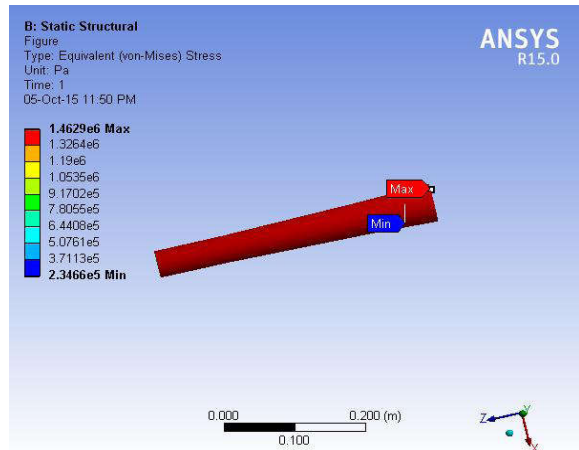


Fig 5 Von-mises stress of Aluminium alloy

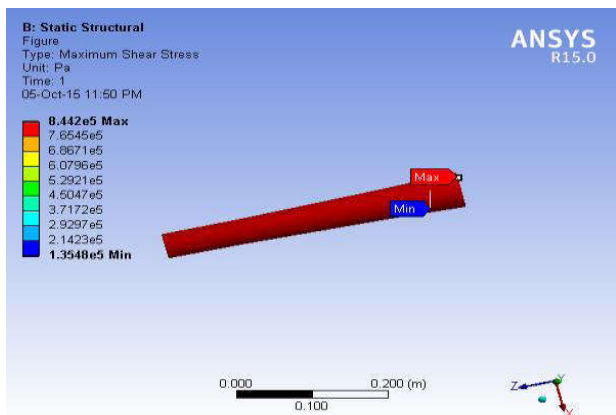


Fig 6 Shear stress of Aluminium alloy

The maximum deflection induced in the drive shaft is 1.1927e-5 mm and the von mises stress is 1.398e6 pa.

Static Analysis of Al-SiC

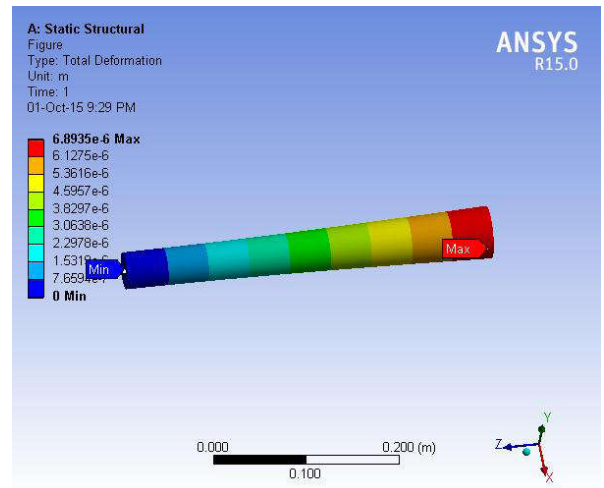


Fig 7 Total deformation of Al-SiC

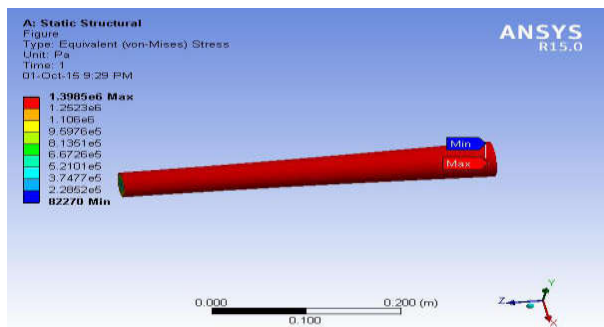


Fig 8 Von mises stress of Al-SiC

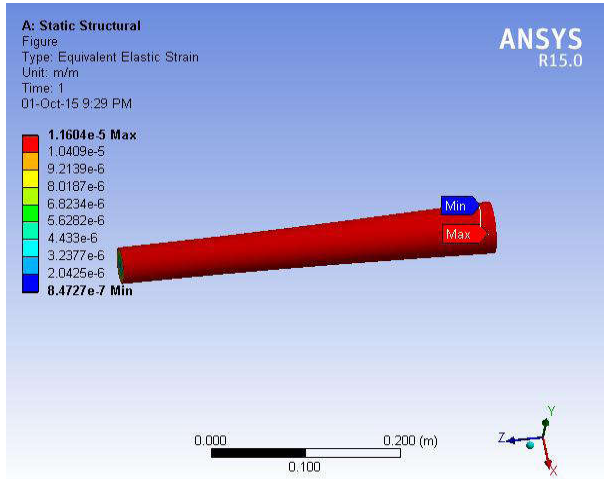


Fig 9 Strain of Al- SiC

Table 3 Static analysis of drive shaft

Material	Total deformation mm	Von misesstress pa	Strain
Aluminium alloy	1.1927e ⁻⁵	1.3985e ⁶	1.9765e ⁻⁵
Al- SiC	6.8935e ⁻⁶	1.3985e ⁶	1.1604e ⁻⁵

CONCLUSION

- The high strength Al-SiC composite drive shaft have been designed to replace the steel, aluminium alloy drive shaft of an automobile.

- The weight savings of the high strength Al-SiC is equal to 60% approximately of the steel shaft and aluminium alloy shaft.
 - The replacement of conventional drive shaft results in reduction in weight of automobile.
 - The finite element analysis is used in this work to predict the deformation of shaft.
 - Hence the single piece high strength Al-SiC drive shaft has been proposed to design to replace the two piece conventional steel, aluminium alloy drive shaft of an automobile.
2. Goldberg, D. E. Genetic Algorithms in Search, Optimization and Machine Learning, Reading MA, Addison-Wesley, 1989
 3. Kim C D *et. al.* 1992, "Critical speed Analysis of Laminated Drive Shafts", Composite Eng. Vol.3, pp. 633-643.
 4. John. W.*et. al.* Engineers Guide to Composite Materials, American Society for Metals, 1986.
 5. Pollard, A. Polymer Matrix Composites in Driveline Applications, GKN Tech., UK, 1989.
 6. Rajeev S and Krishnamurthy, C.S, 1992 "Discrete Optimization of structure using Genetic Algorithm", *Journal of struct. Egg.* ASCE Vol. 118 PP. 1233-1250
 7. Vijayarangan, S., Rajendran, I. Optimal Design of a Composite Leaf Spring Using Genetic Algorithm Computers and Structures 79 2001: pp. 1121 – 1129.
 8. T. Rangaswamy, *et. al.* "Optimal Sizing and stacking Sequence of Composite Drive shafts" ISSN 1392–1320 materials science (medžiagotyra). Vol.11, no.2. 2005
 9. T.Rangaswamy, *et. al.* "Optimal Design and Analysis of Automotive Composite Drive Shaft", International Symposium of Research Students on Materials Science and Engineering December 2002-04 Chennai India.

Acknowledgements

It is a pleasure for me to present this paper where guidance plays an invaluable key and provides concrete platform for completion of the paper. I would also like to express my sincere thanks to my internal guide Asst. Prof. Mr.Sankareswaran Department of Mechanical Engineering, in Anna University regional office Tirunelveli for his unfaltering encouragement and constant scrutiny without which I wouldn't have looked deeper into my work and realized both our shortcomings and our feats. This work would not have been possible without him.

References

1. Beardmore, P. *et al.* The Potential for Composites in Structural Automotive Applications *J. of Composites Science and Technology* 26 1986: pp. 251 – 281.

How to cite this article:

Kalaiyaran A and Sankareswaran N.2016, Design and Analysis of Drive Shaft by Different Reinforcement Material In Metal Matrix Composite. *Int J Recent Sci Res.* 7(8), pp. 12921-12924.