HIGH MODULE CAD USED FOR THE DESIGN AND ANALYSIS OF A COMPOSITE DRIVE SHAFT AND TESTED IT IN ANSYS SOFTWARE FOR OPTIMIZATION

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ABSTRACT
Most cars that are designed with rear wheel drive and a front-mounted engine have transmission shafts. The driveshaft is one of the crucial parts of heavy-duty automobiles. It is very desirable to reduce the weight of the drive shaft since it can contribute to the vehicle's overall weight reduction without increasing costs or sacrificing quality or dependability. The purpose of this effort is to substitute an acceptable composite driveshaft for the standard steel driveshaft used in vehicles. The composite drive shafts may be constructed as a single-piece shaft, which reduces the overall weight, as opposed to the conventional drive shafts, which are made in two sections to reduce the bending natural frequency. The design parameters were optimized with the objective of minimizing the weight of composite drive shaft. The composite driveshaft made up of high modulus material is designed by using CAD software and tested in ANSYS for optimization of design or material check and providing a best material.

Keywords: Drive shaft, Universal joint, Modeling, Composite, Weight reduction, ANSYS.

INTRODUCTION
These days, composite materials are widely employed in a variety of technical projects, such as spacecraft, aircraft, cars, boats, sporting goods, bridges, and buildings. Due to their exceptional qualities, such as their great strength-to-weight ratio and hardness-to-weight ratio, composite materials are widely used in industry. In the 1970s, composite materials were originally used in the aircraft sector, but today, only three decades later, they are being used in the majority of industries. The features and traits of these innovative materials have benefitted the automobile sector, which is regarded as a pioneer in every nation. Metallic vehicle elements have been replaced with composite ones as technology has advanced. Power transmission drive shafts are used in many applications, including cooling towers, pumping sets, aerospace, structures, and automobiles. Drive shafts are usually made of solid or hollow tube of steel or aluminum. For automotive applications, the first composite drive shaft was developed by the Spicer U-Joint division of Dana Corporation for Fordeconomize van models . When the length of a steel drive shaft goes beyond 1500 mm, it is manufactured in two pieces to increase the fundamental natural frequency, which is inversely proportional to the square of the length and proportional to the square root of the specific modulus. The nature of composites, with their higher specific elastic modulus, which in carbon/epoxy exceeds four times that of aluminum, enables the replacement of the two-piece metal shaft with a single-component composite shaft which resonates at a higher rotationalspeed, and ultimately maintains a higher margin of safety. A composite drive shaft offers excellent vibration damping, cabin comfort, reduction of wear on drive train components and increases tire traction. In addition, the use of single torque tubes reduces assembly time, inventory cost, maintenance, and part complexity.

LITERATURE SURVEY
- D.G. Lee [1] manufacture Drive Shaft using Carbon/Epoxy composite with aluminum and find performance of Drive Shaft.
- Bhirud Pankaj Prakash [2] Design and Analysis Composite Drive Shaft for Automotive by using E glass polyester resin with ansis to find deformation.
- Sagar R dharmadhikari [3] Design and Analysis Composite Drive Shaft for Automotive by using

Carbon/Epoxy and genetic algorithm.

- M.R. Khoshravan [4] Design a Composite Drive Shaft and its Coupling for Automotive Application using HM carbon/epoxy.
- R. P. Kumar Rompicharla [5] Design andOptimization of Drive Shaft with Composite Materials. The drive shaft of Toyota Qualis waschosen for determining the dimensions.

CLASSIFICATION OF COMPOSITES Composite materials in general are categorised based on the kind of reinforcements or the surroundingmatrix. There are four commonly accepted types ofcomposite materials based on reinforcements

a) Fibrous composite materials that consist of fibresin a matrix.
b) Laminated composite materials that consist oflayers of various materials.
c) Particulate composite materials that are composedof particles in a matrix.
d) Combinations of some or all of the first threetypes.

And the major composite classes based on structuralcomposition of the matrix area.

a) Polymer-Matrix Composites
b) Metal- Matrix Composites
c) Ceramic- Matrix Composites
d) Carbon- Carbon Composites
e) Hybrid Composites

Methodology:

Modeling and analysis of 3-Dimensional models of the drive shaft were carried out using catia & solid words and analysis is carried out using Ansys software structural analysis of composite drive shaft and steel drive shaft are carried out. The results are compared with steel shaft to validate our project. Study of cause of failures in drive shaft Selection of composite material Preparation of CAD model Analysis the CAD model with existing material with Ansys Analysis of drive shaft by using different composite materials The results are compared with validate our project.

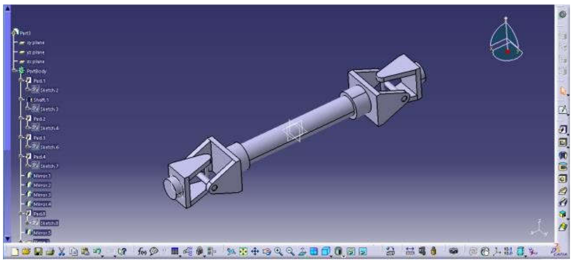
INTRODUCTION TO CATIA

CATIA is an acronym for Computer Aided Three- dimensional Interactive Application. It is one of the leading 3D software used by organizations in multiple industries ranging from aerospace, automobile to consumer products. CATIA provides the capability to visualize designs in 3D. When it was introduced, this concept was innovative. Since Dassault Systems did not have an expertise in marketing, they had revenue sharing tie- up with IBM which proved extremely fruitful to both the companies to market CATIA. In the early stages, CATIA was extensively used in the design of the Mirage aircrafts; however the potential of the software soon made it a popular choice in the automotive sector as well. As CATIA was accepted by more and more manufacturing companies, Dassault changed the product classification from CAD / CAM software to Project LifecycleManagement. The company also expanded the scope of the software.

CATIA can be used at different stages of the design -ideate, draw, test and iterate. The software comeswith different workbenches ("modules") that allow CATIA to be used across varied industries – fromparts design, surface design and assembly to sheet metal design. CATIA can also be used for CNC. CATIA offers many workbenches that can be looselytermed as modules. A few of the importantworkbenches and their brief functionality description is given below: Part Design: The most essential workbench needed for solid modelling. This CATIA module makes it possible to design precise 3D mechanical parts with an intuitive and flexible user interface, from sketching in an assembly context to iterative detailed design. Generative Shape Design: allows you to quickly model both simple and complex shapes using wireframe and surface features. It provides a large set of tools for creating and editing shape designs. Though not essential, knowledge of Part Design will be very handy in better utilization of this module. Assembly: The basics of product structure, constraints, and moving assemblies and parts can be learned quickly. This is the workbench that allows connecting all the parts to form a machine or a component.

3.1 Dimensions of drive shaft Diameter of drive shaft- 40mmLength of drive shaft- 150mm

Modelling of drive shaft

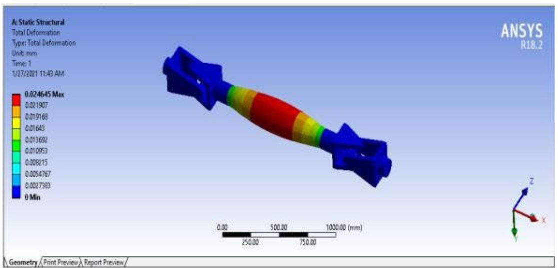


Static analysis of drive shaft

Analysis of programs by methodically analyzing the program text is called static analysis. Static analysis is usually performed mechanically by the aid of software tools. During static analysis the programitself is not executed, but the program text is the inputto the tools. Static analysis can be very useful for exposing errors that may escape other techniques. As the analysis is performed with the help of software tools, static analysis is a very cost-effective way of discovering errors. Data flow analysis is one form of static analysis that concentrate on the uses of data by programs and detects some data flow anomalies . An example of the data anomaly is the live variable problem. In which a variable is assigned some value but then the variable is not used in any later computation.

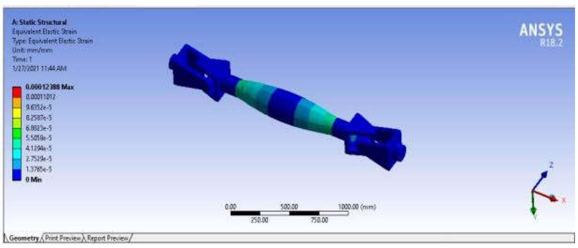
Epoxy carbon Total deformation

Material is used the epoxy carbon the figure showsthe deformation of the drive shaft.



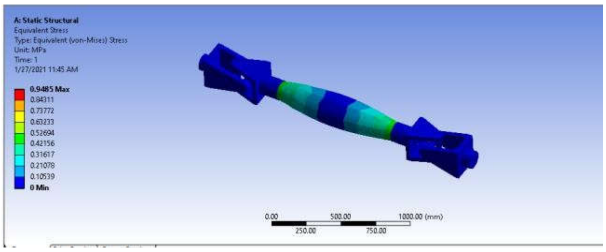
Elastic strain

The figure shows the elastic strain of the drive shaft



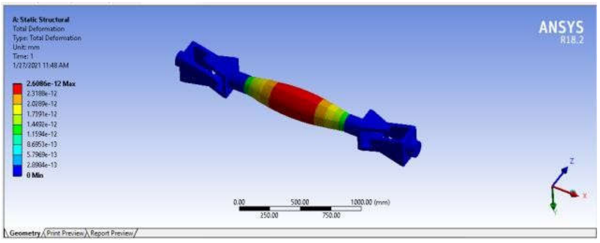
Equivalent stress

The figure shows the equivalent stress of the driveshaft



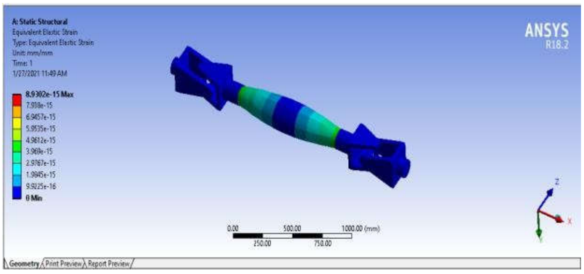
Titanium fiber Total deformation

Material titanium fiber the figure shows thedeformation of the drive shaft



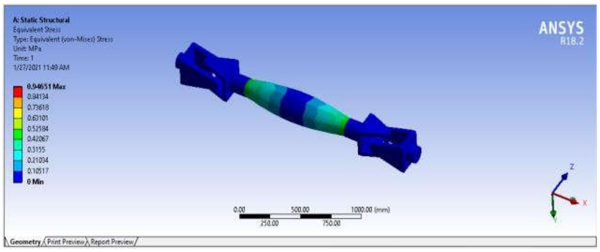
Equivalent strain

The figure shows the equivalent strain of the driveshaft



Equivalent stress

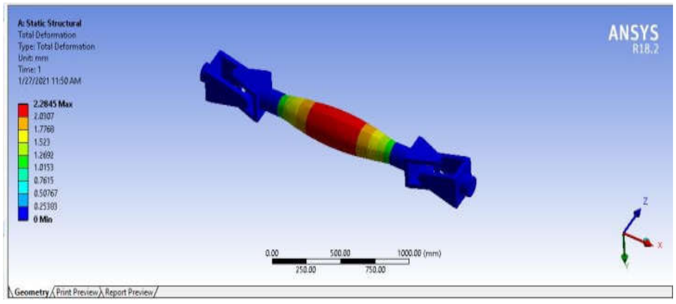
The figure shows the equivalent stress of the driveshaft



Basalt fiber

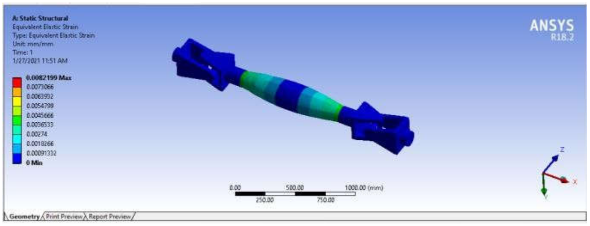
Total deformation

Material is used basalt fiber the figure shows thedeformation of drive shaft



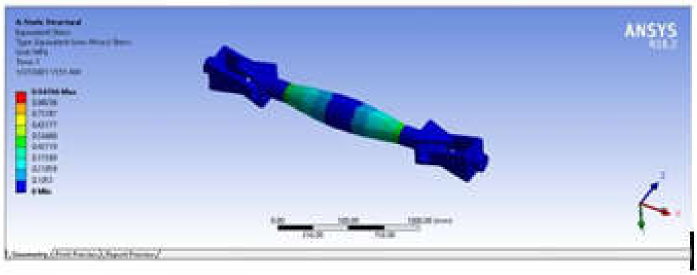
Equivalent strain

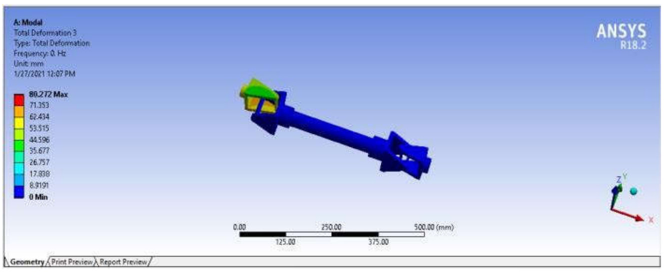
The figure shows equivalent strain of drive shaft



Equivalent stress

The figure shows the equivalent stress of the driveshaft



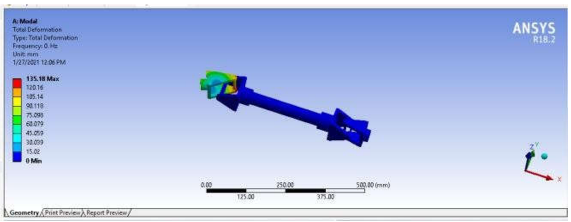


Model analysis

Modal Analysis Process for determining the Nnatural frequencies and mode shapes Given "suitable" initial conditions, the structure will vibrateat one of its natural frequencies ü the shape of the vibration will be a scalar multiple of a mode shapeGiven "arbitrary" initial conditions, the resulting vibration will be a Superposition of mode shapes.Determines the vibration characteristics (natural frequencies and mode shapes) of a structuralcomponents Natural frequencies and mode shapes area starting point for a transient or harmonic analysis **Basalt fiber**

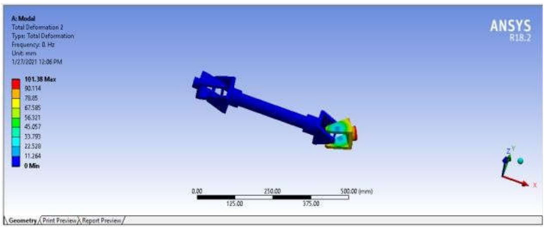
Deformation 1

The figure shows the mode shape of the basalt fibermaterial used and generated the first mode shape ofthe drive shaft



Deformation 2

The figure shows the mode shape of the basalt fibermaterial used and generated the second mode shapeof the drive shaft



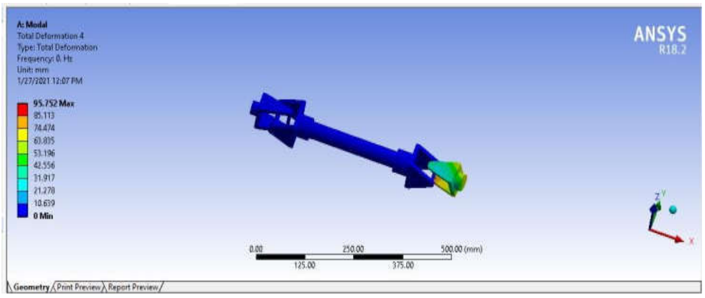
Deformation 3

The figure shows the mode shape of the basalt fibermaterial used and generated the third mode shape ofthe drive shaft

Material	Deformation	strain	stress
Basalt fiber	0.00581	0.0630	$7.2155e^{6}$
Titanium fiber	$6.6327e^{-15}$	$6.8327e^{-14}$	$7.1891e^{9}$
Epoxy carbon	$6.298e^{-5}$	0.000896	$7.1255e^{6}$

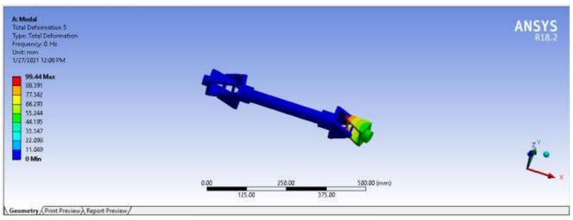
Deformation 4

The figure shows the mode shape of the basalt fiber material used and generated the fourth mode shape ofthe drive shaft



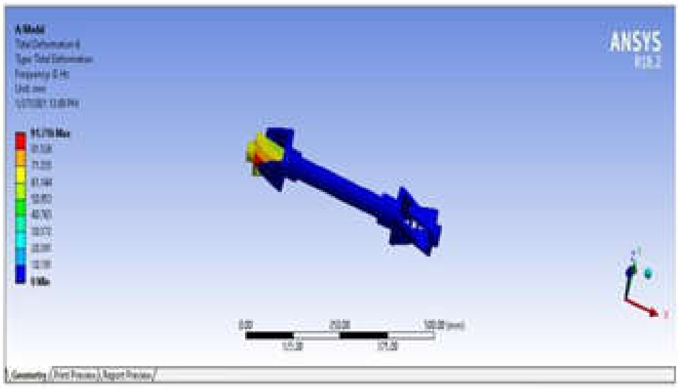
Deformation 5

The figure shows the mode shape of the basalt fibermaterial used and generated the fifth mode shape ofthe drive shaft



Deformation 6

The figure shows the mode shape of the basalt fibermaterial used and generated the sixth mode shape ofthe drive shaft



Result

fiber			

Material	3asalt fiber	tanium fiber	Epoxy carbo nfiber
rmation1	4.2087	2.2037	4.9438
rmation2	3.2261	2.3047	3.4781
rmation3	3.8586	2.708	4.866
rmation4	2.5515	2.6633	5.0363
rmation5	2.5908	2.8518	5.0036
rmation6	2.984	2.8922	4.3477

CONCLUSION

- Modeling and analysis of drive shaft is done
- Modeling of drive shaft is done in catia v5 design software by using various commands
- The catia v5 part file is converted into IGS file and imported to ansys workbench.
- First Static structural analysis is carried out on drive shaft at 100N moment with three different materials, such as basalt fiber, titanium fiber and epoxy carbon fiber in ansys workbench.
- Maximum stress, deformation and maximum strain stress are noted and tabulated
- Second model analysis also done one same three materials.
- From the tables it is concluded that the titanium fiber compared to remaing two materials is showing

efficient results

- Hence titanium fiber is preferable among the two applied materials

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