DESIGN AND ANALYSIS OF COMPOSITE DRIVE SHAFT

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Abstract

The present work shows the design and analysis of composite drive shaft. Substituting composite structures for conventional metallic structures has many advantages because of higher specific stiffness and strength of composite materials. This work deals with the replacement of conventional steel drive shafts with a composite drive shaft. The design parameters were optimized with the objective of minimizing the weight of composite drive shaft. Advanced composite materials can be defined as combination of materials appropriately arranged using reinforcing fibers, carefully chosen matrixes, and sometimes auxiliary materials like adhesive core and other inserts. These combinations after proper manipulation and processing result in finished structure/item with synergistic properties i.e. properties achieved after fabrication cannot be obtained by individual components acting alone. FEM methods play a significant role in analyzing of Composite materials. Present work is conducted to analyze the composite drive shaft by the FEM software ANSYS 2020 Results and graphs will be recorded and presented in the documentation.

Keywords :ANSYS,FEA,CAD,CATIA

I. PROBLEM STATEMENT

Almost all automobiles (at least those which correspond to design with rear wheel drive and front engine installation) have transmission shafts. The weight reduction of the drive shaft can have a certain role in the general weight reduction of the vehicle and is a highly desirable goal, if it can be achieved without increase in cost and decrease in quality and reliability. It is possible to achieve design of composite drive shaft with less weight to increase the first natural frequency of the shaft.

II. INTRODUCTION

2.1 Drive Shaft

A drive shaft, driveshaft, driving shaft, tail shaft (Australian English), propeller shaft (prop shaft), or Cardan shaft (after GirolamoCardano) is a mechanical component for transmitting torque and rotation, usually used to connect other components of a drive train that cannot be connected directly because of distance or the need to allow for relative movement between them.

As torque carriers, drive shafts are subject to torsion and shear stress, equivalent to the difference between the input torque and the load. They must

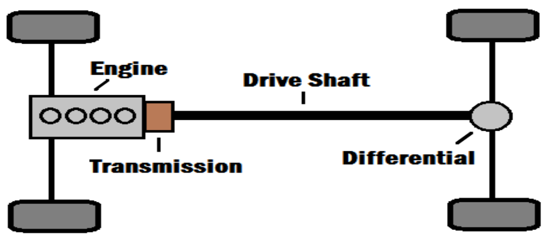


Fig 1. Drive Shaft

therefore be strong enough to bear the stress, while avoiding too much additional weight as that would in turn increase their inertia.

III. AUTOMOTIVE DRIVE SHAFT

3.1 Vehicles

An automobile may use a longitudinal shaft to deliver power from an engine/transmission to the other end of the vehicle before it goes to the wheels. A pair of short drive shafts is commonly used to send power from a central differential, transmission, or transaxle to the wheels.

3.2 Front-engine, rear-wheel drive

In front-engine, rear-drive vehicles, a longer drive shaft is also required to send power the length of the vehicle. Two forms dominate: The torque tube with a single universal joint and the more common Hotchkiss drive with two or more joints. This system became known as *System Panhard* after the automobile company PanhardLevassor which patented it.

Fig 2Front-engine, rear-wheel drive

3.3 Front-wheel drive

In British English, the term "drive shaft" is restricted to a transverse shaft that transmits power to the wheels, especially the front wheels. A drive shaft connecting the gearbox to a rear differential is called a **propeller shaft**, or **prop-shaft**. A prop-shaft assembly consists of a propeller shaft, a slip joint and one or more universal joints. Where the engine and axles are separated from each other, as on four-wheel drive and rear-wheel drive vehicles, it is the propeller shaft that serves to transmit the drive force generated by the engine to the axles.

Several different types of drive shaft are used in the automotive industry:

- One-piece drive shaft
- Two-piece drive shaft
- Slip-in-tube drive shaft

The slip-in-tube drive shaft is a new type that improves crash safety. It can be compressed to absorb energy in the event of a crash, so is also known as a collapsible drive shaft.

3.4 Four wheel and all-wheel drive

These evolved from the front-engine rear-wheel drive layout. A new form of transmission called the transfer case was placed between transmission and final drives in both axles. This split the drive to the two axles and may also have included reduction gears, a dog clutch or differential. At least two drive shafts were used, one from the transfer case to each axle. In some larger vehicles, the transfer box was centrally mounted and was itself driven by a short drive shaft. In vehicles the size of a Land Rover, the drive shaft to the front axle is noticeably shorter and more steeply articulated than the rear shaft, making it a more difficult engineering problem to build a reliable drive shaft, and which may involve a more sophisticated form of universal joint.

3.5 Research and development

The automotive industry also uses drive shafts at testing plants. At an engine test stand a drive shaft is used to transfer a certain speed or torque from the internal combustion engine to a dynamometer. A "shaft guard" is used at a shaft connection to protect against contact with the drive shaft and for detection of a shaft failure. At a transmission test stand a drive shaft connects the prime mover with the transmission

3.6 Motorcycle Driveshaft

Drive shafts have been used on motorcycles since before WW1, such as the Belgian FN motorcycle from 1903 and the Stuart Turner Stellar motorcycle of 1912. As an alternative to chain and belt drives, drive shafts offer long-lived, clean, and relatively maintenance-free operation. A disadvantage of shaft drive on a motorcycle is that helical gearing, spiral bevel gearing or similar is needed to turn the power 90° from the shaft to the rear wheel, losing some power in the process.BMW has produced shaft drive motorcycles since 1923; and Moto Guzzi have built shaft-drive V-twins since the 1960s. The British company, Triumph and the major Japanese brands, Honda, Suzuki, Kawasaki and Yamaha, have produced shaft drive motorcycles

Fig 3. Motorcycle Driveshaft

3.7 Marin Drive Shaft

On a power-driven ship, the drive shaft, or propeller shaft, usually connects the propeller outside the vessel to the driving machinery inside, passing through at least one shaft seal or stuffing box where it intersects the hull. The thrust, the axial force generated by the propeller, is transmitted to the vessel by the thrust block or thrust bearing, which, in all but the smallest of boats, is incorporated in the main engine or gearbox.
The portion of the drive train which connects directly to the propeller is known as the *tail shaft*

IV. MATERIAL USE FOR THE DRIVESHAFT

4.1 Medium carbon steel (AISI 1053)

Medium Carbon Steel have carbon deliberations between 0.25% and 0.60%. These steels may be heat-treated by austenlizing, quenching, and then tempering to recover their mechanical properties. On a power-to-cost basis, the heat-treated medium carbon steels provide great load carrying capacity. An iron-based combination is considered to be an alloy steel when manganese is countless than 1.65%, silicon over 0.5%, copper above 0.6%, or other lowest quantities of alloying essentials such as chromium, nickel, molybdenum, vanadium, or tungsten are present. A vast variety of distinct properties can be created for the steel by replacing these elements in the process to increase hardness, strength, or chemical resistance.

4.2 Mechanical Properties

The mechanical properties of 6061 be contingent greatly on the temper, or heat treatment, of the material Young's Modulus is 69 GPa (10,000 ksi) irrespective of temperature. Annealed 6061 (6061-O temper) has maximum tensile strength no more than 310 MPa (45,000 psi), and maximum yield strength no more than 55 MPa (8,000 psi). The material has elongation (stretch before ultimate failure) of 25–30% T4 temper 6061 has an ultimate tensile strength of at least 210 MPa (30,000 psi) and yield strength of at least 110 MPa (16,000 psi). It has elongation of 16%

4.3 6061 is commonly used for the following:

Construction of aircraft structures, such as wings and fuselages, more commonly in homebuilt aircraft than commercial or military aircraft. 2024 alloy is somewhat stronger, but 6061 is more easily worked and remains resistant to corrosion even when the surface is abraded, which is not the case for 2024, which is usually used with a thin Alclad coating for corrosion resistance. Yacht construction, including small utility boats. Automotive parts, such as the chassis of the Audi A8.

4.4 Titanium Alloy (Ti-6Al-7Nb)

Ti-6Al-7Nb (UNS designation R56700) is an alpha-beta titanium alloy first synthesized in 1977. It featuring high strength and have similar properties as the cytotoxic vanadium containing alloy Ti-6Al-4V. Ti-6Al-7Nb is used as a material for hip prostheses. Ti-6Al-7Nb is one of the titanium alloys that built of hexagonal α phase (stabilized with aluminum) and regular body-centered phase β (stabilized with niobium) Uses Implant devices replacing such as : failed hard tissue, artificial hip joints, artificial knee joints, bone plates, screws for fracture fixation, cardiac valve prostheses, pacemakers, and artificial hearts. Dental application Aircraft materials

V. COMPOSITE MATERIAL

A **composite material** (also called a **composition material** or shortened to **composite**, which is the common name) is a material made from two or more constituent materials with significantly different physical or chemical properties that, when combined, produce a material with characteristics different from the individual components. The individual components remain separate and distinct within the finished structure, differentiating composites from mixtures and solid solutions

The new material may be preferred for many reasons. Common examples include materials which are stronger, lighter, or less expensive when compared to traditional materials.

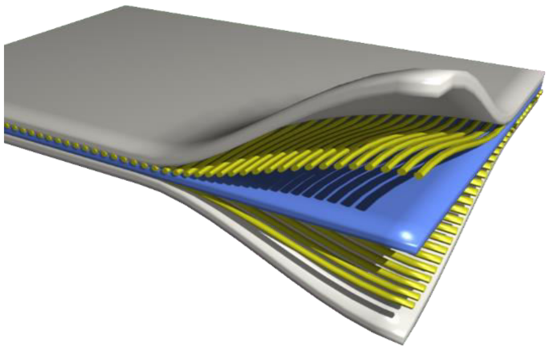


Fig 4. Composite Material

5.1 History

The earliest synthetic composite materials were made from straw and mud combined to form bricks for building construction. Ancient brick-making was documented by Egyptian tomb paintings.

Wattle and daub is one of the oldest synthetic composite materials, at over 6000 years old. Concrete is also a composite material, and is used more than any other synthetic material in the world. As of 2006, about 7.5 billion cubic meters of concrete are made each year—more than one cubic meter for every person on Earth.

5.2 Composite materials

Concrete is the most common artificial composite material of all and typically consists of loose stones (aggregate) held with a matrix of cement. Concrete is an inexpensive material, and will not compress or shatter even under quite a large compressive force. However, concrete cannot survive tensile loading (i.e., if stretched it will quickly break apart). Therefore, to give concrete the ability to resist being stretched, steel bars, which can resist high stretching forces, are often added to concrete to form reinforced concrete.

5.3 Constituents

5.3.1 Matrices -Organic

Polymers are common matrices (especially used for fiber reinforced plastics). Road surfaces are often made from asphalt concrete which uses bitumen as a matrix. Mud (wattle and daub) has seen extensive use. Typically, most common polymer-based composite materials, including fiberglass, carbon fiber, and Kevlar, include at least two parts, the substrate and the resin.Reinforcements Fiber Reinforcement usually adds rigidity and greatly impedes crack propagation. Thin fibers can have very high strength, and provided they are mechanically well attached to the matrix they can greatly improve the composite's overall properties.

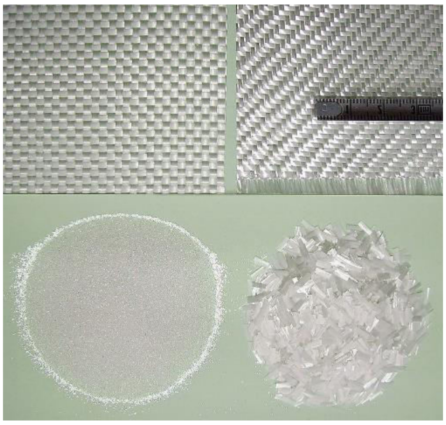


Fig 5Matrices -Organic

5.3.2 Particle

Particle reinforcement adds a similar effect to precipitation hardening in metals and ceramics. Large particles impede dislocation movement and crack propagation as well as contribute to the composite's Young's Modulus. In general, particle reinforcement effect on Young's Modulus lies between values predicted by

5.3.3 Cores

Many composite layup designs also include a co-curing or post-curing of the prepreg with various other media, such as honeycomb or foam. This is commonly called a sandwich structure. This is a more common layup for the manufacture of redoes, doors, cowlings, or non-structural parts. Open and closed-cell-Structured foams like polyvinylchloride, polyurethane, p olyethylene or polystyrene foams, balsa wood, syntactic foams, and honeycombs are commonly used core materials. Open- and closed-cell metal foam can also be used as core materials.

5.3.4 Semi-Crystalline Polymers

Although the two phases are chemically equivalent, semi-crystalline polymers can be described both quantitatively and qualitatively as composite materials. The crystalline portion has a higher elastic modulus and provides reinforcement for the less stiff, amorphous phase. Polymeric materials can range from 0% to 100% crystallinity aka volume fraction depending on molecular structure and thermal history

VI. MOULD FABRICATION METHOD

6.1 Mould overview

Within a mould, the reinforcing and matrix materials are combined, compacted, and cured (processed) to undergo a melding event. After the melding event, the part shape is essentially set, although it can deform under certain process conditions. For a thermoset polymer matrix material, the melding event is a curing reaction that is initiated by the application of additional heat or chemical reactivity such as an organic peroxide. For athermoplastic polymeric matrixmaterial,the melding event is a solidification from the melted state.

6.2 Vacuum bag moulding

Vacuum bag moulding uses a flexible film to enclose the part and seal it from outside air. Vacuum bag material is available in a tube shape or a sheet of material. A vacuum is then drawn on the vacuum bag and atmospheric pressure compresses the part during the cure. When a tube shaped bag is used, the entire part can be enclosed within the bag.

6.3 Woodworking applications

In commercial woodworking facilities, vacuum bags are used to laminate curved and irregular shaped work pieces.

Typically, polyurethane or vinyl materials are used to make the bag. A tube shaped bag is open at both ends. The piece, or pieces to be glued are placed into the bag and the ends sealed. One method of sealing the open ends of the bag is by placing a clamp on each end of the bag. A plastic rod is laid across the end of the bag, the bag is then folded over the rod. A plastic sleeve with an opening in it, is then snapped over the rod. This procedure forms a seal at both ends of the bag, when the vacuum is ready to be drawn.

6.4 Pressure bag moulding

This process is related to vacuum bag molding in exactly the same way as it sounds. A solid female mold is used along with a flexible male mold. The reinforcement is placed inside the female mold with just enough resin to allow the fabric to stick in place (wet layup). A measured amount of resin is then liberally brushed indiscriminately into the mold and the mold is then clamped to a machine that contains the male flexible mold

6.5 Autoclave moulding

A process using a two-sided mould set that forms both surfaces of the panel. On the lower side is a rigid mould and on the upper side is a flexible membrane made from silicone or an extruded polymer film such as nylon. Reinforcement materials can be placed manually or robotically.

6.6 Resin transfer moulding (RTM)

RTM is a process using a rigid two-sided mould set that forms both surfaces of the panel. The mould is typically constructed from aluminum or steel, but composite molds are sometimes used. The two sides fit together to produce a mould cavity. The distinguishing feature of resin transfer moulding is that the reinforcement materials are placed into this cavity and the mould set is closed prior to the introduction of matrix material

6.7 Light Resin Transfer Molding (LRTM)

Similar to the methods performed in Resin Transfer Molding, Light Resin Transfer Molding (Light RTM) involves a closed mold process. A vacuum holds mold A and mold B together to result in two finished sides with fixed thickness levels. Vacuum rings around the tools hold the molds together for this process after dry fiber reinforcements are loaded into mold A before joining with mold B**.**

6.8 Other fabrication methods

Other types of fabrication include press moulding, transfer moulding, pultrusion moulding, filament winding, casting, centrifugal casting, braiding (onto a former), continuous casting and slip forming. There are also forming capabilities including CNC filament winding, vacuum infusion, wet lay-up, compression moulding, and thermoplastic moulding, to name a few. The use of curing ovens and paint booths is also needed for some projects.

6.9 Finishing methods

The finishing of the composite parts is also critical in the final design. Many of these finishes will include rain-erosion coatings or polyurethane coatings.

6.10 Tooling

The mould and mould inserts are referred to as "tooling." The mould/tooling can be constructed from a variety of materials. Tooling materials include invar, steel, aluminum, reinforced silicone rubber, nickel, and carbon fiber.

VII. COMPUTER AIDED DESIGN (CAD)

computer-aided design (**CAD**) is the use of computers (or workstations) to aid in the creation, modification, analysis, or optimization of a design. CAD software is used to increase the productivity of the designer, improve the quality of design, improve communications through documentation, and to create a database for manufacturing. CAD output is often in the form of electronic files for print, machining, or other manufacturing operations. The term **CADD** (for *Computer Aided Design and Drafting*) is also used.

Its use in designing electronic systems is known as electronic design automation (**EDA**). In mechanical design it is known as mechanical design automation (**MDA**) or **computer-aided drafting** (**CAD**), which includes the process of creating a technical drawing with the use of computer software.

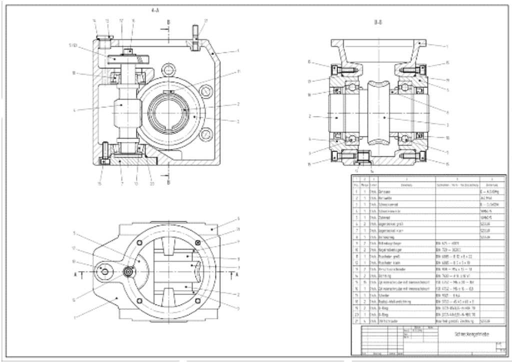


Fig 6 Example of 2D CAD Drawing

. CAD may be used to design curves and figures in two-dimensional (2D) space; or curves, surfaces, and solids in three-dimensional (3D) space. CAD is an important industrial art extensively used in many applications, including automotive, shipbuilding, and aerospace industries, industrial and architectural design, prosthetics, and many more.

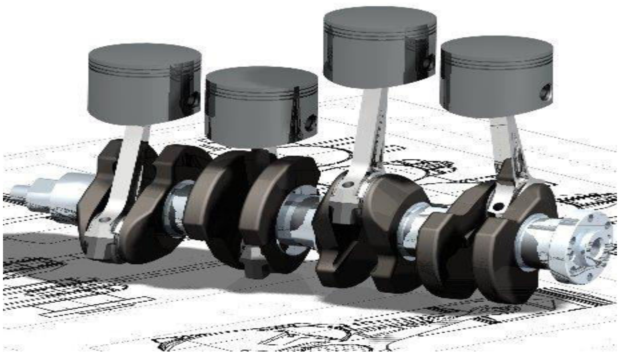


Fig 7 Example of 3D CAD Drawing

VIII. COMMUTER AIDED MANUFACTURING PROCEDURE

Computer-aided design (CAD) is the use of computer systems to aid in the creation, modification, analysis, or optimization of a design. CAD software is used to increase the productivity of the designer, improve the quality of design, improve communications through documentation, and to create a database for manufacturing. CAD output is often in the form of electronic files for print, machining, or other manufacturing operations. Each stage requires specific knowledge and skills and often requires the use of specific software.

Computer-aided manufacturing (CAM) is the use of software to control machine tools and related ones in the manufacturing of work pieces. This is not the only definition for CAM, but it is the most common; CAM may also refer to the use of a computer to assist in all operations of a manufacturing plant, including planning, management, transportation and storage. Its primary purpose is to create a faster production process and components and tooling with more precise dimensions and material consistency, which in some cases, uses only the required amount of raw material (thus minimizing waste), while simultaneously reducing energy consumption.[citation needed] CAM is now a system used in schools and lower educational purposes. CAM is a subsequent computer-aided process after computer-aided design (CAD) and sometimes computer-aided engineering (CAE), as the model generated in CAD and verified in CAE can be input into CAM software, which then controls the machine tool. CAM is used in many schools alongside Computer-Aided Design (CAD) to create objects.

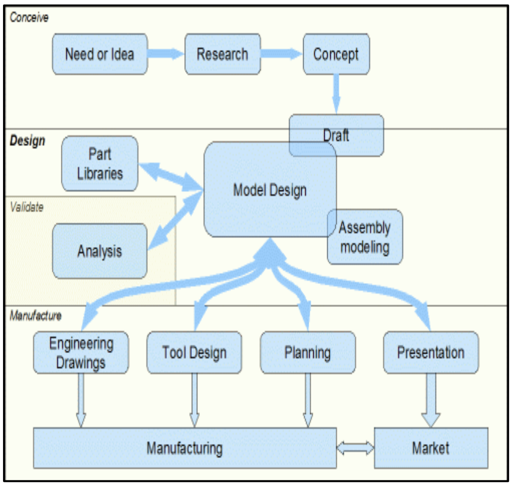


Fig 8 Commuter Aided Manufacturing Procedure

A. *Need or Idea*

Usually, the design process starts with a defined need. The need can be defined by market research, by the requirements of a larger body of work (for example airplane part). Sometimes, but more rarely than you may think, the design process is begun with a new idea or invention.

B. *Research*

Professionals tend to research available solutions before beginning their work. There is no need to "reinvent the wheel". You should study existing solutions and concepts, evaluating their weaknesses and strengths

C. *Concept*

Based on your research, start with a high level concept. You should specify the main principles and major parts. For example, you can consider Diesel or Sterling engines for stationary electric generators

D. *Draft*

You can choose to create a draft by pen and paper. Some prefer to use simple vector graphics programs, others even simple CAD (for example Smart Sketch), yet others prefer to start directly in their main CAD system.

E. *Model Design*

2D and 3D modeling in CAD. The designer creates a model with details, and this is the key part of the design process, and often the most time consuming. This will be described in greater detail in further lessons. asaceva

F. *Part Libraries*

Standard parts, or parts created by other team members, can be used in your model (you don't have to reinvent the wheel). Files representing a part can be downloaded from the Internet or local networks. They are also distributed on CD ROMs or together with CAD as an extension (library).

I.Assembly modeling

Parts are assembled into a machine or mechanism. Parts are put together using mating conditions such as alignment of the axis of two holes. More about how to do this in further lessons. Cad is used in industries. Assembly modeling is a technology and method used by computer-aided design and product visualization computer software systems to handle multiple files that represent components within a product.

J. Engineering Drawings

From your 3D models, you generate a set of engineering drawings for manufacturing. These drawings are then distributed to the departments and individuals responsible for producing that work. Also, these drawings must be tolerance for proper manufacturing. An engineering drawing, a type of technical drawing, is used to fully and clearly define requirements for engineered items.

K. About CATIA V5

CATIA (an acronym of computer aided three-dimensional interactive application) is a multi-platform software suite for computer-aided design (CAD), computer-aided manufacturing (CAM), computer-aided engineering (CAE), PLM and 3D, developed by the French company Dassault Systems. CATIA started as an in-house development in 1977 by French aircraft manufacturer Avions Marcel Dassault, at that time customer of the CADAM software to develop Dassault's Mirage fighter jet. It was later adopted by the aerospace, automotive, shipbuilding, and other industries.

IX. FINITE ELEMENT ANALYSIS (FEA)

FEA is a numerical method. It is very commonly used in finding the solution of many problems in engineering. The problem includesdeigning of the shaft, truss bridge, buildings heating and ventilation, fluid flow, electric and magnetic field and so on. The main advantage of using finite element analysis is that many designs can be tried out for their validity, safety and integrity using the computer, even before the first prototype is built. Finite element analysis uses the idea of dividing the large body in to small parts called elements, connected at predefine points called as nodes. Element behavior is approximated in terms of the nodal variables called degrees of freedom. Elements are assembled with due consideration of loading and boundary condition. This results in a finite number of equations. A solution of these equations represents the approximate behavior of the problem. The design and analysis have done with the 3D modeling software and FEA technique standard FEM tool. The analysis is carried out by using the ANSYS software. This gives the comparison between analytic and numerical value. Part is drawn in CAD software. The CAD software which is involved in this is CATIA and this part is a call to ANSYS in (.igs) format.

9.1 ANSYS

Ansys Inc. is an American public company based in Canonsburg, Pennsylvania. It develops and markets engineering simulation software. Ansys software is used to design products and semiconductors, as well as *to create simulations that test a product's durability,* temperature distribution, fluid movements, and electromagnetic properties.

Ansys was founded in 1970 by John Swanson. Swanson sold his interest in the company to venture capitalists in 1993. Ansys went public on NASDAQ in 1996. In the 2000s, Ansys made numerous acquisitions of other engineering design companies, acquiring additional technology for fluid dynamics, electronics design, and other physics analysis

9.2 Procedure for FE Analysis

There are a number of steps in the solution procedure using finite element method.
The finite element method (FEM), is a numerical method for solving problems of engineering and mathematical physics. Typical problem areas of interest include structural analysis, heat transfer, fluid flow, mass transport, and electromagnetic potential. The analytical solution of these problems generally require the solution to boundary value problems for partial differential equations.

X. ADVANTAGES OF FEA

- Comprehensive result sets, generating the physical response of the system at any location, including some which might have been neglected in an analytical approach.
- Safe simulation of potentially dangerous, destructive or impractical load conditions and failure modes.
- Optimal use of a model. Often, several failure modes or physical events can be tested within a common model.
- The simultaneous calculation and visual representation of a wide variety of physical parameters such as stress or temperature, enabling the designer to rapidly analyse performance and possible modifications.
- Extrapolation of existing experimental results via parametric analyses of validated models.

Relatively low investment and rapid calculation time for most applications

XI. DISADVANTAGES OF FEA

- Large amount of data is required as input for the mesh used in terms of nodal connectivity and other parameters depending on the problem.
- It requires a digital computer and fairly extensive
- It requires longer execution time compared with FEM.
- Output result will vary considerably.

XII. DESIGN OF A COMPOSITE DRIVESHAFT

First, the fibers are selected to provide the best stiffness and strength beside cost consideration.It is misunderstood that carbon fiber shafts are “too stiff’. Indeed, what we meant by too stiff, it is regarding the torsional stiffness rather than the flexural stiffness. It is a best choice to use carbon fibersinalllayers.Sincethefiberorientationangle, that offers the maximum bending stiffness which leads to the maximum bending natural frequency, is to place the fibers longitudinally at zero angle fromtheshaftaxis.Ontheotherhand,theangleof +45° orientation realizes the maximumshear strength and a 90° angle is the best for buckling strength.

The expressions of the reduced stiffness coefficients Q„ in terms of engineering constants are as follows:

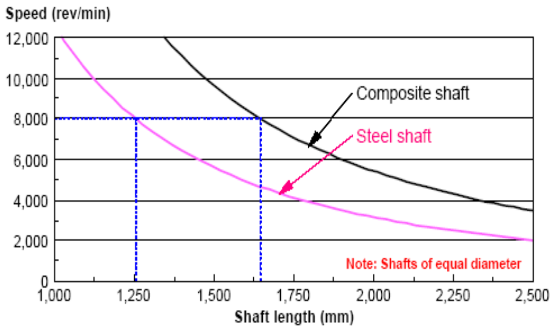
$$Q_{11} = \frac{E_1}{1-\nu_{12}\nu_{21}}, Q_{22} = \frac{6\ 2}{1+\ \ 2"2}$$

$$Q12' \frac{*iz'z}{1-\nu_{12}\nu_{21}} › Q66 \cdot G I z$$

$$\nu_{21} = \frac{E_2}{E_1} "n$$

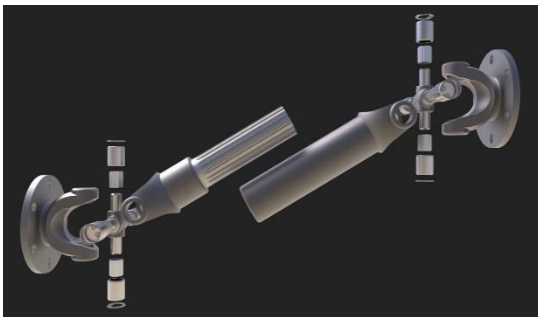
12.1 Lateral bending natural frequency

The main point that attracts designers to use composite materials in the drive shafts is that they make it possible to increase the length of the shaft. he relationship between shaft's length and the critical speed for both types of drive shafts are shown in figure 2. It is evident that for a specific application where the critical speed is about 8000 rev/min, the longest possible steel shaft is 1250 mm, while a composite one can have a length of 1650 mm.



Graph 1. Speed Vs Length

XIII. PROPOSED CAD MODEL



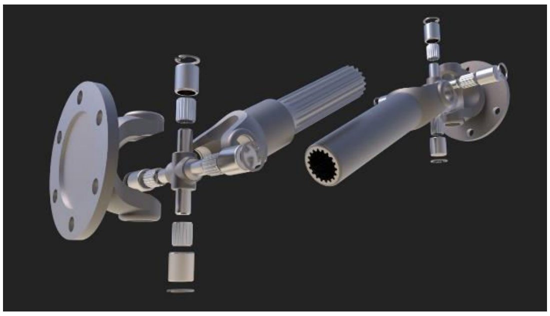


Fig 9. Assembly Of Drive Shaft

Fig 10. Explored View Of Drive Shaft

XIV. FINITE ELEMENT ANALYSIS

14.1 Material properties:

Properties	SAE-AISI 1040	Carbon/Epoxy Composite
Tensile strength	620 MPa	1290 MPa
Yield Strength	415 MPa	1085 MPa
Density	7845 Kg/M^3	1600 Kg/M^3

Table 1. Material Properties*:*

14.2 Boundary Conditions:

Support	Value
Fixed Support	At One Flanged
Ultimate Torque	3500 Nm

Table 2. Boundary Conditions:

14.3 Meshing of Object:

Statistics	Value
Node	327365
Element	172448

Table 3. Meshing Of Object

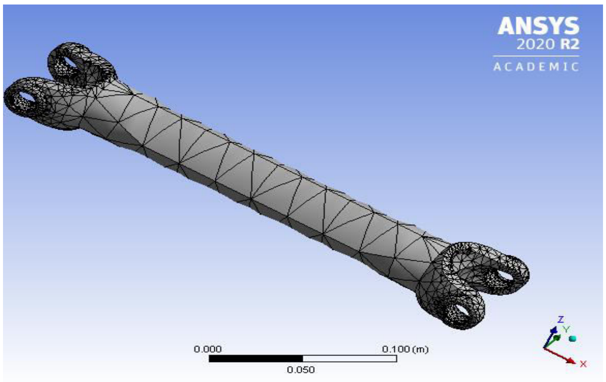


Fig 11. Meshing

XV. ANALYSIS OF SAE-AISI 1040

Boundary Condition Applied

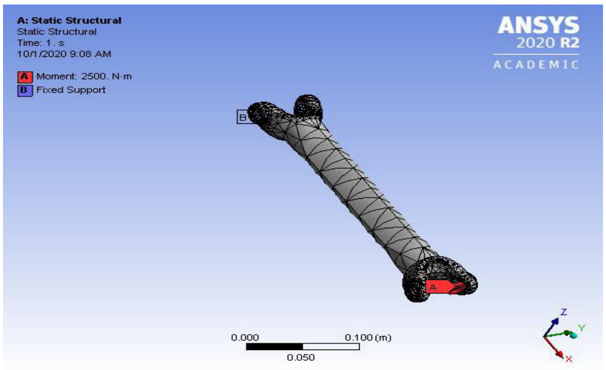


Fig 12 Total Deformation

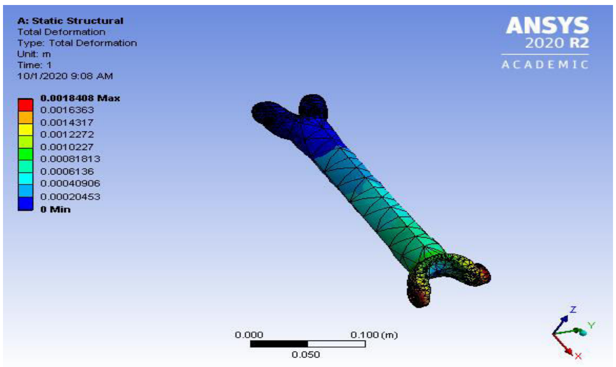


Fig 13. Equivalent Stresses

XVI. ANALYSIS OF CARBON/EPOXY COMPOSITE

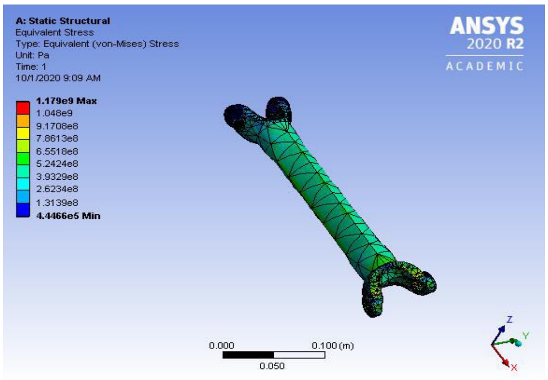


Fig 14. Total Deformation

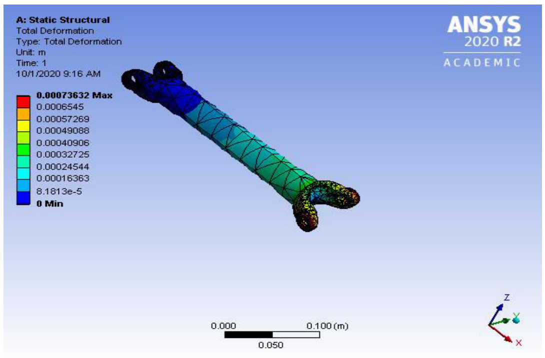


Fig 15. Equivalent Stresses

XVII. RESULT

Particular	Von Messes Stress	Total Deformation	Weight
SAE-AISI 1040	1.17 e9 Pa	1.8 mm	4.98 Kg
Carbon/Epoxy Composite	4.17 e8 Pa	0.7 mm	0.488 Kg

Table 4.Result

- From above table we see that the material properties of carbon/Epoxy composite is much more higher
- Due to lower density the weight is very lower
- As see in table the Stress and total deformation is lower in carbon epoxy composite

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REFERENCES

[1] John. W.et. al. Engineers Guide to Composite Materials, American Society for Metals, 1986.
[2] Beardmore, P. et al. The Potential for Composites in Structural Automotive Applications J. of Composites Science and Technology 26 1986: pp. 251 – 281.
[3] T. RANGASWAMY, et. al. "Optimal Sizing and stacking Sequence of Composite Drive shafts" ISSN 1392–1320 materials science (medžiagotyra).Vol.11, no.2. 2005.
[4] Rajeev S and Krishnamurthy, C.S, 1992 "Discrete Optimization of structure using Genetic Algorithm", Journal of struct. Engg. ASCE Vol. 118 PP. 1233-1250 .
[5] Pollard, A. Polymer Matrix Composites in Driveline Applications, GKN Tech., UK, 1989.
[6] Goldberg, D. E. Genetic Algorithms in Search, Optimization and Machine Learning, Reading MA, Addison-Wesley, 1989 .
[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 Design and Analysis of Automotive Composite Drive Shaft", International Symposium of Research Students on Materials Science and Engineering December 2002-04 Chennai India.
[9] Kim C D et. al. 1992, "Critical speed Analysis of Laminated Drive Shafts", Composite Engg. Vol.3, pp. 633-643.
[10] J. H. Park, J. H. Wang 2001, "Stacking sequence Design of Composite Laminates for maximum Strength Using Genetic Algorithm", Journal of Composite Structures, Vol.52, pp. 217-23.
[11] B Stanly Jones Retnam, M Sivapragash and P Pradeep, Effects of fiber on mechanical properties of hybrid bamboo/glass fiber polymer composites,2012.
[12] K.Vasantha Kumar , Dr.P.Ram Reddy , Dr.D.V.Ravi Shankar, Effect of Angle Ply Orientation On Tensile Properties Bi Directional Woven Fabric Glass Epoxy Composite Laminate,International journal of computational research,volume - 3,2013,pp - 55 -61.
[13] R. Sino , T.N. Baranger , E. Chatelet a, G. Jacquet , Dynamic analysis of a rotating composite shaft,2008.
[14] D.G. Lee, N.P. Suh. Axiomatic design and fabrication of composite structures: Applications in robots, machine tools, and automobiles. Oxford University Press, 2006.
[15] N. Rastogi. Design of composite drive shafts for automotive applications. SAE technical paper series. 2004. 2004-01-0485.