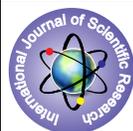


FE Analysis of hollow propeller shaft using different composite material - A Review study



Engineering

KEYWORDS : hollow propeller shaft, composite material, solid works software, ANSYS software

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ABSTRACT

Conventional Drive shaft have less specific modulus and strength , increased weight. But the drive shaft made of composite material have advantages like they have high specific modulus and strength, Reduced weight, lower fuel consumption .

Different available composite material are like Boron epoxy, E-glass, Kevlar epoxy, etc. They have lighter in weight, longer life with higher critical speed and may be optimized the design. For analysis, software likes Solidworks and ANSYS will be used. The parameter like deflection, stresses, natural frequencies under subjected loads using FEA will be studied.

I. INTRODUCTION

The term Drive shaft is used to refer to a shaft, which is used for the transfer of motion from one point to another. Whereas the shafts, which propel (push the object ahead) are referred to as the propeller shafts. Propellers are usually associated with ships and planes as they are propelled in water or air using a propeller fan. However the drive shaft of the automobile is also referred to as the propeller shaft because apart from transmitting the rotary motion from the front end to the rear end of the vehicle, these shafts also propel the vehicle forward. The shaft is the primary connection between the front and the rear end (engine and differential) which performs both the jobs of transmitting the motion and propelling the front end. Thus, the terms Drive Shaft and Propeller Shafts are used interchangeably.

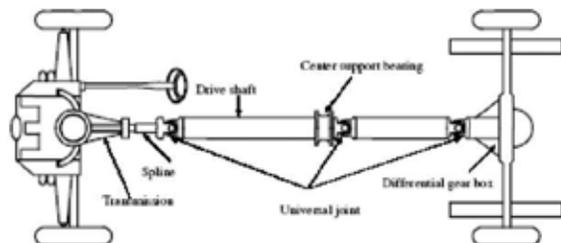


Fig:1.1 propeller shaft arrangement for driving system

Purpose of the Drive Shaft (Or Propeller Shaft)

- It must transmit torque from the transmission to the differential gear box
- The drive shaft must also be capable of rotating at the very fast speed required by the vehicle.
- The drives shaft must also operate through constantly changing the angles between the transmission, the differential and the axels.
- The length of the drive shaft must also be capable of changing while transmitting torque.
- The drive shaft should provide a smooth, uninterrupted flow of power to the axels.

Types of Propeller shaft

- Single piece propeller shaft
- Two piece propeller shaft
- Three piece propeller shaft

II. COMPOSITE MATERIAL

The different composite material likes, E glass, Kevlar Epoxy, boron epoxy, etc. are going to analyzed and studied. The various characteristics and properties of composite material are as under:

Characteristics of composite material:-

- They have high specific modulus and strength
- Reduced weight
- Due to weight reduction, fuel consumption will be reduced.
- They have high damping capacity and hence they produce less vibration and noise.
- They have good corrosion resistance
- Greater torque capacity than steel and aluminum shaft
- Longer fatigue life than steel and aluminum shaft
- Lower rotating weight transmits more of available power.

III. SOLIDWORKS SOFTWARE

Solidworks is a computer graphics system for modeling various mechanical designs for performing related design and manufacturing operations. The system uses a 3D solid modeling system as the core, and applies the feature base parametric modeling method. In short solidworks is a feature based parametric solid modeling system with many extended design and manufacturing applications.

Feature of the Solidworks

- Ease of use:
- Full associatively:
- Parametric & feature based modeling:
- Powerful assembly capabilities:
- Robustness:
- Change management:
- Hardware independence:

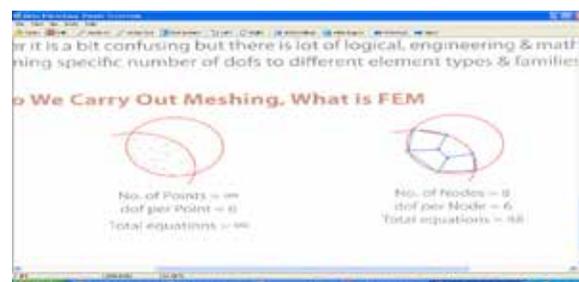
Functions of solidworks

- Part design:
- Assembly design:
- Design documentation (drawings):
- General functionality:

IV. FEM (FINITE ELEMENT METHOD)

The concept of the finite element method is described in following session.

What is FEM ?



- A numerical method

- Mathematical representation of actual problem
- Approximate method

Definition of FEM is hidden in its words itself. Basic theme is to make calculations at only limited (Finite) number of points and then interpolate the results for entire domain (surface or volume).

Finite - Any continuous object has infinite degrees of freedom & it's just not possible to solve the problem in this format. Finite Element Method reduces degrees of freedom from Infinite to Finite with the help of discretization i.e. meshing (nodes & elements).

Element - All the calculations are made at limited number of points known as nodes. Entity joining nodes and forming a specific shape such as quadrilateral or triangular etc. is known as Element. To get value of variable (say displacement) any where in between the calculation points, interpolation function (as per the shape of element) is used.

Method - There are 3 methods to solve any engineering problem. Finite element analysis belongs to numerical method category.

Advantages of FEA (Finite Element Analysis)

- Visualization increases.
- Design cycle time reduces
- No. of prototypes reduces
- Testing reduces
- Optimum design

V. CONCLUSION

The high strength composite material has been replace conventional steel propeller shaft of an automobile. A one piece composite propeller shaft for rear wheel drive automobiles has been high strength composite material with the objective of minimization of weight of shaft & analyzed using ANSYS for better torque transmission and bending vibration characteristics. Different available composite material are like Boron epoxy, E-glass, Kevlar epoxy, etc. using for shaft & analyzed by ANSYS and compare with each other.

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