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Design, Failure Analysis and Optimization of a Propeller shaft for HMV. (Heavy Motor Vehicle).

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Abstract

In this project we are analyzing the failure of a Propeller Shaft for HMV (Heavy Motor Vehicle). The type of material used in the drive shaft need to be known first before stress analysis can be performed using AN SYS software. The known material will provide the information such as density of material, modulus of elasticity and tensile strength of a drive shaft required for the software to perform the stress and failure analysis. Stresses will concentrate in the smaller diameter portion, as consider to this change in shaft diameter according to the requirement we can optimize the shaft for better performance and make it more durable. In any case, one must determine the cause of failure and predict the fatigue life to prevent future occurrence and to improve the performance of the Drive Shaft

Keywords: *Drive shaft. Stress Analysis, Failure analysis, Optimize, tensile strength*.

1. Introduction

. 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.

Drive shaft (Propeller shaft) is a mechanical part of transmission system which is used to transfer the power from engine to the wheel. The movement of vehicles can be provided by transferring the torque produced by engines to wheels after some modification. The transfer and modification system of vehicles is called as power transmission system and have different constructive features according to the vehicle's driving type.

Most automobiles today use rigid driveshaft to deliver power from a transmission to the wheels. A pair of short flexible driveshaft is commonly used in cars to send power from a differential to the wheels.

In automobiles, axle shafts are used to connect wheel and differential at their ends for the purpose of transmitting power and rotational motion. In operation, axle shafts are generally subjected to torsional stress and bending stress due to self-weight or weights of components or possible misalignment between journal bearings.

1.1 Types of Drive Shafts

There are different types of drive shafts in Automotive Industry:

- One-piece driveshaft
- Two-piece driveshaft
- Slip in Tube driveshaft

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 driveshaft.

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2. Literature Review

V.S Bhajantri, S.C Bhajantri, A.M. Shindolkar, S.S Amarapure[1] Substituting composite structures for conventional metallic structures has much advantage because of higher specific stiffness and strength of composite materials. This work deals with replacement of conventional two piece steel drive shaft with a single-piece e-glass/epoxy, high strength carbon/epoxy and high modulus carbon/epoxy composite drive shaft for automobile shaft for an automotive application.

According to this paper it is found that optimum fiber angle orientation will play important role in composite shaft which depends on requirement of composite shaft.

Madhu K.S., Darshan B.H., Manjunath K. [2]

Automotive drive shaft is usually manufactured in two pieces in order to increase the fundamental bending natural frequency because it is inversely proportional to the square of beam length and proportional to the square root of specific modulus. Many research work have been carried out to in this direction to replace two pieces drive shaft with single piece made of composites.

Sagar R Dharmadhikari, Sachin G Mahakalkar, Jayant P Giri, Nilesh D Khutafale. [3]

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This study deals with the review of optimization of drive shaft using the Genetic Algorithm and ANSYS. Substitution of composite material over the conventional steel material for drive shaft has increasing the advantages of design due to its high specific stiffness and strength. Drive shaft is the main component of drive system of an automobile. Use of conventional steel for manufacturing of drive shaft has many disadvantages such as low specific stiffness and strength. Conventional drive shaft is made up into two parts to increase its fundamental natural bending frequency. Two piece drive shaft increases the weight of drive shaft which is not desirable in today's market. Many methods are available at present for the design optimization of structural systems and these methods based on mathematical programming techniques involving gradient search and direct search.

According to this paper 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.

T.Rangaswamy, S. Vijayarangan, R.A. Chandrashekar, T.K. Venkatesh and K.Anantharaman. [4]

The overall objective of this paper is to design and analyse a composite drive shaft for power transmission applications. A one-piece drive shaft for rear wheel drive automobile was designed optimally using E-Glass/Epoxy and High modulus (HM) Carbon/Epoxy composites. In this paper a Genetic Algorithm (GA) has been successfully applied to minimize the weight of shaft which is subjected to the constraints such as torque transmission, torsional buckling capacities and fundamental natural frequency.

The results of GA are used to perform static and buckling analysis using ANSYS software. The results show the stacking sequence of shaft strongly affects buckling torque.

Amol S. BhanageÀ, Vijay B. Patil, and Rajat S. Patil.[5]

Automotive Composite drive shafts offer the potential of lighter and longer life drive train with higher critical speed. This paper presents review on finite element analysis investigation of Composite drive shaft in static, modal and buckling analysis in respect to advantage of using composite materials in terms of weight and stress minimization, effects of fibers winding angle and layers stacking sequence on the critical speed, optimization into single piece drive and critical buckling torque. This review study help to students, academicians and researcher's about current status of FE simulation work and help them to look forward with better and optimized simulation conditions to improve the performance of composite drive shaft.

3. Identified gaps in the literature

Most of the researcher has an objective to use a composite material for higher specific stiffness, weight reduction, high modulus, greater strength and some of the research is done to replace the two piece shaft into single piece of composites to reduce weight and stress minimization. Limited work is done on the basis of failure analysis of a Propeller shaft or drive shaft, there is no accurate prediction to failure of a drive shaft when it is to be fail or life of a drive shaft how much is durable.

4. Problem Formulation

The main objective of this project is:

i. To construct the geometry of the driveshaft using SOLIDWORK.

ii. To investigate the material composition of the drive shaft

iii. Optimization for weight reduction in existing Propeller shaft

iv. To investigate the stress analysis and predict the failure of driveshaft using ANSYS software.

Drive shaft is a mechanical device for transferring power from the engine or motor to the point where useful work is applied. The types of failure which can be happen to the device especially like fatigue failure, torsional stress, bending stress and etc.

People often ask what are the hardness of material that use in drive shaft and how longer the shaft can stay use if the car not involved in accident. This project is to study about the failure that happens to the drive shaft. First, identify the failure cause and condition of the drive shaft. Then do the hardness test to know how hard the material that use in drive shaft. After that we can make an analysis and we try to solve the problem.

5. Research Methodology

- Data acquisition from the company like material, dimension, parts etc.

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- CAD Model generation of a Propeller shaft
- Analysis of CAD Model for optimization of existing design
- Analysis of CAD Model using different material
- Comparison made on the basis of types of material used.
- Stress analysis can be performed using AN SYS software.
- Failure analysis is done using AN SYS software on the basis of different types of materials.

6. Conclusions

Drive shafts are one of the most important components in vehicles. It generally subjected to torsional Stress and bending stress due to weights of components. Most of the time these components are victim to fatigue by the nature of their operation. Driveshaft mainly involves in steering operation of vehicle. Drivers will lose control of their vehicle if the drive shafts broke during high speed cornering. Because of the rotating of drive
Shaft failure can occur. There are many type of material use to make a drive shaft to improve from the failure occur. So the manufacturer choose high hardness and strength material to make sure the drive shaft can hold on a long time. Because of this human life can be in great danger if we don't know when, where and how the drive shaft will failed. It is very important to know the accurate prediction for the drive shaft to fail

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