FE Analysis of Hollow Propeller Shaft using Steel and Composite Material then Compares It

Nimesh A. Patel\textsuperscript{1} Pradip M. Patel\textsuperscript{2} Prof. A.B.Patel\textsuperscript{3}  
\textsuperscript{1, 2} P.G. Student, \textsuperscript{3} Assi. Professor  
\textsuperscript{1, 2, 3} Mechanical Engineering Department  
\textsuperscript{1, 2, 3} L. D. College of Engineering, Ahmedabad.

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. The drive shaft of TATA-407 was chosen, the modelling of the drive shaft assembly was done using Solid works and ANSYS used for predicting analysis results. To estimate stresses under subjected loads using FEA Further comparisons carried out for both steel and composite material.

Keywords: hollow propeller shaft, composite material, Analysis, comparison.

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.

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:

A. Characteristics of composite material:

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

III. VEHICLE AND COMPOSITE MATERIAL SELECTION

The drive shaft of TATA 407 is selected; the modeling of the drive shaft assembly will be done using the Solid works 2009 version and then after the analysis work has been performed on the ANSYS 12.0 version. Here, for the drive shaft composite material is E glass selected.

IV. ANALYSIS OF HOLLOW PROPELLER SHAFT
Fig. 2: Model of hollow propeller shaft in Ansys

Type of Analysis: - 3D
Type of Element: - Tetrahedral (10 Node)

Fig. 3: meshing of hollow propeller shaft

Fig. 4: Boundary condition of hollow propeller shaft

Fig. 5: Moment of hollow propeller shaft

V. RESULTS OF ANALYSIS FOR STEEL PROPELLER SHAFT

A. Von Misses Stresses

Fig. 5: Von misses stresses analysis for steel

B. Maximum Shear Stresses

Fig. 6: Max. Shear stress analysis for steel
C. Result of E glass Epoxy composite Analysis

Von Misses Stresses

![Fig. 7: Von misses stresses Analysis for E glass Epoxy](image)

D. Maximum Shear Stresses

![Fig. 8: Max. Shear stresses Analysis for E glass Epoxy](image)

VI. COMPARISION BETWEEN STEEL AND E GLASS MATERIAL ANALYSIS

<table>
<thead>
<tr>
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<th>Steel</th>
<th>E glass Epoxy</th>
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</thead>
<tbody>
<tr>
<td>Von Misses Stresses</td>
<td>215.3</td>
<td>37.162</td>
</tr>
<tr>
<td>Maximum shear stresses</td>
<td>120.45</td>
<td>21.313</td>
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</table>

VII. 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 Von Misses Stresses and Maximum shear stresses. In this analysis E glass epoxy less stresses generated compare steel. Then comparisons between steel and E glass epoxy Analysis and declare that composite material like E glass Epoxy better than steel material.

REFERENCES


