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Torsional Analysis Of Propeller Shaft

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Abstract

In the present Scenario weight of automobile is major issue. Many Composite materials are used now a day in order to overcome this problem. The use of this composite material is to apply its characteristic for propeller shaft this characteristic is applied to better performance design requirements of the propeller shaft. The last few years have seen the increasing use of composite materials in many ends of engineering applications. Polymer composites are widely used by automobile industries cause polymers have great stiffness properties. Composite shafts are used to reduce the overall weight of vehicle. Composite materials are having high strength, specific stiffness, specific modulus, corrosion resistance, wear resistance, fatigue life and light weight properties. Automobile industries are switching towards composite materials because of its light weight properties.

Keywords— Polymer, Composite Material, Weight.

I. INTRODUCTION

Most of the rear wheel or front wheel drive vehicles have transmission shaft to transmit the power. The weight reduction of the shaft can have certain role in the general weight reduction of the vehicle and is a highly desirable goal. Vehicle weight reduction saves energy, minimizes brake and tire wear and cut down emission. Replacing steel shaft of vehicle with composite shaft will help reducing weight of vehicle. In automotive industry propeller shaft transmits engine power to the wheels. The engine power is transmitted by means of twisting moment of propeller shaft. The conventional materials used for ordinary shaft are, generally 55C8 ,35C8, 45C8, etc. When high strength is required alloy steel such as nickel, nickel-chromium or chrome vanadium steel is used. The natural frequency of composite material shaft is twice that of conventional steel shaft and the stiffness of composite material is four times better than steel shaft so it is easy to make composite shaft in one piece. The composite propeller shaft has many other advantages such as reduced weight and less vibrations. Carbon, Graphite, Kevlar with suitable resins are the advanced composite materials which is mostly used because of their specific strength (strength/density) and specific modulus (modulus/density) and these are ideally suited for drive shaft. Carbon fibber are used in most of the composite drive shaft over the Kevlar and Glass fibre because it's high specific strength and modulus, low thermal expansion and high fatigue strength which are ideal fibres for transmitting shaft. Epoxy or vinyl ester resins are widely used in most of the drive shafts due to its high strength, good wetting of fibres, lower curing shrinkage and better dimensional stability. Modulus of elasticity is less in composite materials, as a result when torque reaches to its peak in the drive line, drive shaft may work as a shock absorber and stress is reduced on part of the drive train extending life. The drive shaft can be solid or hollow cylindrical shape. Hollow circular shafts are commonly used because they are stronger in specific weight than solid circular. In case of solid shafts, the stress distribution is zero at the Centre and maximum at the outer surface, while in hollow circular shafts stress variation is small. The

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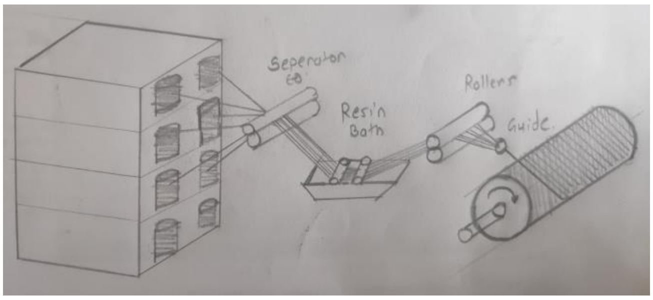
material which is close to the Centre is not completely utilized in solid shafts, so hollow circular shafts are considered over the solid circular shafts.



II. PROBLEM STATEMENT

Design and analysis of composite shaft that is carbon /epoxy and comparative analysis based upon torsional, Natural frequency, buckling strength between steel and composite shaft.

III. WORKING

Filament winding can also be described as the manufacture of parts with high fibre volume fractions and controlled fibre orientation. Fibre wires are immersed into the resin bath of low weight molecules. The impregnated tows are then literally wound around a mandrel (mould core) in a controlled pattern to form the shape of the part. After winding the resin is handle by using heat. The mould core may be removed or may be left as an integral component of the part (Rosati, D.V.). This process is widely used for manufacturing of hollow circular shaft. Pressure vessels, pipes and Shafts have all been manufactured using filament winding. It has been combined with other fibre application methods such as hand layup, pultrusion, and braiding. Compaction is through fibre tension and resin content is primarily metered. The fibres may be impregnated with resin before winding (wet winding), pre-impregnated (dry winding) or post-impregnated. The advantages of wet winding using the lowest cost materials with long life and low viscosity. The pre-impregnated systems produce parts with more consistent resin content and can often be wound fast. By the properties of composite material, we can make helical, hoop shape. Filament winding is widely used to produce such structures as rocket motor cases, power transmission shafts, Pressure vessels tubing and piping. Imaginative variations on the filament winding process have produced a variety of structures such as leaf springs for automotive vehicles. In a filament welding process, the composite wire gets continuously wrapped on rotating mandrel. The filament winding is also used to manufacture paper sheets or continuous fibre reinforced sheet moulding compounds, such as XMC. The sheet is found by slitting the wound shape parallel to the mandrel axis. A large number of fibres roving are pulled from a series of creels in to a resin bath containing catalyst, liquid resin and other ingredients. Fibre tension is controlled using the fibre guides or scissor bars located between each creel and the resin bath. Just before entering the resin bath, the roving usually gathered in to a band by passing them through a textile thread board or a stainless-steel combination.

IV. CALCULATION

- Torque = 200 Nm
- For Hollow Shaft:-
- Angle of Twist (θ)

$$\frac{T}{J} = \frac{G*\theta}{L}$$

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$$\frac{200000}{\left(\frac{\Pi}{32}\right)*Do^4-Di^4}=\frac{76923*\theta}{70}$$

$$\frac{200000}{(\Pi/32)*(40^4-30^4)}=\frac{76923*\theta}{70}$$

Θ = 0.0105 rad.

- Deformation (δ)

$$\delta=\frac{TL}{AE}$$

$$=\frac{2*10^5*1000}{\left(\frac{\pi}{4}\right)*(40^2-30^2)*207*10^3}$$

= 1.75 mm.

- Mass (M)

M = ρ*A*L

$$=7600*\left(\frac{\pi}{4}\right)*(40^2-30^2)*1000$$

= 4178.34gm

- Von- Misses stress (τ)

$$\tau=\frac{16T}{\pi*[D_o{}^3-D_i{}^3]}$$

$$\frac{(200000*16)}{\pi[40^3-30^3]}$$

= 27.52 N/mm^2

- Design of Composites
- Glass Epoxy (M):

M = ρ*A*L

$$=2100*\left(\frac{\pi}{4}\right)*(40^2-30^2)*1000$$

= 1154.53 gm

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M = ρ*A*L

$= 1402*(\frac{\pi}{4})* (40^2-30^2)*1000$

= 770.7 gm

- Carbon Epoxy (M):

M = ρ*A*L

$= 1600*(\frac{\pi}{4})* (40^2-30^2)*1000$

= 879.64 gm

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