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DESIGN, ANALYSIS AND PRACTICAL TESTING OF COMPOSITE SHAFT FOR WEIGHT OPTIMIZATION

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ABSTRACT :- Throughout this experimental study, a bending analysis was carried out for Glass fiber or Carbon Fiber composite drive shafts. The Composite shafts utilized were created utilizing layer winding procedure. Carbon fiber with a matrix of epoxy tar and hardener were used to create outside composite layers required. Three cases amassed in assessment programming and last two for convincing testing. It has additionally been seen that there is no fiber breakage from the turning twisting exhaustion test. Results got from this study show that increasing strength of shaft by using carbon fiber composite material. Get the weight reduction 45%.

key ward: carbon Fiber, Glass fiber, ANSYS, Design.

I. INTRODUCTION

Rapid technological advances in engineering design field result in finding the alternate solution for the conventional materials. The design engineers brought to a point to finding the materials which are more reliable than conventional materials. Researchers and designers are constantly looking for the answers for give more grounded and solid materials which will answer the requirements of individual designers. [9] A drive shaft, or propeller shaft (prop shaft), or Carbon shaft is a mechanical fragment for conveying power and turn, normally used to interface various portions of a drive train that can't be related directly considering distance or the need to think about relative improvement between them. Drive shafts are carriers of power. They are subject to bend and shear pressure, identical to the distinction between the information force and the heap. They should thusly be sufficiently able to bear the pressure, while keeping away from an excess of extra weight as that would thusly expand their idleness.

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A car drive shaft is a turning shaft that transmits power from the engine to the differential gear of rear wheel drive (RWD) vehicles. The torque that is produced from the engine and transmission must be transferred to the rear wheels to push the vehicle forward and reverse. The drive shaft must provide a smooth, uninterrupted flow of power to the axles. [3] The drive shaft and differential are used to transfer this torque. Moreover, a composite driveshaft can be perfectly designed to effectively meet the strength and stiffness requirements. Since composite materials generally have a lower elasticity modulus, during torque peaks in the driveline, the drive shaft can act as a shock absorber. Moreover, the breakage of composite a drive shaft (particularly in SUV's) is less -risky, since it results in splitting up of the fine fibers as compared to the scattering of broken steel parts in various directions.

1.1 Introduction to Drive Shaft

Drive shaft is been utilized in the cars. They are primarily utilized in the business vehicles like vans, trucks, SUV's and so on There ought to be a medium from where the movement from motor is been moved to the uncommon wheels. To move this movement from the motor to the uncommon wheels, drive shaft accepts a huge part. Whenever the distance between the engine and phenomenal wheels is more than 1.5m usage of two-piece drive shaft is been used. Bounce shaft is one of the huge bits of the vehicle, without which we can't move development from engine to the unprecedented wheel without any problem.

To moderate regular resources and economize energy, weight reduction has been the main focus of Automobile manufacturer in the present scenario. Weight reduction can be achieved primarily by the introduction of better material, design optimization and better manufacturing processes .The suspension drive shaft is one of the potential items for weight reduction in automobile as it accounts for ten to twenty percent of the unsprung weight.

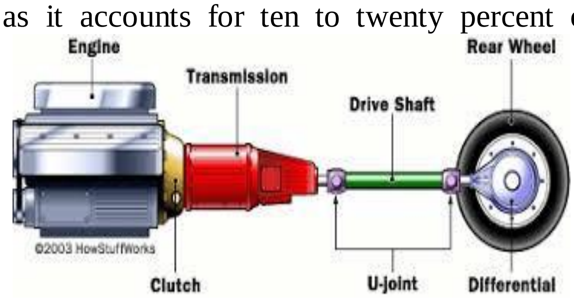

Fig 1: One-Piece Composite Drive Shaft

1.2 Objectives of the project

The objectives of this project are

1) To reduce the weight of the drive shaft in vehicle to increase the fuel efficiency.

2) Static analysis of standard Steel drive shaft, composite Glass fiber and Carbon Fiber drive shaft using FEA. Determining effects of stress.

3) Manufacturing and Testing of Composite drive shaft.

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4) Comparison and Validation of results by Theoretical calculations and Testing
5) Modal analysis of drive shaft.

1.3 Methodology

After referring to multiple references it was understood that how composite drive shaft having optimum weight can be selected using the exact methodology.
For this process we use CATIA V5 R20 and ANSYS workbench 14.5 software

1. CAD model of conventional drive shaft is prepared in CATIA V5 R20 as per actual dimension. Then this model is imported to ANSYS workbench 14.5 software. For pre-processing and to derive a final solution results are derived from ANSYS software.
2. CAD model of composite drive shaft is ready in CATIA V5 R20 according to genuine measurement. Then, at that point this model is imported in ANSYS workbench 14.5. For pre-handling and to determine a last arrangement results are gotten from ANSYS programming.
3. Compare traditional drive shaft and composite drive shaft results.For validation, we require the results derived from theoretical and experimental calculations.
4. To perform the experiment, we manufacture the sample composite material and conventional drive shaft. Testing of these two shafts is been done in torsion test machine and the results are been derived.
5. Later CAD model for these two shafts having same dimensions was been generated and was imported in ANSYS. Results were derived after this process and were compared with the experimental results.
6. Theoretical calculations for sample conventional and composite drive shaft were calculated.
7. Lastly ANSYS, theoretical and experimental results were compared and preferable shaft was selected in automobile.

II. ANALYSIS

Boundary condition

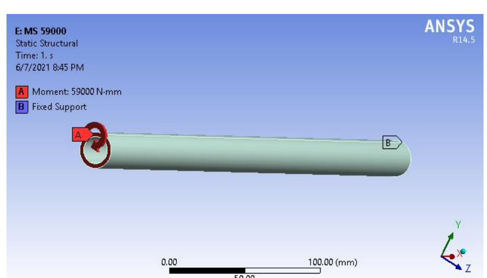

Fig 2 Total Deformation of moment 59000 N-mm apply on MS shaft

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Total Deformation

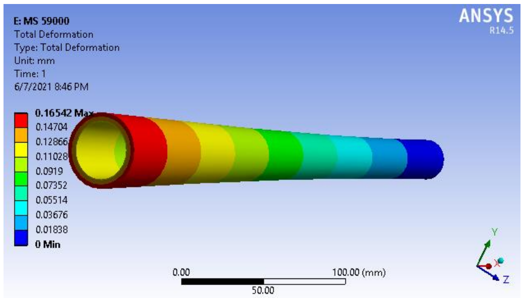

Fig 3 Total Deformation of moment 59000 N-mm apply on MS shaft

Stress

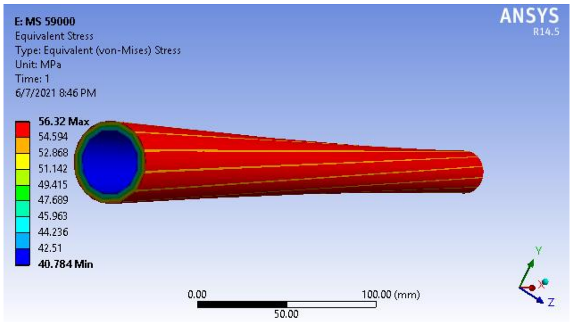

Fig 4 Stress of moment 59000 N-mm apply on MS shaft

Boundary condition

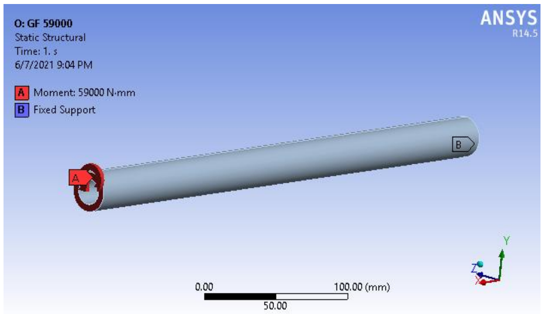

Fig 5 Total Deformation of moment 59000 N-mm apply on MS shaft

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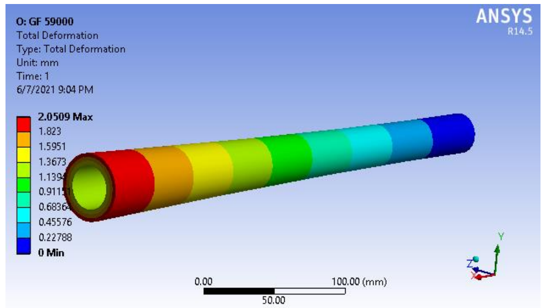

Fig 6 Total Deformation of moment 59000 N-mm apply on MS shaft

Stress

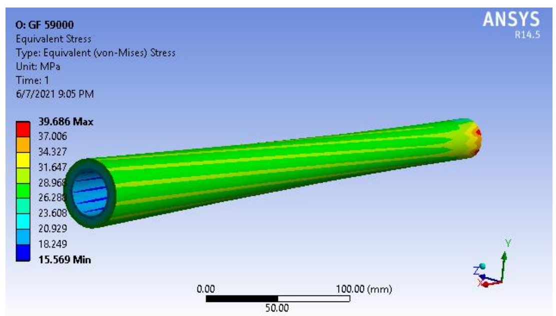

Fig 7 Stress of moment 59000 N-mm apply on MS shaft

Boundary condition

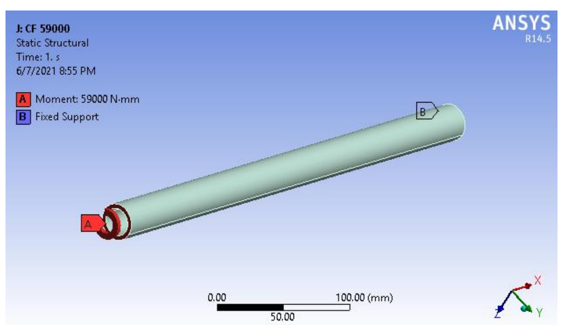

Fig 8 Total Deformation of moment 59000 N-mm apply on MS shaft

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Total Deformation

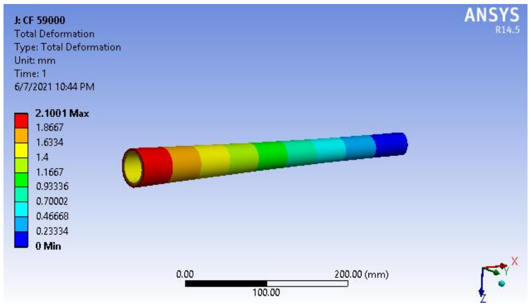

Fig 9 Total Deformation of moment 59000 N-mm apply on MS shaft

Stress

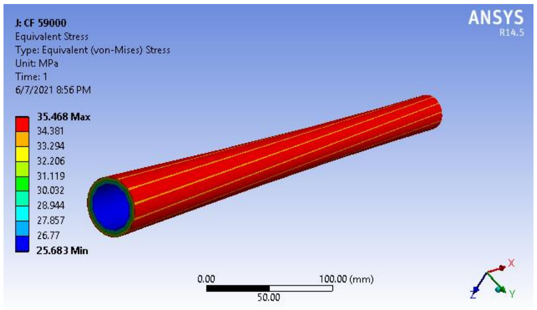

Fig 10 Stress of moment 59000 N-mm apply on MS shaft

III. PRACTICAL TESTING

Though FEA and Analytical calculations are already carried out, drive shaft for Mild steel and Carbon Fiber are manufactured and tested for further validation Based on the type of the matrix phase materials composites are classified as polymer, metal and ceramic matrix composite materials. Various techniques have been developed for the fabrication. Further there are two types of polymer matrix materials: thermoplastics and thermo sets. In the present work thermoset matrix material (epoxy) with Carbon long fibers are used in the fabrication of composite driven shaft.

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Fig.11 Shaft attached for testing on torsion testing machine.

IV. RESULT

ANSYS result

4.1 FEA Results for M.S. Shaft

Sr.No.	Moment (Nmm)	Stress (MPa)	Deformation (mm)
1	10787	0.03024	10.29
2	21557	0.06049	20.595
3	34323	0.096232	32.76
4	4903	0.13747	46.806
5	59000	0.16542	56.32

Table 1 FEA result for M.S. Shaft

4.2 FEA Results for G.F. Shaft

Sr.No.	Moment (Nmm)	Stress (MPa)	Deformation (mm)
1	10787	0.0157	5.347
2	21557	0.031404	10.696
3	34323	0.04996	17.016
4	4903	0.07137	24.309
5	59000	2.0509	39.686

Table 2 FEA result for G.F. Shaft

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4.3 FEA Results for C.F. Shaft

Sr.No.	Moment (Nmm)	Stress (MPa)	Deformation (mm)
1	10787	0.3839	6.487
2	21557	0.7679	12.37
3	34323	1.2217	20.63
4	4903	1.7453	29.47
5	59000	2.10	35.46

Table 3 FEA result for C.F. Shaft

4.4 Testing Result

Twisted Test Result

Sr. No	Torque (N mm)	Twisting Angle	
		MS	CF
1	10787	0.2	0.9
2	21575	0.3	1.6
3	34323	0.4	2.5
4	49033	0.5	3.3
5	59000	1	4

Table 4 Practical testing result of both shaft

V. CONCLUSION

Lessening weight and expanding strength of items have high requests in the vehicle world. Composite materials can satisfy these solicitations widely. The current work incorporates the static examination of common steel shaft and composite shaft. Model is prepared in CATIA V5R20 and subsequently examination is performed through ANSYS R14.5. A general report has been made between steel and composite shaft to find out material having high strength to weight ratio. From the results obtained it is concluded that,

1. Stress occurred in the composite drive shaft is less as compared to conventional drive shaft.
2. Results obtained through ANSYS are validated from experimental testing.
3. Comparison of the results also shows that the results derived using all the calculation methods are similar to each other. Hence, FEA results can be considered as valid method for design purpose.
4. Composite Carbon fiber shaft has less weight than conventional steel drive shaft for analyzed stress. So composites can be suggested for driving shaft of light passenger vehicle.

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