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A SCHEMATIC DESIGN AND ANALYSIS COMPOSITE DRIVE SHAFT USED IN AN AUTOMOBILE VEHICLES

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ABSTRACT: Substituting composite structures for ordinary metallic structures has many favorable circumstances as a result of higher particular firmness and quality of composite materials. This work manages the substitution of regular two-piece steel drive shafts with a solitary piece e-glass/epoxy, high quality carbon/epoxy and high modulus carbon/epoxy composite drive shaft for a car application. The plan parameters were upgraded with the target of limiting the heaviness of composite drive shaft. The outline advancement additionally demonstrated noteworthy potential change in the execution of drive shaft.

Key words:- Torque transmission, Torsional clasping limits, Fundamental horizontal Natural recurrence, Bernoulli Euler hypothesis, Timoshenko shaft hypothesis, Static investigation, Modal examination, Buckling examination, Ansys.

1.0 INTRODUCTION:

Quick mechanical advances in building configuration field bring about finding the substitute answer for the customary materials. The plan engineers conveyed to a point to finding the materials which are more dependable than traditional materials. Analysts and fashioners are continually searching for the answers for give more grounded and strong materials which will answer the necessities of kindred designers. Drive shafts are utilized as power transmission tubing in numerous applications, including cooling towers, pumping sets, aviation, trucks and cars. In the plan of metallic shaft, knowing the torque and the reasonable shear worry for the material, the span of the poles cross area can be resolved. In the present days there is a substantial prerequisite for lightweight materials vehicle. The customary steel material is replaceable by cutting edge composite materials. Composite materials are supported by a large portion of the researcher in the outline of autos because of its higher particular quality and solidness. He expressed the conceivable outcomes of supplanting the regular steel material by composites in the field of car.

Functions of the drive shaft:

To begin with, it must transmit torque from the transmission to the differential rigging box. Amid the operation, it is important to transmit greatest low-equip torque created by the motor. This development changes the edge between the transmission and the differential The length of the drive shaft

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should likewise be equipped for changing while at the same time transmitting torque.

Types of drive shaft:

There are different sort of transmission shaft among them following are critical

•Transmission shaft.
•Machine shaft.
•Spindle.
•Automobile drive shaft.
•Ship propeller shaft.
•Helicopter tail rotor shaft

DRIVE (MECHANISM):

A drive is a twisted bit of a hub, or shaft, or an arm keyed at right edges to the finish of a pole, by which movement is bestowed to or gotten from it; likewise used to change round into responding movement, or responding into roundabout movement. Natural cases of a drive for manual utilize incorporate the drive on a manual pencil sharpener and the drive set that drives a bike by means of the pedals.

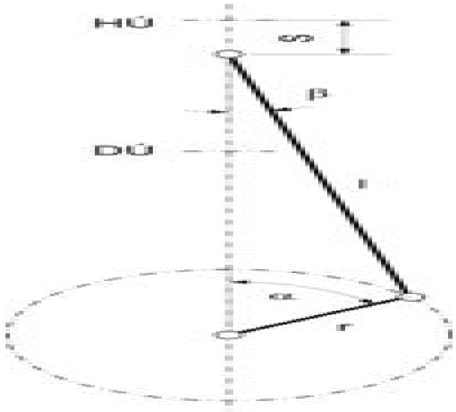

FIGURE 1.1 DRIVE SHAFT MECHANISAM

Drives were once in the past basic on a few machines in the mid twentieth century; for instance all phonographs previously the 1930s were controlled by perfect timing engines twisted with drives, and inward ignition motors of cars were typically begun with drives before electric starters came into general utilize.

Demerits of a conventional drive shaft:

They have less particular modulus and quality. Expanded weight. Traditional steel drive shafts are normally produced in two pieces to build the essential bowing characteristic recurrence in light of the fact that the bowing common recurrence of a pole is conversely corresponding to the square of bar length and relative to the square base of particular modulus. In this manner the steel drive shaft is made in two segments associated by a help structure, orientation and U-joints and henceforth general weight of get together will be more.

Scope of the work:

This undertaking is concentrating on outline a composite drive shaft which was subjected to static torque limit and examination by utilizing limited component investigation programming. The extent of this investigation incorporates:

a) The drive shaft was outlined utilizing the CATIA plan programming.

b) The drive shaft configuration was foreign made from CATIA to investigation 15.0 programming.

c) The drive shaft was squashed and the model will be set with various material layers, winding point and stacking arrangement of the material.

2.0 LITARATURE REVIEW:

[1] Beardmore, P. et al (2000): the conceivable outcomes of supplanting the traditional steel material by composites in the field of car. Depict the conceivable outcomes of composites used to supplant the steel leaf spring and in addition steel drive shaft. The propelled composite materials, for example, graphite, carbon, Kevlar and glass with reasonable saps are broadly utilized as a result of their high particular (quality/thickness) and high particular (modulus/thickness

[2] Goldberg, D. E. (2005) did a relative examination on the possibilities of precious stone polishing and ball shining with a plan to set up zones of their successful application. Work solidified layer after ball polishing is observed to be 1.3-1.7 times more noteworthy than that after precious stone shining. Most extreme leftover worries with a jewel of sweep 2 mm is 110 Kgf/mm2 and contrasted its execution and titanium ball shining. Precious stone polishing is prudent when there is higher interest for surface, and less solidness.

[3] Vijayarangan, S., Rajendran, I. (2001) separated the diagram prerequisites due to the physical geometry (greater range)range) of the drive shafts used as a piece of the said applications, including auto applications, the shear quality which decides the stack passing on constrain, is of minor arrangement noteworthiness since the mistake mode is ordered by catching; thusly, the principal layout segments are the winding regular repeat and the torsional fastening quality, which are components of the longitudinal and circle bowing solidness, independently. The variable of the cover thickness bigly influences the fastening quality, and a slight effect on the bowing customary repeat.

[4] Beardmore, P. et al. (2008) have proposed a disappointment demonstrate for tubular single lap steel-steel adhesively fortified joints with nonlinear mechanical properties and creation lingering warm burdens. The 15 nonlinear tractable anxiety strain relationship of the glue was demonstrated by a two-parameter exponential condition that was exhibited by the underlying ductile modulus and extreme rigidity of the cement. have examined the impacts of cement fillers on the quality of tubular single lap cement joints and warm attributes of glue joints.

[5] T. Rangaswamy, et. al.(2002) have talked about a straightforward hereditary calculation for streamlining basic frameworks with discrete outline factors and, a punishment based change strategy is utilized to change the compelled issue into an unconstrained issue. The idea of improvement utilizing bland calculation is additionally introduced in detail utilizing three-bar truss issue. Streamlining for clasping of covered plates by whole number programming and hereditary calculation. has utilized GA to upgrade welded pillar structure comprising of a very nonlinear target work with five nonlinear imperatives. the utilization of hereditary calculation for the base thickness plan of composite overlaid plates.

3.0 Methodology:

The methodology as per follows:

- The specification of the shaft for its loading and operating conditions
- Obtaining 2D drawing loading conditions from design conditions
- Preparation of 3D finite element model using hyper mesh
- The above hyper mesh model analysis in Ansys 14.0 or 16.0 comparison

- between the results obtained from theoretical calculation and the result taken from Ansys 16.0

Table design requirements for steel drive shaft:

Parameter of Shaft	**Symbol**	**Value**	**Unit**
Outer Diameter	do	90	mm
Inner Diameter	di	83.36	mm
Length of the Shaft	L	1250	mm
Thickness of shaft	T	3.32	mm

DESIGN OF STEEL DRIVE SHAFT

mass of the steel drive shaft, "m= ρal= ρ × π/4 × (do2- di2) ×l"… (1)

= 7600 x 3.14/4 x (902 – 83.362) x 1250

[m = 8.58 kg]

torque transmission capacity of steel drive shaft, "t= ss× π /16 × [(do4- di4) × do]" …(2)

[t = 55.93 ×103 n-m]

Fundamental natural frequency, the natural frequency can be found by using the two theories:

1) Timoshenko beam theory
2) Bernoulli Euler theory

Timoshenko beam theory-ncrt "fnt= ks (30 π p2) / l2 x √ (er2 / 2ρ)"…..(3)

"ncrt = 60 fnt"….. (4)

fnt= natural frequency base on Timoshenko beam theory,

hzks = shear coefficient of lateral natural frequency

p = 1, first natural frequency

r = mean radius of shaft

fs = shape factor, 2 for hollow circular cross section

n = no of ply thickness,

1 for steel shafts "1 / ks 2= 1 + (n2π 2 r2) / 2l2 x [1 + fs e / g]"…. (5)

1 / ks 2 = 1+ (12π 2 86.822) / 2 x12502 x [1 + 2x207x103 / 80 x103]

[ks= 0.982]

fnt= 0.982 (30 x π x 12) / 1250 x √ (207x103 x 86.682/2x 7600)

[fnt= 299.54 hz]

[ncrt = 17972.4 rpm]

DESIGN OF COMPOSITE DRIVE SHAFT

The specifications for the composite drive shaft are same as that of steel drive. Mass of the Compositedrive shaft.

m = ρAL = ρ × Π / 4 × (do2- di2) × L … (1)

= 1600 x 3.14/4 x (902 – 83.362) x 1250

[m = 1.80 Kg]

ASSUMPTIONS:

- The shaft pivots at a steady speed about its longitudinal hub.
- The shaft has a uniform, round cross area.
- The shaft is superbly adjusted, i.e., at each cross area, the mass focus agrees with the geometric focus.
- All damping and nonlinear impacts are rejected.
- The stretch strain relationship for composite material is direct and versatile; henceforth, Hooke's law is appropriate for composite materials.
- STATIC ANALYSIS

A static investigation is utilized to decide the removals, stresses, strains and powers in structures or segments caused by loads that don't incite critical inactivity and damping impacts. A static

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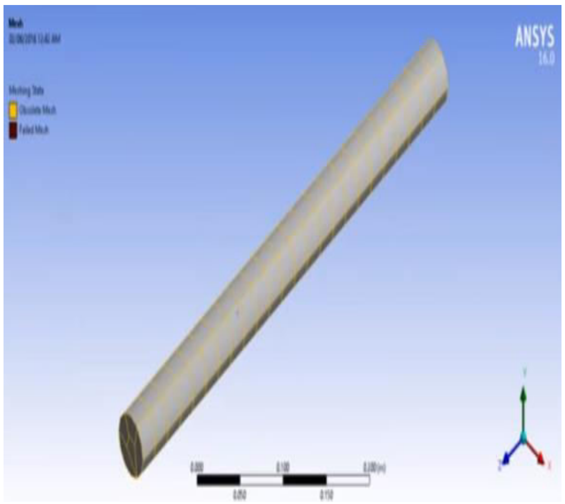
investigation can however incorporate enduring dormancy loads, for example, gravity, turning and time differing loads. In static investigation stacking and reaction conditions are expected, that is the heaps and the structure reactions are accepted to differ gradually regarding time



FIGUREBOUNDARY CONDITIONS OF MODEL ANALYSIS

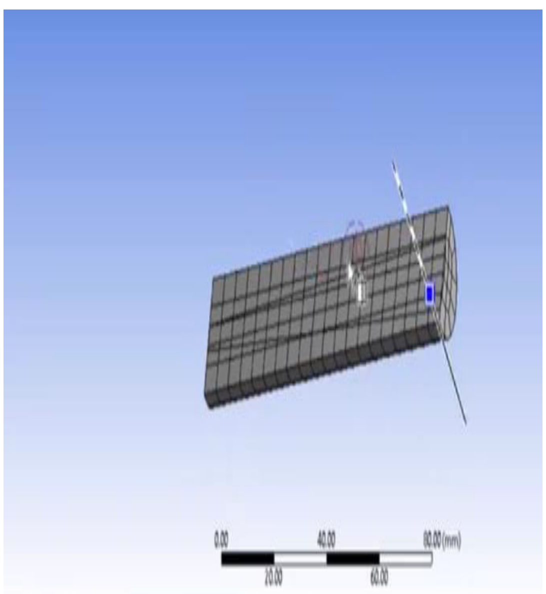


FIGURE HALF ROUND DRIVE SHAFT MESHING MODEL

4.0 RESULTS:

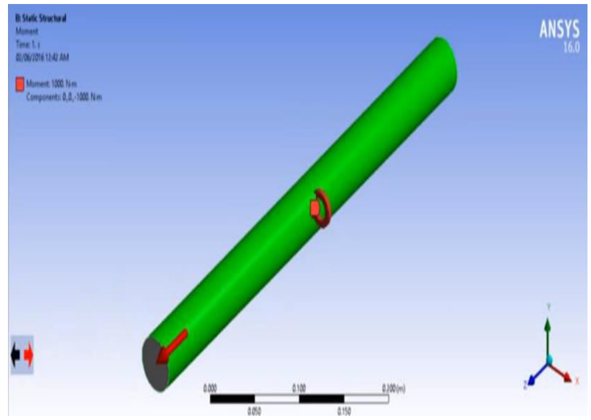


FIGURE 4.1 STATIC STRUCTURAL OF THE DRIVE SHAFT

DETAILS OF MOMENT	
scope	
scoping method	geometry selection
geometry	1 face
definition	
type	Moment
Define by	Vector
Magnitude	10,000 N-m
behavior	Deformable
Suppressed	No

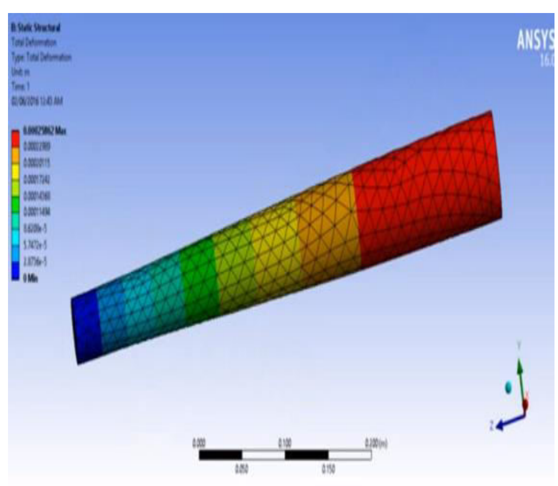


FIGURE TOTAL DEFORMATION

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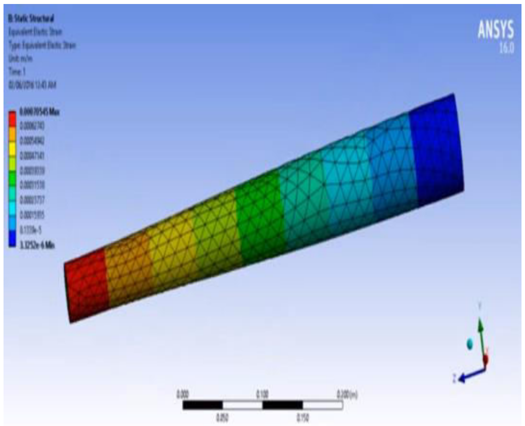

FIGURE EQUIVALENT ELASTIC STRAIN

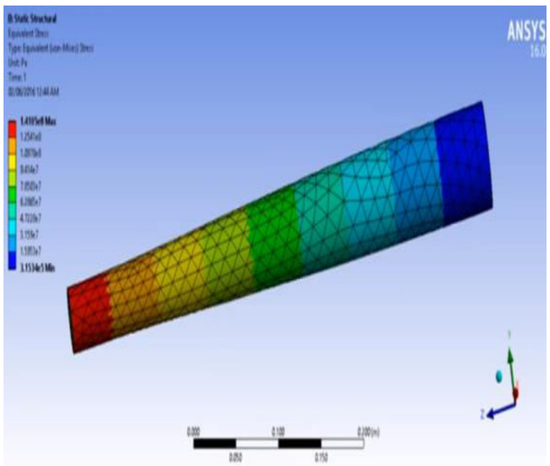

FIGURE 4.5 EQUIVALENT VON-MISSES STRESS

4.2 DRIVE SHAFT WITH HM – Carbon / Epoxy

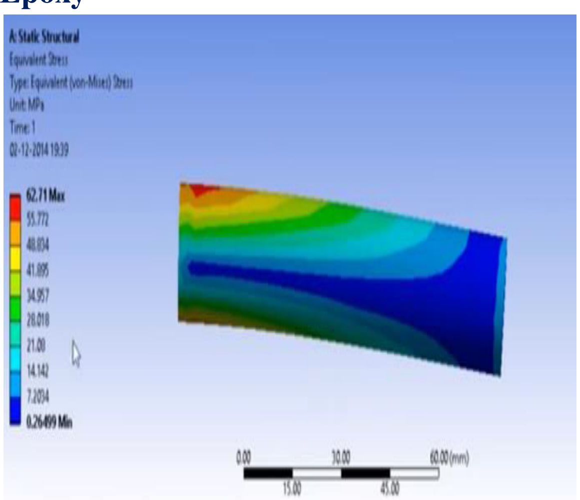

FIGURE EQUIVALENT VON MISES STRESS

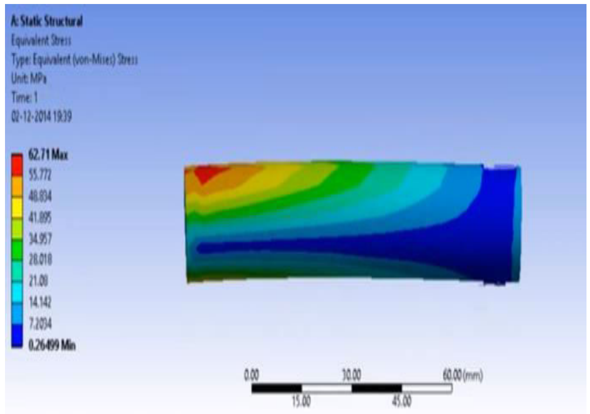

FIGURE EQUIVALENT VON MISES OF 0.777778 STRESS MOMENT

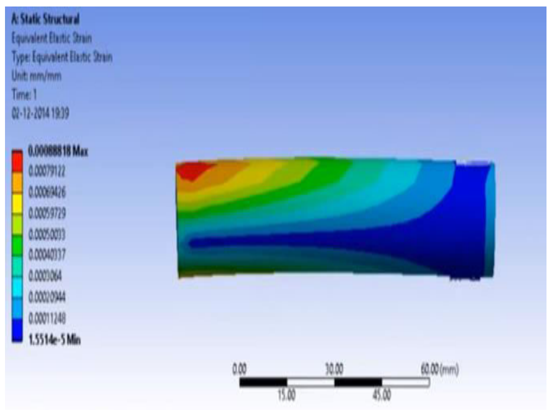

FIGURE EQUIVALENT ELASTIC STRAINS

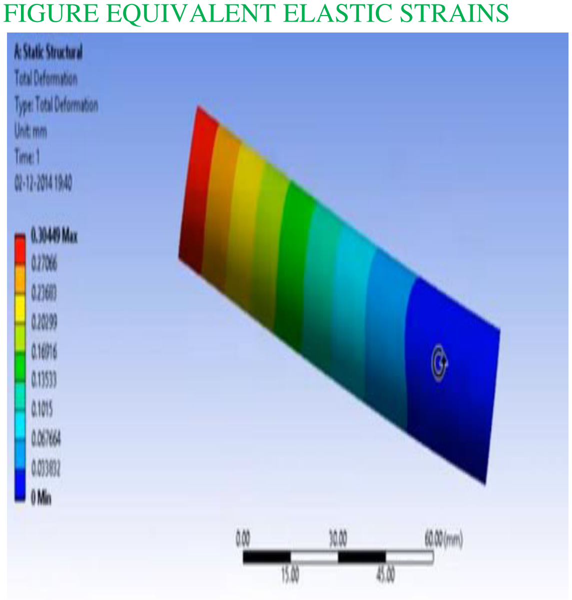

FIGURE STATIC STRUCTURAL OF TOTAL DEFORMATION

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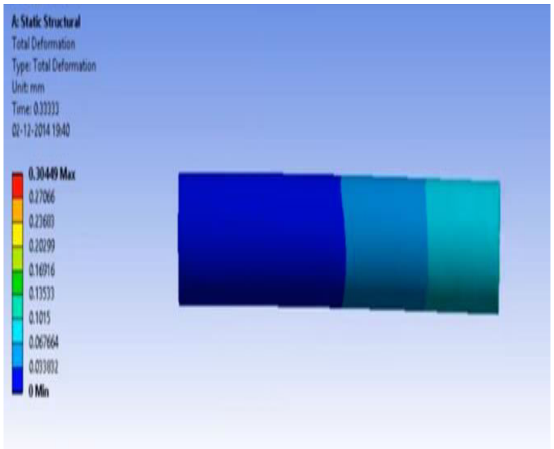


FIGURE STATIC STRUCTURAL OF MAXIMUM TOTAL DEFORMATION

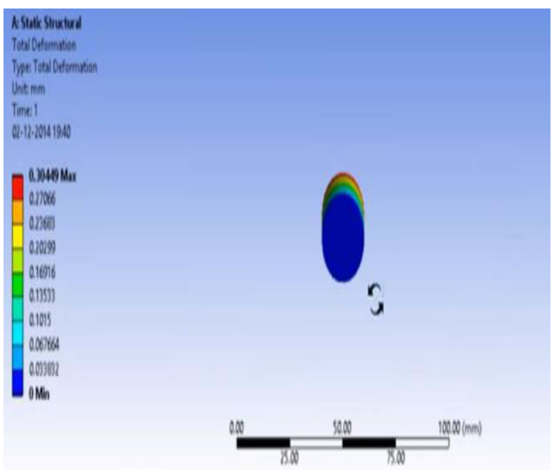


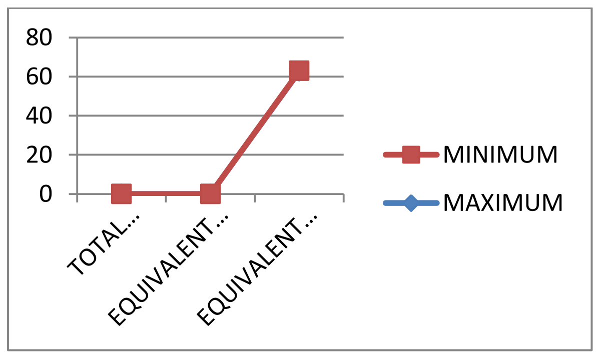
FIGURE FRONT VIEW OF THE DRIVE SHAFT

TABLE 4.1 DRIVE SHAFT USING HS – Carbon / EpoxyMAXIMUM AND MINIMUM VALUES

PARAMETERS	MAXIMUM	MINIMUM
TOTAL DEFORMATION	0.30449	0
EQUIVALENT ELASTIC STRAIN	0.0070545	**0**
EQUIVALENT VON MISSES STRESS	1.405e8 min	1.1534e5 min

TABLE 4.2 DRIVE SHAFT USING HM – Carbon / EpoxyMAXIMUM AND MINIMUM VALUES

PARAMETERS	MAXIMUM	MINIMUM
TOTAL DEFORMATION	0.00025462	0
EQUIVALENT ELASTIC STRAIN	0.00088818	1.5514e-5
EQUIVALENT VON MISSES STRESS	62.71	0.26499



DRIVE SHAFT USING HM – Carbon / Epoxy ALLOY MAXIMUM AND MINIMUM VALUES

CONCLUSIONS:

The accompanying conclusions are drawn from the present work. The E – Glass/Epoxy, High Strength Carbon/Epoxy and High Modulus Carbon/Epoxy composite drive shifts have been intended to supplant the steel drive shaft of a car. A composite drive shaft for wheel drive car has been outlined ideally by utilizing Genetic Algorithm for E – Glass/Epoxy, High Strength Carbon/Epoxy and High Modulus Carbon/Epoxy composites with the goal of minimization of weight of the pole which was subjected to the requirements, for example, torque transmission, torsional kicking limits and regular bowing recurrence.

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