



## Design, Analysis & Optimization of Drive Shaft with Composite Material

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### ABSTRACT

In IC Engines thermal energy of the burnt fuel gases is born-again into motility energy (of a regulator) by a Slider Crank Mechanism. In brief, the inferior thermal energy of the gases is born-again into the high-grade motility mechanical energy of the regulator. IC engines therefore single-handed caused the commercial revolution and contributed to the worldwide economy considerably.

IC Engines are therefore effective that they're accustomed date in cars. it's therefore extraordinarily necessary to assess how power transmission to distant components of machines /automobiles, scale back power losses throughout the facility transmission and increase the service life of the facility mechanism.

Most cars have engines mounted on the front and a rear-wheel-drive i.e. the engine mounted within the front delivers mechanical power at the rear of the vehicle. To transmit the facility from the engine to the rear wheels, a driving shaft is connected between the transmission and differential at the rear axles. Whenever there's a movement within the main shaft of the transmission the facility is transmitted through the driving shaft to the differential, therefore the rear wheels rotate consequently. Conventionally the shaft is created from SM45 steel.

For vehicles with larger wheelbases, longer shafts are used. however, this raises another issue as long shafts bend quite shorter shafts attributable to the load. This ends up in unbalanced mass distribution around the shaft leading to whirling at sure speeds. This limits the facility transmission capability of the mechanism. to beat this, long drive shafts are bisected and every element is coupled to the opposite by a coupler. a complete of 3 universal joints are accustomed couple the bisected shaft with transmission and rear differential. This will increase the load of the vehicle considerably.

### INTRODUCTION

We have seen that the length of the shaft will be reduced by bisecting the shaft and inserting universal joints between completely different sections of the shaft. but universal joints cannot transmit power efficiently. Thus, once the number of couplers will increase, power transmission through the assembly reduces. and also, the weight of the assembly will increase adversely poignant the fuel economy of the car.

Composite materials are employed in automotive parts attributable to their properties like low weight, high specific stiffness, corrosion resistance, ability to supply advanced shapes, high specific strength, and high impact energy absorption, etc. Composite materials may also stand up to warm temperatures, and their physical properties will be controlled comparatively simply. it'll scale back the usage of the coupler. Conventionally 2 items of steel shaft having 3 universal joints are used however, within the case of composite materials, the coupler intermediate isn't used.

Because in stuff deformation and bending is low as compared to traditional shafts. The high-strength composite materials are accustomed to scale back weight and increase power transmission.

### OBJECTIVE

The overall objective of this work is to cut back the load whereas retentive the required mechanical properties. this could in turn increase the general decrease in fuel consumption. And it'd decrease the price to manufacture the rotating shaft assembly. The modeling of the drive shaft assembly was done mistreatment ANSYS package.

### WORKING PRINCIPLE

The force that's made from the engine and transmission should be transferred to the rear wheels to push the vehicle forward and reverse. The drive shaft should offer a swish, uninterrupted flow of power to the axles. The rotating shaft



and differential are accustomed transfer this force. First, it should transmit force from the transmission to the differential case. throughout the operation, it's necessary to transmit most low-gear force developed by the engine. The driveshafts should even be capable of rotating at the in no time speeds needed by the vehicle. The rotating shaft should additionally operate through perpetually dynamic angles between the transmission, the differential, and also the axles. because the rear wheels roll over bumps within the road, the differential and axles move up and down. This movement changes the angle between the transmission and also the differential. The length of the driveshaft should even be capable of fixing whereas sending force. Length changes are caused by shaft movement thanks to forcing reaction, road deflections, braking masses so on. a blunder joint is employed to make amends for this motion. The slip joint is sometimes a product of an interior and external spline. it's placed on the forepart of the rotating shaft and is connected to the transmission.

## MATERIAL PROPERTIES

### E-GLASS organic compound

A chemical compound is mostly factory-made by Step-growth chemical change or additional chemical change. once combined with varied agents to boost or by any means alter the fabric properties of polymers the result's mentioned as plastic. Composite plastics talk to those varieties of plastics that result from bonding 2 or additional consistent materials with completely different material properties to derive a final product with sure desired material and mechanical properties.

Fiber-reinforced plastics are a class of composite plastics that specifically use fiber materials to automatically enhance the strength and physical property of plastics. the initial plastic material while not fiber reinforcement is understood because of the matrix. The matrix could be a powerful however comparatively weak plastic that's bolstered by stronger stiffer reinforcing filaments or fibers. The extent that strength and physical property is increased in a very fiber-reinforced plastic depends on the mechanical properties of each fiber and matrix, their volume relative to at least one another, and also the fiber length and orientation among the matrix. Reinforcement of the matrix happens by definition once the FRP material exhibits enhanced strength or physical property relative to the strength and physical property of the matrix alone.

It is seen that Low-E glass comes in high, moderate, and low gain panels, Low-E glass works by reflective heat to its supply, Low-E glass is glazed with an associate ultra-thin golden coating. Works efficiently at terribly low motility speed, during this case, one hundred rad/sec.

Description	E-Glass Resin
Density	2100 Kg/m <sup>3</sup>
Young's Modulus	3.4E+10 N/mm <sup>2</sup>
Poisson's magnitude relation	0.366

## STRUCTURAL STEEL

- 1. Characteristics** - Structural steel differs from concrete in its attributed compressive strength as well as tensile strength.
- 2. Strength** - Having high strength, stiffness, toughness, and ductile properties, structural steel is one of the most commonly used materials in commercial and industrial building construction.
- 3. Constructability** - Structural steel can be developed into nearly any shape, which is either bolted or welded together in construction. Structural steel can be erected as soon as the materials are delivered on-site, whereas concrete must be cured at least 1–2 weeks after pouring before construction can continue, making steel schedule-friendly construction material.



4. **Fire resistance** - Steel is inherently a noncombustible material. However, when heated to temperatures seen in a fire scenario, the strength, and stiffness of the material are significantly reduced. The International Building Code requires steel to be enveloped in sufficient fire-resistant materials, increasing the overall cost of steel structure buildings.
5. **Corrosion** - Steel, when in contact with water, can corrode, creating a potentially dangerous structure. Measures must be taken in structural steel construction to prevent any lifetime corrosion. The steel can be painted, providing water resistance. Also, the fire resistance material used to envelop steel is commonly water-resistant.

Description	Structural Steel
Density	7600 Kg/m <sup>3</sup>
Young's Modulus	207 GPA
Shear Modulus	80 GPA
Poisson's ratio	0.3
Yield Strength	370 MPa
Shear Strength	275 MPa

#### DEMERITS OF TYPICAL STEEL SHAFT

- Fuel consumption may be exaggerated because of a rise in weight.
- Power loss may be shaped.
- Less corrosion and fatigue resistance.
- They having less strength and stiffness.
- Conventionally shaft is created from 2 items because of bending, so 3 universal joints area units are used. once the coupler will increase power transmission capability decreases.
- Efficiency decreases.

#### APPLICATION OF MATERIAL

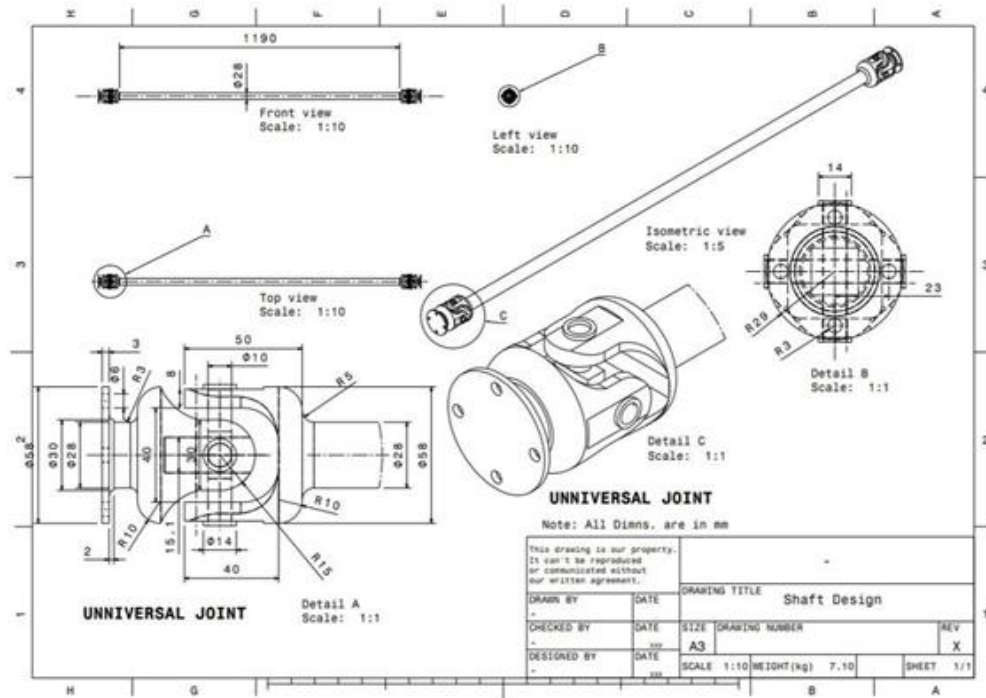
- Aircrafts
- Boats and marine
- Sporting instrumentation
- Automotive parts
- Suit of armor, Building materials

#### ADVANTAGES

1. **Increased efficiency:** The power is not wasted in friction (from the belt, chain, etc., and especially, gearboxes.)
2. **Reduced noise:** Being a simpler device, a direct-drive mechanism has fewer parts that could vibrate, and the overall noise emission of the system is usually lower.
3. **Longer lifetime:** Having fewer moving parts also means having fewer parts prone to failure. Failures in other systems are usually produced by the aging of the component (such as a stretched belt), or stress.
4. **Faster and precise positioning:** High torque and low inertia allow faster positioning times on permanent magnet synchronous servo drives. Feedback sensor directly on rotary part allows precise angular position sensing.
5. **Drive stiffness:** Mechanical backlash, hysteresis, and elasticity are removed avoiding the use of gearbox or ball screw mechanisms.



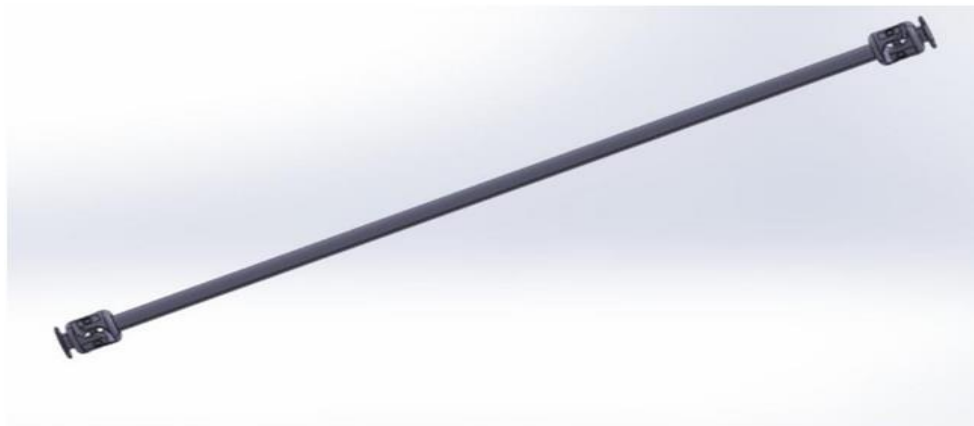
### DESIGN OF MODEL

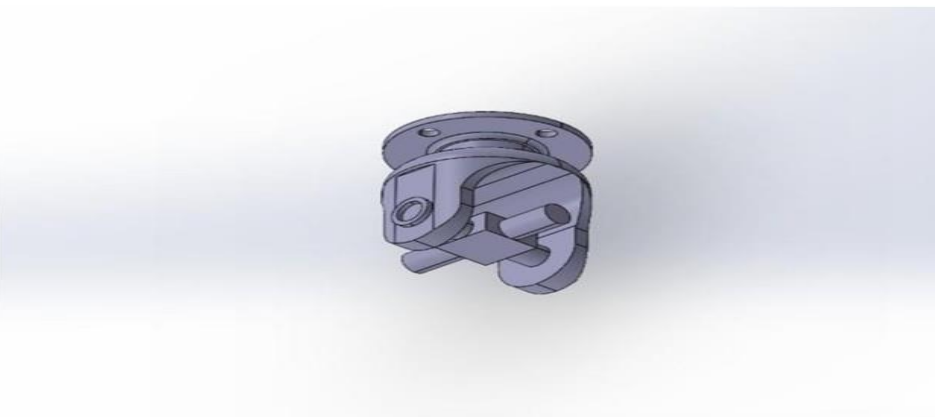
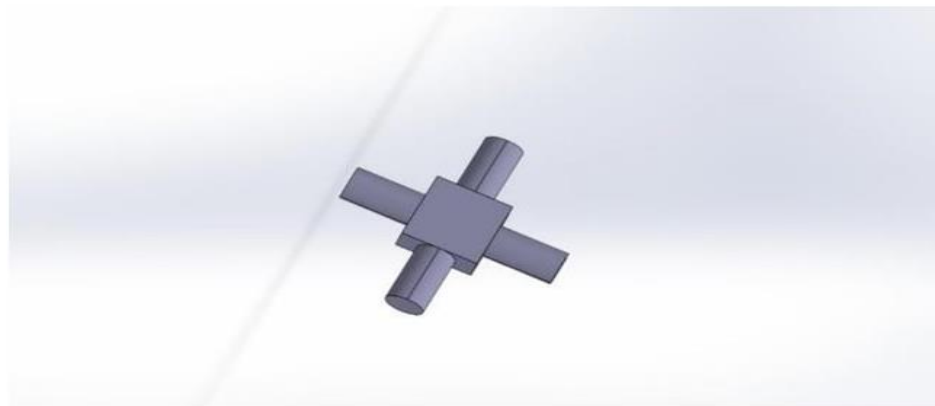
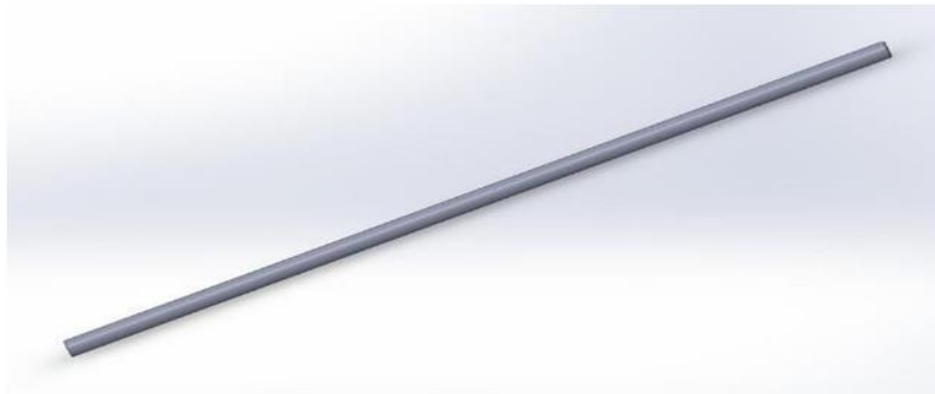


### SOLIDWORKS

SolidWorks could be a solid modeling software package and a computer-aided engineering malicious program that runs totally on Microsoft Windows. whereas it's attainable to run SolidWorks on MacOS, it's not supported by SolidWorks. SolidWorks is revealed by Dassault Systems.

### FINAL STYLE IN SOLIDWORKS

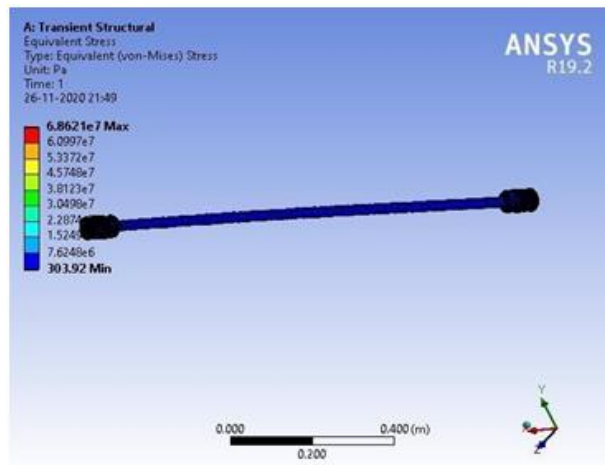




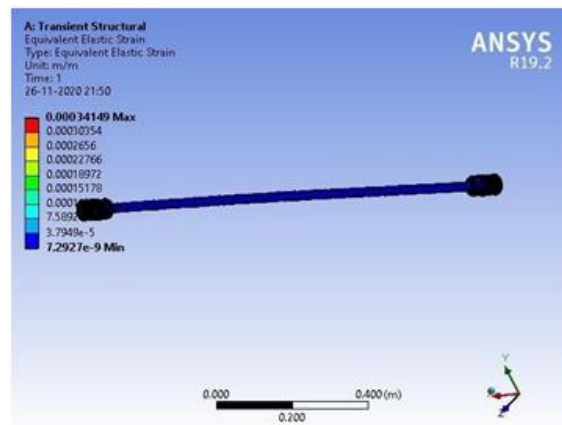
#### **ANALYSIS USING ANSYS WORKTABLE**

Ansys, Inc. could be a world public company based mostly in Canonsburg, Pennsylvania. It develops and markets multiphysics engineering simulation computer code for product style, testing, and operation. Ansys was based in 1970 by John Swanson. Swanson sold his interest within the company to venture capitalists in 1993.

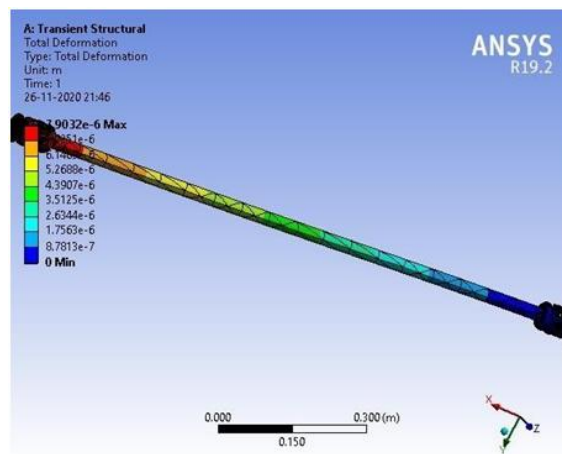
#### **ANALYSIS OF DRIVE SHAFT FOR STEEL**



Stress Analysis

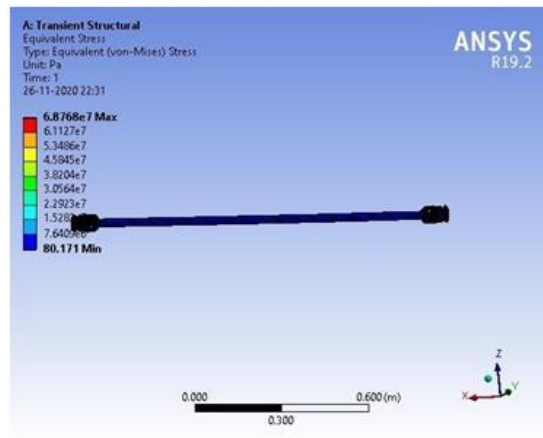


Strain Analysis

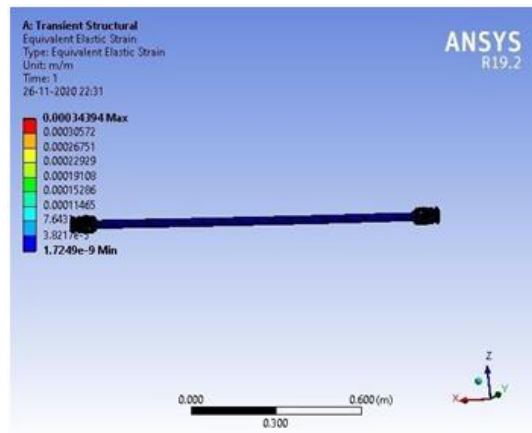


Deformation

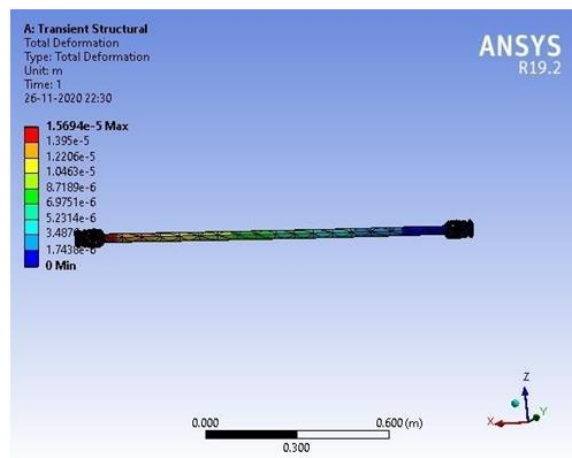
**ANALYSIS OF DRIVE SHAFT FOR E-GLASS RESIN**



Stress Analysis



Strain Analysis



Deformation

## CONCLUSION



Following outcomes were observed:

1. The usage of composite material will decrease the amount of weight when compared to a conventional steel shaft.
2. When the weight decrease, fuel consumption also decreases thus fuel economy increases.
3. By usage of composite material, a single-piece shaft can be implemented. Then the power loss decreases.
4. In this analysis, the composite shaft has less deformation when compared to a conventional steel shaft.
5. The usage of composite material has resulted in weight reduction
6. Taking into consideration the weight saving, deformation, shear stress-induced, and resonant frequencies it is evident that E-Glass/Epoxy composite has the most encouraging properties to act as a replacement for steel out of the considered two materials.

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