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Design, Analysis and Weight Optimization Lathe Machine Gear by Using Composite Material

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Abstract: ***To design the spur gear to study the weight reduction and stress distribution for cast steel and composite materials. Gearing is one of the most critical components in a mechanical power transmission system, and in most industrial rotating machinery. It is possible that gears will predominate as the most effective means of transmitting power in future machines due to their high degree of reliability and compactness. In addition, the rapid shift in the industry from heavy industries such as shipbuilding to industries such as automobile manufacture and office automation tools will necessitate a refined application of gear technology. To design the spur gear model using designs software. To study the impact analysis for cast steel and composite materials. To study the torque loading for cast steel and composite materials. Finally, comparing and analysing of the composite gear with existing cast steel gear is to be done.***
Keywords: Gear, Composite Material, Ansys, fibre, Epoxy.

I. INTRODUCTION

Spur gears or straight-cut gears are the simplest type of gear. They consist of a cylinder or disk with teeth projecting radially. Though the teeth are not straight-sided (but usually of special form to achieve a constant drive ratio, mainly involute but less commonly cycloidal), the edge of each tooth is straight and aligned parallel to the axis of rotation. These gears mesh together correctly only if fitted to parallel shafts. No axial thrust is created by the tooth loads. Spur gears are excellent at moderate speeds but tend to be noisy at high speeds. Spur gear teeth are manufactured by either involute profile or cycloidal profile. Most of the gears are manufactured by involute profile with 20° pressure angle.

When two gears are in mesh at one instant there is a chance to mate involute portion with non-involute portion of mating gear. This phenomenon is known as "interference" and occurs when the number of teeth on the smaller of the two meshing gears is less than a required minimum. To avoid interference we can have undercutting, but this is not a suitable solution as undercutting leads to weakening of tooth at its base. In this situation Corrected gears are used. In corrected gears Cutter rack is shifted upwards or downwards.

A gear or cogwheel is a rotating machine part having cut teeth or, in the case of a cogwheel, inserted teeth (called cogs), which mesh with another toothed part to transmit torque. Geared devices can change the speed, torque, and direction of a power source. Gears almost always produce a change in torque, creating a mechanical advantage, through their gear ratio, and thus may be considered a simple machine. The teeth on the two meshing gears all have the same shape.[1] Two or more meshing gears, working in a sequence, are called a gear train or a transmission. A gear can mesh with a linear toothed part, called a rack, producing translation instead of rotation.

II. OBJECTIVES

1) The objective of the project is to reduce the stress distribution, deformation and weight of spur gear by using composite materials in the application of gear box.
2) Stress analysis such as prediction of contact stress and bending stress.
3) The designed composite spur gear is compared with the existing gear materials, such as structural steel, Gray cast iron and aluminium alloy. The tool which is used to analyse the different spur gear materials is ANSYS.
4) Prediction of transmission efficiency
5) The final outputs of these analyses for all the materials are to be compared. From this comparison, the stress induced, deformation and weight for composite spur gear materials are to be less than that of the general spur gear materials.

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A. CAD Modeling

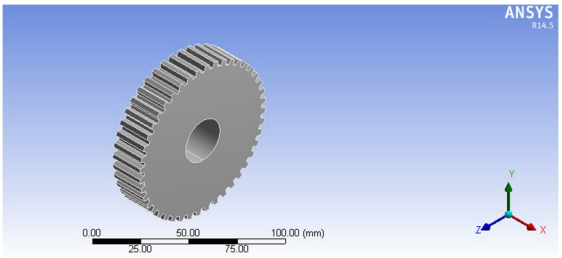


Fig1. Spur gear model imported in ANSYS software

B. FEA Analysis

Meshing

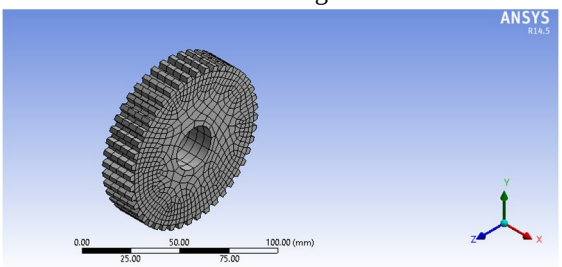


Fig 2. Spur gear meshing in ANSYS

Boundary Condition

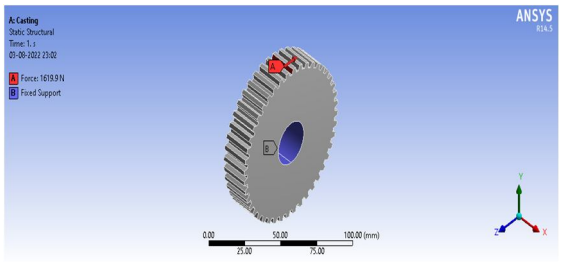


Fig 3. Boundary condition applied as per calculation to gear geometry.

C. Cast Iron Result

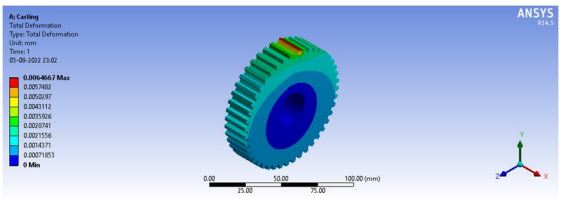


Fig 4. Total deformation in cast iron gear due to applied boundary condition.

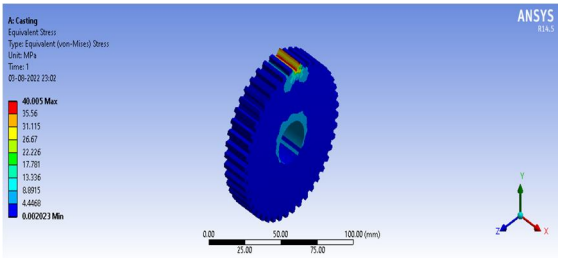


Fig 5. Stress generated in cast iron gear due to applied boundary condition.

D. Silicon Nitride Result

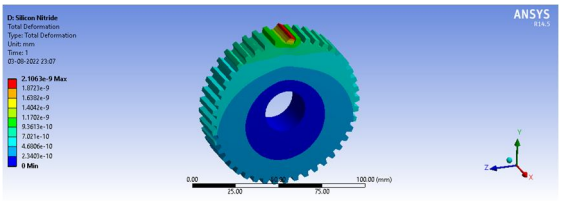


Fig 6. Total deformation in silicon nitride gear due to applied boundary condition.

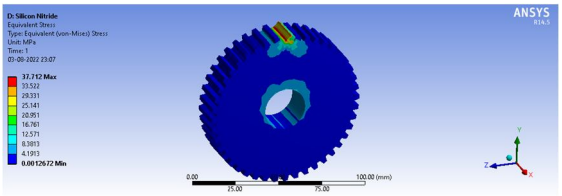


Fig 5. Stress generated in silicon nitride gear due to applied boundary condition.

III. RESULT TABLE

Sr. No.	Material	Stress (MPa)	Deformation (mm)
1	Cast Iron	40.005	0.006
2	Glass Fiber	43.52	0.11
3	Carbon Fiber	43.01	0.0889
4	Silicon Nitride	37.71	2.16e-9

Table1.Result of all material by using ANSYS software

Weight of Gear

Sr. No.	Material	Weight (Kg)
1	Cast Iron	0.8299
2	Glass Fiber	0.230
3	Carbon Fiber	0.184
4	Silicon Nitride	0.381

Table 2. Weight of all materials gears

IV. CONCLUSION

On the basis of that study, the analysis of four material gears in the application of gear box which is used in Lathe machine. So, we consider similar boundary condition for all analysis. From this analysis we got the stress values for Silicon Nitride materials is less as compared to the cast steel spur gear. So, from these analysis results, we conclude that, the stress induced, deformation and weight of the Silicon Nitride spur gear is less as compared to the cast steel spur gear. Hence silicon nitride is best as per our application with minimum weight and high strength.

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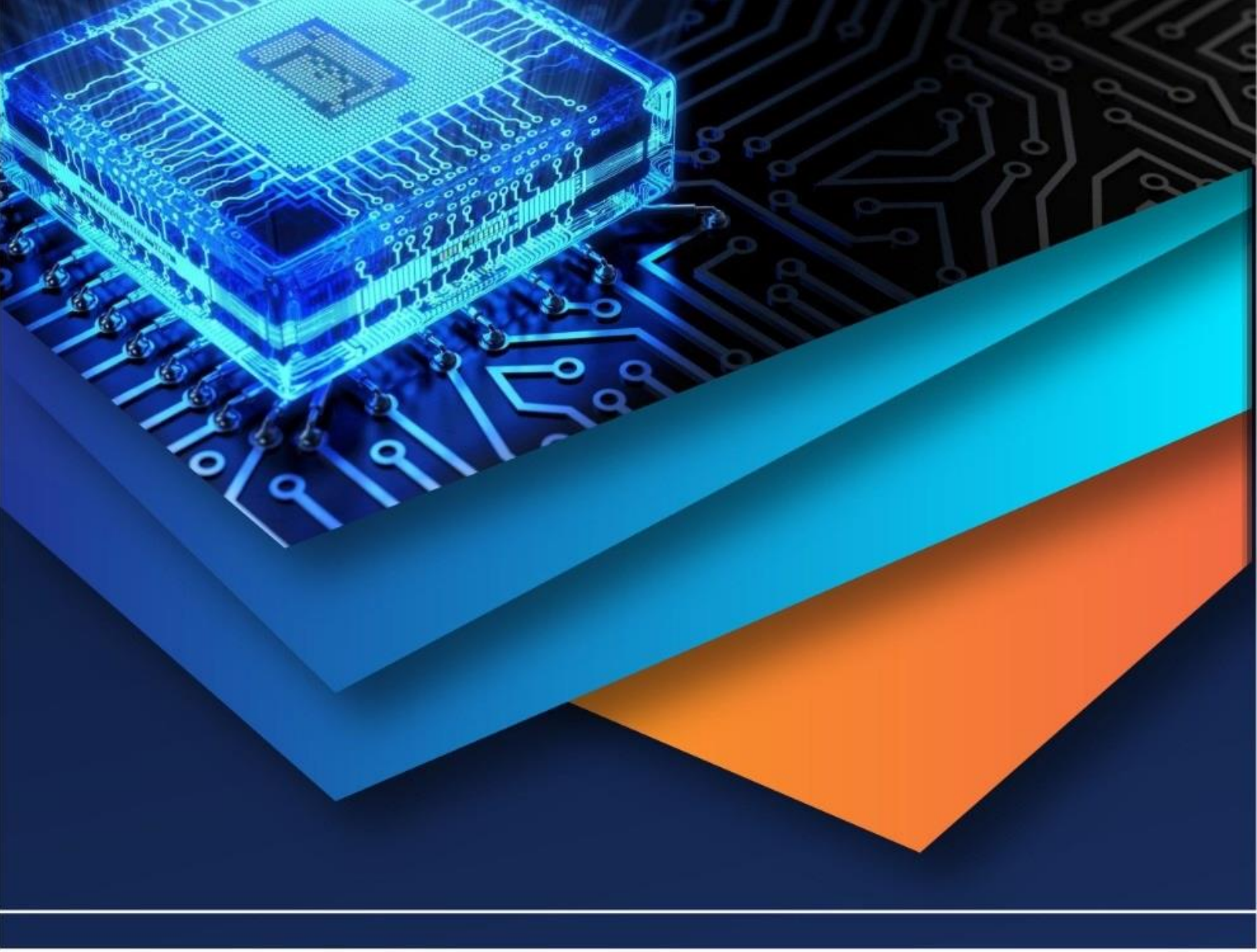
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