Optimization of static characteristic of Bevel Gear

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***Abstract*:** *The main objective of this project is to increase the static characteristics by using composites. First we create paramatric model in creo at various stages and after it will be analysized in the ansys workbanch 14.5. It is observed that Glass filled polyamide composite material is selected as a best material for differential gear box which can be increase the static characteristics. Comparison of various stresses and strain result using ANSYS-14.5 workbanch with Glass filled polyamide composite and Aluminium alloy are also being performed. The model of gear box generated using CREO 3.0 used to perform comprehensive Finite Element Analysis of composite material gear box using ANSYS-14.5 workbench.*

Keywords: bevel gear, optimal design, static.

I. INTRODUCTION

Gears are the most important component in a power transmission system. Recent years it has been brought demands in engineering technology for gear teeth which can operate at ever increasing speed and load capacities.[6] when tooth stress of the safety limits exceed, the gears generally fail. So it is essential to explore static characteristics of the material [15]. The important considerations while selecting a gear material is the ability of the gear material to withstand high frictional temperature and less abrasive wear [3]. Weight, manufacturability and cost are also important factors those are need to be considered during the design phase. [12] Moreover, the gear must have enough thermal storage capacity to prevent distortion or cracking from thermal stress until the heat can be dissipated [20]. It must have well anti fade characteristics i.e. their effectiveness should not decrease with constant prolonged application and should have well anti wear properties [4]. The upcoming requirement of power saving and efficiency of mechanical parts during the past few years increased the use of composite materials. Moreover the use of composite materials have also increased due to their properties such as weight reduction property with enough strength , high specific stiffness, corrosion free, ability to produce complex shapes, high specific strength, high impact energy absorption and many more[19]. Product development has changed from the traditional serial process of design, followed by prototype testing and

manufacturing but to more on computer aids. CAE (Computer Aided Engineering) has greatly influenced the chain of processes between the initial design and the final realization of a product. CAE software helps in product designing, 3-D visualization, analysis, simulation and impacted a lot on time and cost saving to the industry [21], [22].A Gear box is one of the important mechanical components of transmission system used in variety of machines. Differential Gear box increases effective weight of vehicle which in turn directly affects the performance and efficiency of the vehicle. So there is a requirement to make light and effective gears [15]. Therefore, in the present work composite materials are used to make light weight gears in order to perform such duty efficiently.

II. STATIC ANALYSIS

In this paper we have used aluminium alloys as a material of bevel gear. And we made a change in bevel gear design in order to improve its static characteristic.

Assumptions:

- A static analysis calculates the effects of dead load acting on a structure of bevel gear.
- The differential gear box need to be redesigned to providing energy saving by weight reduction, improve the natural frequency, and damping effect.
- Such a scope of gear box is providing the application of composite material providing substantial load, weight and static characteristics.
- Time- varying loads (wind and seismic loads commonly defined in many building codes)
- Static analysis is used to determine the displacements, stresses, total deformation, von mises stress, strains, and forces in structures or components caused by loads that do not induce significant inertia and damping effects.

TABLE I
MATERIAL PROPERTIES

Material	Young Modulus (Pa)	Poisson's Ratio	Density(kg*m^3)
Aluminum alloys	2E+ 11	0.33	2600

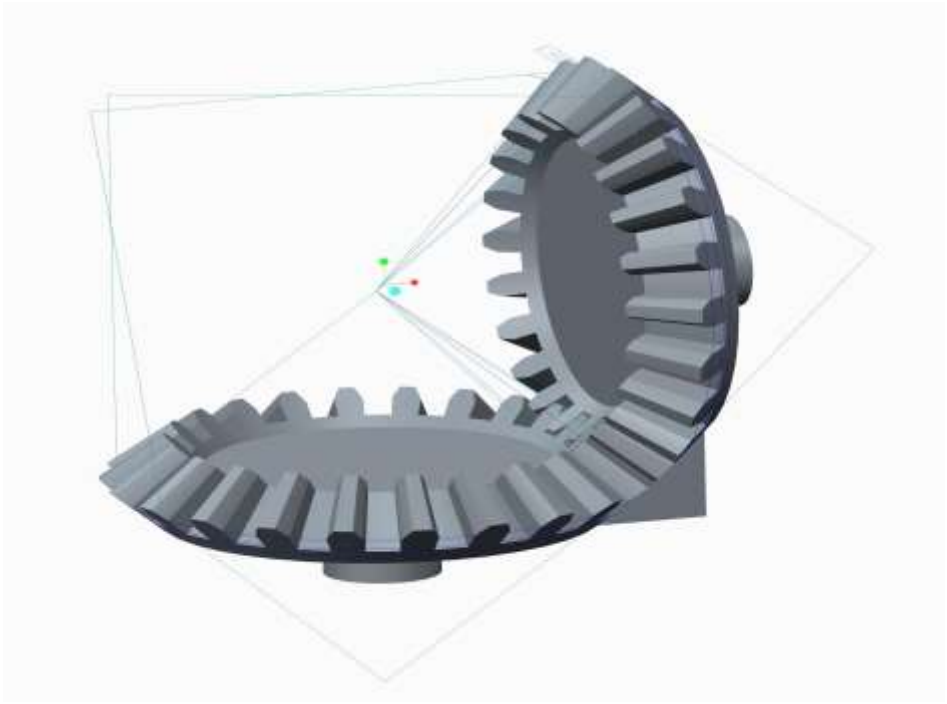

Fig 1 : BEVEL GEARBOX

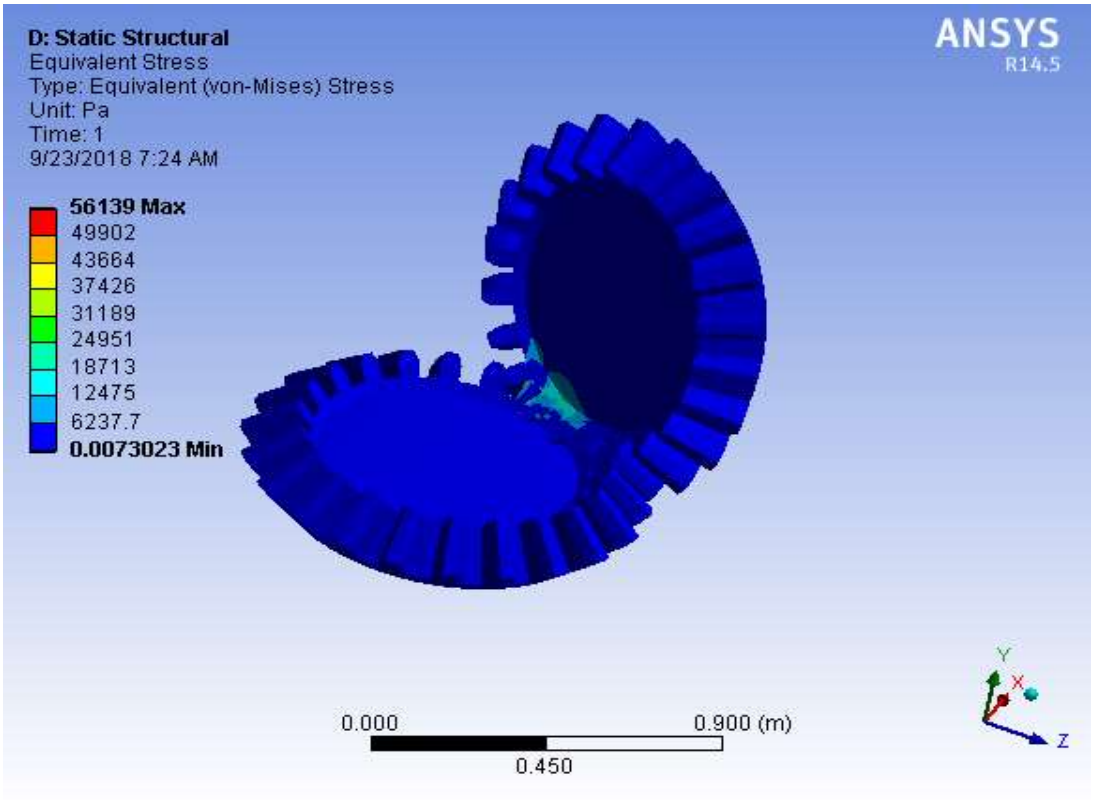

Fig 2 : VON-MISES EQUIVALENT STRESS OF ALUMINIUM ALLOYS GEAR

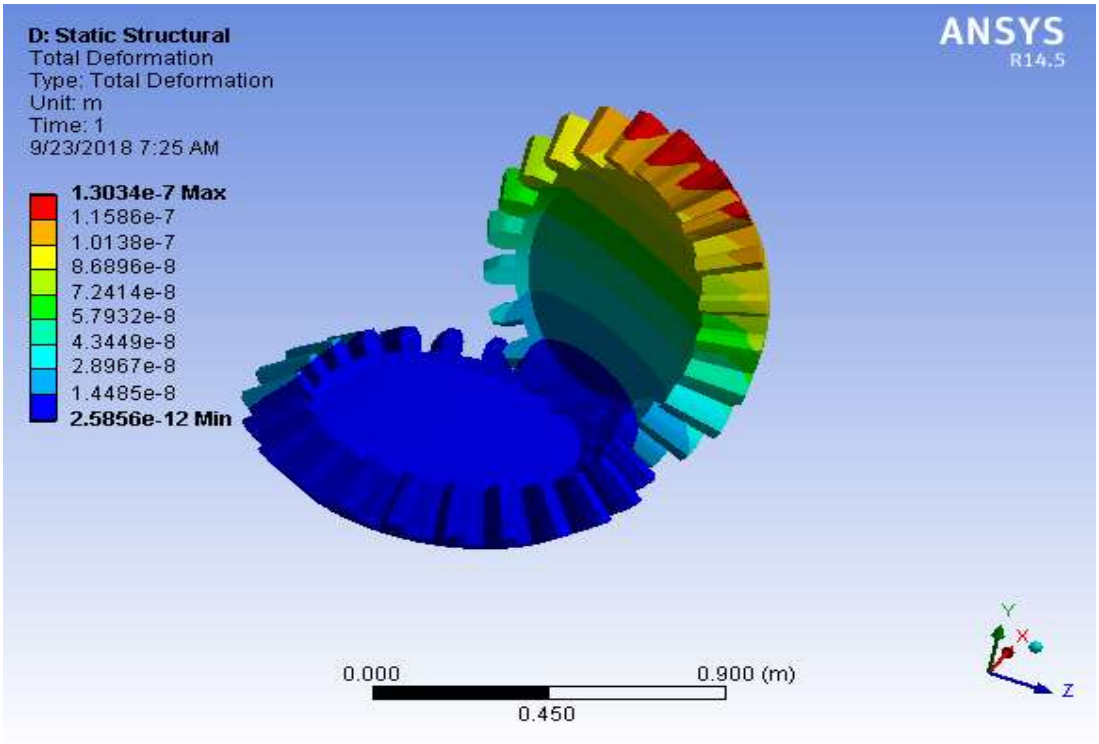

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Fig 3 : TOTAL DEFORMATION OF ALLUMINIUM ALLOYS BEVEL GEAR

Before redesigning

The dead load and cutting forces are consider to static analysis. The result of static analysis of existing bevel gears is shown in figure 3. it will be indicate the maximum deflection in bevel gear during the static analysis of the ANSYS 14.5.

If the manufacturing process is retain as conventional method then it must be restrict the modification in structure of the bevel gear.

To increase the static characteristic of the conventional bevel gear, we can change the material used to manufacture the bevel gear. We can increase the static characteristics of bevel gear by composite as a material of bevel gear.

Conventional bevel gear is shown in fig 1 which is made model in Pro-E 5.0. The static analysis before the redesign shows that it would increase the static characteristics of the bevel gear by glass filled polymide (composites).

TABLE 2

MATERIAL PROPERTIES

Material	Young Modulus (Pa)	Poisson's Ratio	Density(kg*m^3)
Glass filled polymide	1.57E+12	0.314	840

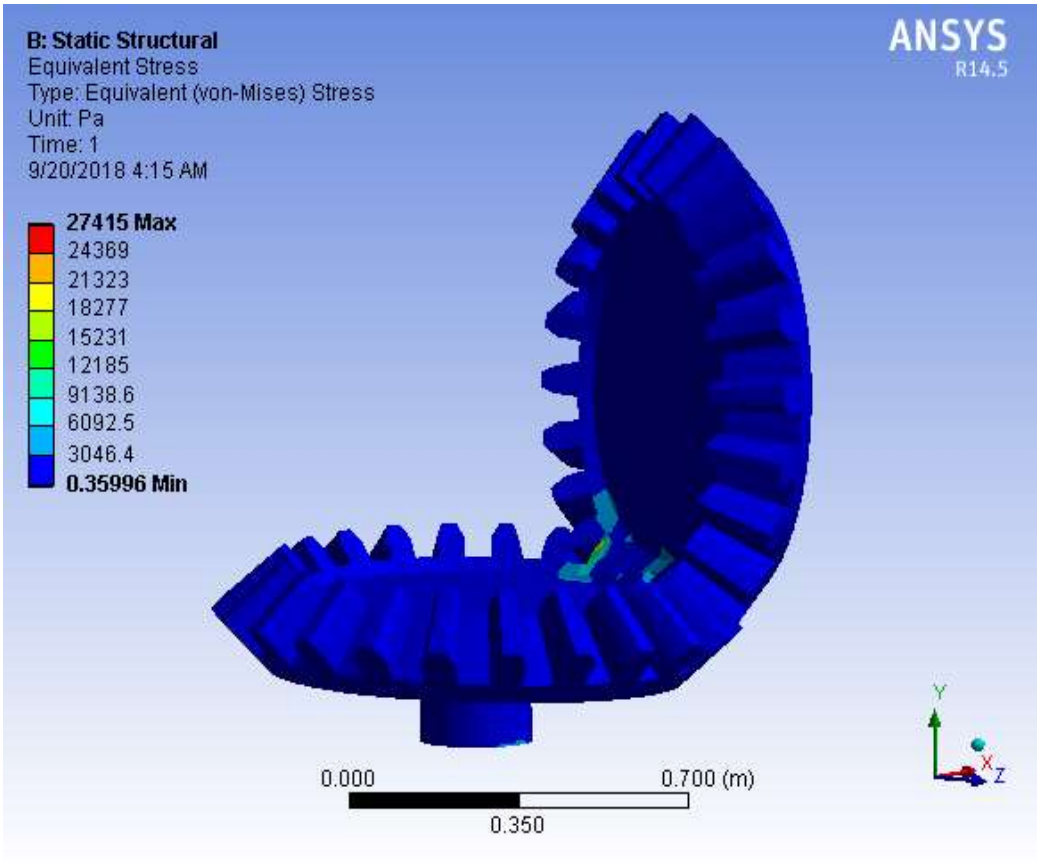

FIG 5 : VON-MISES EQUIVALENT STRESS OF GLASS FILLED POLIMIDE

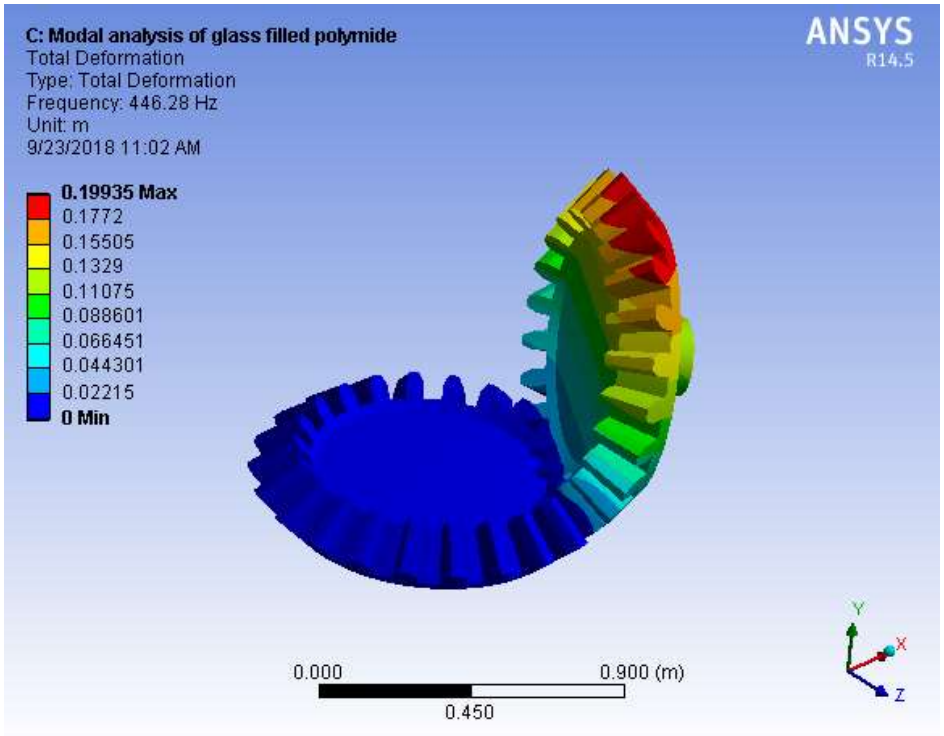

Fig 6 : TOTAL DEFORMATION OF GLASS FILLED POLYMIDE

The composites used in bevel gear proved beneficial as they reduced weight of load occurs on it. The static analysis of the composites bevel gear is shown in figure 5 and 6.

The static analysis of composites bevel gear is shown that the maximum deflection is reduced and performance is increase.

The composites has a reduced deformation which ultimately increases specific stiffness. Thus the composites proves to be better than the aluminium alloys by all means.

III. CONCLUSION

Based on the static analysis of aluminium alloys and composites of bevel gears shows that the deflection is reduced with base material which ultimately increases the static stiffness. Structural gear box with composites material offers further analyze and also optimized.

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