STRESS ANALYSIS OF SPUR GEAR DRIVE USING FINITE ELEMENT METHOD BY VARYING PRESSURE ANGLE

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Abstract **This paper describes the study of variation in the stress in a spur gear tooth for different pressure angle. For every analysis of crack initiation and its propagation in any engineering design, it is very necessary to have a deep prediction on the stress, deflection, stiffness. The present research work concentrates on the stress behavior of spur gear of different pressures angles. The stress is determined by the equivalent stiffness of each pair at any instant of contact is determined using the individual tooth stiffness of that pair in contact. The strain energy difference is validated by finite element analysis under proper stress for a spur gear of different pressure angle. This work explores a clean study on the stress and other elements for a further cause analysis of crack and its propagation.**

I. INTRODUCTION

Failure of the engineering structures is caused by cracks, which is depending on the design and operating conditions that extend beyond a safe size.

As a load sharing based stress calculation leads to an effective design of any precision spur gear drive, there has been always a growing interest among the researchers to improve the transmission ability of the gear drive. In this work, individual tooth stiffness of gear is calculated by measuring deflection gear tooth for the given load. From the individual tooth stiffness, the load sharing behavior is determined by calculating the equivalent stiffness of pair in contact. The gear will fail either by either by inadequate bending or contact strength. The inadequate bending strength will initiate crack at the gear tooth root and it will propagate along the least resistance path.

The variation in gear mesh stiffness reflects the severity of tooth damage. The work is driven by the need to improve the accuracy of computing the gear mesh stiffness which plays a major role in gear fault diagnosis. A refined total potential energy model, as reported in literature is adopted and extended to compute the total time varying mesh stiffness.

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II. PROBLEM STATEMENT

Failure in engineering design is caused by crack propagation, which depends on the design and operating condition and can be avoided by analyzing and understanding the manner it originates. An investigation into a stress analysis and its position and its influences.

III. FINITE ELEMENT METHOD

The Finite Element Method (FEM) is the most widely applied computer simulation method in engineering, closely integrated with CAD/CAM packages. FEM or FEA is based on the idea of building a complicated object with simple blocks, or, dividing a complicated object into small and manageable pieces.

The flowchart that explains the various steps involved in the finite element analysis of gear drive.

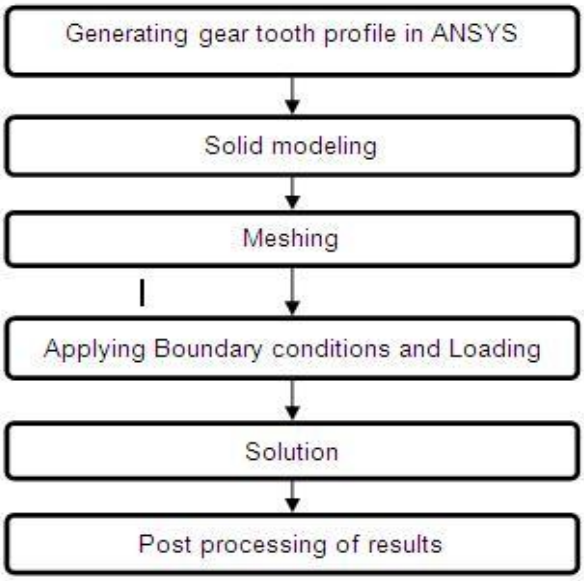

Fig 3.1 FEA Procedures

IV. GEAR GEOMETRICAL MODELING

The spur gear geometrical model is developed in finite element software package ANSYS WORK BENCH for three different spur gears at varying pressure angles.

This model was developed for various pressure angle spur gear drives. These pressure angles are 14.5 and 20. The gear specifications considered for analysis. The model of the spur gear is drive was shown in figure.

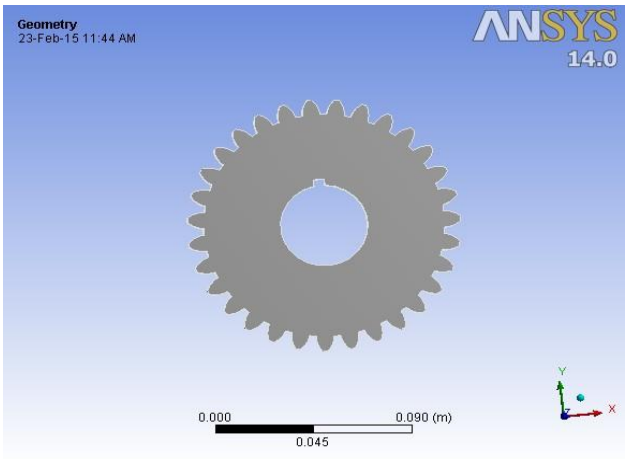

Fig 4.1 FEA Spur Gear Model at Pressure Angle 14.5

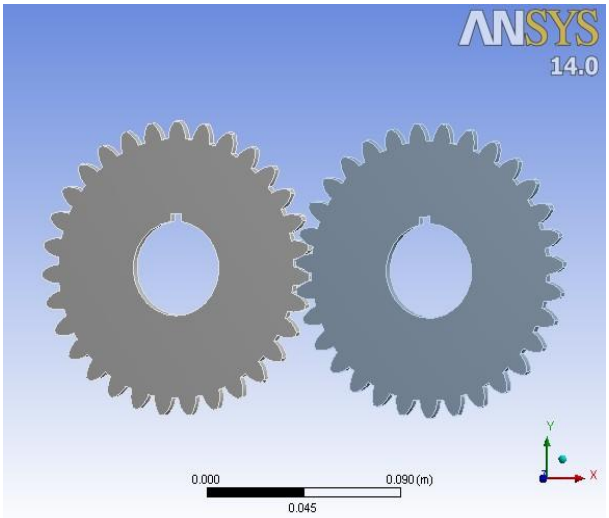

Fig 4.2 FEA Spur Gear Model of spur gear drive and pinion

V. RESULT AND DISCUSSIONS

The finite element method is a method for solving engineering and methodical and physical science problem. The main use of this method is to solve the problem in the field of stress analysis, heat transfer, fluid flow, mass transfer and electromagnet theory problems.

Analysis of the spur gear drive and pinion is based on the contact ratio, due to engaging of the gear drive and pinion of same teeth and same material, the load can be shared equally to gear drive and pinion. Here the Equivalent Stress, Maximum Shear Elastic Strain, Maximum Shear Stress and shear stress can be analyzed. This analysis was done for the two varying different pressure angles of the spur gear teeth in the drive and the pinion. The example of the analysis of the pressure angle 14.5 spur gear drives is shown in figures.

Equivalent Stress analysis

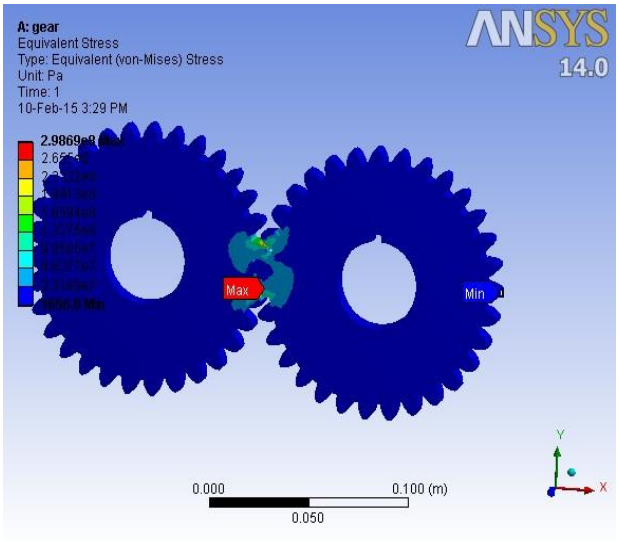

Fig 5.1 Equivalent Stress

Maximum Shear Stress

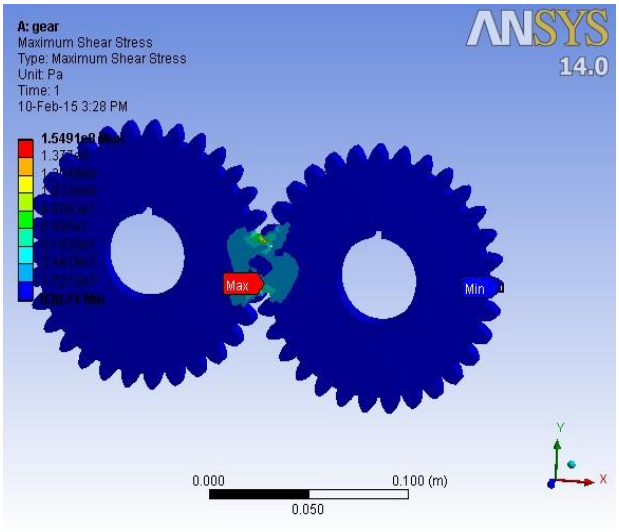

Fig 5.1 Maximum Shear Stress

Shear stress

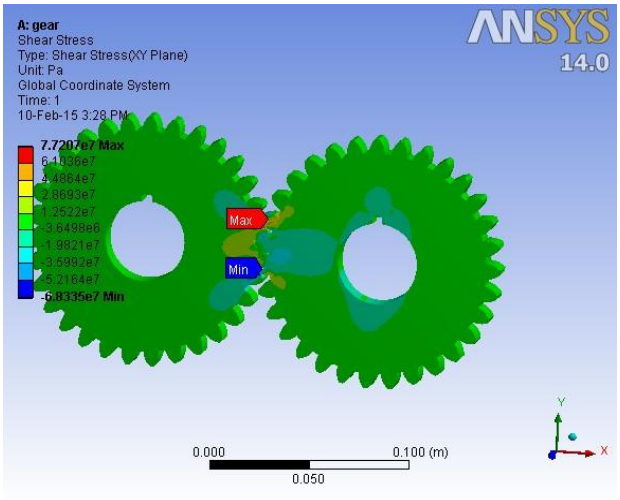

Fig 5.1 Shear Stress

Stress analysis of the varying pressure angle spur gear teeth was tabulated below.

Description	Pressure angle	
	14.5^0	20^0
Equivalent Stress (Pa)	2.9869 e8	2.8432 e8
Maximum Shear Stress(Pa)	1.5491 e8	1.4787 e8
Shear Stress(Pa)	7.7207 e7	7.6301 e7

Table 5.1 Stress Values for Different Pressure Angle

From this tabulation Shear stress is increased with the decrease of pressure angles. The stress value is increase up to 14% and 12 % for the pressure angle value of 14.5º and 20º can be visualized from the shown result.

VI. CONCLUSION

Among from the different value of pressure angles for the spur gear were concluded that teeth with higher pressure angle have better performance than common pressure angles of 14.5^0, 20^0 degree for shear stress minimization.

The load capacity of the gear drive is increased by the pressure angle increased value. The basic dimensions of the gears are common for the different type of pressure angles. The module is important geometrical parameter during the design of gear.

As the pressure angle on increases, the bending stress decreases and bending load capacity increases. Decision on maximum magnitude of pressure angle is constraint by the safe contact ratio and tooth peaking effect.

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