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A Review Paper on Design and Analysis of Helical Gear Using ANSYS, FEM & AGMA Standards

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Abstract – *This review paper gives the information about Strength of gear surface and tooth root strength of helical gear as they are to be major problem for the failure of gear pair. Thus, this review paper mainly focus on the theoretical, analytical and finite element method, computation of bending stress and contact stress acting on the root of helical gear.Many authors have use different approaches and means to conclude their main intension of finding out the contact stress and gear failure causes in static condition using finite element analysis, AGMA standards.This review paper consist theoretical and analytical & numerical method for the helical gear pair analysis*

Key Words: **Helical gear, helix angle, fatigue failure, contact stress, bending stress etc…**

1. INTRODUCTION

Power transmission has always been of high importance. The efficiency of any machine depends on the amount of power loss in the process. Gears are mostly used to transmit torque and angular velocity. These gears play a most predominant role in many automobile. Gears with involute teeth have widely been used in industry because of the low cost of manufacturing. Critical evaluation of helical gear design performance therefore plays a crucial role in estimating the degree of success of such gear systems in terms of stresses and deformation developed in helical gears. Helical gears have more advantages than other gears especially spur gears like it has smoother engagement of teeth, silent in operation, can handle heavy loads and power can be transferred between non parallel shafts, high efficient etc. Due to these advantages it has wide range of applications in high speed high power mechanical systems. Helical gears have a smoother operation than the spur gears because of a large helix angle that increases the length of the contact lines. Designing highly loaded helical gears for power transmission systems that are good in strength and low level in noise necessitate suitable analysis methods that can easily be put into practice and also give useful information on contact and bending stresses One of the main reason of the failure in the helical gear is bending stresses and vibrations. But the stresses are occurred due to the contact between two gears while power transmission process is started. Due to meshing between two gears contact stresses are evolved, which are determined by using analyzing software called ANSYS. Finding stresses has become most popular in research on gears to minimize the vibrations, bending stresses.

2. LITERATURE REVIEW

[1].Kailash Bhosale had done the Analysis of bending strength of helical gear by FEM. In this work bending strength of helical gear is found out with the help of three dimensional photoelasticity. A helical gearbox with 2.2 kW power transmitting at 760 rpm and Number of Teeth = 30mm, Pitch circle Diameter = 60mm, Module = 2mm, Pressure Angle =20°, Helix Angle = 12054', Addendum = 64mm, Base circle Diameter = 56.38mm, Dedendum = 55mm. A solid modeling is done with Catia and then by using the hyper mesh meshing is done. Analysis is done with Ansys Workbench 12.1. The analysis of bending stress in gear tooth was done by Mr. Wilfred Lewis known as Lewis equation. In the Lewis analysis, the gear tooth was treated as a cantilever beam. The tangential component (Pt) causes the bending moment about the base of tooth. The Lewis analysis was based on the following assumptions: The effect of radial component (PR) was neglected. The effect of stress concentration was neglected. At any time only one pair of teeth was in contact and takes the total load.

[2]. Tribhuvan Singh,Mohd. Parvez had carried out the analysis of helical gear using AGMA standards and FEM. In this work a parametric study was conducted by varying the face width and helix angle to study their effect on the bending stress of helical gear. This thesis investigates the characteristics of an involute helical gear system mainly focused on bending and contact stresses using analytical and finite element analysis. To estimate the bending stress, three- dimensional solid models for different number of teeth are generated by Pro/Engineer

that is a powerful and modern solid modeling software and the numerical solution is done by ANSYS, which is a finite element analysis package. The analytical investigation is based on Lewis stress formula. This thesis also considers the study of contact stresses induced between two gears. Present method of calculating gear contact stress uses Hertz's equation. To determine the contact stresses between two mating gears the analysis is carried out on the equivalent contacting cylinders. The results obtained from ANSYS are presented and compared with theoretical values.

[3.] A. Sathyanarayan Achari, R.P.Chaitanya Sriniwas Prabhu had done the work on A comparison of bending stress and contact stress of helical gear as calculated by AGMA standards and FEA. In this paper, bending stress at the root of the helical gear tooth and surface contact stresses are computed by using theoretical method as well as FEA. To estimate the bending stress at the tooth root Lewis beam strength method was applied. NX CAD 8.5 modeling software package was used to create the 3D solid model of helical gear pairs. NX Nastran 8.5 software package was used to analyze the gear tooth root bending stress. Contact stresses were calculated by AGMA standards. In this also NX CAD 8.5 modeling software package was used to generate helical gear tooth contact models. NX Nastran 8.5 software package was used to analyze the surface contact stress. Ultimately, these two methods, tooth root bending stress and contact stress results were compared with respect to each other.

[4]. B. Venkatesh V. Kamala, A. M. K. Prasad had done the work on Design, Modeling and Manufacturing of Helical Gear. In this work, structural analysis on a high speed helical gear used in marine engines, have been carried out. The dimensions of the model have been arrived at by theoretical methods. The stresses generated and the deflections of the tooth have been analyzed for different materials. Finally the results obtained by theoretical analysis and Finite Element Analysis were compared to check the correctness. A conclusion has been arrived on the material which was best suited for the marine engines based on the results. Basically the project involves the design, modeling and manufacturing of helical gears in marine applications. It was proposed to focus on reduction of weight and producing high accuracy gears

[5]. S. Sai Anusha, P. Satish Reddy, P. Bhaskar, M. Manoj had done the investigation to make use of helical gear, by analyzing the contact stresses for different Pressure angles (14.5˚,16˚,18˚,20˚)Helixangles(15˚,20˚,25˚,30˚)and(80mm,90 mm,100mm,110mm, 120mm) Facewidth. A Three-dimensional solid Model was generated by Pro-E. The numerical solution was done by Ansys by using finite element analysis package. The analytical approach was based on contact stress equation, to determine the contact stresses between two mating gears. The results obtained from Ansys; Analytical values were compared with theoretical values. The present analysis is useful in quantifying the above said parameters that helps in safe and efficient design of the helical gear. The effect of helix angle on contact stress was studied by varying the helix angle for four different angles were 15˚, 20˚, 25˚, 30˚. A typical trend has been observed when the 15˚ helix angle stress value was 285.7 high when compared to 20˚ helix angle. The effect of face width on Von-Mosses stress was studied by varying the face width for different values were (80mm, 90mm, 100mm, 110mm & 120mm) respectively. The results were indicated that as the face width increases contact stress decreases. When Compare with the ANSYS and AGMA stress values were little higher than theoretical values

[6]. Raghava Krishna Sameer, B. V. Srikanth had worked on the Contact stress analysis of modified helical gear using catia & ansys In this paper parametric study was done by varying the geometry of the teeth to investigate their effect of contact stresses in helical gears. As the strength of the gear tooth was important parameter to resist failure. In this study, it was given that the effective method to estimate the contact stresses using three dimensional models of both the different gears and to verify the accuracy of this method. The two different result obtained by the ansys with different geometries are compared. Based on the result from the contact stress analysis the hardness of the gear tooth profile can be improved to resist pitting failure.

3. CONCLUSION

1) In theory of helical gear we are considering that load is acting at one point and the stress is calculated. But, in case of FEM a continuous load is considered. So a pressure will act along the teeth of helical gear.

2) Helix angle is critical for contact stress as increasing helix angle increases contact stresses because of increase in the area of contact.

3) It is observed that the bending & compressive stresses of Al-Alloy are less than the of the other material like steel.

4) Maximum bending stress decreases with increasing face width and it will be higher on gear of lower face width with higher helix angle.

5) Parametric study is done by varying the geometry of the teeth. By varying the parameters like module, pressure angle, face width the new modified gear tooth is obtained and modified helical gear have more capacity contact stresses compared with normal helical gears.

4. REFRENCES

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