TO STUDY THE DESIGN AND MODELING OF HIGH SPEED HELICAL GEAR TO BENDING STRENGTH AND CONTACT STRENGTH

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ABSTRACT
In the review paper to gear design the bending stress and surface strength of the gear tooth are considered to be one of the main contributors for the failure of the gear in a gear set. Thus, the analysis of stresses has become popular as an area of research on gears to minimize or to reduce the failures and for optimal design of gears. The bending and contact stresses are calculated by using analytical method as well as predictible element analysis. To estimate bending stress modified lewis beam strength method is used. Pro-e solid modeling software is used to generate the 3-D solid model of helical gear. Ansys software package is used to analyze the bending stress. Contact stresses are calculated by using modified AGMA contact stress method. In this also Pro-e solid modeling software is used to generate contact gear tooth model. Analytically it can be validated by using Lewis and AGMA bending equation. Study will be conducted by varying face width to find stress. Ansys software package is used to analyze the contact stress.

Key word: Helix angle, glass filled polyamide, bending stress, contact stress, face width.

I. INTRODUCTION
One of the best methods of transmitting power between the shafts is gears. Gears are mostly used to transmit torque and angular velocity. The rapid development of industries such as vehicle, shipbuilding and aircraft require advanced application of gear technology. Customers prefer cars with highly efficient engine. This needed up a demand for quite power transmission. Automobile sectors are one of the largest manufacturers of gears. Higher reliability and lighter weight gears are necessary to make automobile light in weight as lighter automobiles continue to be in demand. Gears are use to transmit power and motion from one shaft to another. Helical gears are currently being used increasingly as a power transmitting gear owing to their relatively smooth and silent operation, large load carrying capacity and higher operating speed. 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. Gears are used to change the speed, magnitude, and direction of a power source. Gears are being most widely used as the mechanical elements of power transmission.

In helical gears there is a problem of failures at the root of the teeth because of the inadequate bending strength and surface pitting. This can be avoided or minimized by proper method and modification of the different gear parameters. In view of this the main purpose of this work is by using analytical approach and numerical approach to develop theoretical model of helical gear in mesh and to determine the effect of gear tooth stresses. The main steps involved in this work are described as follow: • Modeling the gear without losing its geometry in Pro/engineer software. • Generate the profile of helical gear teeth model to calculate the effect of gear bending, using three-dimensional model and compare the results with modified Lewis theory. • Develop and determine models of contact elements, to analysis contact stresses using ANSYS and compare the result with AGMA contact stress equation.

II. LITERATURE REVIEW
1. Seok-Chul Hwang, Jin-Hwan Lee, Dong-Hyung Lee c, Seung-Ho Hana, Kwon-Hee Lee [1]. Contact stress analyses for spur and helical
gears are performed between two gear teeth at different contact positions during rotation. Two examples of spur and helical gears are presented to investigate the respective variations of the contact stress in a pair of mating gears with the contact position. The variation of the contact stress during rotation is compared with the contact stress at the lowest point of single-tooth contact (LPSTC) and the AGMA (American Gear Manufacturers Association) equation for the contact stress. In this study, we can see that the gear design that considers the contact stress in a pair of mating gears is more severe than that of the AGMA standard. This study presents the change in the contact stress of spur and helical gears in relation to the contact position. Regarding changes in the contact stress, the maximum value measured at the lowest point single-tooth contact is compared with the contact stress calculated based on the AGMA standard. According to the analysis, the design that considers the contact stress is stricter than the AGMA standard. The values calculated by using finite element analysis are below the contact fatigue strength of the material; hence, they yield the appropriate strength and safety.


The main objective of this paper is to develop a parametric model of differential Gearbox by using CATIA-V5 under various design stages. It is observed that Glass filled polyamide composite material is selected as best material for differential gearbox and is found to be the most suitable for different revolutions (2500 rpm, 5000 rpm and 7500 rpm) under static loading conditions. Comparisons of various stress and strain results using ANSYS-12 with Glass filled polyamide composite and metallic materials (Aluminum alloy, Alloy Steel and Cast Iron) are also being performed and found to be lower for composite material. Glass filled polyamide composite material is used for gears and are analyzed using ANSYS for equivalent (VonMisses) stress, displacement (total deformation) and maximum shear elastic strain for different revolutions (2500 rpm, 5000 rpm and 7500 rpm) under static conditions. Comparisons of various stress and strain results with Glass filled polyamide composite and metallic materials (Aluminium alloy, Alloy Steel and Cast Iron) are also being performed and found to be lower for composite material. By observing these analysis results, Glass Filled Polyamide composite material is selected as a best material for Differential Gearbox which in turn increases the overall mechanical efficiency of the system.

3. Utkarsh M. Desai, Prof. Dhaval A. Patel [3].

In this work, a metallic gear of Alloy Steel is replaced by the composite gear of 30% Glass filled Poly-ether-ether Ketone (PEEK). Such Composites material provides much improved mechanical properties such as better strength to weight ratio, more hardness, and hence less chances of failure. In this work, an analysis is made with replacing metallic gear with composite material such as PEEK so as to increase the working life of the gears to improve overall performance of the machine. Finally the Modeling of spur gear is carried out using SOLID WORK and bending stress analysis of spur gear is carried out using ANSYS V14. Von mises stress for alloy steel is to be found as 6.50 Mpa and for composite material it is to be found as 5.96 Mpa as shown in the figure. For that, analytical and finite element method are applied for determining bending stress of gear tooth. The obtained FEA result is compared with the analytical result and found that both result are comparable. Result shows that by stress analysis the strength of the GF 30 PEEK spur gear is more when compared with alloy steel spur gear. Also the density of the GF 30 PEEK is very less when compared with alloy steel. So we can conclude that the alloy steel spur gear can be replaced by GF 30 PEEK (composite) spur gear due to its high strength, low weight and damping characteristics.


In this paper, an attempt has been made to compare the performance of various helical gear systems for a given set of specification through an analytical approach based on AGMA standards as well as a finite element analysis approach. Three different helical gear systems namely single, herringbone, crossed helical gear systems were evaluated. The developed FEA model was validated against the analytical approach and was found to be very close. Further stress analysis was carried out using FEA. The developed FEA model was validated against the analytical approach and was found to be very close. Further stress analysis was carried out using FEA. It was found that the overall performance of crossed helical gear was found to be the best in terms of stress as well as tooth strength at low speeds and low loads whereas herringbone and single helical gear systems are employed for optimum values of speeds and loads. The low stresses observed in case of single helical gear makes its use in case of high speeds and heavyloads.
5. Siva Prasad, Syed Altaf Hussain, V.Pandurangadu, K.PalaniKumar[5].

This paper describes design and analysis of Spur gear. In the present work, it is proposed to substitute the metallic gear of sugarcane juice machine with plastic gears to reduce the weight and noise. For the purpose of two different types of plastic materials were considered namely Nylon and Polycarbonate and their viability are checked with their counterpart metallic gear (Cast iron). Based on the static analysis, the best plastic material is recommended for the purpose. Static analysis of a 3-D model has been performed using ANSYS 10.0. Compared to Cast iron spur gears Nylon gears are suitable for the application of sugarcane juice machine application under limited load conditions. The majorities of nylons tends to be semi-crystalline and are generally very tough materials with good thermal and chemical resistance. The different types give a wide range of properties with specific gravity, melting point and moisture content tending to reduce as the nylon number increases. Nylons can be used in high temperature environments. Heat stabilized systems allow sustained performance at temperatures up to 185°C. Polycarbonates received their name because they are polymers containing carbonate groups (−O−(C=O)−O−). Most polycarbonates of commercial interest are derived from rigid monomers. A balance of useful features including temperature resistance, impact resistance and optical properties position polycarbonates between commodity plastics and engineering plastics. To find the suitable design gears with less weight and less cost, corrosion resistance, frictionless also. To design and manufacture a sugarcane juice for a common people including women. With less cost, self lubricating neat and clean hygienic juice. With more material removal of deflection and stress are increased. So for safe operation of this design is more appropriate under limited load conditions for Nylon gear.

6. Faydor L. Litvin a, Alfonso Fuentes b, Ignacio Gonzalez-Perez a, Luca Carvenali a, Kazumasa Kawasaki a, Robert F. Handschuh [6].

The contents of the paper cover: (i) computerized design, (ii) methods for generation, (iii) simulation of meshing, and (iv) enhanced stress analysis of modified involute helical gears. The approaches proposed for modification of conventional involute helical gears are based on conjunction of double- crowned pinion with a conventional helical involute gear. Double-crowning of the pinion means deviation of cross- profile from an involute one and deviation in longitudinal direction from a helicoid surface. The pinion-tooth surfaces are in point contact, the bearing contact is localized and oriented longitudinally, edge contact is avoided, the influence of errors of alignment on the shift of bearing contact and vibration and noise are reduced substantially. The developed theory is illustrated with numerical examples that confirm the advantages of the gear drives of the modified geometry in comparison with conventional helical involute gears. The discussions above allow to draw the following conclusions:

1. A new geometry of modified involute helical gears, based on the following ideas, has been proposed:
   a. The pinion of the gear drive is double-crowned and therefore the pinion tooth surface is mismatched of an involute helicoid in profile and longitudinal directions.
   b. The gear tooth surface is designed as a conventional screw involute helicoid.

2. The pinion and gear tooth surfaces contact each other instantly at a point, the bearing contact is localized, and the function of transmission errors is a parabolic one of a low magnitude.

3. The parabolic function of transmission errors is able to absorb discontinuous linear functions of transmission errors caused by misalignment and therefore the noise and vibration are reduced.

4. The bearing contact is oriented longitudinally and this is in favor of the increase of contact ratio. The shift of bearing contact caused by misalignment is reduced.

7. J. Venkatesh, Mr. P. B. G. S. N. Murthy [7].

In the gear design the bending stress and surface strength of the gear tooth are considered to be one of the main contributors for the failure of the gear in a gear set. Thus, the analysis of stresses has become popular as an area of research on gears to minimize or to reduce the failures and for optimal design of gears In this paper bending and contact stresses are calculated by using analytical method as well as Finite element analysis. To estimate bending stress modified Lewis beam strength method is used. Pro-e solid modeling software is used to generate the 3-D solid model of helical gear. Ansys software package is used to analyze the bending stress. Contact stresses are calculated by using modified AGMA contact stress method. In this also Pro-e solid modeling software is used to generate contact gear tooth model. Ansys software package is used to analyze the contact stress. Finally these two methods bending and contact
stress results are compared with each other. In this work analytical and Finite Element Analysis methods were used to predicting the Bending and contact stresses of involute helical gear. Bending stresses are calculated by using modified Lewis beam strength equation and Ansys software package. Contact stresses are calculated by using AGMA contact stress equation and Ansys software package.

III. CONCLUSION

In this paper author have been presented a brief review of design and modelling and analysis of high speed helical gear for contact and bending stress using hertz, lewis and AGMA equations and ANSYS with various face width and helix angle and found their effect due to bending and contact stress and its value compared. And also deferent material is tried for weight reduction and cost optimization.

REFERENCES


