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CONTACT STRESSES ANALYSIS OF SPUR GEAR USED IN AUTOMATED LATHE MACHINE- A REVIEW PAPER

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ABSTRACT
Spur gears are common type of gear used in modern industries. Even from delicate watches to advance aerospace industries gears plays vital role to transmit power between parallel shafts. They are known for its efficiency, simplicity and veracity. While transmitting power from one shaft to other high Stresses are developed at mating point is nothing but the Contact Stresses. For getting exact Velocity ratio, load carrying capacity, High speed gear must fit considering all this parameters. There are various methods for finding Pitting stresses i.e. Contact Stresses. Lewis Bending Equations, AGMA (American Gear Manufactures Association) equation are some theoretical equations. Most of the research paper enlightened results of Theoretical Method, Finite Element Analysis & Experimental Investigation of spur gear used in Lathe Machine.

The main aim of this dissertation work is to identify and minimize contact stresses that occur in Automated Lathe Machine Gear Box. Lot of case studies are performed to calculate & minimize contact stresses between mating pair of gear. For simulation purpose use FEA tools as Abaqus, Hypermesh & compare experimental investigation using photo-elastic method with theoretical Hertzian methods.

Keywords: Contact Stresses, LPSTC, HPSTC, AGMA, Hertz-contact stress, Silicon nitride, Backlash, Composites, Epoxy fibre.

I. INTRODUCTION
Gears plays as an important role in power transmission system. Because of its compact design features in modern automated industries gears are the vital component in power transmission. In lathe machines headstock a simple spur gear is used. Most of the time gear fails due to higher contact stresses between gear pairs on tooth of gear. The gear tooth fails due to Creep, Scoring and Pitting. The failure of gears tooth is the main concern of breakdown of any system; hence it is necessary to find out optimum solution to reduce contact stresses to avoid gear failure. It is also necessary to increase stiffness, strength, toughness, and hardness of spur gear to enhance load transmission between two gear teeth.

II. LITERATURE REVIEW
Pawan Kumar Patel et al. [1] studied comparative analysis of spur gear using different material such as alloy, gray cast iron, carbon fibre, Epoxy carbon and Epoxy E glass was used. All these materials were tasted as contact stresses were developed after loading. A CAD model was developed in CATIA V5-6R 2017 and statistical structural analysis also performed. This practical and numerical data was compared after validation material was analysed in ANSYS 19.2. All results were compared and found data to reduce stresses.

K. G. Raptis et al. [2] studied mechanical behaviour of spur gear tooth in terms of reliability and fatigue endurance. Authors also gave the optimized stress distribution after loading. The experimental investigation was done on Highest Point of Single Tooth Contact (HPSTC), Lowest Point of Single Tooth Contact (LPSTC) around a gear tooth subject to a point load. He used Monocromatic and white light with load of 22.240N. All results were compared experimentally & analytically. He found that deviation increases with number of gear teeth while keeping the teeth of pinion constant, as the teeth number increases the maximum stress decreased.

Santosh patil et al. [3] Studied the effect of coefficient of friction on contact stresses generates as on a line of action between gear pair. Theoretical and Finite Element Analysis was carried out in meshed gear. The effect of

gear material on performance of gear was determined. Theoretical analysis was used for validation of FE results, the effect of coefficient of friction on contact stresses between pair of gear is determined using the verified FE model. Authors found 10% increment in contact stresses when frictional coefficient values increases from 0 to 0.3. He also put relation between contact stresses & coefficient of friction and its effect on gear performance, this parameter was useful to found contact stress in meshed gears.

Mr. Ankush vilas chandanshive et al. [4] studied different composite material. Authors used Cast iron, Glass fibre, Carbon fibre, Silicon nitride as a gear material for research purpose, apply equal load for each case, puts similar boundary conditions for analysis in the application of gear box used in Lathe machine. They put all results in a tabulated form using ANSYS software, were found that stresses induced in Silicon Nitride spur gear is less as compared to Cast steel spur gear used in lathe machine for fluctuating load conditions. Silicon nitride is best material having minimum weight, high strength, stiffer & toughness too having very less deformation values.

Deepika potghan et al. [5] this paper gave stress analysis of spur gear used in lathe headstock. He used Grey cast iron, High carbon steel as a gear material. Stresses results were obtained using Finite Element Analysis (FEA) using ansys workbench method, compare this with theoretical Hertzian equation had found very close results.

Rakesh A. Ashtekar et al. [6] this paper deals with reduction of contact stresses, spur gear vibrations for pinion & gears arrangement in lathe headstock. Authors introduced different values of Backlash. This paper enlightened spur gear with three different values backlash and without backlash to determine the stress analysis & vibration generated. Also bending stresses, shear stresses were calculated in FE software. Model was tested for vibration using NV-Gate FET analyser. Results obtained from FEA & Experimental backlash increases the frequency and vibration too, so it was quite better for selection of better gear material.

Prafulla M. Chor et al. [7] studied to minimize contact stresses of spur gear by increasing the Module of gear. Authors used spur gear train for analysis. The contact stresses are calculated by Hertz's Equation and experimental investigation was done using strain gauge. He determined fatigue strength its impact on gear failure. Applied input parameters were Module (m), Nominal input power (p), Gear ratio (u), Pinion speed (R.P.M.), No. Of teeth on pinion (z), Pressure angles (α), Material for pinion & gear. After investigation authors found module was important parameter it must at higher side to reduce contact stresses.

Putti Srinivasa Rao et al. [8] studied the complex design of spur gear, authors aim to reduced both contact & deformation stresses was arrived the best combination for driver & driven gear. For investigation he used 3 different materials, a software programme was created for 9 different combinations. All the results from FEA are compared with theoretical Hertz's equation values. They found FEM model was accurate.

Mr. Bharat Gupta et al. [9] studied factors affect the design of spur gear such as Contact Pressure, Frictional forces. They were agreed contact stresses plays as a key role for designing spur gear. They attempted calculation of contact stresses using FEA & to check it with analytical one.

Mohd Hassan et al. [10] research shows effect of composite materials on performance of gear. It also explores some alternative materials to improve performance of gear. In this paper analysis was performed on gear of Cast iron, Epoxy fibre, Glass filled Nylon 6, Aluminium alloy, Nylon 101. For every material a constant load was applied as results were compared practically & theoretically. Authors found that composite spur gear gave more favourable results compared to casted gear used in lathe machine. In comparative study Epoxy Fibre was light in weight, handle more load than Nylon 101, Nylon 6 & Cast iron materials.

Khin khin thant et al. [11] studied types of spur gear stresses, as pitting stress & bending stress. Contact stresses were calculated along the contact line using minimum elastic potential. Authors found spur gear stresses in four different parameter using MATLAB and compare this with allowable contact stresses. They also evaluate various factors on performance of gear such as change of normal modules, addendum factors, fillet radii, change of pressure angle.

Suhas Borate et al. [12] this dissertation worked to identify gear design stresses and optimize weight of spur gear. Authors performed analysis & optimization of spur gear using FEA, The results were compared with Hertz contact stresses, authors found that while changing conventional design parameter weight of gear reduced as 30.01% for Equivalent stresses, 10.21% for contact stresses & 12.51% of total mass reduced with modified gear design.

III.CONCLUSION

This study present analysis of contact stresses of Spur Gear used in lathe machine. Stresses are calculated by utilizing Hertz-theory, AGMA standard. Results can also be find out using Finite Element Analysis, results obtained theoretically & practically are comparable with latest FEA software and we will get favorable results after reviewing most of the research work. Other factors such as Gear tooth profile, Pressure angle, Module, Fillet radius, Gear material, Coefficient of friction are essential parameter which effects on gear design for development of Contact Stresses, it is necessary to redefine some values and gear tooth profile. This parameter directly affects contact stresses developed between mashing gears, Hence there is further scope to do work on this factors.

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