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# Review Paper on Analytical and Finite Element Analysis of Spur Gears

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**Abstract -** This thesis investigates the characteristics of a gear system together with contact stresses, bending stresses, and therefore the transmission errors of gears in mesh. Wheel work is one in all the fore most essential elements in mechanical power transmission systems. The contact stresses were examined using FEM models.

Current strategies of conniving gear contact stresses use Hertz's equations, that were originally derived for contact between 2 cylinders. To change the investigation of contact issues with FEM, the stiffness relationship between the 2 contact areas is typically established through a spring placed between the 2 contacting areas. This will be achieved by inserting a contact component placed in between the 2 areas wherever contact happens. The results of the 2 dimensional FEM analyses from ANSYS square measure conferred. These stresses were compared with the theoretical values. Each result agrees all right. This means that the FEM model is correct.

**Keywords** –Spur gear, hertz-contact stress, bending stress, finite element analysis, contact stress, Dynamic Load

## 1. INTRODUCTION

Function: To transmit power, motion and position.

Advantage: High power transmission potency, 98%, compact, high speed, precise temporal arrangement. Disadvantage: Gears area unit a lot of expensive than belts and chains. Gear producing prices increase sharply with enhanced preciseness together with high speeds, serious masses, and low noise

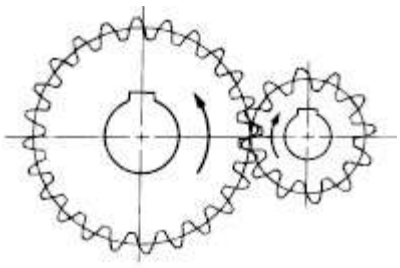

Fig: 1.1 Spur Gears [12]

Spur gears, see Fig. 1.1, are the simplest and most common type of gears with teeth parallel to the shaft axes and transmitting motion between parallel shafts.

In the today's world of manufacture Gears square measure the key means that for the mechanical power gear mechanism, and in most industrial rotating machinery. Attributable to the high degree of dependability and compactness gears dominates the sector of mechanical power transmission. Gear case is employed to convert the input provided by a first-rate mover into associate degree output needed by finish application. thanks to increasing demand for quiet and long-run power transmission in machines, vehicles, elevators and generators, folks square measure trying to find a additional precise analysis technique of the gear systems. Gear wheel is that the most elementary gear accustomed transmits power between 2 parallel shafts with nearly99 potency. It needs the higher analysis strategies for coming up with extremely loaded spur gears for power transmission systems that square measure each sturdy and quiet. Thanks to development of computers folks square measure victimization numerical approach for the analysis

Gears are the most commonly used in industrial applications to transmitting motion and power. They are varying from small size used in watches to the large size of gears in the lifting devices. Spur gear is easy to manufacture. The spur gear is widely used to transmit power from one shaft to another. It is used to vary the speed and torque e.g. lathe machine, watches etc. when the gears are in mating contact then the stresses are developed on the tooth of gear. Due to this stresses tooth failure is occurring like pitting, scoring, and creep. Tooth failure is that the major issue of drugs causes breakdown the system that used the gear. To avoid this failure the important factor is to increase the strength of gear.

### 1. 1 Gear Technology

Gears square measure the foremost common means that of transmission power within the trendy technology world. They vary from a little size utilized in watches to the massive gears utilized in watches to the massive gears utilized in lifting mechanisms and speed reducers. They type very important parts of main and accessory mechanisms in several machines like vehicles, tractors, metal cutting machine tools etc. Toothed gears are used to change the speed and power ratio as well as direction between input and output [1].

### 1.2 Spur Gear

The spur gear is simplest type of gear manufactured and generally used for transmission of rotary motion between parallel shafts. The gear is that the initial alternative possibility for gears except once high speeds, loads and ratios direct towards other options. Other gear varieties may additionally be most popular to produce a lot of silent low-vibration operation.

A single spur gear is generally selected to have a ratio range of between 1:1 and 1:6 with a pitch line velocity up to 25 m/s [6]. The spur g ear has associate degree operational potency of 98-99%. The pinion is created from a tougher material than the wheel.

A gear pair should be selected to have the highest number of teeth consistent with a suitable safety margin in strength and wear. The minimum variety of teeth on a gear with a traditional pressure angle of twenty degrees is 18. This is a cylindrical shaped gear in which the teeth are parallel to the axis. It has the largest applications and it is the easiest to manufacture. They are simple in construction, easy to manufacture cost less.

## 2. LITERATURE REVIEW

**Seok-ChulHwanga et al. [1]** studied the contact stress analysis for a combine of 6 gears throughout rotation. He investigated several variation of contact stress analysis for voluted and spur wheel with the various contact position in an exceedingly combine of 6 gears. Compares the variation of contact stresses throughout rotation at very cheap purpose of single tooth contact (LPSTC) & the AGMA (American Gear makers Associated) equation for the contact stress. Select the design that considered the contact stress is stricter than the AGMA Standard. By using FEA analysis calculate the contact fatigue strength of material for the appropriate strength & safety. He carried out FEA analysis using AGMA equations.

**In other study by Prashant Kumar Singh et al. [2]** the thermal and wear behavior of gears of various thermoplastic materials like propen nitrite hydrocarbon vinyl benzene (ABS), High Density Polyethylene (HDPE) and Poly Oxy methelyne (POM) were examined at different torque levels and different rotational speeds. The authors found that the wear rate of polymer gears increases with torque but decreases with rotational speed.

**R. PrabhuSekar et al. [3]** studied minimize wear of the gear teeth by adopting the non-standard gear. Discussed the parametric study between standard and non-standard gear.Detailed study of standard and non-standard gears on wear by using or comparing the results between FEM and analytical approach. Suggested the one possible solution for the enhancement of wear resistance and load carrying capacity of the gear tooth in bending and contact. Judging the change in gear and drive parameters of non-standard pinion and gear. He carried out Analytically use of Hertz equation and FEA.

**I.S. Al-Tubi et al. [4]** investigated the micro pitting initiation and propagation when subjected to varying torques load under a constant rotational speed. For affecting the micropitting the main factors are surface roughness, excessive loading (contact stresses), gear tooth micro-geometry and lubricant film thickness are found. On the both addendum and Dedendum of the pinion and wheel the contact stresses and minimum specific film thickness occurs by analytical method and the micropitting observed by experimentally. He carried methodology by Analytically (ISO/IR) and experimentally.

**Xiang Dai et al.[5]]** investigated FEA/contact approach studied that the static and dynamic anatomical structure strains in spur wheel pairs. Investigate by analytically and through an experiment vibration of spur wheel combine. The FEA result and experimental results are compared.

**Shuting Li et al. [6]** in this paper studied the method for exact bending strength and contact strength calculations of a thin walled gear at high speed by using FEM s/w. It was found that when gear speed exceeds 10000 rpm the centrifugal load-deformed thin-walled gear has greater effects on tooth contact pattern, tooth surface contact stress, root bending stress and tooth load-sharing ratio. The calculation of strength design of a high speed thin-walled gear problem has not been solved, but gives the idea, method and steps of the calculation for this problem.

**Xihui Liang et al. [7]** studied the mesh stiffness of gears with tooth indentation by analytical methodology.Also studied the three level of pitting i.e. slight pitting, moderate pitting and severe pitting. And the results of analytical method is compared with FEA. Compares the mesh stiffness with indentation level to the single-tooth try mesh amount and double-tooth try mesh amount. The author found that the indentation result on gear tooth.

**T. Osman et al. [8]** in this paper studied the interactions between contact fatigue and dynamic tooth loads on gears. Objective of this project is to examine the dynamic tooth loads to pitting in spur gears. In this comparison between experimental and simulated surface failure had done.

Santosh S. Patil et al. [9] in this paper studied about the strain on the gear tooth at the connecting helical gear pairs by experimentally. He done the experimental testing and analysis of contact stress in helical gear. FEA analysis done and examination with the experimental results and also the result was sensible. Hence they found the gear dynamic stress test rig (GDSTR) experimental setup proved to be a suitable method for contact stress evaluation on gear tooth flank. From the experimental study the effect of friction on gear contact stresses is

significant and cannot be eliminated. Limitation is the experimental setup found wear misalignments and slight vibrations.

**3. CONCLUSION OF LITERATURE REVIEW**

Following points can be concluded by study of the above literature reviews:

It could be concluded that there are several stages had been done in order to investigate gear bending strength.

1. Most researchers used the fundamental Lewis Bending Equation and AGMA Standards with modifications to induce the primary read of substances tooth strength. In fact, there are also some other equations such as Aida & Yoshio TERAUCHI and many researchers also try to formulate their calculations to predict gear strength.
2. The second stage is to simulate gears using Finite Element Method (FEM) in order to have the analysis of gear strength. Technological advances in FEM provide an opportunity for researchers to conduct various tests based on various parameters.
3. the most important stage is to put the gears to physical experiment or testing facilities to determine and validate all data from numerical calculation and FEM method

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