International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878 (Online), Volume-8 Issue-4, November 2019

Contact Stresses and Bending stresses for Worm & Helical Gear

B. Dhanraj, Maruthi Gangadhar, M. Vishnuvardhan, K. Rajasekhar Reddy.

Abstract: Surface Strength of the gear tooth depends on the contact stress and the bending stress caused due to the applied load on the tip of its gear tooth. Analysis has become popular in decreasing the failures. Fatigue causes in the root bending stress and Surface indentation causes in the contact stress. Then modified Lewis beam strength is used for bending stress and the AGMA method is used for contact stresses by varying the face width. Analytical results are based on Lewis formula and the theoretical values were calculated by AGMA standard so the results were validated.

Keywords: Surface Strength, Contact Stress , Bending Stress

I. INTRODUCTION

Helical gears are cylindrical gears inclined to the trace o f the tooth. Similar to spur gears, it has a higher pressure rati o and is capable of transmitting heavy force in noiseless and less vibration. A pair of helical gears with the same angle but opposite to the helix side.

And the reference portion of the gear is in the normal pl ane, its hobbing mechanism rotating, and helical gears will b e produced using the spur gear hobbing machine and hobbin g tool. Their processing has the drawbacks of making it hard er to produce thanks to the grinding of teeth.

If the reference sections are in the rotating plane, the center distance is the same as the spur gears, as long as the module and the number of their teeth are the same. The helical gears are classified into two groups made by KHK, with the gears in the rotating plane and the normal (normal) plane in the reference section.

It makes it easy to switch to spur gears. Howsoever requires special hobbing cutters and grinding stones in this case, causing a lot in terms of production cost. On the other side, it is possible to use spur gear hobbing equipment and grinding stones if the transverse parts are in the normal plane. While it can no longer suit the center length of helical gears with the same unit and number of teeth in spur gears, it is impossible to swap. Therefore, the center range is typically not an integer number. Spur gears can not create axial thrust forces because the twist in the trace of the tooth generates axial thrust force. It is therefore necessary to use the thrust bearings to gain strength. When merging right and left hand helical gears to create double helical gears, however, the thrust force will be eradicated.

1.1 Formation of Helical Gears

If the many cuts are made on a spur gear perpendicular to the axis and engineered by rotating each cut piece unmistakably as it is in a staircase, as shown in Figure 1.1, then the meshing becomes smoother and exceptional due to contacts taking place in the various phases. The all-inclusive contact ratio increases so that even if the normal spur gear has fewer teeth and The touch ratio is lower than the unit, this configuration (known as stepped gear) facilitates transmission.

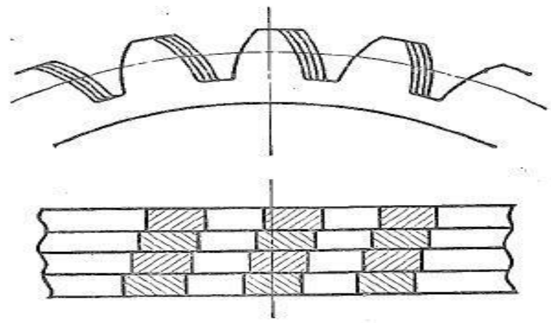


Figure 1.1 Stepped Gear

In a stepped gear, if the divisions are made infinitely narrow and the tooth line is twisted in the direction of the shaft, i.e. helicoids with the shaft in the center, it becomes a helical gea as shown in Figure 1.2.

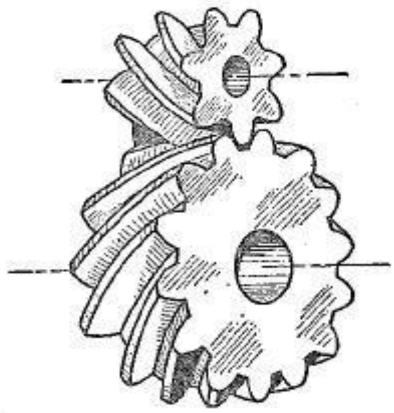


Figure 1.2 Helical Gear

Helical gears transmit rotatio smoothly with less movement and sound, making it acceptable for high rotation speeds. However,

Manuscript published on November 30, 2019.
* Correspondence Author
B. Dhanraj*,Mechanical department, Vardhaman college of engineering, Hyderabad, India. Email: dhanraj2205@vardhaman.org
S. Maruthi Gangadhar, Mechanical department, Vardhaman college of engineering,Hyderabad,India. Email: gangadhar.8011@gmail.com
M. Vishnuvardhan, Mechanical department, Vardhaman college of engineering, Hyderabad, India. Email: mukkotivishnu@gmail.com
K. Rajasekhar Reddy, Mechanical department, Vardhaman college of engineering, Hyderabad, India.Email: rajasekhar730@vardhaman.org

since its force is perpendicular to the tooth surface (normal load) and holds a component in the sense of the gear axis, as it generates the essential axial thrust for the thrust bearing. In order to balance a thrust force within a gear, there are few gears combining helical gears with the opposite twist angle called double helical gear or herringbone gear (like bone shape in a herring). In contrast, regular helical gears are sometimes referred to as single helical gears..

II. WORM GEAR

Worm gears are one type of gear among the oldest gear types, but this does not mean that they are complete, reliable and antiquated engineering, the main reasons for their bad experiences are misapplication and misused by some engineers with the worm gear. So for every use, no form of gearing works. It is important to compare strengths, limitations versus application to determine what type of gearing to use. Many areas can vary from the other types of gearings to be addressed for proper application and operation of worm gears.

Worm gear reducers are quiet enough, lightweight enough, and in a single stage will have large reduction ratios. For worm gearing, the ideal ratio is 5: 1 to 75: 1. This is the general range for most the catalog reducers. Practical, highly successful implementations. For ratios under 3: 1.worm gearing for most applications is not at all practical solution, and other types of gearing should be taken into account. Worm gearing ratios above the listed ranges as part of multi-stage reduction are usually more practical.

Worm gears are able to withstand heavy operating shocks and overloads. When properly applied. Worm gearing can deliver good performance and save costs. Worm gear has an inherent overload capacity of 200 percent (i.e., 3x rating) in its rating. There will be no other forms of gearing incorporated in the service factor. Therefore when sizing a worm gear set the lower service factor than the normal.

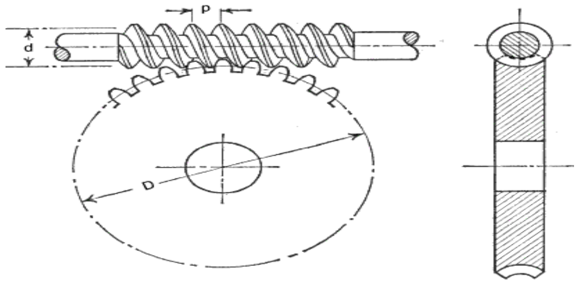


Figure 2.1 Worm Gear

III. PROPOSED METHODOLOGY :

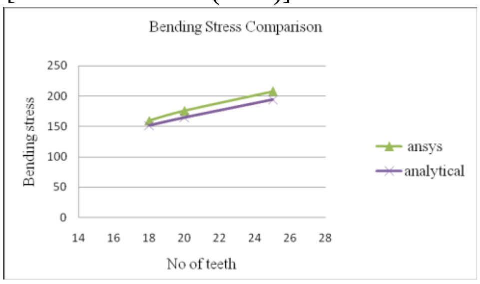
The research is going away on various fields on surface strength and the defects in tip of the gear tooth by varying the face width. Most of the Research is carried out to reduce the failures in gear tooth using AGMA standards and Lewis formulae. Contact Stresses and bending Stresses were validated

Focused to establish the characterization method of seven polyamide grade to manufacture an automotive worm gear and the composite properties is measured for the worm gear lo adings like tensile strength, elongation, abrasion and impact resistance. Von misses stress were calculated using finite element analysis before the rig test for the PA worm gear, the injection process evaluated through the capillary rheometry so the influence of moisture absorption will have definite result to PA6 with 30% GF and with PA 60% GF [Alexander Luis Gasparin (2012)].

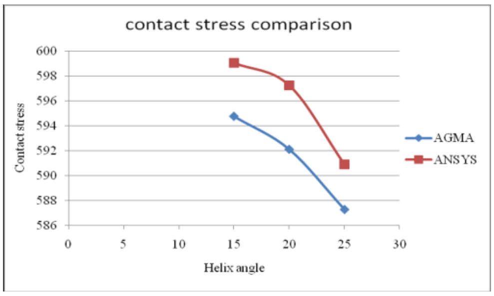
Reviewed the paper on worm gear and identify the defects in worm gear in challenging and diagnosed the faults at initial stage. There are various methods to diagnose and to detect the fault with worm gear boxes, since it is used in many applications such as conveyors, escalators has to work for 24 hours in a day in a production system in order to detect the faults in worm gear various methods has been studied like emission analysis temperature analysis wear debris analysis out of these many techniques wear debris analysis is most commonly used technique [Sagar B Ghodake(2016)].

Proposed a work on high speed helical gear sued in planer machine. Gear is an important component for the mechanical power transmission, so load can be applied on the tip of the tooth and bending stress is calculated for different materials So bending stress calculated for different materials using FEA analysis, so bending stress calculated by ANSYS is 15 and it is validated with AGMA and Lewis equation out of the different materials aluminum is selected as best material for less weight, less cost and the less corrosion than other materials [Parth Bhatt(2016)].

Proposed a work on bending and surface strength of the gear tooth, as it is considered as one of the major failure in the gear. The two stresses i, e root bending stress and tooth contact stresses results the failure of the gear, fatigue causes in the root bending stresses and surface indentation causes in the contact stresses in order to estimate the bending stress and contact stress 3D model is generated by CATIA and calculated the Von mises stresses in FEA ANSYS. Analytical results are based on LEWIS formula and the theoretical values were calculated by AGMA standard so the results were validated [Chetan E kolambe(2016)].



Graph between AGMA bending stress and Ansys results



Graph between AGMA contact stress and Ansys results.

Retrieval Number: D9581118419/2019©BEIESP
DOI:10.35940/ijrte.D9581.118419
Journal Website: www.ijrte.org

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

Proposed a work on gear design bending stress and the surface strength is the major reason for the failure of the gear. So, the analysis of stresses on gear has become popular to decrease the failures. The modified Lewis beam strength is used for bending stress and AGMA method is used for contact stresses. So three dimensional numerical methods of investigations has been conducted on analysis of contact and bending stresses for all types of gears under dynamic condition with and without cracked teeth [J VENKATESH(2014)].

Focused on gear teeth failures which is indenting on surface fatigue due to high contact stresses occurring at gear tooth this paper mainly focuses on to reduce the contact stresses by changing different face width. The effect of face width on von misses stresses is studied by varying the face width from 21mm to 28mm. the results are shown that, the face width increases contact stresses decreases. Thus stress values obtained are less than allowable stress [Hlwan htet htet san(2017)].

IV. RESULT ANALYSIS:

The analysis is carried out by solver ANSYS. The following table shows the modal analysis shows the equivalent stresses & Total deformation.

S.No	Equivalent Stress (Mpa)	Total Deformation
1	3589.8	7.4891
2	4336.8	10.4569
3	4446.9	12.356
4	4778.9	8.156
5	5249.8	11.850
6	5144	11.759

Table:1 Modal Analysis

V. CONCLUSIONS

Reviewed the paper on worm gear and Helical gear and identify the defects challenging and diagnosed the faults at initial stage. There are various methods to diagnose and to detect the fault The modified Lewis beam strength is used for bending stress and AGMA method is used for contact stresses. So three dimensional numerical methods of investigations has been conducted on analysis of contact and bending stresses for all types of gears under dynamic condition with and without cracked teeth. Thus stress values obtained are less than allowable stress.

REFERENCES

1. Alexandre Luís Gasparina, Leandro Luís Corsoa, Eduardo Kirinus Tentardinib, Regina Célia Reis Nunesc, Maria Madalena de Camargo Forted, Ricardo .
2. Vinicius Bof de Oliveirae,2012.Polyamide Worm Gear: Manufacturing and Performance, Volume-15, PP-483-489.
3. Sagar B Ghodake1, A. K. Mishra, V. Deokar,2016. A Review Paper on Fault Detection of Worm Gearbox, Vol. 3.
4. Parth J. Bhatt, Pranav B. Bhatt.2016. Material optimization of high speed single helical gear by using fea approach, Volume-34
5. Chetan E. Kolambe, Dhananjay R. Barde,2016. Study of Helical Gear Analysis Using FEA Software , Volume-6.
6. J. Venkatesh, Mr. P. B. G. S. N. Murthy,2014. Design and Structural Analysis of High Speed Helical Gear Using Ansys, Vol. 4, pp.01-05.
7. Hlwanhtet san, Htay htay win, Myin thein,2017. Design and contact stress analysis of Helical gear for light weight , Volume- 5.

AUTHORS PROFILE

Mr. B Dhanraj is presently working as Assistant Professor in Mechanical Engg. Department in Vardhaman college of Engineering, Shamshabad. He is having 5 years of teaching experience and 3 years of industrial experience. He published 5 international journals and attended 2 international conferences. His areas of research interest are Design, manufacturing, analysis.

. **Mr. S M Gangadhar Reddy** is presently working as Assistant Professor in Mechanical Engg. Department in Vardhaman college of Engineering, Shamshabad. He is having 7 years of teaching experience. He published 5 international journals and attended 3 international conferences. His areas of research interest are manufacturing, industrial engineering, production.

Dr. M Vishnu Vardhan is presently working as Associate Professor in Mechanical Engg. Department in Vardhaman college of Engineering, Shamshabad. He is having 9 years of teaching experience and 2 years of industrial experience. He published 8 international journals and attended 7 international conferences. His areas of research interest are cryogenic treatment, Optimization, manufacturing, analysis.

Mr. K Rajasekhar Reddy is presently working as Assistant Professor in Mechanical Engg. Department in Vardhaman college of Engineering, Shamshabad. He is having 6 years of teaching experience. He published 3 international journals and attended 2 international conferences. His areas of research interest are Design, manufacturing, analysis.

.