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“Experimental and Theoretical Investigation of influence of Design Parameter on Helical Gear System”: A Review

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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. This review paper are focus on the theoretical and experimental method, computing the 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 dynamic condition apply on it [1]. Helical gears are widely used in companies, sheep marine, where the power transmission is required at heavy loads as well as medium load with smoother and noiseless operation as well as fine operation. Helical gear are generally used to transmit torque for transmission at very high speed when compared to other kind of gear transmissions generally this system are explain the system of theoretical as well as experimental helical gear box. [5]

Keywords: Helical gear, Helix angle, Gear teeth, Stress, Strain, FFT Analyzer.

1. Introduction

Gears are the very important component in a power transmission system. Advances in engineering technology in now a days they have brought demands for gear teeth, which can operate at ever increasing load capacities and speeds [4]. In their Helical gear system the gear and pinion only two gear meshing to each other as below.

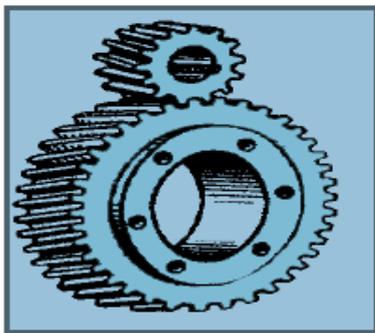


Fig.1. Simple Gear and Pinion drive [11]

As in this paper the author Chetan G. Dhangar is say about reduction type gear box and for speed reduction. In this system in pinion gear because they fix at site of pulley for the speed reduction. The gears generally fail when tooth stress abow the standard limit so it's necessary to choose proper material for that specific gear. The important considerations while selecting a gear material is the ability of the gear. [11] Material to withstand more frictional temperature and few abrasive wear [7]. A gear is a part of rotating machine having cut teeth, which mesh with another toothed part they are in order to transmit torque. Two or more

than that gears working in this so it's called a transmission and it can be produce some mechanical advantage thus may be considered a simple machine. The devices can be change the speed, torque, and direction of a power source. The most common situation is for a gear to mesh with other gear then both gears can be mesh to each other. A non-rotating toothed part, called a rack.

Helical gears are widely used in companies as well as sheep marine purpose where the power transmission is required at heavy loads as well as medium with and noiseless operation. [1] but they depend upon the material, pressure angle, teeth of gear, etc. it's not thing is that the helical gear are generally used to transmit torque for transmission at v high speed when compared to other kind of gear transmissions this application are planetary gear cannot gain high load at high speed as well as medium speed difference Is that in helical gear and planetary gear box system the failure if teethe menace fail all system at planetary gear box author modi Sayed in paper [1] but this case is also applicable in case of helical gear system. an the explain the design the helical gear with defined specification. This as an involving modern design, some materials, with the some consideration of forces, and its mechanical properties. Power transmission is an very important for that purpose. The efficiency of any machine depends on the amount of power loss in the system as well as how much power they can gain. Gears are mostly used to transmit power and velocity or angular velocity These gears play a most important role in many automobile sector. Gears with involute teeth have widely been used in company because of the no more cost of manufacturing the gear. Critical evaluation of helical gear design performance therefore plays

important role for estimating the degree of success of such gear systems in terms of stresses developed in helical gears. The gears have more advantages compare to other gears. Generally spur gears like it has smooth engagement of teeth, one on other to each other silent in operation, can handle heavy loads as well as medium load and power can be pass in between of non parallel shafts, high efficient etc. so the advantages it has wide range of applications in more speed more power mechanical systems. Helical gears have a fine operation than the spur gears because of a large helix angle that increases the length of the line in that contact[1].

1.1. Material Selection

Table. 1 Material Selection

Sr. No.	Material	Young Modulus	Poisson Ration
1	Aluminum alloy	340	0.23
2	Stainless steel	200	0.28
3	Alloy steel	200	0.28
4	En8	80	0.29

2. Experimental setup and working process

2.1 Experimental setup-

As setup aligned by coupling at parallel axis shaft as below at no load condition.

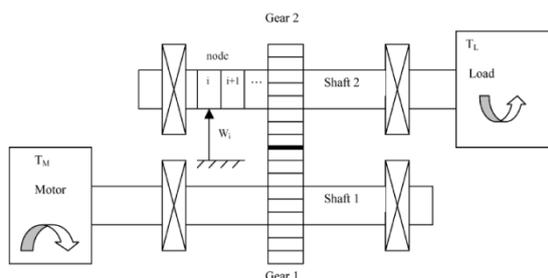


Fig.2-Gear test rig model for numerical simulations.

As given Setup there are some component while making the complete project Motor, Gear box, Pulley, Belt, Strain gauge, Load sensor, Digital display, FFT Analyzer etc. by using all this component hole setup is completed and after alignment to run the process of working. but again the author *Syed Ibrahim c.* in this paper [10] Said about the gear box high torque capacity and low weight .but in general practically helical gear is lightly as compare to planetary gear box, because of in weight reduction type helical gear box only two gear, pinion and gear.

2.1.1 Helical Gear Characteristics

- ☑ Helix angle 6 to 22 degrees
- ☑ Larger speeds more smooth and quiet operation
- ☑ Used in automobiles
- ☑ Helix angle must be the same for both the mating
- ☑ Produces axial thrust which is a disadvantage.

2.2 Working process-

The system start with input electric supply of AC motor with some phase. Due to that the capacity of motor depends upon the capacity of gear box. If the system is not change that the chances of gear teeth failure and to cut the shaft. As in this system to start the working procedure as below.

To start the motor with mounting helical gear box on that at initial condition no load apply on that. Pulley mount on output shaft of gear box on that pulley U shape belt is attached by tightening and slacking condition for that wheel is mounting on that. When we act the load on wheel by using belt then the stresses are to be generate on the gear teeth due to strain gauge the predict of stresses by using DAS. How much amount of load act on the system to show of digital display. As well as by using FFT Analyzer is predict the frequency of that system. Same working procedure of all gear system in industry as well as any purpose. If the load is increases on gear teeth then the different effect on different gear bog teeth.

3. Design and load optimization on gear

As per requirement of gear will be design. As follow the design and specification of helical gear.

3.1 Helix angle

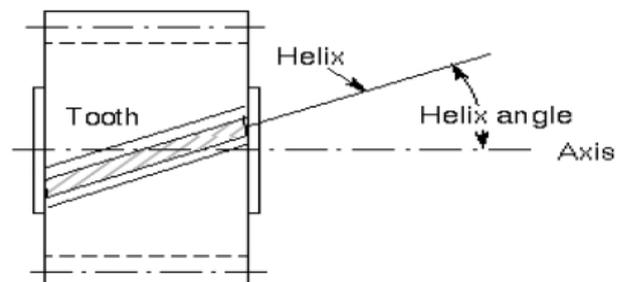


Fig.-3 Helix angle

In our field engineering, a helix angle is the angle between any axial line and helix in between distance that is called of helix angle ,on its right, circular cylinder Common applications are helical gears, and worm gears. The helix angle references the axis of the cylinder, distinguishing it from the lead angle, which references a line perpendicular to the axis. The helix angle is the geometric supplement of the lead. The helix attitude is measured in levels.

Concept: In terms specific to screws, the helix angle can be located via unraveling the helix from the screw, Representing the phase as a right triangle, and calculating the perspective this is fashioned. note that while the terminology directly refers to screws, those ideas are analogous to maximum mechanical programs of the helix attitude.

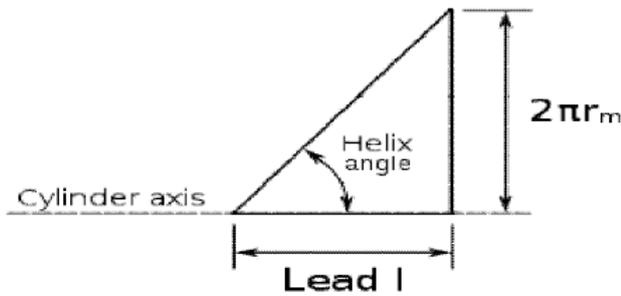


Fig.4 Conceptual Helix angle

The helix angle can be expressed as:

$$\text{Helix angle} = \arctan(2\pi r_m/l)$$

Where

l = is lead of the screw or gear

r_m = is mean radius of the screw thread or gear

3.2 Load optimization on gear

Due to applying load on gear some stresses generated on the gear tooth. Some forces are there are as.

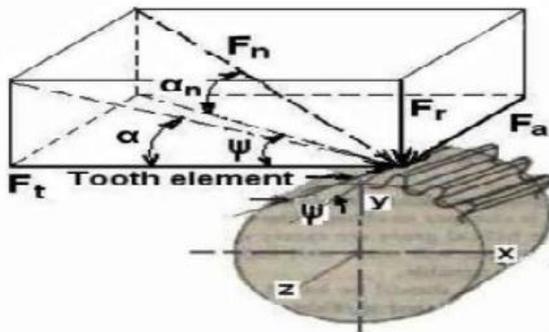


Fig.5 Tooth force and its components acting on a Right hand helical gear [5]

Where,

F_t - Thrust load on gear

F_n - Normal load on gear

F_a - Axial load on gear

F_r - Radial load on gear

Helical Gears - Force Analysis:

$$F_r = F_n \sin \alpha_n$$

$$F_t = F_n \cos \alpha_n \cos \psi$$

$$F_r = F_t \tan \alpha$$

$$F_a = F_t \tan \psi$$

$$F_a = F_n \cos \alpha_n \sin \psi$$

3.3 Helical Gears- Tooth Proportions:

In helical gears, the normal module m_n should be selected from standard values, the first preference values are m_n (in mm) = 1, 1.25, 1.5, 2, 2.5, 3, 4, 5, 6, 8 and 10 The standard proportions of addendum and dedendum are $h_a = m_n$, $h_f = 1.25 m_n$, $c = 0.25 m_n$

4. Result and Discussion-

As the resulting load calculated for the gear train having in which there are four loads generally W_t , W_w , W_s , W_d etc. Deflection of gear teeth depends upon the gear teeth, pressure angel, Helix angle and material. Gear teeth are not proper in angle then the more wear material of gear. By using 3-Phase, 3hp motor to run the gear at 20 degree pressure angle at five reduction ration gear. If the gear and pinion ration is more than seven the more chances of load applying on pinion because of static tooth load (W_s) should always be greater than dynamic tooth load (W_d). And also the dynamic tooth load (W_d) should not be more than the wear tooth load (W_d). So that the system the considering some factors while run the any gear project e.g. Specific power of motor they can handle gear box in proper way, Material selection, Teeth angle, Pressure angle etc.

5. Conclusion

As on the basis of that there conclusion is that the load Appling helical gears the generated of stresses is different as experimentally as well as theoretically due to loading condition, material properties, pressure angle and gear teeth. So the difference is that while making reading.

- 1) Helix angle is ancritical angle for contact surface stress is if increasing the helix angle.
- 2) More bending stress decreases when increasing face width.
- 3) When we calculating the stress by using theoretical then we get result only at one point because of single point contact loading
- 4) by observing and concluding all data and we get the thing about Al alloy compressive and bending stress is high as compare to other material.

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