

# Study of Motorcycle Gear Box

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## ABSTRACT

The spur gear is the simplest type of reducer, in which the teeth are cut parallel to the axis of the shaft on which the reducer is mounted. Spur gears are used to transmit power between parallel shafts. For the analysis of the structural analysis, the fatigue analysis and the analysis of the contact stresses, as well as for the evaluation of the reaction forces on the spur gear using the FEM analysis in the Ansys workshop. In this study, the performance of spur gears must be assessed using rotation simulation techniques, structural analysis using the calculation of total deformation, equivalent stress and shear stress. And to perform a fatigue analysis to predict the damage, the gear life factor and the SN curve. In this study, contact analyzes are performed to determine conditions, friction load, pressure, penetration and gaps. Evaluation of the reaction force in the xyz direction. Finite element analysis uses ANSYS software, with which engineers can apply the method of creating computer prototypes, components and transferring CAD models of structures into a system product. And it improves the profile of the structural elements thanks to the optimization of the shape. Physical reactions such as voltage levels, temperature distributions or electromagnetic fields can be examined.

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## INTRODUCTION

Gearboxes are used to transfer torque, movement and angular speed from one shaft to another in a variety of applications. There are also a variety of types of gear to choose from. This chapter deals with the simplest types of gears, spur gears, designed for parallel operation. Gear There are many other tooth configurations for some applications. This chapter provides a brief introduction to spur gear design, which increases the complexity of design problems using these more complicated tooth shapes. But I can't give a complete treatment of this complex topic. The dental profile can be distinguished as an involute curve and a cycloid. The gear tooth must first be designed with the profile of the developing tooth. If basic specifications such as pressure angle, modulus, number of teeth and speed variation coefficient are specified, the spiral tooth profile can be implemented using the gear specifications and involute function [1].



Figure number 1.1: Spur Gear (courtesy: spur gear)

**Face Width:** the width along the contact surface between the gears is called the face width.

**Tooth Thickness:** the thickness of the tooth along the circle of the step is called the tooth thickness.

**Diameter Division (DP):** the size of the gear tooth is described by the pitch of the diameter. Larger gears have fewer teeth per inch of diameter pitch because the diameter pitch is reversed relative to the gear tooth size.

The calculation of the load distribution along the contact path is extremely important when designing the gearbox. This distribution occurs simultaneously with transmission errors and contact rigidity. A finite element analysis could also be an alternative method of determining this error at each touch point via the touch line.

Different types of gears are determined by the three classifications above, e.g. helical gear, worm gear, double gear (herringbone gear), bevel gear, hypoid gear (hyperboloids) also as gear. This study deals with the planning, analysis and testing of helical gear systems. Gears aren't defined only by their function. Instead, they're determined by their geometry, where geometry indicates the form and relative dispositions of a body.

In addition, other definitions to be discussed during this study are: base frame, contact angle, ring gear engagement and get in touch with ratio. The bottom rack represents the traditional dental section in each set of teeth and regulates the form or shape of the tooth and therefore the different dimensions of the dental section. Namely the modulus, the entire depth of the teeth, the circular pitch and therefore the radius of curvature. The rack is that the basis of a typical system of interchangeable gears. To know the concept of the pressure angle, it's assumed that if a tangent is drawn on the event profile of a tooth at any point of the curve and a radial line is drawn through this tangent point, now is connected to the middle of the gear dental, therefore the oblique angle between this tangent and therefore the radial is defined because the contact angle at the purpose. It's also referred to as the working pressure angle. Counting on the correction factors and installation dimensions, it's going to deviate from the quality pressure angle.

## LITERATURE REVIEW

There are many sorts of gears subject to cyclical constraints in various sectors, including wind turbines, gas and oil gears and power plants. Modern industrial gearboxes generally fail due to the fatigue of materials with repeated loading, which is manifested by the superficial depression of the tooth flank. These components must be ready to suffer fatigue damage during their lifetime. If you fully comprehend the instrument of dental failure, you'll design more reliable gears. Numerical methods are powerful tools for studying these complex physical phenomena. The greater part of the exploration to audit break arrangement and subsequently the spread of a tooth for modern riggings has been conducted numerical strategies and simulations of two-dimensional displaying of limited components. One among the foremost basic mistakes in compound steel gears with smooth contact surfaces and appropriate grease is that the beginning of pits under the surface. Surface shear worries because of contact loads cause a major development move which can cause exhaustion splits.

They utilized the FRANC (Fracture Analysis Code) program to reenact the spread of dental breaks. Another investigation introduced by Albrecht built up a framework that included tooth strain, gear reverberation and transmission clamor with NASTRAN. The spread of exhaustion cuts in test tubes like dentition. They predicted crack propagation in several models of cracked samples using two numerical approaches: the limited component strategy and consequently the weight work procedure.

The arrangement of this section is as per the following. In segment 4.2, a whole three-dimensional model is created to survey the arrangement and proliferation of cracks during a gear. Additionally, methods for calculating the looks of fatigue cracks and therefore the duration of diffusion are presented. Section 4.3 describes the calculation of the breakage duration. Section 4.4 examines the subsequent results of crack propagation simulations: duration of crack fatigue propagation, variation of stress intensity factors over the whole width of the surface, crack path, crack face shape and 3D crack surface after crack propagation.

Miryam B. Sanchez et. al [1] Right now, comb stiffness of the sets of spike gears is surveyed considering both the overall avoidances of the teeth and in this manner the neighborhood contact diversions at each purpose of the contact way and approximated by a simple investigative capacity. With this capacity, the heap conveyance proportion is determined and contrasted and the past outcomes got from the theory of the base flexible P.E. (MEPE model) thinking about the dental disfigurements, ignoring the microwave mish appending's.

Seok-Chul Hwanga et al. [2] examined the examination of the contact worries for a couple of decrease gears during turn. He

inspected the individual variety of the contact voltage examination for the ring gear and subsequently the ring gear with the different contact position during a couple of rigging wheels. Look at the adjustment in contact voltages during revolution at absolute bottom contact point with one tooth (LPSTC) and in this way the American Gear Manufacturers Associated (AGMA) condition for the contact voltage.

Prashant Kumar Singh et al. [3] the heat and wear conduct of apparatuses made with different thermoplastic materials like acrylonitrile-butadiene-styrene (ABS), high thickness polyethylene (HDPE) and polyoxy-methylene (POM) has been examined in a few sets. Also, speed. The creators found that the mileage pace of polymer gears increments with torque, however diminishes with speed.

B. Vaitkar et al. [24] the creator found that the contact was focused on utilizing FEA programming tentatively. The examination is led with a photo flexible technique. The job of weight edge, contact proportion and twisting worry for transmission execution were likewise clarified. Job of medications geometry to expand gear life and diminish contact stresses.

### Objective

- To evaluates the performance of spur gear by proposing rotational method simulation technique.
- To perform structural analysis by calculating total deformation, equivalent stress and shear stress.
- To perform fatigue analysis to predict damage, factor of safety life of gear and SN curve.
- To perform contact analysis to find its status, frictional stress, pressure, penetration and gap.
- To evaluates reaction force on xyz direction

## METHODOLOGY

Geometry of the gear tooth and the load condition In this chapter, stress, fatigue and contact analyzes for straight tooth gearboxes are performed using the finite element method. The mathematical model of a spur arrangement with the following geometrical data: the number of teeth on gear 1 and gear 2 is 18 and 15, the normal modulus is  $m = 5$  mm, the external diameter of gear 1 and of the gear 2100 mm and 85 mm, diameter of the circle of the pitch of the gear 1 and of the gear 2 90 mm and 75 mm, wheelbase = 82.5 mm and tooth surface width = 15 mm.

### Analytical Methods in contact stress analysis:

The study of the deformation of solid bodies in touch in one or more points is named contact mechanics. If two gears mesh, the contact area is theoretically a line. The curvatures of the individual contact surfaces at the contact points vary consistent with the required dimensions of the tooth profile of the adjusting wheels, also because the current positions of the contact point on the action line when the tooth surfaces roll and slide during action. The sort of contact is therefore analogous to that of two cylinders in touch with constantly changing radii of curvature. Although it's theoretically in touch with the road, thanks to the mutual pressure, the road actually develops during a band of a particular width along the length of the teeth. The strain model developed during this volume is sort of complicated.

### FEM Analysis:

The use of the finite element method as a tool to solve various technical problems in industrial applications is a completely new concept. EGF was used in the late 1950s and early 1960s, but not in the same way it is today. Initially, the calculations were done by hand and a force-based method was used, but not the trajectory-based method used today. Special computers were used to perform the analysis in 60 seconds. GEF was limited to expensive mainframes used in the aerospace, automotive, defense and nuclear industries.

### Program Controlled

This is the default value. With this parameter, the application selects the Penalty property for the contact between two rigid bodies and the increased Lagrange property for all other contact situations.

### Pure Penalty

Basic contact formulation based on Penalty method.

### Augmented Lagrange

Also a method based on penalties. Compared to the pure penalty method, this method generally leads to better conditioning and is less sensitive to the size of the contact stiffness coefficient. In some analyzes, however, the augmented Lagrange method may require additional iterations, especially if the deformed mesh is too deformed.

## RESULTS

Table: For Total deformation

Total deformation			Total deformation		
Time	Min	Max	Time	Min	Max
0.200	0.017	0.1728	2.800	0.244	2.2862
0.400	0.035	0.33503	3.000	0.262	2.4487
0.600	0.052	0.49719	3.200	0.279	2.6109
0.800	0.07	0.65922	3.400	0.297	2.7727
1.000	0.087	0.8208	3.600	0.314	2.9344
1.200	0.105	0.98285	3.800	0.332	3.096
1.400	0.122	1.1463	4.000	0.349	3.2573
1.600	0.14	1.3097	4.200	0.367	3.4184
1.800	0.157	1.4728	4.400	0.384	3.5795
2.000	0.175	1.6359	4.600	0.401	3.7407
2.200	0.192	1.7985	4.800	0.419	3.902
2.400	0.209	1.9612	5.000	0.436	4.0631
2.600	0.227	2.1237			

## CONCLUSION

In this thesis, the virtual condition is given to examine structural analysis, fatigue analysis and analysis of contact stresses and to develop the reaction forces on the helical gearbox using the Fem analysis in the Ansys workshop. The calculation of the study is presented below.

- The total deformation of the spur gear assembly was less than 4 mm.
- Directional deformation of the spur gear was observed. Their value is 4.0163 mm
- The equivalent stress (von-stake stress) of the spur gear was observed, its maximum value is 830.82 MPa
- The maximum main stress for the helical gearbox was observed. Their value is 708.35 MPa
- The maximum shear stress on the spur gear was observed. Their value is 394.43 MPa
- In the analysis of contact stresses, the pressure on the gear teeth is 1620.1 MPa
- In the analysis of the contact stresses, the frictional stress on the gears is 162.01 MPa
- In the analysis of contact stresses, the sliding thickness of the teeth is 0.79801 mm
- In the analysis of contact stresses, the concentration on the teeth is 0.027434 mm
- When calculating the reaction force, the maximum force on the spur teeth of the spur gear is 83240

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