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Design and Optimization of Bevel Gear Using Dynamic Analysis

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ABSTRACT- Gears are central resource for power transmission in computerization industry. Slant apparatuses are utilized to transmit the power between two crossing shafts at practically any edge or speed. Slope riggings transmit control between two converging shafts at any edge or between non-meeting shafts.

While transmitting power bevel gears are suffer from high contact stress due to frictional force in between two mating gears. These high contact stresses will reduce by using optimum bevel gear's tool profile angle with high strength material. If tool profile angle design will not make accurate then gear will goes to failure in fracture.

The fundamental point of this task is to upgrade the structure of slope equips by decreasing device profile edge. Structure of incline apparatuses done utilizing Unigraphics CAD programming and Ansys FEA programming is utilized in this task for performing dynamic examination of slant gears. In view of examination results best slant apparatuses will propose. This apparatuses will investigated by high quality Steel amalgam material.

Keywords – Bevel Gear, Ansys FEA, CAD, Transmitting Power.

I. INTRODUCTION

A gear is a pivoting machine part having cut teeth, or by virtue of a cogwheel, implanted teeth (called gear-teeth), which work with another toothed part to transmit torque. Prepared devices can change the speed, torque, and course of a power source. Riggings frequently produce a modification in torque, making a mechanical ideal situation, through their device extent, and thus may be seen as a clear machine. The teeth on the two cross area furnishes all have a comparable shape. At any rate two cross segment gears, working in a gathering, are known as an apparatus train or a transmission. An apparatus can work with a direct toothed part, called a rack, making translation instead of turn.

Fig. 1 shows the different gears

1.2 TYPES OF GEARS

Fig. 2 shows the different types of gears

HELICAL GEAR

Helical apparatuses are utilized with parallel shafts like spike equips and are barrel shaped riggings with winding tooth lines. They have preferred teeth fitting over spike equip and have predominant quietness and can transmit higher burdens, making them appropriate for fast applications.

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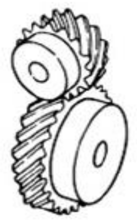
A sketch of helical gears

SCREW GEAR

Screw apparatuses are a couple of same hand helical riggings with the curve point of 45° on non-parallel, non-converging shafts.



A sketch of screw gears

Fig. 3 shows the screw gear

MATERIALS USED IN GEAR MANUFACTURING PROCESS

- The different materials utilized for apparatuses incorporate a wide assortment of cast irons, non ferrous material and non – metallic materials. The choice of the apparatus material relies on:
  - Sort of work
  - Fringe speed
  - Level of precision required
  - Strategy for assembling
  - Required measurements and weight of the drive
  - Admissible pressure
  - Stun obstruction

II. LITERATURE REVIEW

Karlis Paulins et al (2014) created winding incline gear with improved plan of rigging spaces with enhanced tooth closes. It is conceivable to advance rectangular-produced, winding incline pinion/gear sets with steady tooth stature and a typical pitch cone peak. The work effectively accomplished the recalculation of the apparatus spaces, with no adjustments in the flank geometry or tooth-cutting procedure. At the point when the mating pinion is planned without a corresponding front cone, it is silly to structure the rigging with a reciprocal back cone. Progressively reasonable geometry for current machining and checking of spaces, because of the consideration of chamfer type surfaces in the essential structure.

Jihui Liang, 2lili Xin (2013) clarified the dynamic recreation of winding incline gears. Mechanical properties of winding slant apparatus have noteworthy effect in general mechanical structure and assume a significant job in the framework improvement, quality check, flaw conclusion and shortcoming forecast. The rigging tooth cross section and dynamic burden is a significant issue in the apparatus research field. The exact demonstrating of winding angle rigging depends on SOLIDWORKS programming and virtual model of apparatus fitting parameterization is acknowledged through ADAMS.

Xiang Tieming et al (2015) did the free modular examination for winding apparatus wheel dependent on Lanczos strategy. So as to get the winding slope apparatus wheel normal frequencies and mode shapes in the unconstrained state with the end goal of dynamic attributes study. So as to check the adequacy of the limited component examination results, the test modular test dependent on the motivation power hammer percussion transient single-point excitation and multi-point reaction investigation strategy has been finished. The greatest distinction estimation of regular recurrence between exploratory modular test outcome and limited component modular examination results is 29.86 Hz, the most extreme mistake rate is 0.41%, which affirmed the consequence of limited component technique is powerful and solid.

III. PROBLEM DEFINITION AND METHODOLOGY

Incline gears are utilized to transmit the power between two crossing shafts at practically any point or speed. While transmitting force incline riggings are experience the ill effects of high contact worry because of frictional power in the middle of two mating gears.

METHODOLOGY

- Design of bevel gear using NX-CAD
- Structural static, Modal and Harmonic analysis of bevel gear done using Ansys.
- Analysis done using Stainless steel material.
- Design modified for bevel gear using NX-CAD with reducing tooth profile angle.
- Structural static, Modal and Harmonic analysis of bevel gear done using Ansys.
- Stress, Vibrations is reduced in bevel gear with optimized design

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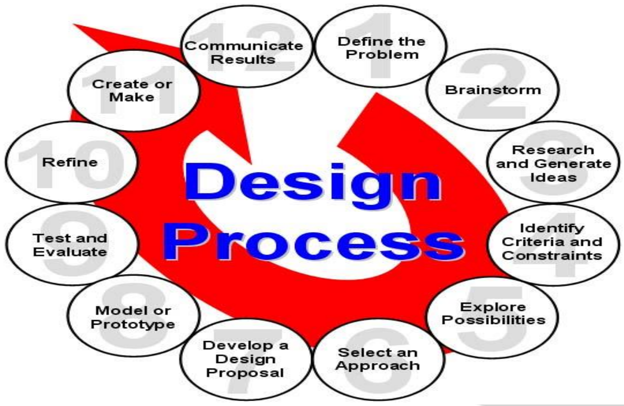
IV. INTRODUCTION TO CAD

COMPUTER AIDED DESIGN

PC supported plan (CAD), otherwise called PC helped structure and drafting (CADD), is the utilization of PC frameworks to aid the creation, alteration, investigation, or enhancement of a structure. PC helped plan (CAD) is the utilization of PC frameworks to aid the creation, change, investigation, or improvement of a structure.



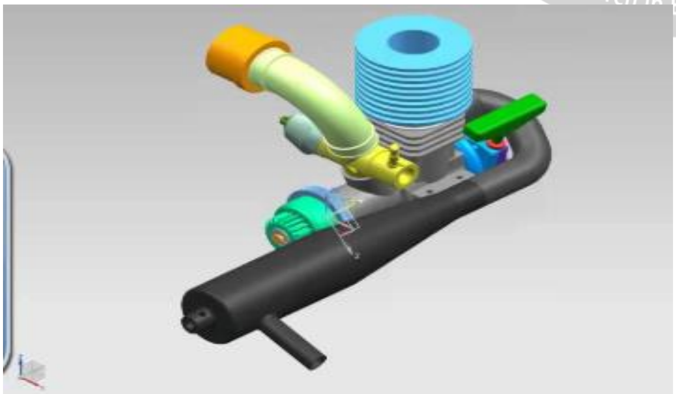
UNI GRAPHICS INTRODUCTION

Overview of Solid Modeling

The Unigraphics NX Modeling application gives a strong displaying framework to empower quick theoretical plan. Specialists can join their prerequisites and structure confinements by characterizing numerical connections between various pieces of the plan.

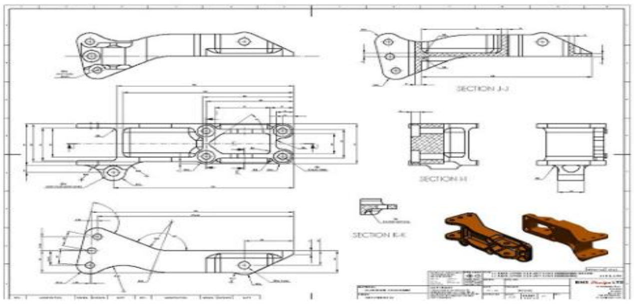
Creating and Editing Features

Highlight Modeling gives you a chance to make highlights, for example, gaps, spaces and notches on a model. You can then legitimately alter the components of the element and find the element by measurements.



INTRODUCTION TO DRAFTING

The Drafting application is intended to enable you to make and keep up an assortment of drawings produced using models created from inside the Modeling application. Drawings made in the Drafting application are completely acquainted to the model.



3D MODEL OF BEVEL GEAR

GEAR DESIGN

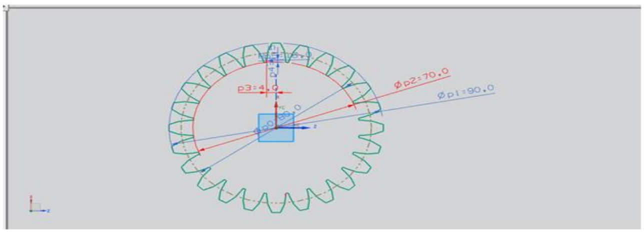


Fig: 2D sketch of the bevel gear

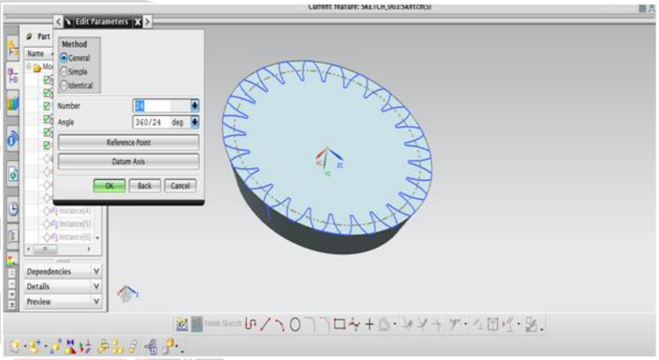


Fig: making circular revolve of the sketch

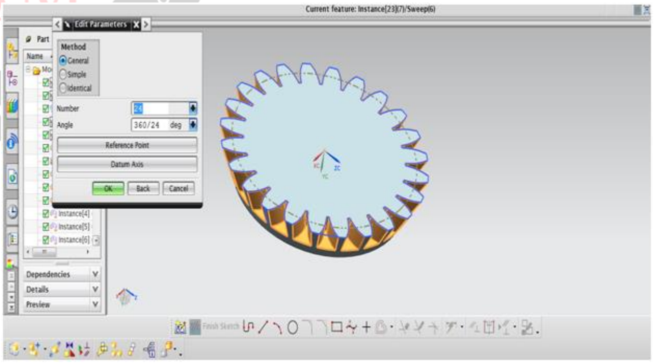


Fig: 3D model of the bevel with teeth extrusion

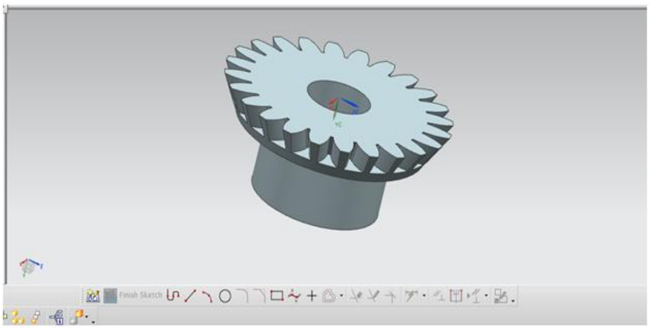


Fig: final model of the bevel gear

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PINION DESIGN:

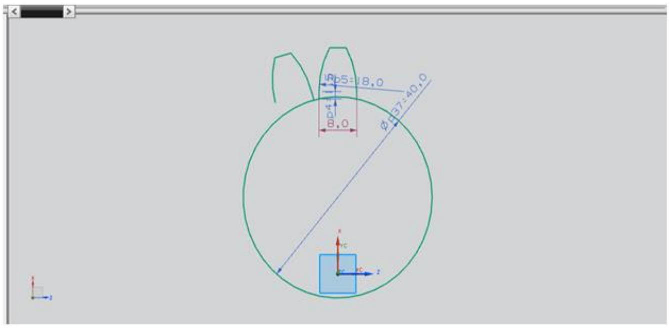

Fig: 2D sketch of the pinion design

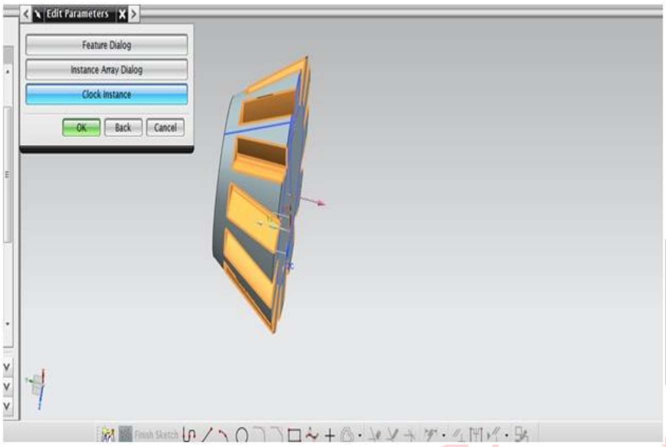

Fig: shows the making instances

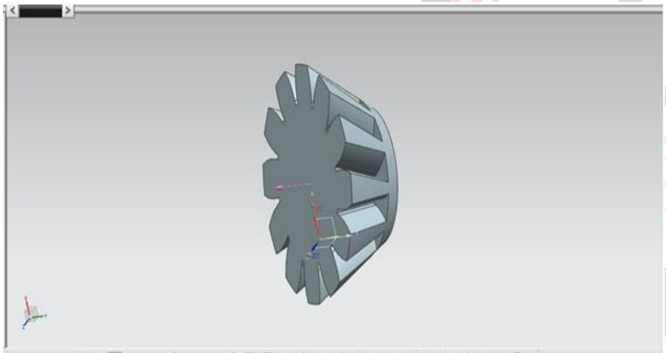

Fig: shows the 3D model of the pinion

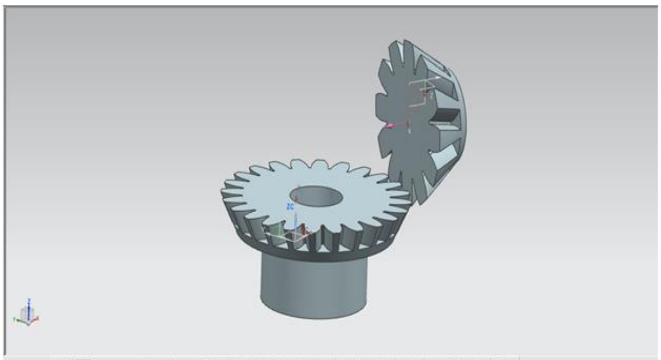

Fig: shows the final 3D model

V. STRUCTURAL ANALYSIS OF BEVEL

STATIC ANALYSIS OF BEVEL GEAR

Material Properties of stainless steel

Young's Modulus 206000 MPA

Poisson's Ratio = 0.3

Ultimate Tensile Strength = 1030 MPA

Density= 7850 Kg/m3

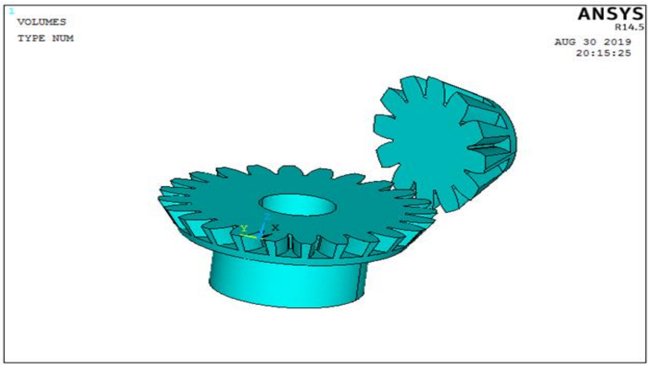

Fig: Imported design in Ansys

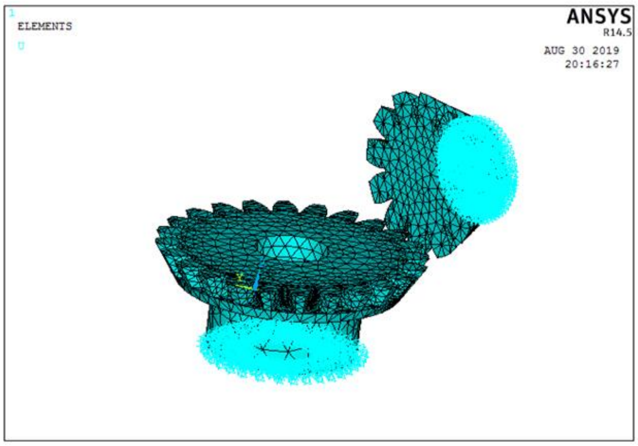

Fig: Applied fixed constraints on bevel gear

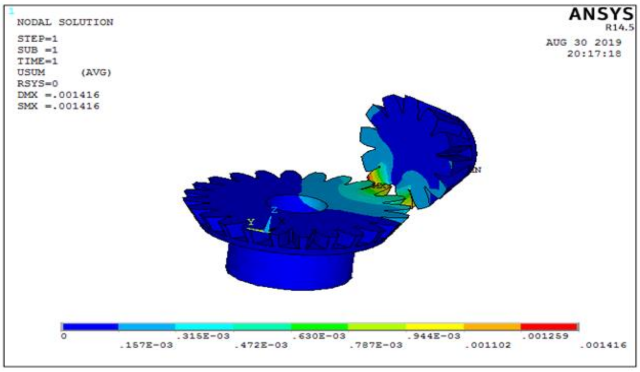

Fig.: Displacement results on bevel gear

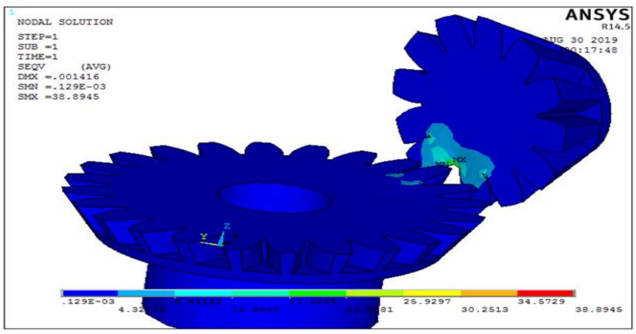

Fig: Stress results on bevel gear

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MODAL ANALYSIS OF BEVEL GEAR

Modular investigation is a procedure of removing modular parameters (characteristic frequencies, damping misfortune variables and modular constants) from estimated vibration information.

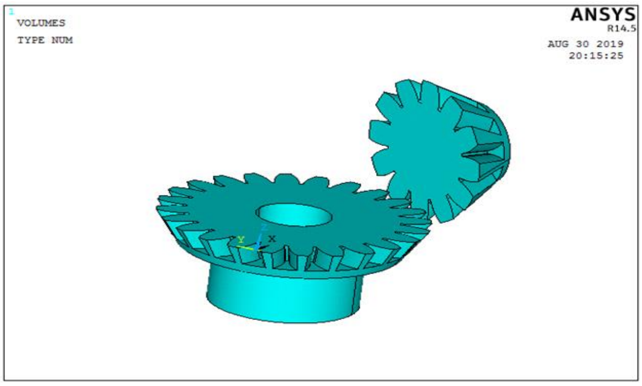

Fig: Imported design in Ansys

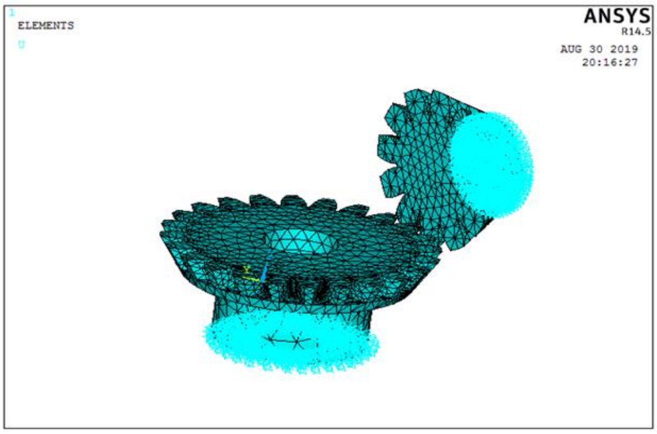

Fig: Applied fixed constraints on bevel gear

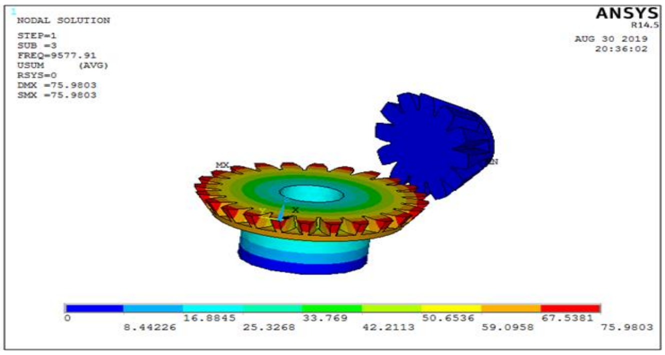

Fig: Mode shape-3 results

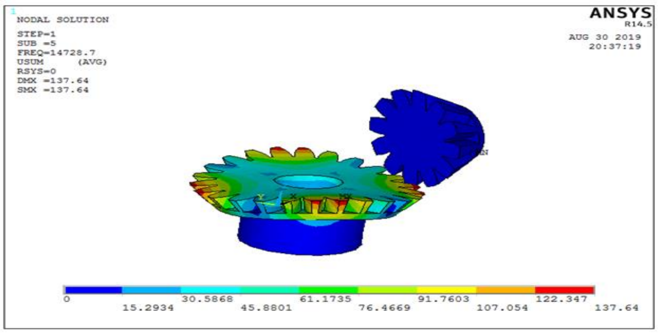

Fig: Mode shape-5 results

HARMONIC ANALYSIS OF BEVEL GEAR

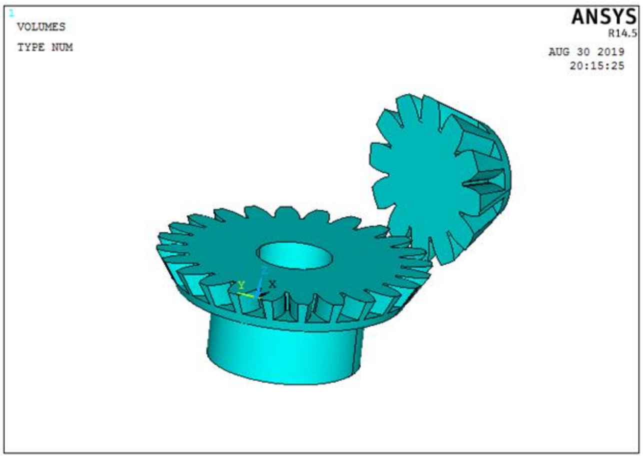

Fig: Imported design in Ansys

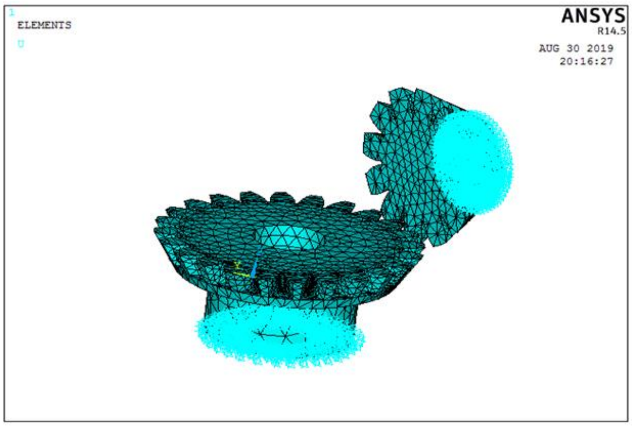

Fig: Applied fixed constraints on bevel gear

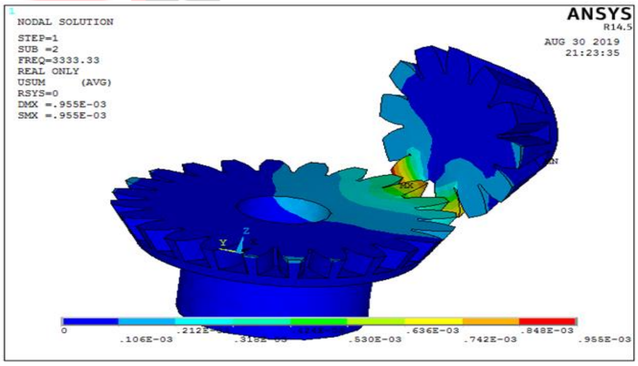

Fig: 2nd harmonic deformation response of bevel gear

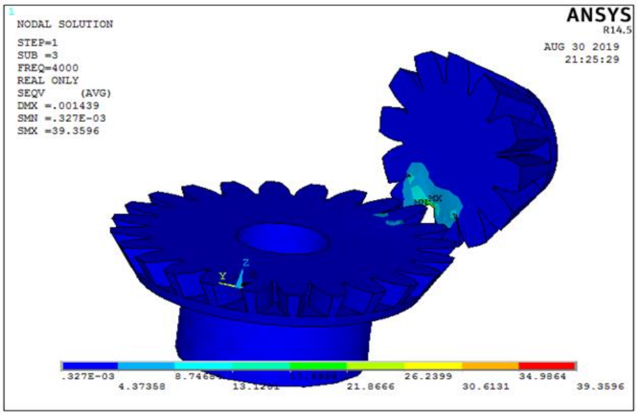

Fig: 3rd harmonic stress response of bevel gear

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DESIGNING OF MODIFIED BEVEL GEAR

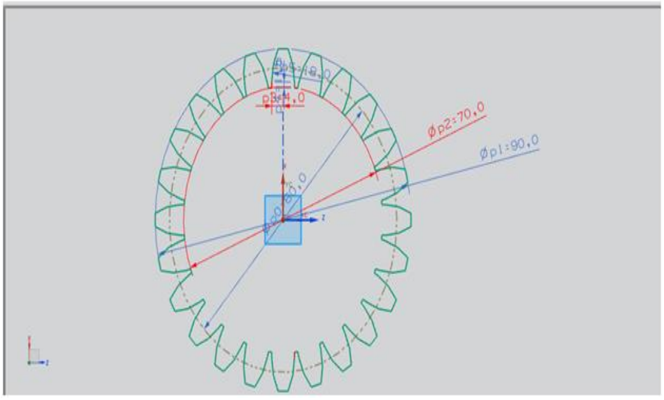

Fig: 2D sketch of the gear

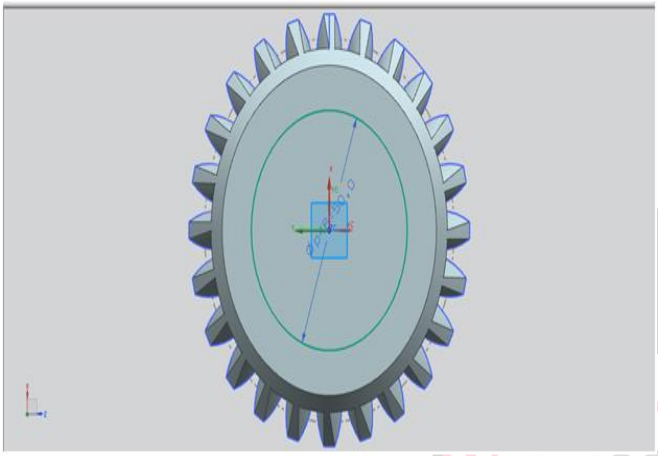

Fig: shows the sketch of top head

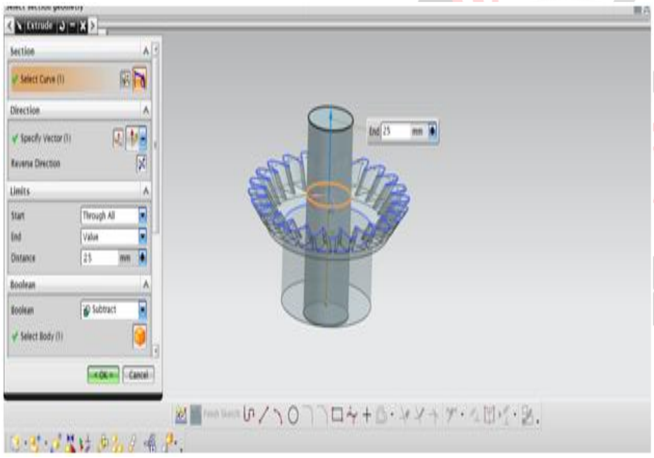

Fig: shows the subtraction of material

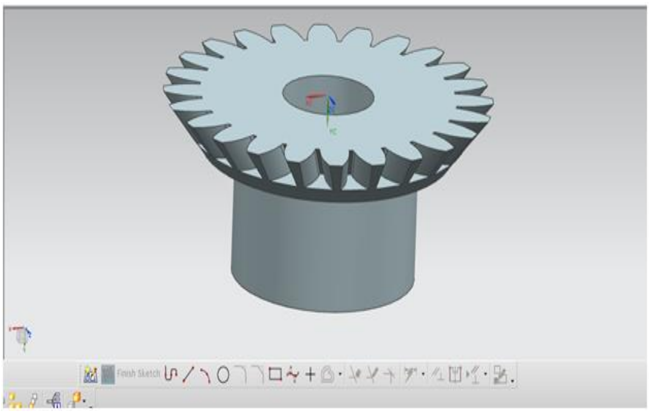

Fig: shows the 3D model of gear

PINION DESIGN

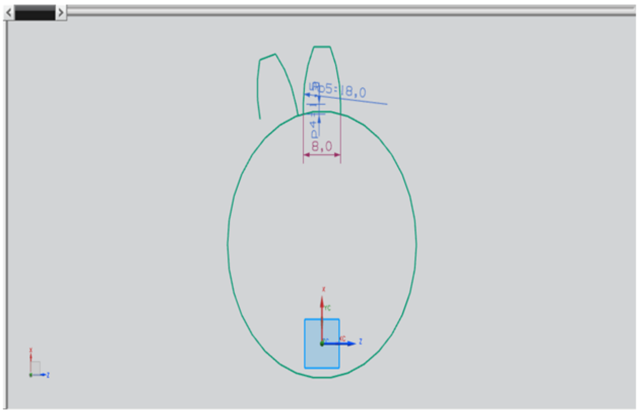

Fig: shows the 2D sketch of the pinion

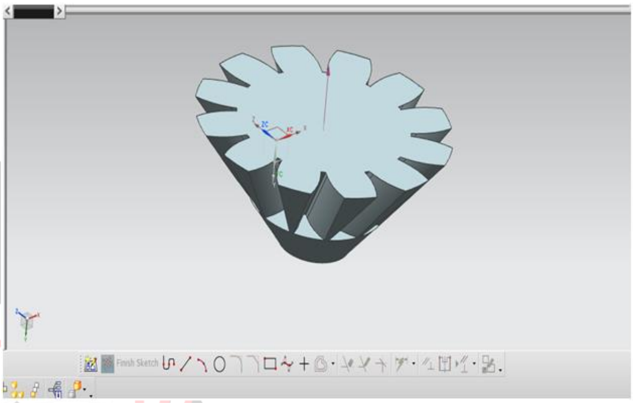

Fig: shows the 3D model of the pinion

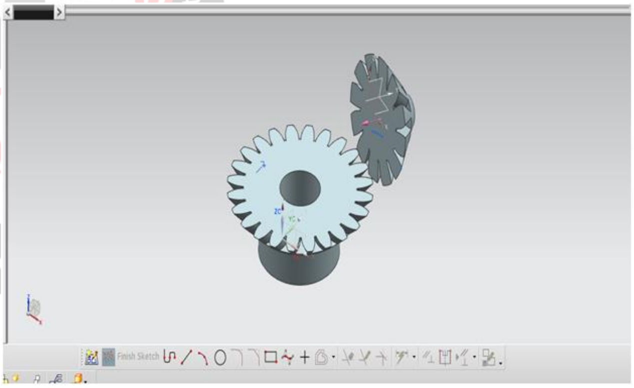

Fig: shows the assembly of final model

VI. STRUCTURAL ANALYSIS OF MODIFIED BEVEL GEAR

STATIC ANALYSIS OF BEVEL GEAR

Young's Modulus 206000 MPA

Poisson's Ratio = 0.3

Ultimate Tensile Strength = 1030 MPA

Density= 7850 Kg/m3

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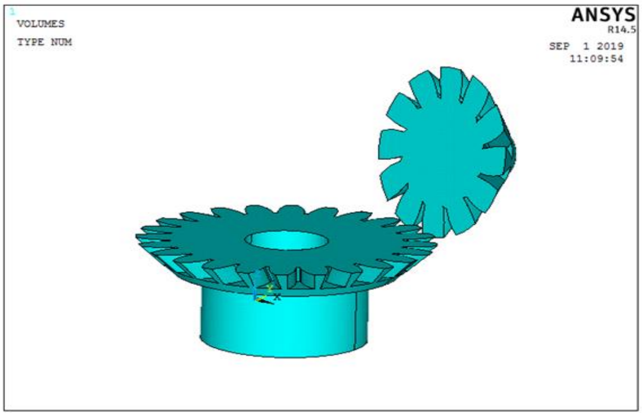

Fig: Imported design in Ansys

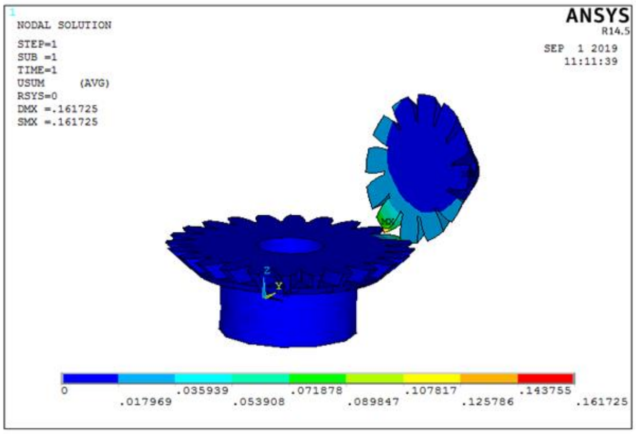

Fig: Displacement results on bevel gear

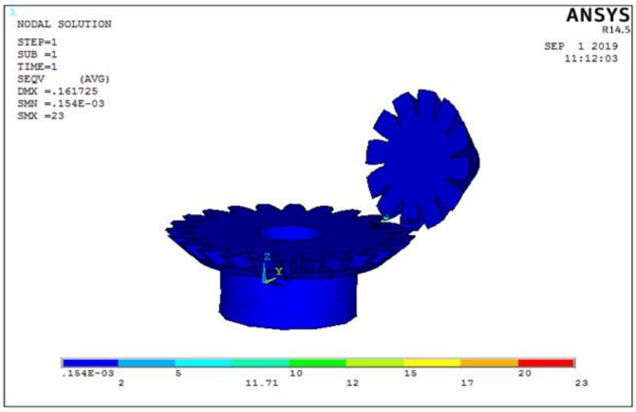

Fig: Stress results on bevel gear

MODAL ANALYSIS OF MODIFIED BEVEL GEAR:

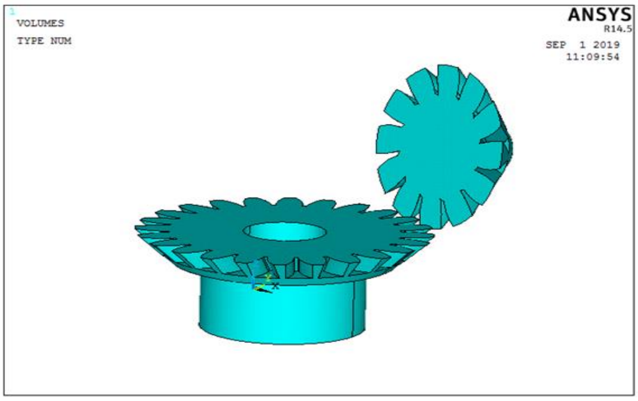

Fig.: Imported design in Ansys

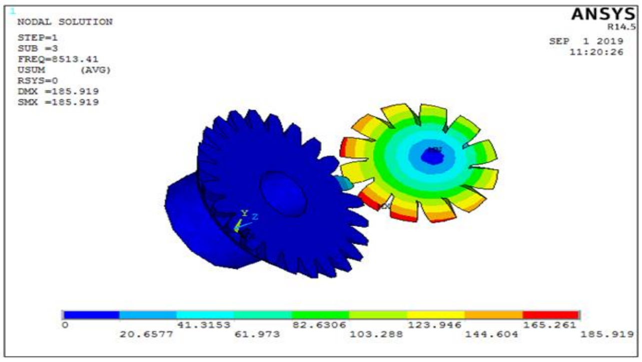

Fig: Mode shape-3 results

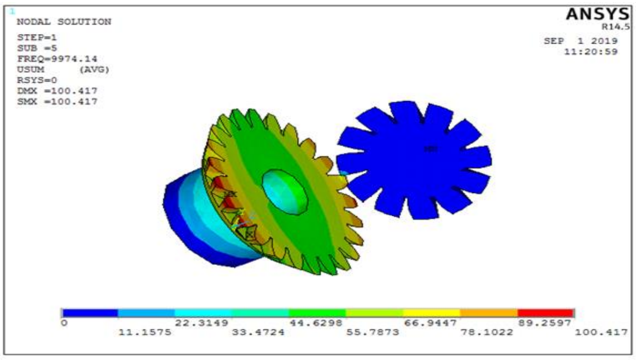

Fig: Mode shape-5 results

HARMONIC ANALYSIS OF MODIFIED BEVEL GEAR

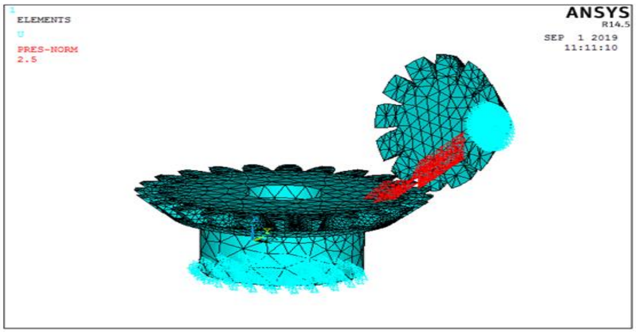

Fig: Applied contact pressure on bevel gear

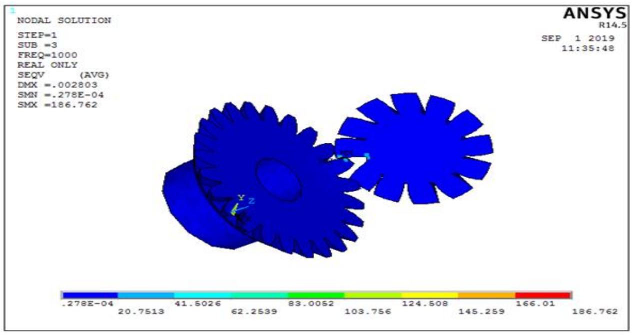

Fig: 3rd harmonic stress response of bevel gear

VII. RESULTS AND CONCLUSION

Bevel gear design studied briefly in this project. To develop design of bevel gears, UNIGRAPHICS software is used. Ansys software is used for performing analysis of bevel gears.

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Analysis results are given below

RESULTS	EXISTED BEVEL GEAR	MODIFIED BEVEL GEAR
Deformation(mm)	0.001	0.161
Stress(MPa)	38.89	23
Natural frequency range (Hz)	8533 - 14729	7905 – 9974
Forced frequency range (Hz)	2666 - 4000	666 – 1000

From analysis results concluded that modified bevel gear formed less stress and less frequency results. So it is the best for transmitting high power

REFERENCES

[1] Bhandari V.B., (2003), Design of Machine Elements, Tata McGraw-Hill Publishing Company Ltd, New Delhi

[2] Ratnadeepsinh M. Jadeja et al (2013), "Bowing Stress Analysis of Bevel Gears", International Journal of Innovative Research in Science, Engineering and Technology, 3041-3046

[3] Bruzhas V.V. et al (2015),"Development of strong state models for the apparatuses of various geometry", Procedia Engineering 129 (2015) 369 – 373

[4] Abhijeet .V. Patil et al (2014), "Investigation of twisting quality of slant gear by FEM", International Journal of Innovative Research in Advanced Engineering, 424-429

[5] M. Muralidhara Rao et al (2015), "Showing and Analysis of Spiral Bevel Gear", International Journal of Advances in Marine Engineering and Renewables, 85-91

[6] Shigley, Mechanical Engineering, McGraw−Hill Primis, Eighth Edition, ISBN: 0−390−76487−6

[7] PSG College of Technology, 2008, Design Data Book, Coimbatore

[8] Josip Bernic et al (2015), "Examination of Mechanical Properties and Resistance to Creep of 20MnCr5 Steel and X10CrAlSi25 Steel", Procidia Engineering 100 (2015) 84 – 89

[9] IS 9283:2013, Indian standard Motor for submersible siphon sets – determination second amendment

[10] J.Thomson, et, al. "Advancement of without lead bearing material for aviation application ", International diary for metal throwing, 2010, ISSN 1939-5981

 DOI : 10.35291/2454-9150.2019.0452