Contact Stress Analysis In Design And Modification of Helical Gears

P Purushotham Yadav[a], Dr.P. Paul Pandian[b]
[a]*M.Tech Student, Department of Mechanical Engineering, Mallareddy Engineering College, Hyderabad, Telangana, India.*
[b]*Professor, Department of Mechanical Engineering, Mallareddy Engineering College, Hyderabad, Telangana, India.*

Abstract:Helical apparatus is a well known sort of rigging having its teeth cut an edge, known as helix edge consequently taking into consideration more steady and smoother coinciding between equip wheels. Helical riggings are better decision when the heaps are overwhelming, the velocities are high, or the commotion level must be kept low. Contact stresses happening in the apparatus tooth is one of the principle purposes behind rigging tooth disappointment. The primary goal of this venture is to break down the contact worries with various helix points and coefficient of grating. The business limited component programming ANSYS is utilized for examination. The outcomes acquired from ANSYS esteems are contrasted and hypothetical qualities.

Keywords: Helix angle, Contact Stress, Coefficient of Friction, Catia V5, Ansys Results**.**

1. INTRODUCTION

The apparatuses in a transmission are practically equivalent to the wheels in a crossed, belt pulley framework. Preference of apparatuses is that the teeth of a rigging avert slippage. At the point when two riggings work, on the off chance that one apparatus is greater than the other, a mechanical preferred standpoint is created, with the rotational paces, and the torques, of the two riggings contrasting in extent to their distances across. Rigging is a fundamental segment in many machine parts; its application differs from little adapted engine to and muddled aviation adornments. Human has been natural about the possibility that the continued twisting of wood or metal forward and backward with high adequacy could burst it. He found that the rehashed pressure can deliver break with worry inside flexible farthest point of material. The weariness examination for structure planning depends on approach which has been advanced in the course of the most recent 100 years or something like that. The specific first exhaustion investigation has been finished by German mining engineer, W.A.S. Albert who performed number of continued stacking test on press chain.

Exhaustion is the most imperative disappointment mode to be considered in a mechanical plan. Weakness is the procedure of consistent limited perpetual basic change showing up in a material subjected to fluctuating pressure conditions. On the off chance that as far as possible does not surpass as far as possible, the body will recover its unique state. Fashioner ought to have a decent learning of logical and observational procedures to get powerful outcomes in deflecting disappointment. Mechanical disappointment is watched fundamentally because of weakness configuration hence exhaustion turns into an undeniable plan, thought for some structure, for example, air ship, rail autos, car suspension, Vehicle edge and extensions In typical conditions, contact weariness is a standout amongst the most widely recognized disappointment modes for equip tooth surfaces. Apparatus tooth association causes cement wear for the duration of the life of rigging drive.

The fundamental point of this investigation is to foresee contact weakness split inception coming about because of high anxieties or strains amid the cross section process. These contact stresses are for the most part at their most astounding at some separation under the surface, where beginning breaks are well on the way to show up. Keeping in mind the end goal to expand the twisting exhaustion quality at the tooth root filet of riggings, gears with high weight point and positive addendum adjustment factor are by and large embraced. Bharat Gupta et. al. has considered contact pressure, the central factor to decide the required measurement of riggings. Intensive investigations of contact pressure created between the diverse mating gears are for the most part critical for outfit outline. Explanatory techniques for computing gear contact stresses utilize Hertz's conditions, which were initially determined for contact between two barrels

Helical Gears

The teeth on helical riggings are sliced at an edge to the substance of the apparatus. At the point when two teeth on a helical rigging framework draw in, the contact begins toward one side of the tooth and continuously spreads as the apparatuses pivot, until the point that the two teeth are in full commitment. This continuous commitment influences helical riggings to work substantially more easily and discreetly than goad gears. Consequently, helical riggings are utilized in all auto transmissions.

Figure 1: Helical Gear

2. LITERATURE REVIEW:

- Vicky Lad, Dr. L. P. Singh [2016].[1] DESIGN Modeling AND ANALYSIS OF HELICAL GEAR USING CATIA, ANSYS AND AGMA PARAMETERS, Gears are utilized to transmit the power between two shafts. In the apparatus plan a few burdens are available in it when they transmit the power. Amid transmitting the power the twisting pressure is considered as the fundamental driver for disappointment of rigging. In this paper twisting pressure can be computed by utilizing scientific strategy which is figured by the AGMA (American Gear Manufacturing Association) estimation and the model is outlined in CATIA V5 and spared in IGES configuration and afterward foreign made in the ANSYS 17 programming where it tends to be investigated. The fundamental goal of this examination needs to research the anxieties incited in adapt tooth profile. This can be accomplished by changing such outline parameter in the current plan.The outcomes are then contrasted and both the AGMA and ANSYS methodology.

- A.Y Gidado, I. Muhammad, A. A. Umar [2] [2014] Design, Modeling and Analysis of Helical Gear According Bending Strength Using AGMA and ANSYS, In this paper one of the central disappointment modes are contemplated in light of the count of twisting pressure. Helical riggings are generally utilized in industry where the power transmission is required at overwhelming burdens with smoother and quiet activity. To evaluate the bowing pressure, three-dimensional strong models for various face width are created by Pro/Engineer that is an intense and present day strong displaying programming and the numerical arrangement is finished by ANSYS, which is a limited component investigation bundle. The explanatory examination depends on Lewis push equation. In this paper a helical rigging was displayed on Pro designer out of control fire 4.0 and push investigation part is done on ANSYS 11.0. The outcomes are then contrasted and both AGMA and FEM methodology.

- K. NARESH, C. CHANDRUDHU [3] [2016] DESIGN AND ANALYSIS OF HELICAL GEAR. Helical apparatuses are generally utilized in industry where the power transmission is required at overwhelming burdens with smoother and silent task. Helical rigging are for the most part used to transmit power or torque for transmission at fast when contrasted with other sort of apparatus transmissions this application are clarify the plan the helical rigging with characterized detail. It's have an including present day outline, particular character, particular materials, with thought of investigation of power, and its mechanical properties. In this undertaking we outline the helical by utilizing strong works 2016 premium and play out the examination by utilizing strong works reenactment by utilizing diverse materials and distinctive burdens connected on it.

- Mohit Singh, Waris Khan, Sanjeev Kumar [4] [2016] Auxiliary ANALYSIS OF COMPOSITE MATERIAL HELICAL GEAR UNDER DIFFERENT LOADING CONDITION. In this work an endeavor has been made to supplant the metallic riggings of steel combination with the composites. The composites consider were the Aluminum Silicon carbide composite Carbon fiber epoxy composites and carbon fiber silicon carbide artistic composite . Endeavors have likewise been done for demonstrating of the transmitting power adapt gathering on creo 3.0 and fem based basic conduct of various material were examined. Ansys 14.0 is utilized the investigation instrument in the present work to decide the aggregate distortion , von misses pressure and the characteristic frequencies at different mode. Composite apparatuses offer enhanced properties over steel combinations and these can be utilized as better option for supplanting metallic riggings.

- Khaldoon F. Bretheea,b, Dong Zhenc, FengshouGua, Andrew D. Ball [5] [2017], Helical apparatus wear observing: Modeling and test approval, The model comprises of a 18 level of opportunity (DOF) vibration framework, which incorporates the impacts of the supporting course, driving engine and stacking framework. It additionally couples the transverse and tensional movements coming about because of time-shifting erosion powers, time fluctuating cross section solidness and the excitation of various wear severities. Vibration marks because of tooth wear seriousness and frictional excitations were procured for the parameter assurance and the approval of the model with the test results. The exploratory test and numerical model outcomes demonstrate unmistakably associated conduct, over various apparatus sizes and geometries. The otherworldly tops at the lattice recurrence parts alongside their sidebands were utilized to analyze the reaction designs because of wear. The paper infers that the work vibration amplitudes of the second and third sounds and in addition the sideband segments increment significantly with the degree of wear and henceforth these can be utilized as successful highlights for blame discovery and conclusion.

- Wenliang Li n, Weiyang Lin, Jinyong Yu, [6] [2016] Predicting contact characteristics for helical gear using support vector machine. Grinding power and contact torque are critical factor in elements qualities of transmission framework. Be that as it may, it is exceptionally hard to gauge rubbing power and contact torque. Numerical strategy is extremely mind boggling to counsel the mathematic model and set aside greater opportunity to compute. A technique was proposed, numerical calculation and bolster vector machines were consolidated to anticipate the grinding power and the rubbing torque of helical apparatus. To start with, numerical technique was developed to ascertain contact attributes. At that point the outcomes were embraced as contributions for help vector machines to anticipate contact power and grinding torque. The conclusion demonstrates the outcomes are immediate usage which originated from the yield of help vector machines. Since the outcomes are accessible straightforwardly from the yield of the numerical technique. The proposed technique gives the likelihood to anticipate grinding power and grating torque in Engineering.

- Nitin Kapoor, Virender Upneja, Ram Bhool and Puneet Katyal [7]. The primary target of this paper is to created parametric model of differential Gearbox by utilizing CATIA-V5 under different plan stages. It is watched that Glass filled polyamide composite material is chosen as best material for differential gearbox and is found to reasonable for various insurgencies (2500 rpm, 5000 rpm and 7500 rpm) under static stacking conditions. Examinations of different anxiety results utilizing ANSYS-12 with Glass filled polyamide composite and metallic materials (Aluminum combination, Alloy Steel and Cast Iron) are likewise being performed and observed to be bring down for composite material.

3. MODELING OF HELICAL GEAR

CATIA (Computer Aided Three-dimensional Interactive Application) (in English typically articulated/) is a multi-arrange CAD/CAM/CAE business programming suite made by the French organization Dassault Systems facilitated by Bernard Charles. Written in the C++ programming dialect, CATIA is the establishment of the Dassault Systems programming suite.

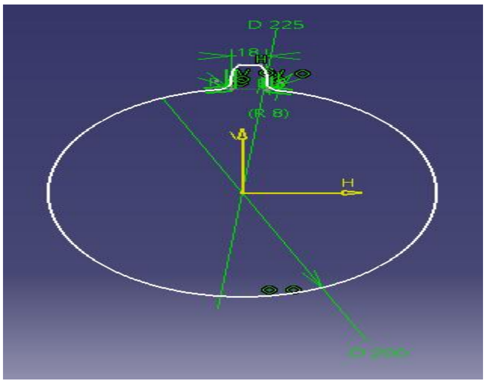

Figure 2:Sketch model for 15° Helix Angle

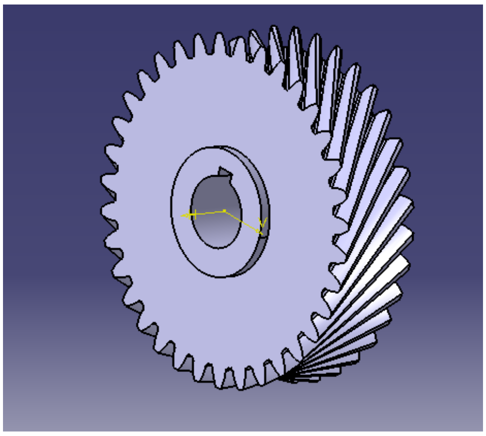

Figure 3: Final model for 15° Helix Angle

Material Data

Gray Cast Iron:

Density	$7.2e^{-006}$kg mm^{-3}
Young's Modulus	$1.1e^{+005}$MPa
Poisson's Ratio	0.28
Bulk Modulus	83333MPa
Shear Modulus	42969 MPa

4. ANALYSIS

ANSYS is broadly useful limited component examination programming, which empowers designers to play out the accompanying undertakings:

- Build PC models or exchange CAD model of structures, items, segments or frameworks
- Apply working burdens or other plan execution conditions.
- Study the physical reactions, for example, feelings of anxiety, temperatures appropriations or the effect of electromagnetic fields.
- Upgrade a plan right off the bat in the improvement procedure to lessen generation costs.
- A run of the mill ANSYS investigation has three particular advances.
- Pre Processor (Build the Model).

Ansys results of 15° Helix Angle:

Object Name	Minimum	Maximum
Total Deformation (mm)	0	$3.6068e^{-006}$
Equivalent Elastic Strain	$8.5652e^{-009}$	$1.3395e^{-004}$

(mm/mm)		
Equivalent Stress (MPa)	$9.4217e^{-004}$	14.638

Table1: Ansys results for 15° Helix Angle

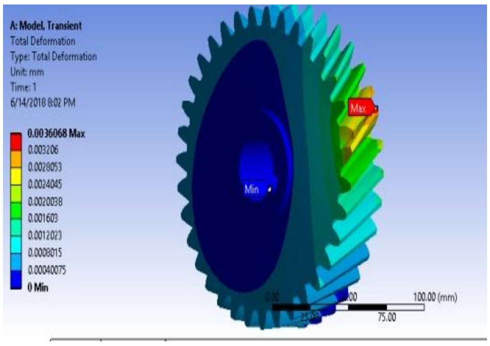

Figure4: Total Deformation for 15° Helix Angle

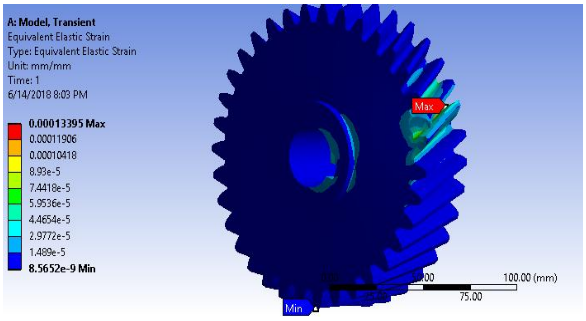

Figure5: Equivalent Elastic Strain for 15° Helix Angle

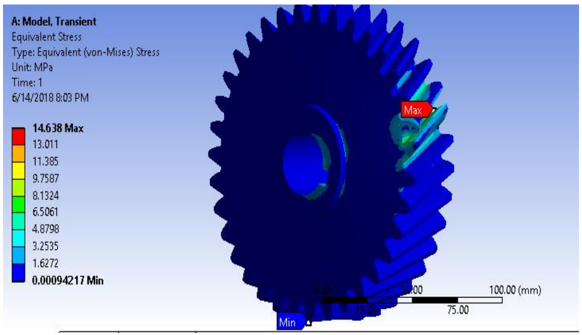

Figure6: Equivalent Stress for 15° Helix Angle

Ansys results of 18° Helix Angle:

Object Name	Minimum	Maximum
Total Deformation (mm)	0	$1.7501e^{-006}$
Equivalent Elastic Strain (mm/mm)	$8.0827e^{-009}$	$1.2708e^{-004}$
Equivalent Stress (Pa)	889.1	$1.3863e^{+007}$

Table2: Ansys results for 18° Helix Angle

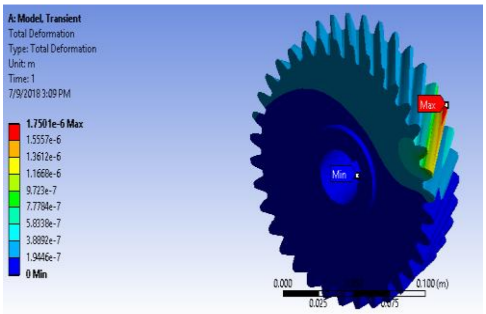

Figure7: Total Deformation for 18° Helix Angle

Ansys results of 24° Helix Angle:

Table3: Ansys results for 24° Helix Angle

Object Name	Minimum	Maximum
Total Deformation (mm)	0	$1.8939e^{-006}$
Equivalent Elastic Strain (mm/mm)	$8.0075e^{-009}$	$1.2964e^{-004}$
Equivalent Stress (Pa)	668.69	$1.3952e^{+007}$

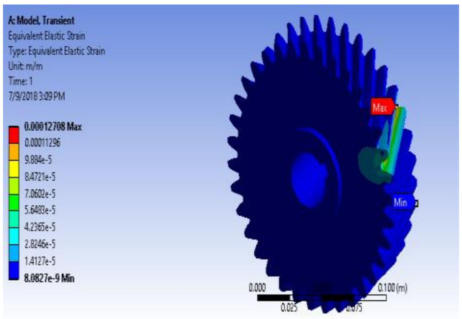

Figure8: Equivalent Elastic Strain for 18° Helix Angle

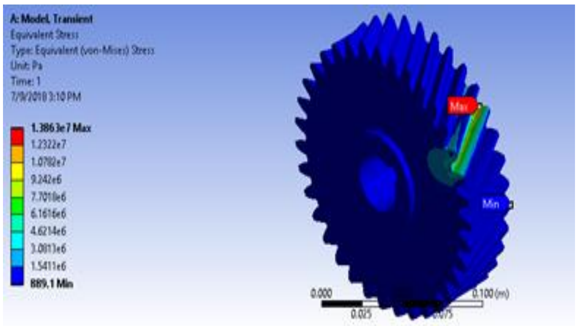

Figure9: Equivalent Stress for 15° Helix Angle

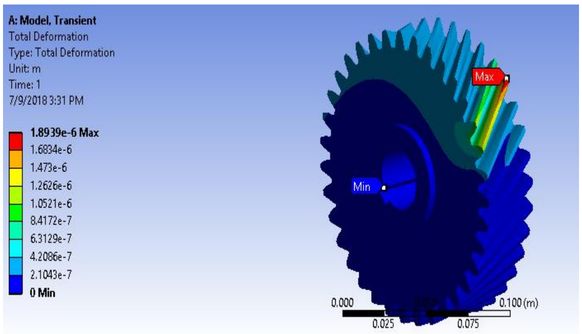

Figure10: Total Deformation for 24° Helix Angle

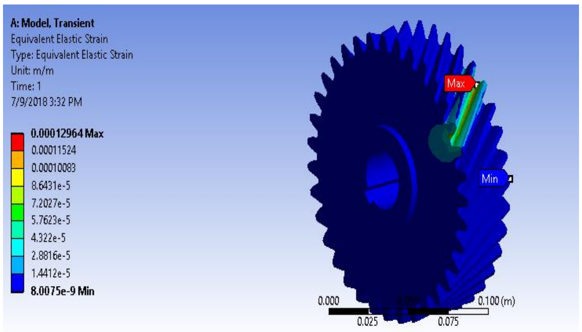

Figure11: Equivalent Elastic Strain for 24° Helix Angle

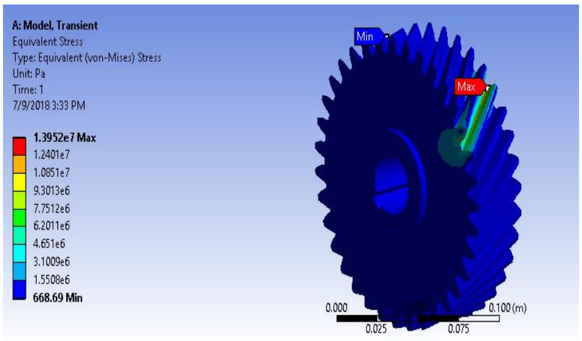

Figure12: Equivalent Stress for 24° Helix Angle

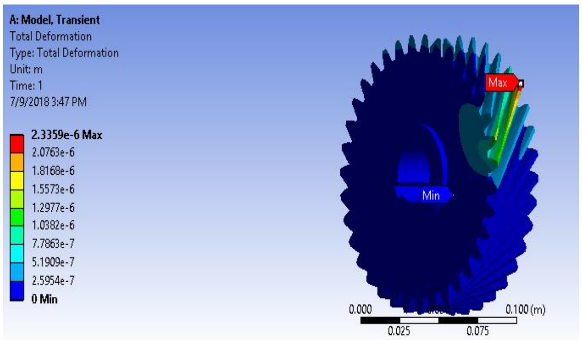

Figure13: Total Deformation for 36° Helix Angle

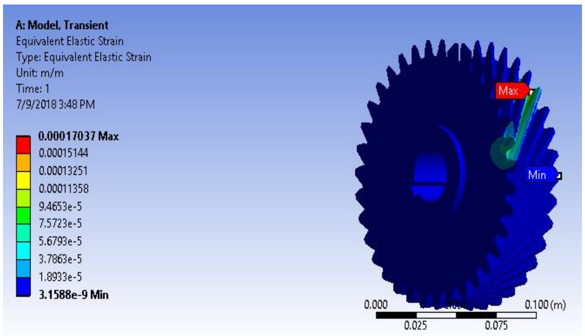

Figure14: Equivalent Elastic Strain for 36° Helix Angle

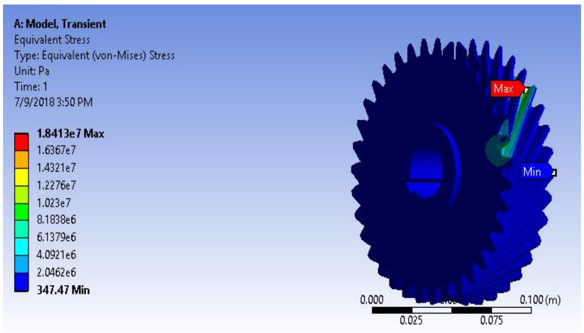

Figure15: Equivalent Stress for 36° Helix Angle

Ansys results of 36° Helix Angle:

Object Name	Minimum	Maximum
Total Deformation (mm)	0	$2.3359e^{-006}$
Equivalent Elastic Strain (mm/mm)	$3.1588e^{-009}$	$1.7037e^{-004}$
Equivalent Stress (Pa)	347.47	$1.8413e^{+007}$

Table4: Ansys results for 36° Helix Angle

5. CONCLUSION

Utilizing the ansys applying grating for different points with loads like got the above outcomes by watching that,

- Least distortion acquired for 18°gray cast iron is $1.7501e^{-006}$ mm and highest twisting for 15°is $3.6068e^{-006}$ mm.
- High Equivalent Elastic Strain acquired is $1.7037e^{-004}$ mm/mm for 36° and most minimal Equivalent Elastic Strain for 18°is $1.2708e^{-004}$ mm/mm.cc
- High Equivalent Stress is gotten 36° Gray cast press $1.8413e^{+007}$ Pa. most reduced Equivalent Stress for 15° is 14.638 MPa.

REFERENCES:

[1] A.Y Gidado, I. Muhammad, A. A. Umar [2] Design, Modeling and Analysis of Helical Gear According Bending Strength Using AGMA and ANSYS, International Journal of Engineering Trends and Technology (IJETT) – Volume 8 Number 9-Feb 2014.

[2] Vicky Lad, Dr. L. P. Singh [2016]. Configuration Modeling AND ANALYSIS OF HELICAL GEAR USING CATIA, ANSYS AND AGMA PARAMETERS, International Journal of Mechanical Engineering and Technology (IJMET) Volume 7, Issue 4, July–Aug 2016, pp.221– 226, Article ID: IJMET_07_04_023.

[3] K. Naresh, C. Chandrudhu [2016] OUTLINE AND ANALYSIS OF HELICAL GEAR. Global JOURNAL OF PROFESSIONAL ENGINEERING STUDIES Volume VI/Issue 4/AUG 2016.

[4] Mohit Singh, Waris Khan, Sanjeev Kumar [2016] Auxiliary ANALYSIS OF COMPOSITE MATERIAL HELICAL GEAR UNDER DIFFERENT LOADING CONDITION. Global JOURNAL OF ENGINEERING SCIENCES and RESEARCH TECHNOLOGY et al., 5.(6): June, 2016

[5] Khaldoon F. Bretheea,b, Dong Zhenc, FengshouGua, Andrew D. Ball [5] [2017], Helical apparatus wear observing: Modeling and exploratory approval, Mechanism and Machine Theory, Article history, Accepted 17 July 2017

[6] Wenliang Li n, Weiyang Lin, Jinyong Yu, [6] [2016] Anticipating contact attributes for helical rigging utilizing bolster vector machine. Neurocomputing Communicated by Hongli Dong Available online 21 October 2015