International Journal of Research
Available at https://journals.pen2print.org/index.php/ijr/
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 06 Issue 07
June 2019

3d Model and Program Generation for Gear Train by Using Cam

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ABSTRACT
The gear is an important component serving as a key player in power transmission mechanisms. The reason that gearing is so important is because the gear is the convenient way to obtain reliable power transmission without slippage. If there is only one gear mounted on each shaft, the gear train is known as simple gear train. that is, each shaft has only one gear. Usually when two gears mate, they rotate opposite to each other. When we use three gears each mounted on separate shaft, the direction of rotation of the last gear will be same as that of the direction of rotation of first gear.
Problem definition of the project is the component has 20 number of teeth and they subjected to contact force in between driver and follower gears. So it needs to specify proper type of material and optimized NC Program for manufacturing to get high surface finish due to presence of teeth.
The aim of this project is to create a 3d model of reverted gear train and analyze the those gears for proposing proper material and optimum machining process plan (generating optimized NC program) this gives the high surface finish. To developing design of gear train, NX-CAD shall be used. After that static analyzed by Ansys software. Finally NX-CAM software is used for generating accurate NC program for manufacturing.

INTRODUCTION

1.1 OVERVIEW OF GEAR:

Gearing is one of the most critical components in a mechanical power transmission system, and in most industrial rotating machinery. It is possible that gears will predominate as the most effective means of transmitting power in future machines due to their high degree of reliability and compactness. In addition, the rapid shift in the industry from heavy industries such as shipbuilding to industries such as automobile manufacture and office automation tools will necessitate a refined application of gear technology.

1.2 GEAR TRAIN

Gear train is a combination of gears and used for transmitting motion and power from one shaft to another shaft. Gear trains are used to achieve large and different velocity ratio in small area or space. Gear trains are use for increasing or reducing speed of driven shaft. Examples of gear trains use in machines are lathe machine, milling machine, in watch and many others.

1.3 TYPES OF GEAR TRAIN

- Simple Gear Train
- Compound Gear Train
- Riveted Gear train
- Epicycle Gear Train

1.4.1 SIMPLE GEAR TRAIN

Simple gear train is a type of gear train. Gear train are use to obtain different velocity ratio or to transmit power from one shaft to another. In simple gear train multiple gears are used to obtain different

e-ISSN: 2348-6848
p-ISSN: 2348-795X
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velocity ratio. Only one gear is mounted on each shaft and these shafts are rigidly fixed or not movable. Simple gear train consist three major area or part and these are driving gear, driven gear and intermediate gears. In which driving gear is mounted on driving shaft and driven gear is mounted on driven shaft and these both gears are mesh with the help of intermediate gears. In simple gear train intermediate gears play major role and intermediate gears will be one or more in simple gear train depending upon design or application. To obtain different velocity ratio different size gears are used. In simple gear trains power and motion transmit from driving gear to intermediate gears and from intermediate gears to driven gears. In this way simple gear trains are work.

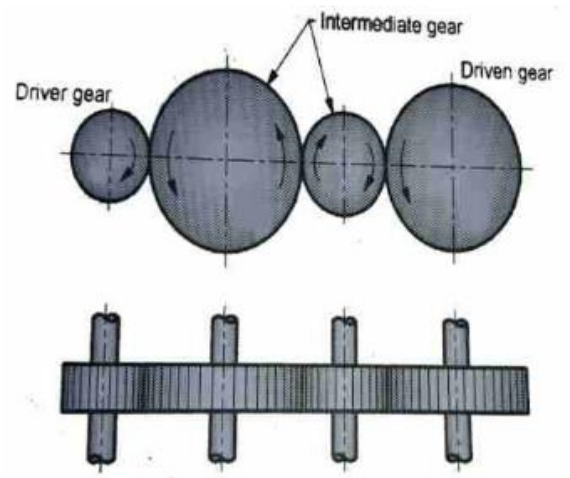

Fig.1.1 Simple gear train

1.4.2 COMPOUND GEAR TRAIN

Compound gear train is a type of gear train in which two intermediate gears (gears between driving gear and driven gear) are mounted on one shaft. Means only one gear on driving shaft and driven shaft, and intermediate shafts have two mounted gears. Compound gear trains are use to get large velocity ratio or different speed in a small area or space. Compound gear box is good example of compound gear trains.

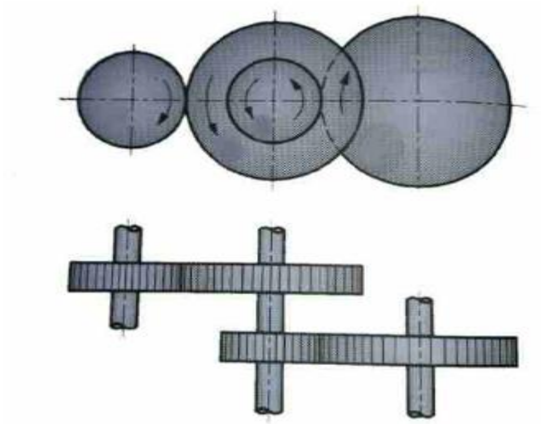

Fig.1.2 Compound gear train

1.3 REVERTED GEAR TRAIN

Reverted gear trains are a special type of gear trains. In which driving gear shaft axis and driven gear shaft axis are in a line. In reverted gear train one gear is mounted on each driving and driven shaft and on intermediate shaft two gears are mounted, reverted gear train are arrange in this way that driving gear transmit motion and power to intermediate shaft gear and other gear of intermediate shaft transmit motion and power to driven gear. Reverted gear trains are use there, where velocity ratio required in small space. Watches are good example of reverted gear trains. In watches reverted gear trains are used, in which minute and hour hands of watches are on a same axis.

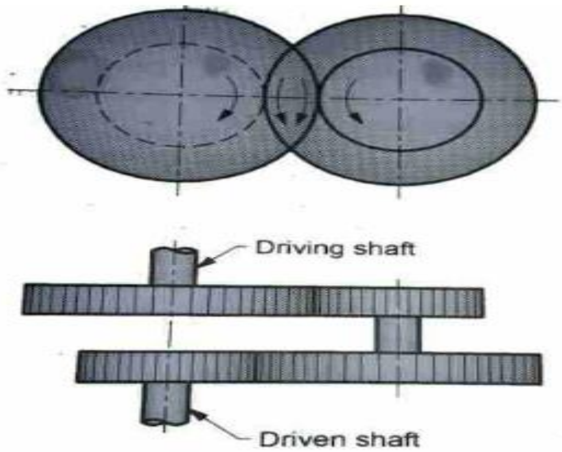

Fig.1.3 Reverted gear train

1.4.4 EPICYCLIC GEAR TRAIN

In above gear trains simple gear train, compound gear train and reverted gear train, gear shaft axis is fixed or not movable but in

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p-ISSN: 2348-795X
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epicyclic gear trains, the shaft axes are not fixed means the shaft axis is movable. There is a relative motion between the gears axis. Epicyclic gear trains may consist of simple gear trains, compound gear trains and mixed simple and compound gear trains. The advantage of epicyclic gear train is that, it can get very high or very low velocity ratio compared to simple gear trains and compound gear trains. The common example of epicyclic gear train is differential gear box of automobile.

Fig.1.4 Epicyclic gear train

These are the type gear trains are use in machine according to require velocity ratio, speed, space and application.

1.4 OBJECTIVES OF PROJECT

The goals of this project is to develop the manufacturing NC program for accurate and analyzed reverted gear train. To developing design of gear train, NX-CAD shall be used. After that static analyzed by Ansys software. Finally NX-CAM software is used for generating accurate NC program for manufacturing.

1.5 INTRODUCTION TO UNIGRAPHCS

UNIGRAPHICS, developed by Siemens systems, France, is a completely re-engineered, next-generation family of CAD/CAM/CAE software solutions for product life cycle management. It is easy to use state of the art user interface and delivers innovative technologies for maximum productivity and creativity.

It serves the basic design tasks by providing different work benches. A work bench is defined as a specified environment consisting of a set of tools, which allows the user to perform specific design tasks in a particular area. The basic work benches in UNIGRAPHICS are

- Part design
- Wire frame and surface design
- Assembly design
- Drafting

NX, also known as NX unigraphics or usually just u-g, is an advanced CAD/CAM/CAE software package developed by Siemens PLM software.

It is used, among other tasks, for:

- Design (parametric and direct solid/surface modelling)
- Engineering analysis (static, dynamic, electro-magnetic, thermal, using the finite element method, and fluid using the finite volume method).
- Manufacturing finished design by using included machining modules

First release of the new "next generation" version of unigraphics and i-deas, called NX. this will eventually bring the functionality and capabilities of both unigraphics and i-deas together into a single consolidated product.

Increasing complexity of products, development processes and design teams is challenging companies to find new tools and methods to deliver greater innovation and higher quality at lower cost. leading-edge technology from Siemens PLM software delivers greater power for today's design challenge. from innovative synchronous technology that unites parametric and history-free modeling, to NX active mockup for multi-cad assembly design, NX delivers breakthrough technology that sets new standards for speed, performance, and ease of use.

NX automates and simplifies design by leveraging the product and process knowledge that companies gain from experience and from industry best practices. it includes tools that designers can use to capture knowledge to automated repetitive tasks. the result is reduced cost and cycle time and improved quality.

Overview of Solid Modeling:

The Unigraphics NX Modelling application provides a solid modeling system to enable rapid conceptual design. Engineers can incorporate their requirements and design restrictions by defining mathematical relationships between different parts of the design.

Design engineers can quickly perform conceptual and detailed designs using the Modeling feature and constraint based solid modeller. They can create and edit complex, realistic, solid models interactively, and with far less effort than more traditional wire frame and solid based systems. Feature Based solid modeling and editing capabilities allow designers to change and update solid bodies by directly editing the dimensions of a solid feature and/or by using other geometric editing and construction techniques.

Advantages of Solid Modeling:

Solid Modeling raises the level of expression so that designs can be defined in terms of engineering features, rather than lower-level CAD geometry. Features are parametrically defined for dimension-driven editing based on size and position.

Features:

- Powerful built-in engineering-oriented form features-slots, holes, pads, bosses, pockets-capture design intent and increase productivity
- Patterns of feature instances-rectangular and circular arrays-with displacement of individual features; all features in the pattern are associated with the master feature.

Blending and Chamfering:

- zero radius
- Ability to chamfer any edge
- Cliff-edge blends for designs that cannot accommodate complete blend radius but still require blends

Advanced Modeling Operations:

- Profiles can be swept, extruded or revolved to form solids
- Extremely powerful hollow body command turns solids into thin-walled designs in seconds; inner wall topology will differ from the outer wall, if necessary
- Fixed and variable radius blends may overlap surrounding faces and extend to a Tapering for modeling manufactured near-net shape parts
- User-defined features for common design elements (Unigraphics NX/User-Defined Features is required to define them in advance

General Operation:

Start with a Sketch

Use the Sketcher to freehand a sketch, and dimension an "outline" of Curves. You can then sweep the sketch using Extruded Body or Revolved Body to create a solid or sheet body. You can later refine the sketch to precisely represent the object of interest by editing the dimensions and by creating relationships between geometric objects. Editing a dimension of the sketch not only modifies the geometry of the sketch, but also the body created from the sketch.

Creating and Editing Features:

Feature Modeling lets you create features such as holes, slots and grooves on a model. You can then directly edit the dimensions of the feature and locate the feature by dimensions. For example, a Hole is defined by its diameter and length. You can directly edit all of these parameters by entering new values. You can create solid bodies of any desired design that can later be defined as a form feature using User Defined Features. This lets you create your own custom library of form features.

Associativity:

Associatively is a term that is used to indicate geometric relationships between individual portions of a model. These relationships are established as the designer uses various functions for model creation. In an associative model, constraints and relationships are captured automatically as the model is developed. For example, in an associative model, a through hole is associated with the faces that the hole penetrates. If the model is later changed so that one or both of those faces moves, the hole updates automatically due to its association with the faces. See Introduction to Feature Modeling for additional details.

Positioning a Feature:

Within Modeling, you can position a feature relative to the geometry on your model using Positioning Methods, where you position dimensions. The feature is then associated with that geometry and will maintain those associations whenever you edit the model. You can also edit the position of the feature by changing the values of the positioning dimensions.

Reference Features:

You can create reference features, such as Datum Planes, Datum Axes and Datum CSYS, which you can use as reference geometry when needed, or as construction devices for other features. Any feature created using a reference feature is associated to that reference feature and retains that association during edits to the model. You can use a datum plane as a reference plane in constructing sketches, creating features, and positioning features. You can use a datum axis to create datum planes, to place items concentrically, or to create radial patterns.

Expressions:

The Expressions tool lets you incorporate your requirements and design restrictions by defining mathematical relationships between different parts of the design. For example, you can define the height of a boss as three times its diameter, so that when the diameter changes, the height changes also.

Boolean Operations:

Modeling provides the following Boolean Operations: Unite, Subtract, and Intersect. Unite combines bodies, for example, uniting two rectangular blocks to form a T-shaped solid body. Subtract removes one body from another, for example, removing a cylinder from a block to form a hole. Intersect creates a solid body from material shared by two solid bodies. These operations can also be used with free form features called sheets.

Undo:

You can return a design to a previous state any number of times using the Undo function. You do not have to take a great deal of time making sure each operation is absolutely correct, because a mistake can be easily undone. This freedom to easily change the model lets you cease worrying about getting it wrong, and frees you to explore more possibilities to get it right.

Additional Capabilities:

Other Unigraphics NX applications can operate directly on solid objects created within Modeling without any translation of the solid body. For example, you can perform drafting, engineering analysis, and NC machining functions by accessing the appropriate application. Using Modeling, you can design a complete, unambiguous, three dimensional model to describe an object. You can extract a wide range of physical properties from the solid bodies, including mass properties. Shading and hidden line capabilities help you visualize complex assemblies. You can identify interferences automatically, eliminating the need to attempt to do so manually. Hidden edge views can later be generated and placed on drawings. Fully associative dimensioned drawings can be created from solid models using the appropriate options of the Drafting application. If the solid model is edited later, the drawing and dimensions are updated automatically.

Parent/Child Relationships:

If a feature depends on another object for its existence, it is a child or dependent of that object. The object, in turn, is a parent of its child feature. For example, if a HOLLOW (1) is created in a BLOCK (0), the block is the parent and the hollow is its child. A parent can have more than one child, and a child can have more than one parent. A feature that is a child can also be a parent of other features. To see all of the parent-child relationships between the features in your work part, open the Part Navigator.

Creating a Solid Model:

Modeling provides the design engineer with intuitive and comfortable modeling techniques such as sketching, feature based modeling, and dimension driven editing. An excellent way to begin a design concept is with a sketch. When you use a sketch, a rough idea of the part becomes represented and constrained, based on the fit and function requirements of your design. In this way, your design intent is captured. This ensures that when the design is passed down to the next level of engineering, the basic requirements are not lost when the design is edited.

The strategy you use to create and edit your model to form the desired object depends on the form and complexity of the object. You will likely use several different methods during a work session. The next several figures illustrate one example of the design process, starting with a sketch and ending with a finished model. First, you can create a sketch "outline" of curves. Then you can sweep or rotate these curves to create a complex portion of your design.

PROBLEM DEFINITION AND METHODOLOGY

Problem definition of the project is the component has 20 number of teeth and they subjected to contact force in between driver and follower gears. So it needs to specify proper type of material and optimized NC Program for manufacturing to get high surface finish due to presence of teeth.

METHODOLOGY

- Design of reverted gear train shall be done by NX-CAD
- Analysis was done on designed Gear train using Ansys software.
- Analysis was done by using low carbon steel.
- Contact stress results obtained from analysis results.

Manufacturing of reverted gear train done using NX-

DESIGNING OF REVERTED GEAR

4.1 DESIGN PROCEDURE FOR REVERTED GEAR:

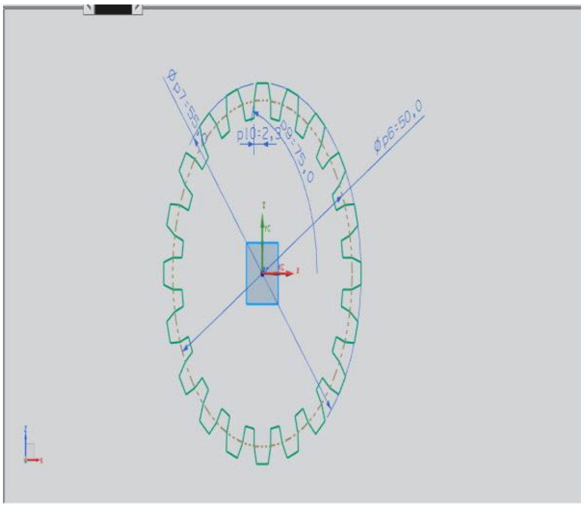


Fig.4.1 2Dsketch of Reverted gear

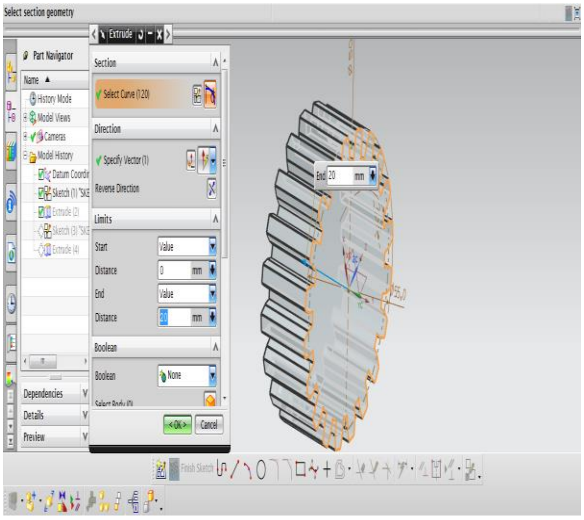


Fig.4.2 Extrude of above 2Dsketch of Reverted gear

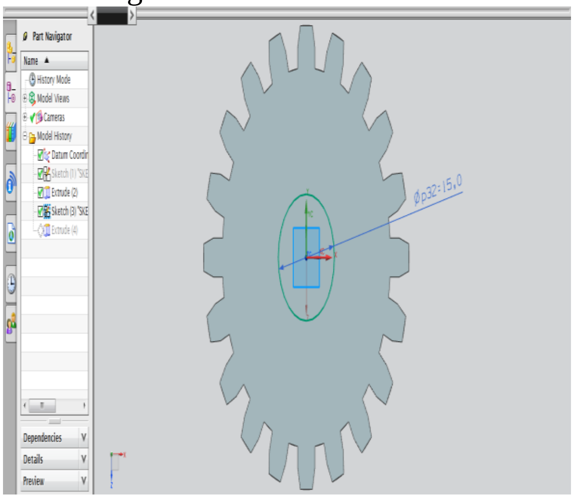


Fig.4.3 2Dsketch of Reverted gear

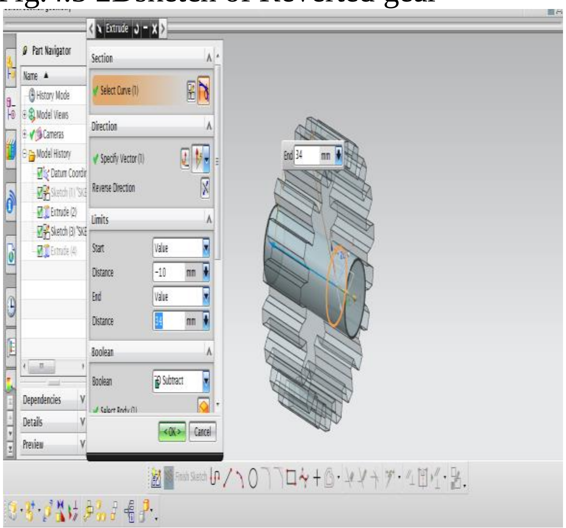


Fig.4.4 Extrude of above 2Dsketch of Reverted gear

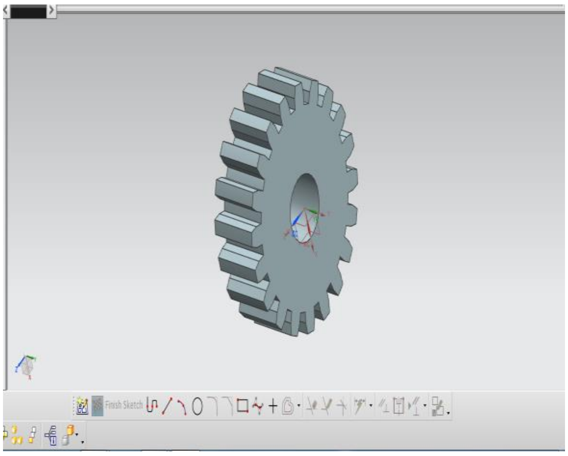


Fig.4.5 Final model of Reverted gear

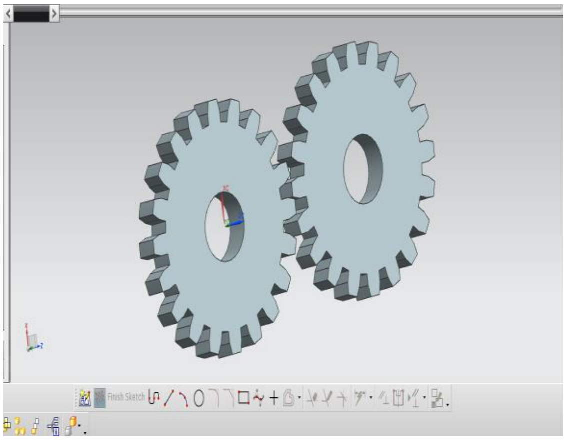


Fig.4.6 Final model of Reverted gear

STRUTURAL ANALYSIS OF REVERTED GEAR

5.1 FINITE ELEMENT METHOD

The Basic concept in FEA is that the body or structure may be divided into smaller elements of finite dimensions called "Finite Elements". The original body or the structure is then considered as an assemblage of these elements connected at a finite number of joints called "Nodes" or "Nodal Points". Simple functions are chosen to approximate the displacements over each finite element. Such assumed functions are called "shape functions". This will represent the displacement within the element in terms of the displacement at the nodes of the element.

The Finite Element Method is a mathematical tool for solving ordinary and partial differential equations. Because it is a numerical tool, it has the ability to solve the complex problems that can be represented in differential equations form. The applications of FEM are limitless as regards the solution of practical design problems.

Due to high cost of computing power of years gone by, FEA has a history of being used to solve complex and cost critical problems. Classical methods alone usually cannot provide adequate information to determine the safe working limits of a major civil engineering construction or an automobile or an aircraft. In the recent years, FEA has been universally used to solve structural engineering problems. The departments, which are heavily relied on this technology, are the automotive and aerospace industry. Due to the need to meet the extreme demands for faster, stronger, efficient and lightweight automobiles and aircraft, manufacturers have to rely on this technique to stay competitive.

FEA has been used routinely in high volume production and manufacturing industries for many years, as to get a product design wrong would be detrimental. For example, if a large manufacturer had to recall one model alone due to a hand brake design fault, they would end up having to replace up to few millions of hand brakes. This will cause a heavier loss to the company.

The finite element method is a very important tool for those involved in engineering design; it is now used routinely to solve problems in the following areas.

- Structural analysis
- Thermal analysis
- Vibrations and Dynamics
- Buckling analysis

Available Commercial FEM software packages

- ANSYS (General purpose, PC and workstations)
- SDRC/I-DEAS (Complete CAD/CAM/CAE package)
- NASTRAN (General purpose FEA on mainframes)
- LS-DYNA 3D (Crash/impact simulations)
- ABAQUS (Nonlinear dynamic analysis)
- NISA (A General purpose FEA tool)
- PATRAN (Pre/Post processor)
- HYPERMESH (Pre/post processor)

5.2 STATIC ANALYSIS OF REVERTED GEAR

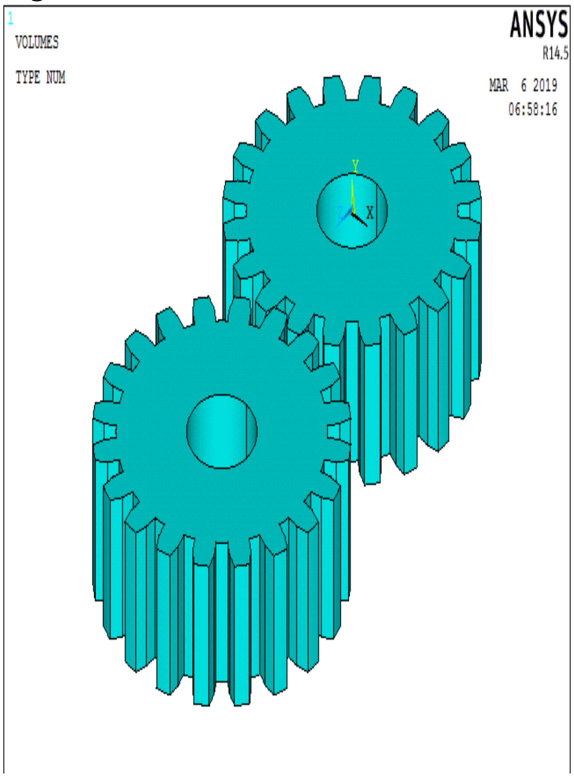
Steel material properties

Young's modulus: 200Ga
Poisson ratio :0.3
Density : 8000Kg/m^3
Yield strength : 280MPa

Loading condition

Contact pressure 3MPa is applied in between contact point of Reverted gear
Center hole constrained in all DOF.

Fig.5.1



Imported model in Ansys

International Journal of Research
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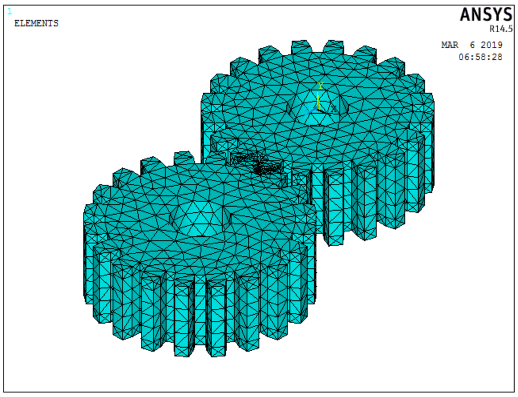


Fig.5.2 Created mesh on Reverted gear

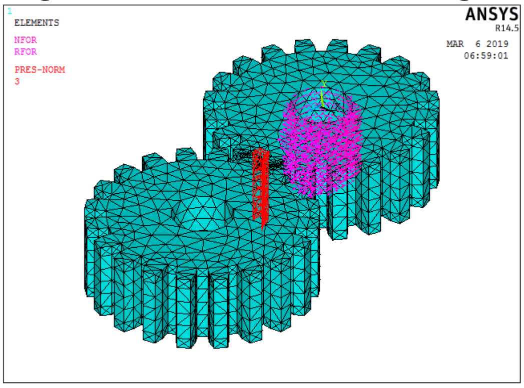


Fig.5.3 Applied pressure on Reverted gear

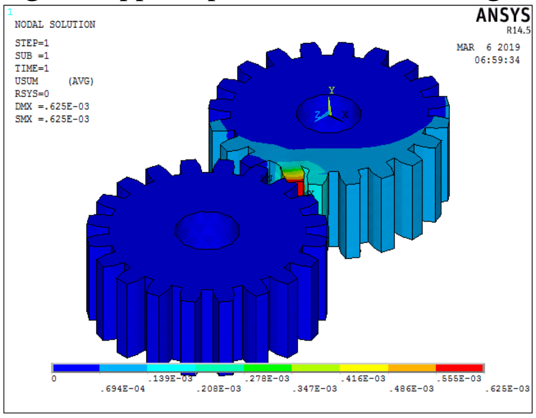


Fig.5.4 Deformation results on Reverted gear

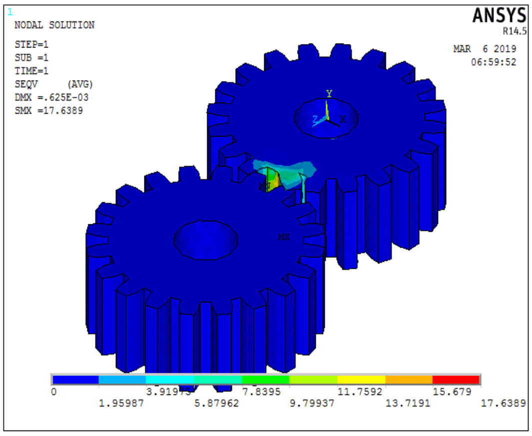
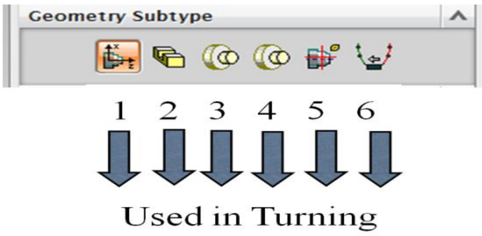


Fig.5.5 Stress results on Reverted gear

Create geometry

- Create Geometry dialog box is used to define:



1. MCS_SPINDLE
2. WORKPIECE
3. TURNING_WORKPIECE
4. TURNING_PART
5. CONTAINMENT
6. AVOIDANCE

6.4 MANUFACTURING PROCESS OF DRIVER GEAR

6.4.1 Making Raw material

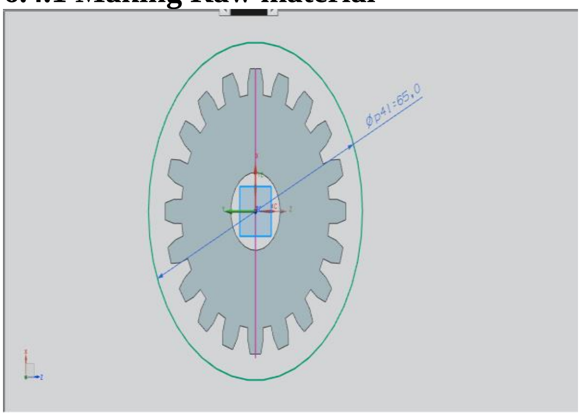


Fig 6.1 2D sketch of raw material

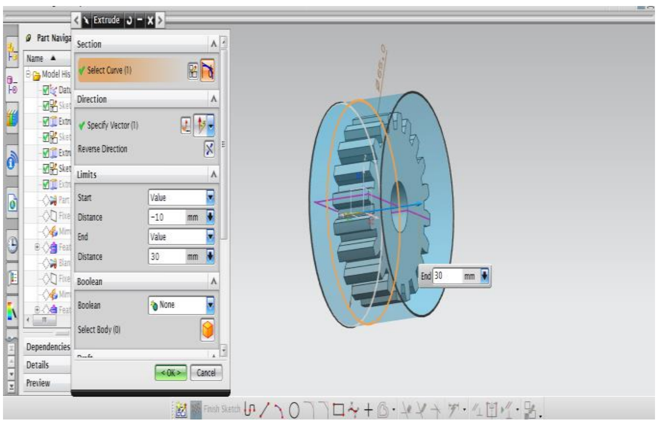


Fig 6.2 Extrude of 2D sketch of raw material

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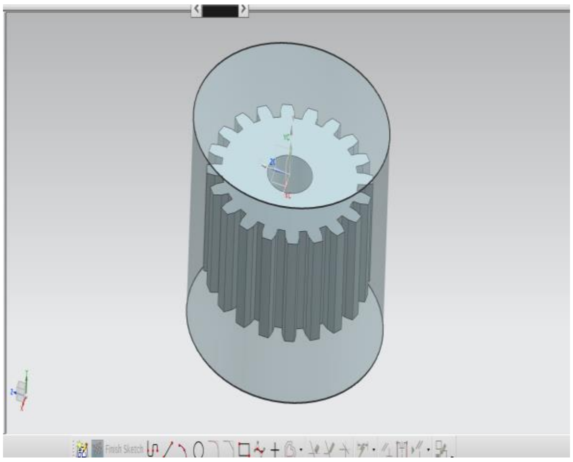

Fig 6.3 Raw material surrounding of gear

6.4.2 Assigning Machining coordinate system, raw material and part for turning operations

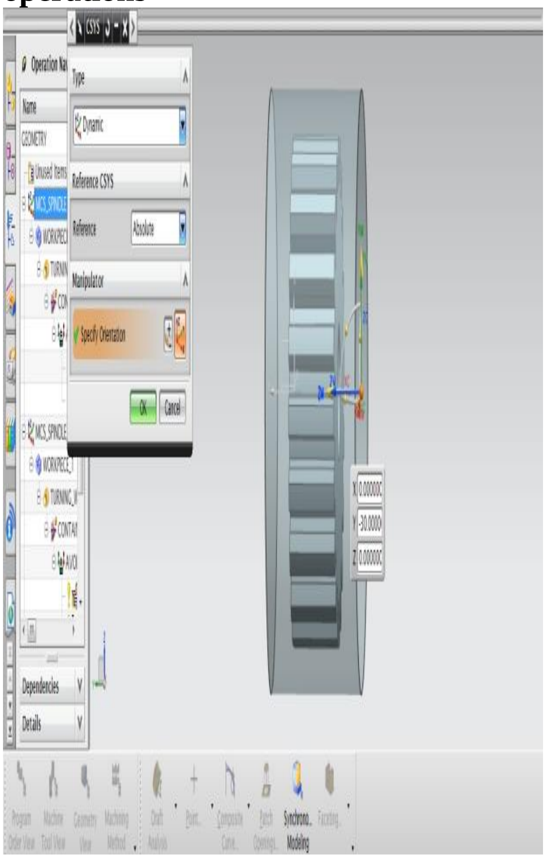

Fig 6.4 Assigning Machining coordinate system

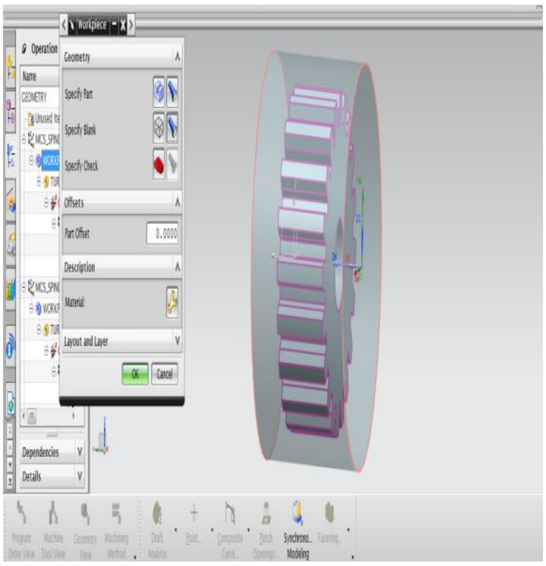

Fig 6.5 Assigning raw material and part

6.4.3 FACE TURNING OPERATION

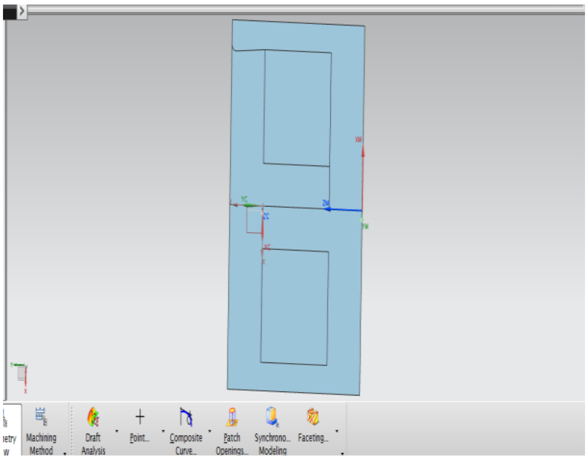

Fig. 6.6 Generating turning spun

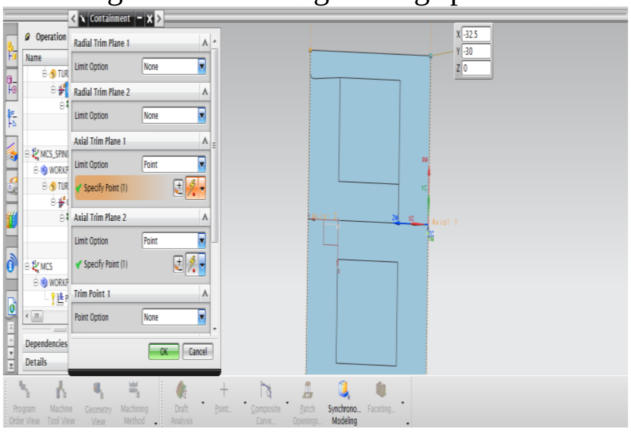

Fig. 6.7 Assigning material limits

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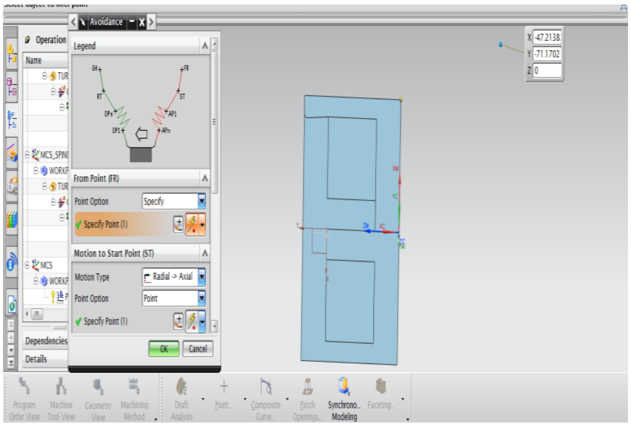

Fig. 6.8 Assigning tool moving points

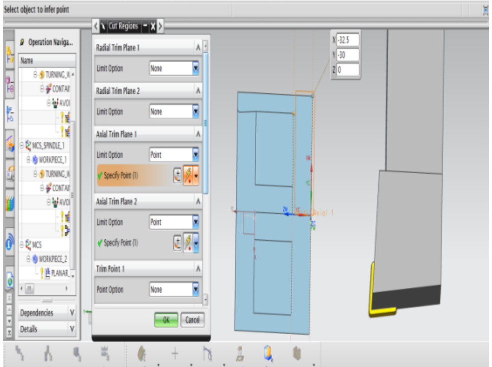

Fig. 6.9 Assigning Face cutting limits

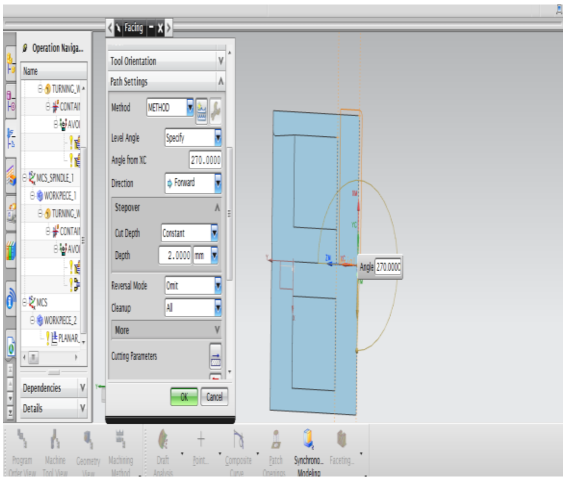

Fig. 6.10 Assigning depth of cut

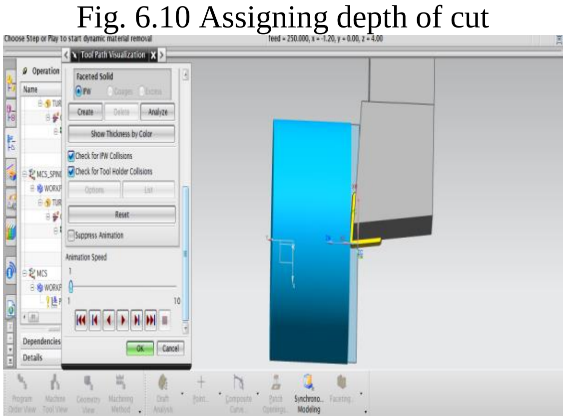

Fig.6.11 Facing operation

6.4.4 ROUGH TURNING OPERATION

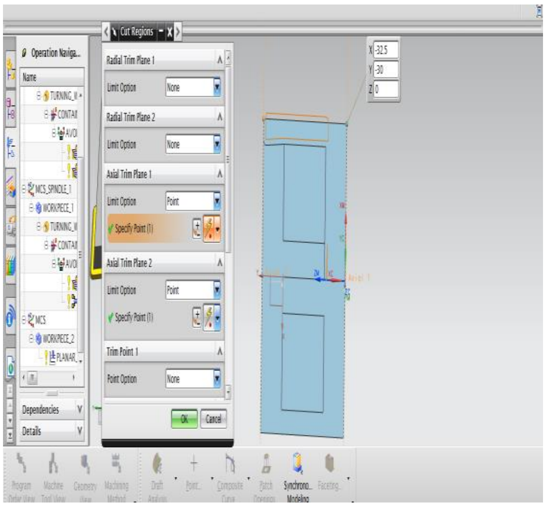

Fig. 6.12 Assigning Rough cutting limits

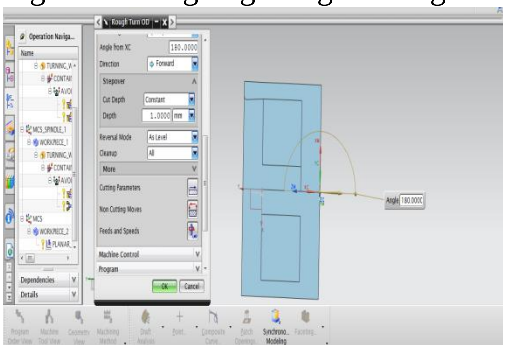

Fig. 6.13 Assigning depth of cut

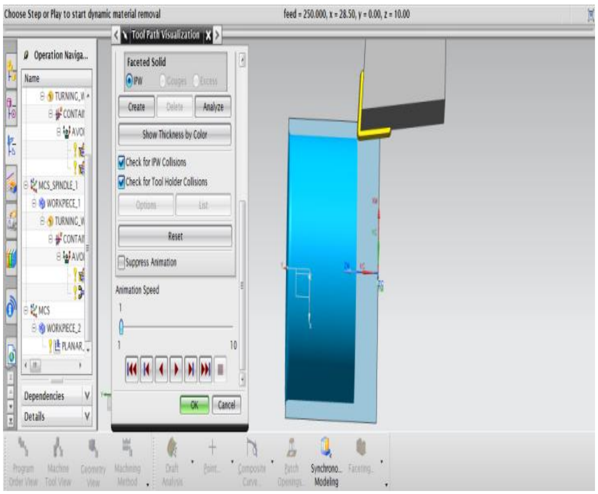

Fig.6.14 Rough turn operation

6.4.5 Assigning Machining coordinate system for Back face operations

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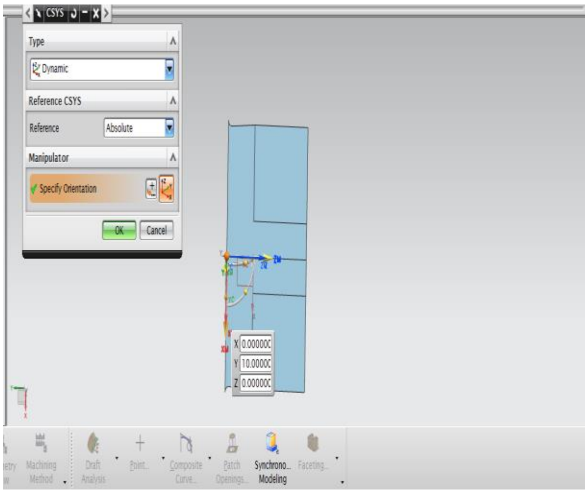

Fig.6.15 Assigning Machining coordinate system for Back face operations

6.4.6 FACE TURN OPERATION

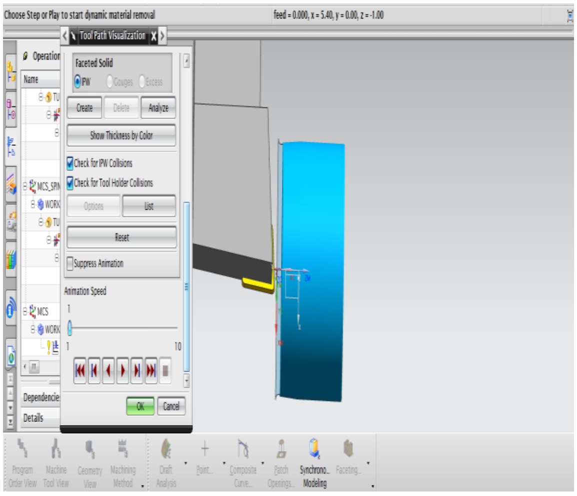

Fig.6.16 Facing operation

6.4.5 DRILLING OPERATION

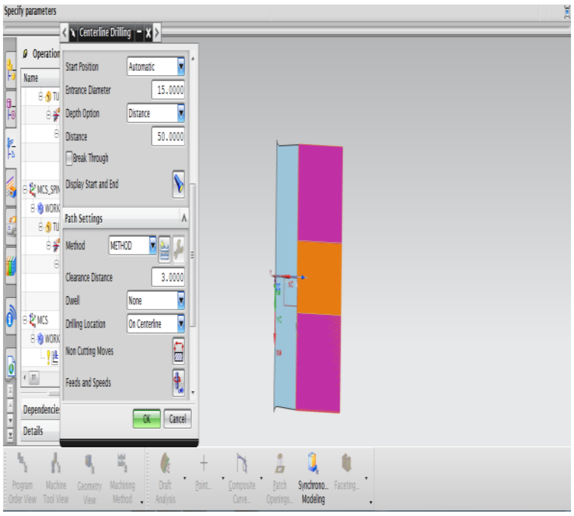

Fig.6.17 Drilling operation

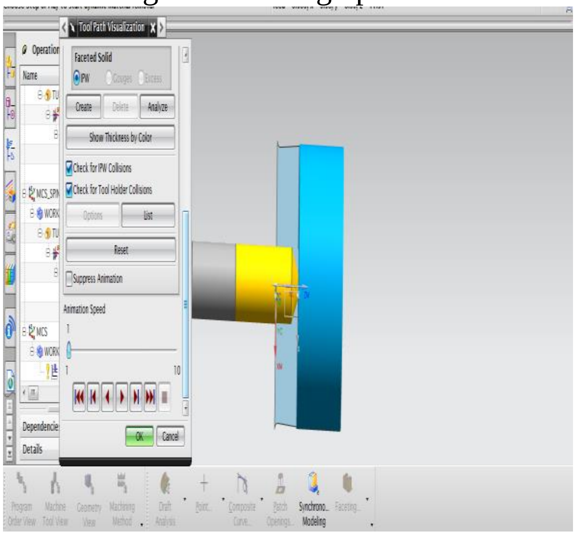

Fig.6.18 Drilling operation

6.4.6 Assigning Machining coordinate system, raw material and part to Milling operations

Fig.6.19 Assigning Machining coordinate system

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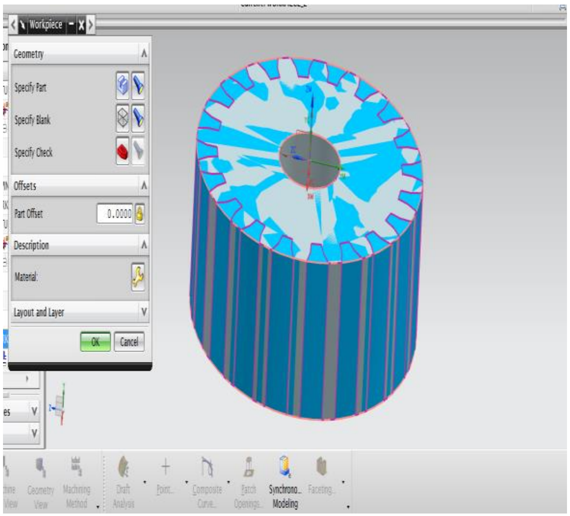


Fig.6.20 Assigning work piece and part

6.4.7 PLANAR MILLING OPERATION

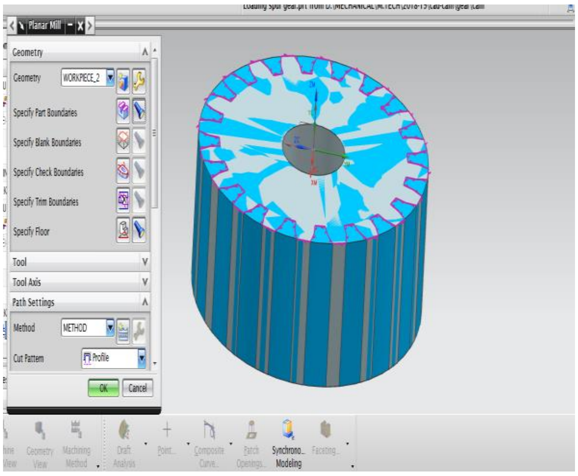


Fig.6.21 Assigning part boundaries

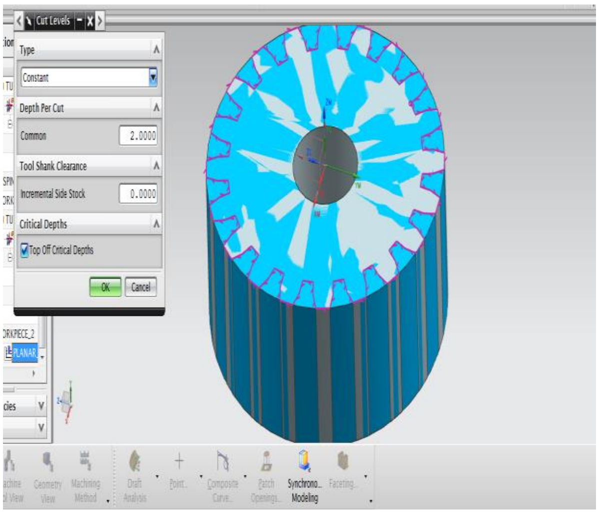


Fig.6.22 Depth of cut value

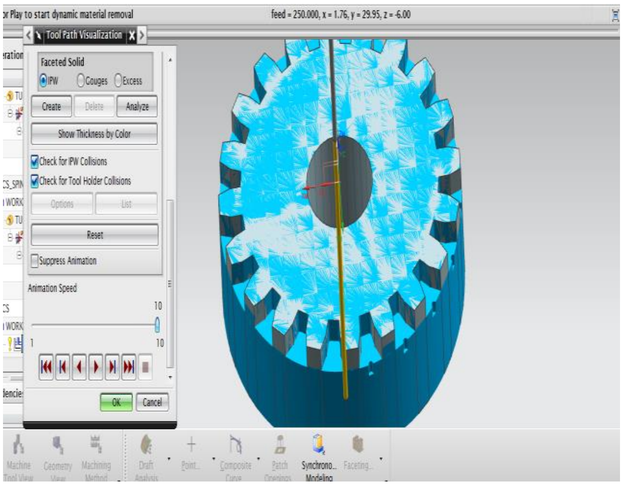
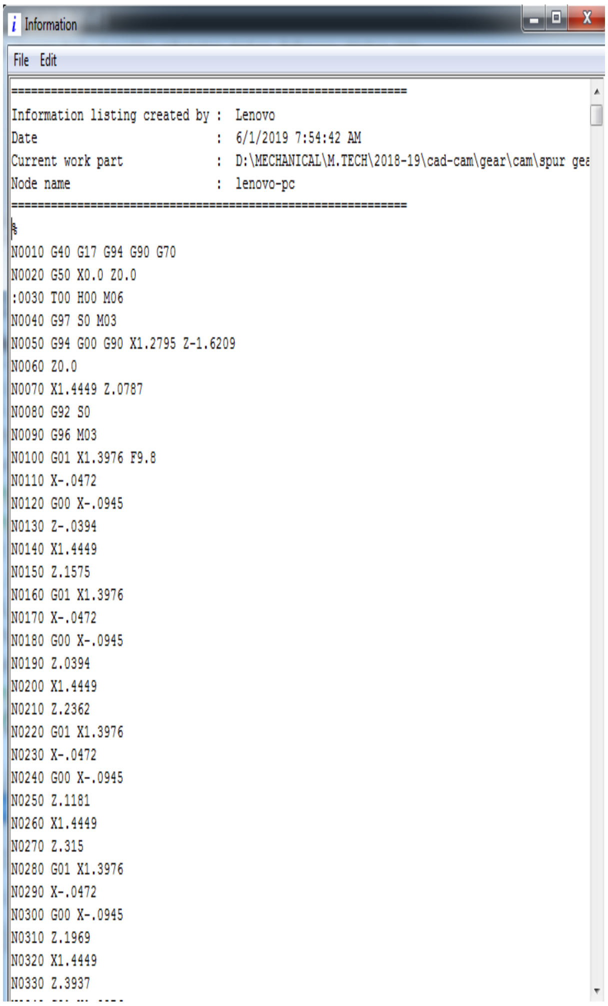


Fig.6.23 Planar milling operation

6.5 NC PROGRAM



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International Journal of Research
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e-ISSN: 2348-6848
p-ISSN: 2348-795X
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International Journal of Research
Available at https://journals.pen2print.org/index.php/ijr/
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 06 Issue 07
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N5070 X1.1035 C307.122
N5080 C304.878
N5090 X1.1024 C302.634
N5100 X1.1018 C302.195
N5110 X1.0968 C301.827
N5120 X1.089 C301.651
N5130 X.9912 C299.654
N5140 X.9863 C299.583
N5150 X.9055 C299.008
N5160 X.9067 C297.
N5170 X.9055 C294.992
N5180 X.9863 C294.417
N5190 X.9912 C294.346
N5200 X1.089 C292.349
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N5220 X1.1018 C291.805
N5230 X1.1024 C291.366
N5240 X1.1035 C289.122
N5250 C286.878
N5260 X1.1024 C284.634
N5270 X1.1018 C284.195
N5280 X1.0968 C283.827
N5290 X1.089 C283.651
N5300 X.9912 C281.654
N5310 X.9863 C281.583
N5320 X.9055 C281.008
N5330 X.9067 C279.
N5340 X.9055 C276.992
N5350 X.9863 C276.417
N5360 X.9912 C276.346
N5370 X1.089 C274.349
N5380 X1.0968 C274.173
N5390 X1.1018 C273.805
N5400 X1.1024 C273.366
N5410 X1.1035 C271.683
N5420 X1.1024 C270.
N5430 X1.1417
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nc.txt - Notepad

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N4990 X.9067 C315.
N5000 X.9055 C312.992
N5010 X.9863 C312.417
N5020 X.9912 C312.346
N5030 X1.089 C310.349
N5040 X1.0968 C310.173
N5050 X1.1018 C309.805
N5060 X1.1024 C309.366
N5070 X1.1035 C307.122
N5080 C304.878
N5090 X1.1024 C302.634
N5100 X1.1018 C302.195
N5110 X1.0968 C301.827
N5120 X1.089 C301.651
N5130 X.9912 C299.654
N5140 X.9863 C299.583
N5150 X.9055 C299.008
N5160 X.9067 C297.
N5170 X.9055 C294.992
N5180 X.9863 C294.417
N5190 X.9912 C294.346
N5200 X1.089 C292.349
N5210 X1.0968 C292.173
N5220 X1.1018 C291.805
N5230 X1.1024 C291.366
N5240 X1.1035 C289.122
N5250 C286.878
N5260 X1.1024 C284.634
N5270 X1.1018 C284.195
N5280 X1.0968 C283.827
N5290 X1.089 C283.651
N5300 X.9912 C281.654
N5310 X.9863 C281.583
N5320 X.9055 C281.008
N5330 X.9067 C279.
N5340 X.9055 C276.992
N5350 X.9863 C276.417
N5360 X.9912 C276.346
N5370 X1.089 C274.349
N5380 X1.0968 C274.173
N5390 X1.1018 C273.805
N5400 X1.1024 C273.366
N5410 X1.1035 C271.683
N5420 X1.1024 C270.
N5430 X1.1417
N5440 Z-.6693
N5450 G0 Z.3937
N5460 M02
%
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e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 06 Issue 07
June 2019

RESULTS AND CONCLUSION

In this project Manufacturing process plan generated for steel reverted gear. Design of reverted gear train completed by NX-CAD software. Ansys software is used for analyzing the gear. NX-CAM software is used for manufacturing process generating for gear.

Finally Accurate NC Program generated for steel reverted gear..

TOOLING LIST

TURNING POINTS

TOOL NAME	DESCRIPTION	NOSE RAD	TOOL ORIENT	ADJ REG
OD_80_L	Turning Tool-Standard	0.2000	5.0025	0
OD_80_L_1	Turning Tool-Standard	0.2000	5.0025	0
ID_80_L	Turning Tool-Standard	0.2000	275.1395	0

CONVERT TO NC CODE

Using the post processor we have to convert CL file data into machine specified NC part program

1. In the Project Manager, select the first operation on the Operations page, then hold down the Shift key and select the last operation. All the cutting operations are selected.
2. Press the right mouse button and select NC Code from the menu.
3. Select a Machine Format file from the pull down list (3-Axis/5-Axis).
4. Select Apply.

RESULTS

1. 3D model of automobile piston component is done using NX-CAD software.
2. Generated 3D model is drafted and cross checked with 2D inputs for verification.
3. Tool path is generated on 3D model of automobile piston using NX-CAM software
4. NC program is generated for automobile piston component and this program is given to 4-axis TURN-MILL CNC machine through DNC line

REFERENCES:

1. J. J. Uicker, G. R. Pennock, and J. E. Shigley, 2003, Theory of Machines and Mechanisms, Oxford University Press, New York.
2. B. Paul, 1979, Kinematics and Dynamics of Planar Machinery, Prentice Hall.
3. JJ Coy, DP Townsend, EV Zaretsky, "Gearing", NASA Reference Publication 1152, AVSCOM Technical Report 84-C-15, 1985
4. Chad Randl, "Revolving architecture: a history of buildings that rotate, swivel, and pivot".
5. L. Meirovitch: Elements of Vibration Analysis, McGraw-Hill, New York, 1986.
6. John M. Miller (2005-10-26). "Hybrid electric vehicle propulsion system architectures of the e-CVT type". *IEEE Transactions on Power Electronics* 21 (3): 756–767.doi:10.1109/TPEL.2006.872372.
7. B. Paul, 1979, Kinematics and Dynamics of Planar Machinery, Prentice Hall.
8. J. J. Uicker, G. R. Pennock and J. E. Shigley, 2003, Theory of Machines and Mechanisms, Oxford University Press, New York.
9. P. A. Simionescu (1998-09-01). "A Unified Approach to the Assembly Condition of Epicyclic Gears". *ASME Journal of Mechanical Design* 120 (3): 448–453. doi:10.1115/1.2829172.
10. Lynwander, P., 1983, *Gear Drive Systems: Design and Application*. Marcel Dekker, New York
11. Smith, J. D., 1983, *Gears and Their Vibration: A Basic Approach to Understanding Gear Noise*. Marcel Dekker, New York and MacMillan, London