International Journal of Advance Research in Science and Engineering
Volume No.07, Special Issue No.04, April 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

DESIGN OF GEAR USING PARAMETRIC MODELING

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ABSTRACT:

The parametric model is capable of creating spur gear with different modules and number of teeth by modifying the parameters and regenerating the model. Only making the CAD model of gear blank geometry using CREO software (without any teeth profile) with only giving the data major diameter and face width. For gear analysis we are depending on ROMAX, which only provides analysis data of gear teeth. Gear blank is made from all the input/calculated parameters. Parameters are taken from ROMAX for geometry creation. Accurate involute profile is created using equation , which include even addendum modification. Drawing is updated automatically, as it is linked to gear parameters. Parametric modeling is strong tool for the industries mechanical product design. Current scenario of the market is competitive. To sustain in the market for company product time to the market have to be minimum. Companies existing product demands from the customer are to be provided quickly as soon as possible. Existing product requirement has same parametric features of components for different specification. Parametric modeling can be used for saving the modeling time. Knowledge based approach can be useful for saving the design time. Lot of repetitive calculation can be saved avoiding tedious work. Creo 2.0 software is selected having strong parameterization. Mechanical product selected is reduction type gearbox. Reduction type gearbox manufactured by many companies across the world. Algorithm

Keywords: *Analysis[1], CAD[2], Creo2.0[3], Gear[4], ROMAX[5], Parametric Modeling[6], Pro/program[7]etc.*

1. INTRODUCTION: Gear are common components in many mechanical designs , but the surface profile of the gear teeth is relatively difficult to Draw accurately. Since gears are normally either purchased Components, or else fabricated with standard cutters, they are often not drawn in exact detail, but simply as circular blanks.

In this competitive environment, time to market for the mechanical product design becoming shorter. Enterprises over the world are using CAD software's according to their product instead of using pencil, drafter, eraser and large sheets. Nowadays, advancement is that industries are using the customized CAD software's for their products. For industries it is necessary to launch innovative products or existing products as quick as

possible to sustain in the global competitive world. Generally 80% of time is waste in design process in whole product development cycle. Lot of time can be save in the design stage. Design stage have repeatable task such as modeling process, design calculations for the some mechanical products. This repetitive task can be captured and standardized[1]. Parameterization technique is suitable for this work. Gearbox is widely used for the transmission purpose because of the high efficiency of transmission, compactness, reliability. Globally lot of industries manufacturing gearboxes for their customer's according to their types and specification. Each specification of gearbox assembly has its own modeling approach. Parametric modeling can used for different configuration of the same assembly.

Without the teeth cut out. One may require detailed finite element analysis of a gear set, or perhaps may need to Fabricate gears with a rapid prototyping machine. Either of these will require an exact cad model of the tooth geometry, and approximate methods will not always meet the requirements.

1.1 Creo as Parametric modeling software

PTC Creo, previously known as Pro/E is parametric, 3D CAD/CAM/CAE solution created by parametric technology corporation (PTC). It is used by many industries for design and manufacturing applications. Developed by Dr.Samules P. Geisberg in the mid 1980s, as ruled based constraints 3D CAD modeling system. Special importance is given to an unitary database management system. It has facility functions such as sketch, part, assembly, drawing, manufacturing processing, mechanism simulation and finite element analysis and automatic measurement. Two-dimensional CAD software has disadvantage like cannot have all product information, stability, validity and general parametric modeling of complex models and losing information. This disadvantage is overcome by PTC in Pro/E.

1.2. Gear terminology:

(1) Pitch circle**:** An imaginary circle that contacts the pitch circle of any other gear with which it is in mesh.

(2) Pitch diameter (D): The diameter of the pitch circle.

(3) Number of teeth (N): The number of teeth on the gear.

(4) Diametral pitch (P): The number of teeth of a gear per inch of its pitch diameter.

(5) Module (m): The ratio of pitch diameter to the number of teeth. It is reciprocal of the diametral pitch. The pitch diameter is specified either in inches or millimeters.

(6) Pressure angle (a): The angle through which forces are transmitted between meshing gears. It is either 14.5°or 20°. It defines the geometry of the gear tooth and also determines the diameter of the base circle.

(7) Addendum (a): The Radial distance from the pitch circle to the top of the gear tooth.

(8) Dedendum (b): The Radial distance from the pitch circle to the bottom of the tooth space.

Fig-1.2**.** Spur gear train

2. LITERATURE REVIEWS:

Lot of research have been done in the area of parametric modeling. Ault H.K.[5] has discuss basics of parametric modeling. Monedro J. [6] describes the evolution of parametric technique. Macros is one type of tool which be used for remodeling. Macros is recording a script of commands and data values used to create model. Constraints term is closely related to parametric design. Yin C.G. et al.[7] have clearly expressed method for modeling parametric constraints among different product's features. Traditional way of the gearbox design is available from standard handbook. Calculation has to be done and model the gearbox parts and assemble it in suitable 3D CAD software. New approach for the remodeling is by relating the parameters and constraints of gearbox. Proposed work can be implemented with the help of software development project related to CAD software. Parametric assemblies can be done by three approaches top-down, bottom-up, both. Bottom up approach allows user to modify the each part and assembly separately. Topdown approach good for any size assembly, is ideal for tens of thousands of parts [8]. Gulati V.[9] parametric modeling for jewellery in Visual Basics application with AutoCAD with help of Active automation is done. Algorithm is defined which can utilize geometric CAD entities (points, line, circle, etc.) and operations (extraction, revolution, union, intersection etc.). Zhao Y.[10] A software is developed by Visual Basic for three-dimensional heating furnace design with ActiveX-Automation technology in Solid Edge. Gao S.[11] ,Variational design is achieved by Excel. Firstly in Solid Edge component/part of 3-d model generated and the model parameters in the Excel for the drum parts. Zhou S. [12] & Shrivastava R.[13] have done use of Solid works and API for modeling bearing sections and rangoli patterns respectively. Cucovics s. et al[14], developed automatic determination of grinding tool profile for helical surfaces machining by using CATIA/ VB interface. Shah D. B.[15] developed an automated 3D modeling of flange coupling. If the power transmission capacity is changed the dimensions of flange coupling parts are changed, when the coupling parameters are changed the solid model of coupling is changed. The time required to draw 3D model of different dimensions of flange coupling is more. Instead of to draw the model of coupling for different input parameter shah integrates the Autodesk Inventor (3D modeling software) with Microsoft Excel spreadsheet. Trivedi R.D.[16], Integration of modeling CAD software Pro/E

with Microsoft Excel spreadsheet is done. Excel spreadsheet is formed containing all features name and respective dimensions. Another Excel sheet containing bearing database is formed. Second sheet linked with first by VLOOKUP or HLOOKUP function. Excel sheet containing feature name linked with bearing model in Pro/E. Firstly generic model of bearing is modeled in Pro/E. This technique is more suitable and simple than any other techniques like VB interfacing, Pro/Toolkit etc. Peipei G. [17].

3.PROCEDURE:

- Gear Blank is made from all the input/calculated parameters.
- Parameters are taken from Romax for geometry creation.
- Accurate involute profile is created using equation, which includes even addendum modification.
- Critical parameters are verified with Romax to ensure profile accuracy
- Drawing is updated automatically, as it is linked to gear parameters.
- As a first time right initiative this process has been already incorporated in all the new projects like 9-Speed, 8-Speed & 7-Speed TM.

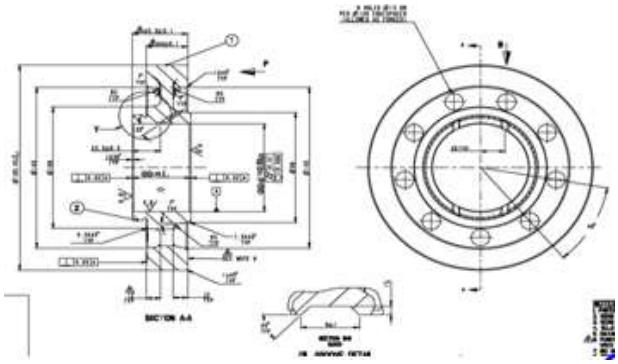

Fig3.1.drafting of gear

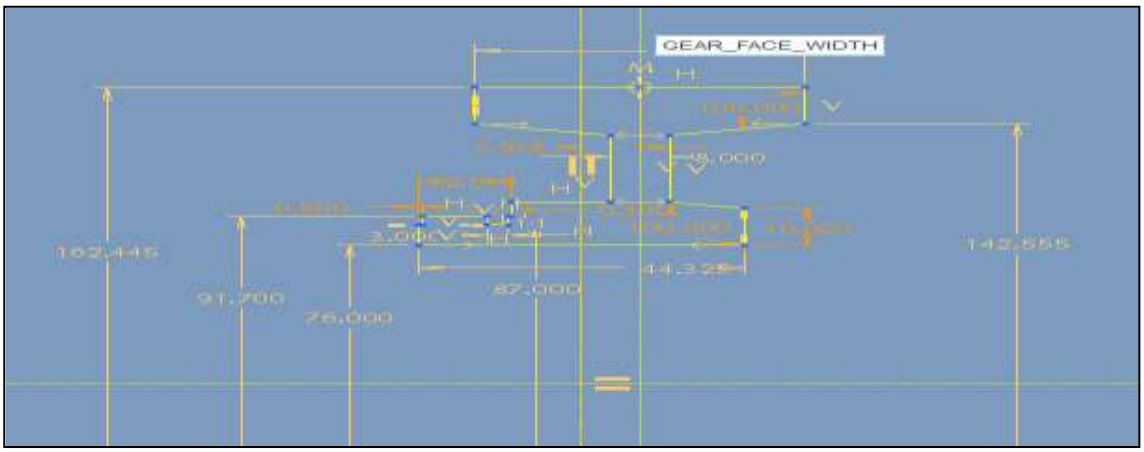

Fig.3.2 gear blank

International Journal of Advance Research in Science and Engineering
Volume No.07, Special Issue No.04, April 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

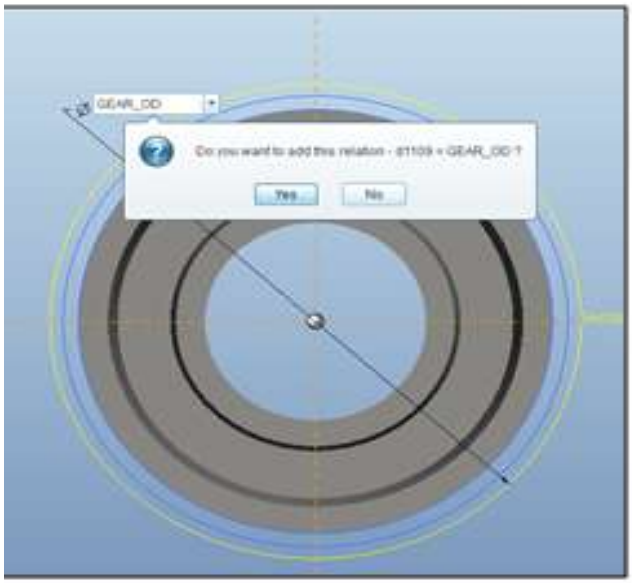

Fig.3.3. basic gear cad relation

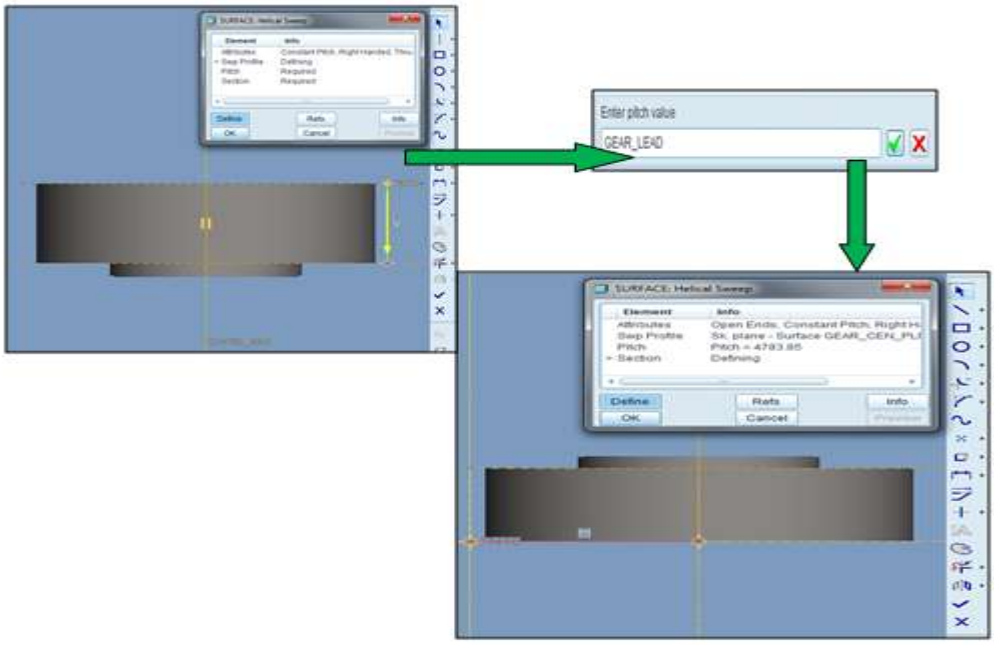

Fig.3.4. central axis of gear

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www.ijarse.com
IJARSE
ISSN: 2319-8354

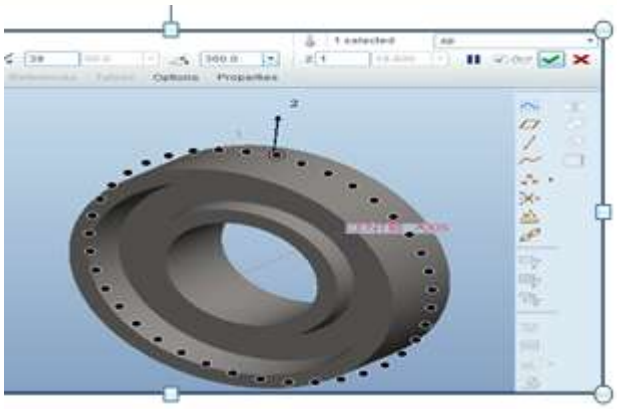

Fig.3.5.gear not pattern parameter

4. LEARNING OBJECTIVES:

- Create Simple Extruded Solid Models.
- Understand the Basic Parametric
- Modeling Process.
- Create 2-D Sketches.
- Understand the "Shape before Size"
- approach.
- Use the Dynamic Viewing commands.
- Create and Modify Parametric
- Dimensions.
- Create 3d solid object using 3d printing machine.
- Analyses this 3d object using ansys software (14.0).

5. PARAMETERS NEEDED FOR GEAR:

- GEAR_NOT
- GEAR_MODULE
- GEAR_HELIX_ANGLE
- GEAR_ADDM_FACTOR
- GEAR_ADUM_MODI_VALUE
- GEAR_DDUM_FACTOR
- GEAR_PRES_ANGLE
- GEAR_FACE_WIDTH
- GEAR_HUB_WIDTH
- GEAR_BLANK_WIDTH
- GEAR_BORE_DIA

- GEAR_TOOL_TIP_RAD
- GEAR_SEMI_TOPPING
- GEAR_HAND_OF_HELIX
- SPLN_NOT
- SPLN_MODULE
- SPLN_HELIX_ANGLE
- SPLN_ADDM_FACTOR
- SPLN_ADUM_MODI_VALUE
- SPLN_DDUM_FACTOR
- SPLN_PRES_ANGLE
- SPLN_GRV_DIA
- SPLN_GRV_WIDTH
- SPLN_TOOL_TIP_RAD
- SPLN_SEMI_TOPPING

fig 5.1.gear

6. FUTURE SCOPE:

CAD Model & Drawing templates to be made of different types of gear profiles, so that CAD modeling & drawing making time will be reduced, as we only have to save the model & drawing with new part no. & change the parameters.Simple parts like Bearing sleeves & Thrust washers can be also converted to parametric models.

7. CONCLUSION

The parametric model is capable of creating gear with different modules and number of teeth by modifying the parameters and regenerating the model. Sets of gears having the same module and pressure angle can be created and assembled together. It is possible to carry out finite element analysis such as contact stresses between gear teeth pair and effect of root fillet radius on the root stresses. User interface in the excel is developed. Results obtained for the current work shown that lot of time is saved. Time saved can be unitized for the innovative development in the existing product and new product. Industries can used this type of customization in parametric CAD software for their product design and development. Less expertise on design and modeling of the mechanical product can do the job easily with few hours training. Current module is valid for reduction ratio up to 6:1. Same producer can be implemented for the multistage gearbox design and also for spur, bevel, worm and combination of them.CAE analysis can be done for optimization in terms of mass & stiffness of gear blanks.Through parametric modeling, Manual Typing Input errors in drawings can be minimized (~50%), as all the inputs are linked directly with the corresponding parameters assigned in the CAD model. Correct weight can be measured of the gears (Hence complete transmission weight can be calculated accurately) at virtual level itself.Accurate Gear CAD model with involute teeth profiles for early development of parts through proto route, i.e. Wire Cutting, RPD etc, to check part fitment.We can avoid the risk of making new cutters (Which posses huge cost impact), if any minor modification comes after proto assembly.

8.ACKNOWLEDGEMENT:

Thanks to Mr. Shivraj Gurav for his valuable contribution in developing the research work.

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