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DESIGN AND SIMULATION OF THE PROCESS OF MAKING STRAIGHT GEARSUSING THE MASTERCAM X5 TO GENERATE G-CODE

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ABSTRACT
In its development, every manufacturing industry increasingly makes people think more creatively and are faced with new problems, especially in making new innovations. The purpose of these production issues is to achieve faster and more efficient production targets. The metal machining process is an important factor to support the quality of the final product, but there is one obstacle that must be faced.
The process of making gears is currently being done not only using a milling machine, there are many machines that are used to produce gears, to reduce the error rate in the process of making wheels using a CNC machine, a simulation is carried out using the Master Cam program. technology produced using software assistance to speed up work and make products better in terms of accuracy and effectiveness. The use of technology in the manufacture of products in various industrial fields continues to be developed in order to increase efficiency. This is also the case with the ceramics industry, which has been increasingly being used as a ceramics household needs. In the production process, the Machining industry gradually using automated processes to replace processes manuals. The purpose of this research is to analyze the manufacture of gears using a CNC machine.The results of this study are expected to be a reference in making gears using a CNC machine. Analysis of machining processes performed includes machining parameters, time and yield or productThis research is an application of the CAD CAM course, the Mastercam software application is very helpful in mold making innovation.
Keywords: Master Cam X5, Gears, Aluminum, Cad Cam.

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Introduction

The Manufacturing (Machinery) industry is currently developing rapidly along with the needs of service users or manufacturers, companies are required to innovate to develop technology to make it more effective and efficient. One of the manufacturing industries that are required to continuously innovate is an industry engaged in machining. One of the machining products which is considered difficult to manufacture is gear components, so we need a technology that is able to reduce the occurrence of human error.
Many factors affect the occurrence of an error in the process of making a machining product, moreover the manufacturing process already uses automation technology, which is done based on the movement of the program that has been made. In order to produce a program so that the results of the component manufacturing process are accurate, it is necessary to design the correct drawing. At this time the Machinery Industry has used a lot of application-based software in the Industry such as the Master Cam software. Master Cam can generate G Code from images created during the simulation process.
In the process of making a product there are three important stages, namely design, analysis, and the production process. The design stage can be carried out with the help of a computer known as CAD, while the analysis stage is carried out using CAM in the Production Process stage which is carried out using a CNC machine [1].
With CAD and CAM we no longer need to draw manually because time efficiency is not achieved. To get the G code, we just have to do a simulation to produce the G code [2].

Industrial development in Indonesia has progressed quite rapidly. This matter
This can be proven by the fact that the majority of industries in Indonesia already use internal combustion engines
production process that replaces manual processes.

Gears

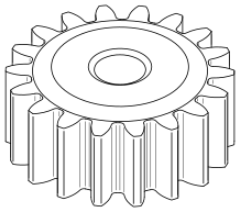
Gears or gears are parts of a machine that rotate to transmit power. Gears have teeth that intersect with the teeth of other gears. Two or more gears that touch and act together are known as gear transmissions, and can provide a mechanical advantage through the ratio of the number of gears. Gears are able to change the rotational speed, torque and direction of power to the power source. Not all gears correspond to other gears; one case is the gear and pinion pair which originates or generates translational, not rotational, forces.

Analog gear transmission with belt and pulley transmission. The advantage of gear transmission over belts and pulleys is that there are teeth that can prevent slipping, and the power transmitted is greater. However, gears cannot transmit power as far as a wheel and pulley transmission system can unless there are multiple gears involved.

When two gears with an unequal number of teeth are combined, a mechanical advantage can be obtained, both rotational speed and torque, which can be calculated by a simple equation. Gears with a larger number of teeth play a role in reducing the rotational speed but increasing the torque. Accurate speed ratios based on the number of teeth is a feature of gears that override other transmission mechanisms (eg belts and pulleys). Precision movements such as watches benefit greatly from this precise ratio of winding speeds. In cases where the power source and load are close together, gears have the advantage of being able to design small sizes. The disadvantages of gears are that they are more expensive to manufacture and require lubrication which results in higher operating costs. [3].

Types of gears

1. Spur gear



Spurs are the simplest gears, consisting of a cylinder or disk with radially shaped teeth. The tips of the teeth are straight and aligned parallel to the axis of rotation. These gears can only be connected in parallel

2. Inner gear

Internal gear (or internal gear, internal gear) is a gear whose teeth are located on the inside of the gear cylinder. Unlike the external gears which have teeth outside the cylinder. The internal gears do not change the direction of rotation.

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3. Helical Gear

CAM (COMPUTER AIDED MANUFACTUR)

Currently there are many computer workstations such as windows which are PC-based; some CAD systems can also run on UNIX or LINUX operating systems. For somewhat complex production plans, high-speed (and possibly multiple) CPU machines with large amounts of RAM are recommended. Human and computer interface via a computer mouse but also via a pen and digitizing graphics tablet. Manipulation of the model image on the screen can also be done using the spacemouse/spaceball. Some systems also support stereoscopic glasses for 3D model images.
There are 2 types of CAD (computer aided design) software. 2D design software allows the designer to design shapes with very limited 3D properties.
1. Draw a 2D model using TechSoft 2D design software.
2. After the design is completed, the image will be processed. Converts the drawing to more detail on a series of X, Y, and Z coordinates. Processing must be done before the CNC machine cuts the design from the material. When the CNC machine forms the cutting material based on coordinates, sequentially until the desired shape.
3. CAD/CAM software allows designers to manufacture designs on a single computer instead of making actual ones. Design testing using the 'Simulation' software ('CAD/CAM Design Tools' software).

When the design is run through the simulation software, the computer displays the manufacturing process on the screen. Also check whether the design can be manufactured successfully or not. Many designs are changed before they can be made by a CNC machine.
4. After all the testing and repairs for the design have been carried out, the last one is manufacturing.

Master Cam

Mastercam is software used to describe or plan machining processes virtually through a computer screen. The results of the machining process planning are then used as a guide in programming CNC (computer numerical controlled) machines. Mastercam was developed in Massachusetts in 1983. The company that developed Mastercam was CNC Software, Inc. which is one of the oldest computer-aided design/computer-aided manufacturing-based PC software developers. CNC Software, Inc. currently located in Tolland, Connecticut. Currently Mastercam is growing widely and is often used both in industry and education.

Basic elements of the machinery process

Based on technical drawings, where the geometric specifications of a machine component product are asked, one or several types of machining processes must be selected as a process or sequence of processes used to make them. For this reason, it is necessary to understand the five basic machining processes, namely:

Cutting speed	V (m/min)
Feeding speed	V_f(mm/min)
Depth of cut	a (mm)
Cutting time	tc (min)
Furious earning speed (Rate of metal removal)	Z (cm^3/min)

The basic elements of the machining process are calculated based on the dimensions of the workpiece and tool and the size of the machine tool.
The basic elements of the lathe process can be known or calculated using the formula.

Basic elements can be calculated with the following formulas:
Cutting speed : v=(π.d.n)/1000;m/min where d=diameter
the average, namely : d=(do+dm)/2;mm..
Feeding speed : v_f=f.n ;mm/min.
Cutting time : tc=l_t/v_f ; min.
Feeding speed : Z =A.v.
Where, the cross section was furious before it was cut
A=f.a ;mm^2. Then Z=f.a.v ;cm^3/min.

Research Method

To facilitate the research process and flow, it is necessary to determine the methods used so that the expected results are maximized.

Tools and Materials

Tool

The equipment used in this study are as follows:
a. Laptops
b. Software Master Cam X5
Materials
The materials to be used in this study are as follows
a. aluminum
The method used in this study is the analytical method, which is a method used to predict a component or design by analyzing the design with the required analytical methods. In this case the simulation uses MasterCam X5
Research Procedures
The research procedure to be carried out in this study is as follows:
a. Making technical drawings
Technical drawings are needed to visualize the product to be made.
b. Gear Manufacturing Village
c. Analysis and simulation
The analysis is carried out to see the machining process used in the component manufacturing process, while the simulation is carried out to see how the component is produced so as to produce a product that is in accordance with the technical drawings.

Research Flowchart

To simplify the design process of the gear manufacturing process and the simulation process using MasterCam, a flow chart is made as follows

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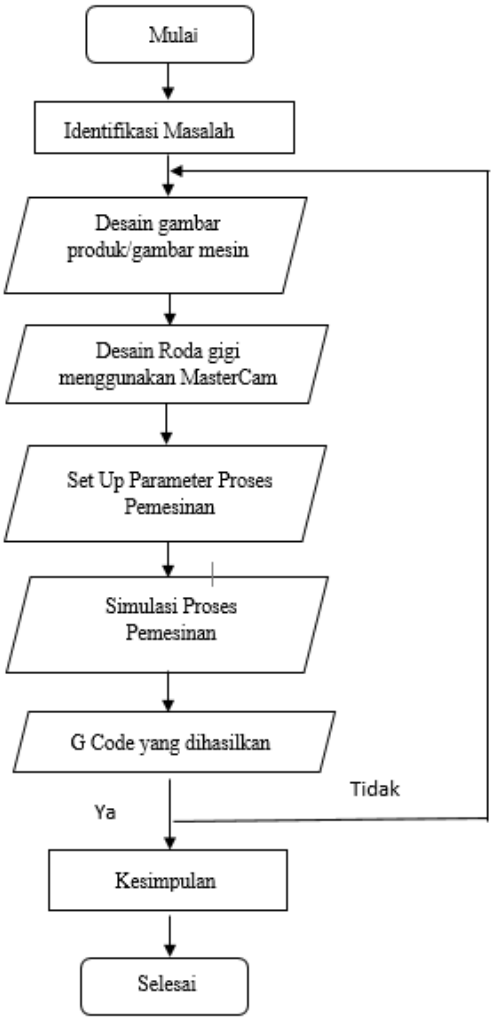
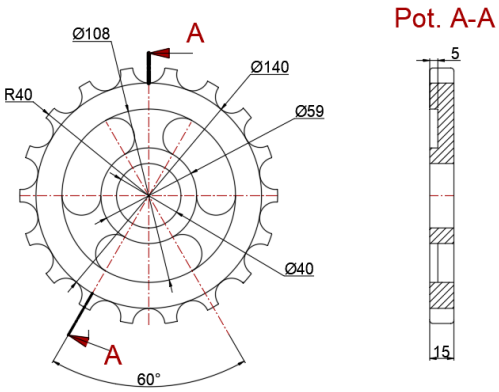


Straight Gear Design

Gears to be made with the following dimensions:



Results and Discussion

Design and Manufacture Process

a. 2D Design Process

Master Cam X5 software has capabilities that can be used to design. In making the design for the manufacture of gears, the first thing to do is draw in 2D with an outer mold size of 85 x 85 x 15 mm.

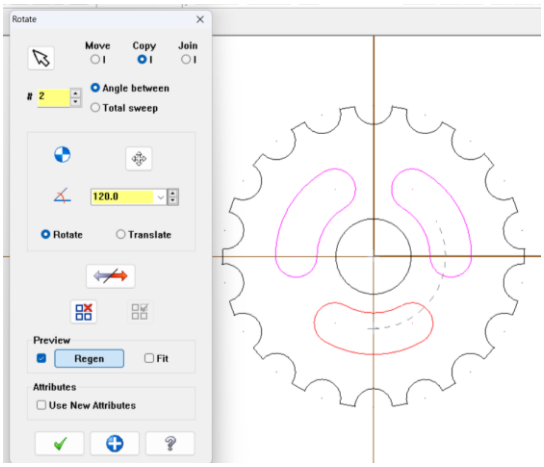
b. 3D Design Process

3D design is a computer image that represents an actual object and contains physical information about the object. The way of making it is by giving it a certain height

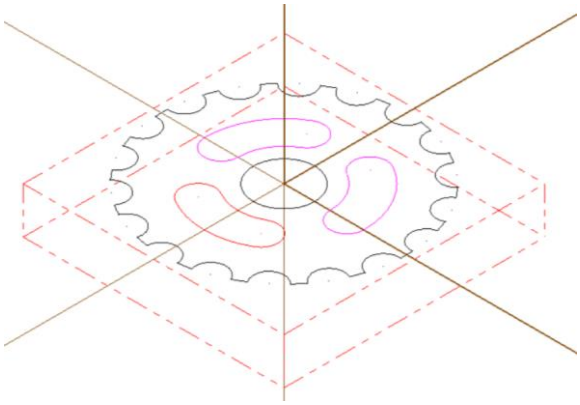
MasterCam Setup Process

The metal mold design process for making tile prints begins with the mold drawing process. The drawing or design process can be done using AutoCAD, Inventor or trim software on MasterCam. In this research, the drawing process was carried out in the Inventor software with the aim of making it easier to convert to masterCam. The following is a picture of the results of the process with the Inventor software.

Make the center of the gear section with the Rotate command



Determine the size or dimensions of the workpiece with the Stoke up command Write down 85 mm length x 85 mm width x 15 mm height



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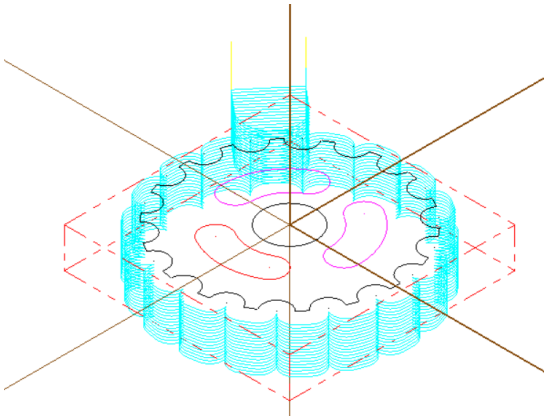
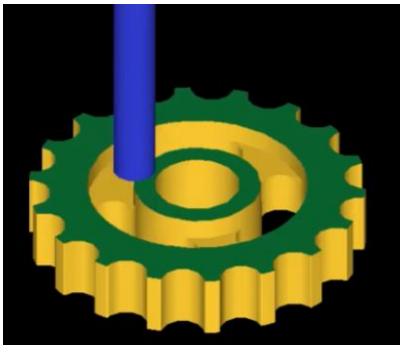
Milling tool feeding direction



To get the G code, select the verify button to get the simulation results of the gear manufacturing process.



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