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DESIGN OF NEVEL JOINT MANUFACTURING PROCESS USING MASTERCAM X5 TO PRODUCE G CODE

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Abstract
MasterCam is a software used to simulate the machining process where the final result produces a G code that can later be used on a CNC machine and can be used to create an object according to the design in the simulation process. With the MasterCam software, it can simplify and accelerate the manufacture of a product with the same dimensions and shape. CNC machines are used to make products in large quantities without any difference from all of these products, because CNC moves and operates based on a program, not based on the skills of the operator. A study has been conducted using MasterCam software on how to make a Nevel product so that the resulting G code can be transferred to a CNC machine. The material used to make a nevel is brass.

Keywords: *MasterCAM, Nevel, Brass, CNC, G-Code*

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Introduction

Electrical energy is currently still receiving attention from industry where its need both in industry and in society is a basic need that cannot be eliminated, the availability of electrical energy is increasing every year along with many industrial sectors developing both in manufacturing and other fields.

To balance the need for electrical energy, many industries use power plants that can be used by internal parties in the industry without taking it from the State Electricity Company (PLN). Currently, many industries are installing generators to produce electricity with different capacities. In general, the manufacturing industry requires three to four generators with an average capacity of more than 4 mW for each generator, because the need for electrical energy is very large, such as for processes in the manufacturing industry. The generator used produces exhaust gas which can be used as an alternative fuel to produce steam can be reused for the production process so that operational costs can be smaller [1].

The process of using a generator will produce exhaust gas with a fairly high temperature which is still used to heat the water in the reservoir.

Utilizing heat from flue gas is an alternative form of energy to reduce costs for the company [2].

The exhaust gas emitted by the generator reaches a temperature of 4000C with a mass flow rate of 3.03 kg/s. with exhaust gas pressure of 2 bar. The exhaust gas temperature from the generator can still be used to heat water before it enters the APK. Thus, this effort is useful as alternative energy and reduces production costs.

Utilizing waste energy can use a heat exchanger, the type that is widely used is the shell and tube type, for the reason that this type of heat exchanger has a fairly large ratio of volume to fluid weight, this type is easy to make and easy to carry out the cleaning process.

The process of entering exhaust gas into the shell and tube can be via a fire pipe or water pipe.

From this design, it is hoped that a heat exchanger that has high effectiveness will be produced. The aim of this design is:

1. Understand the influence of tube size, distance between tubes and their arrangement on the performance of
the APK.
2. The influence of tube size, distance between tubes and the shape of the tube arrangement on the performance of the APK.
3. Identify the most economical design conditions [3].

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.

2.1 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.

2.1.1 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

METHODOLOGY

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

3.1 Tools and Materials

3.1.1. Tools

The equipment used in this study is as follows:
a. Laptop
b. MasterCam X5 Software

3.1.2 Materials

The materials to be used in this study are as follows
a. Copper (Cu) Material

3.2 Design Method

The method used in this design is the analysis method, which is a method used to predict a component or design by analyzing the design with the required analysis methods. In this case, the simulation uses MasterCam X5

3.3 Design Procedure

The research procedures to be carried out in this design are as follows:
a. Making engineering drawings
Engineering drawings are needed to visualize the product to be made.
b. Nevel Design
c. Analysis and simulation
Analysis is conducted to see the machining process used in the manufacturing process of the component, while simulation is conducted to see how the component is produced to produce a product that matches the engineering drawing.

3.4 Nevel Design

Nevel has the following dimensions:

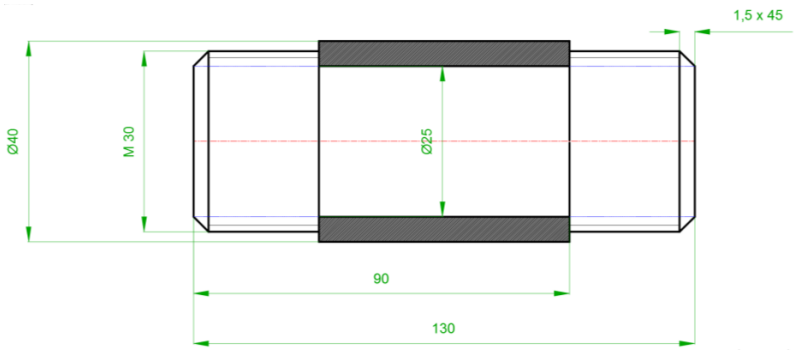


Figure Nevel Dimensional Drawings

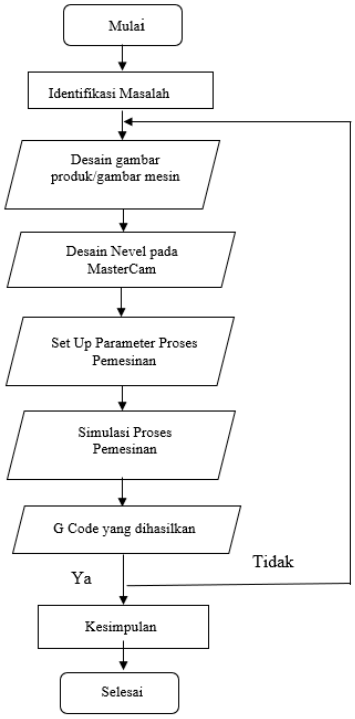


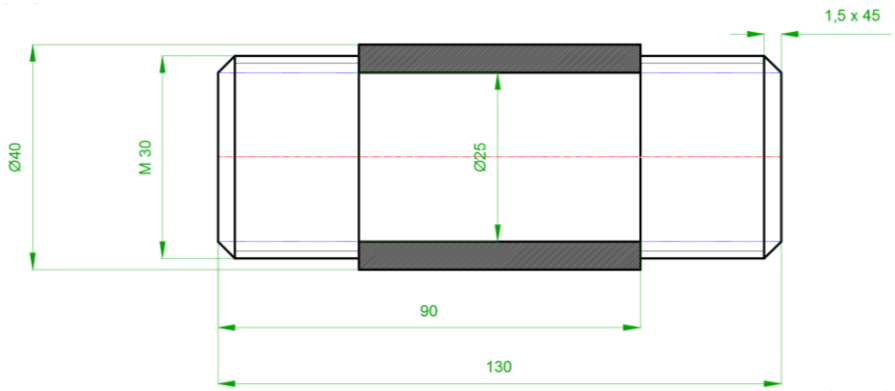
Figure Nevel Design flow diagram image

RESULTS AND DISCUSSION

Workpiece Installation

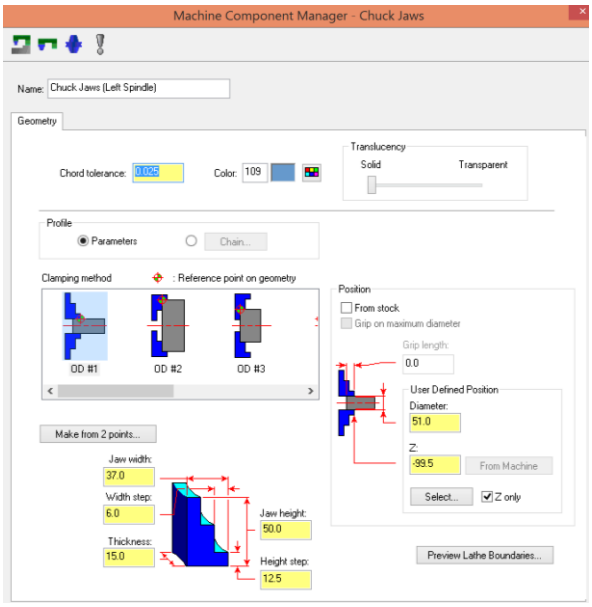
The nevel making process uses a lathe, simulation process steps on mastercam x5

1. Drawing nevel dimensions



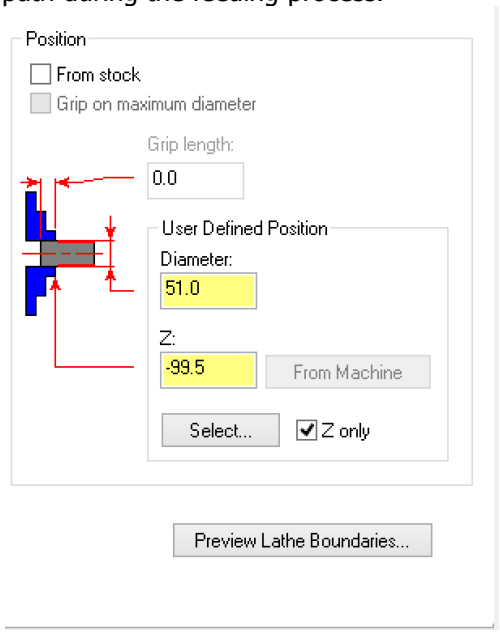
Determining the Workpiece Clamping

The workpiece must be clamped before being processed, using a clamping tool, in the mastercam the clamping process already has a command. As in the picture below

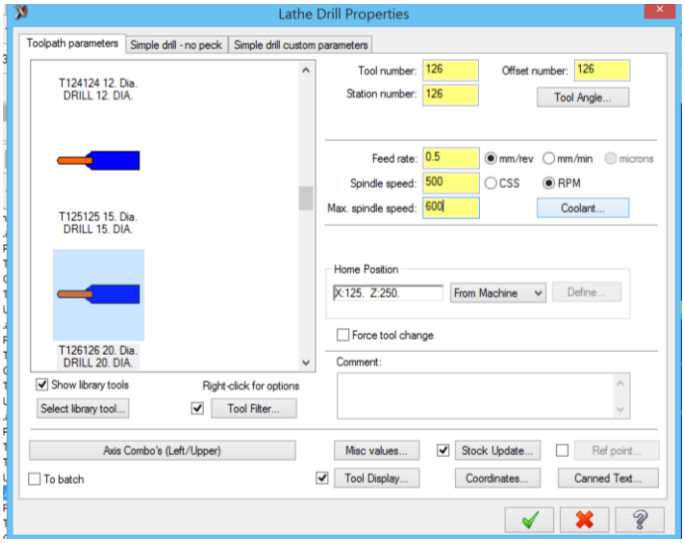


Determining Toolpaths

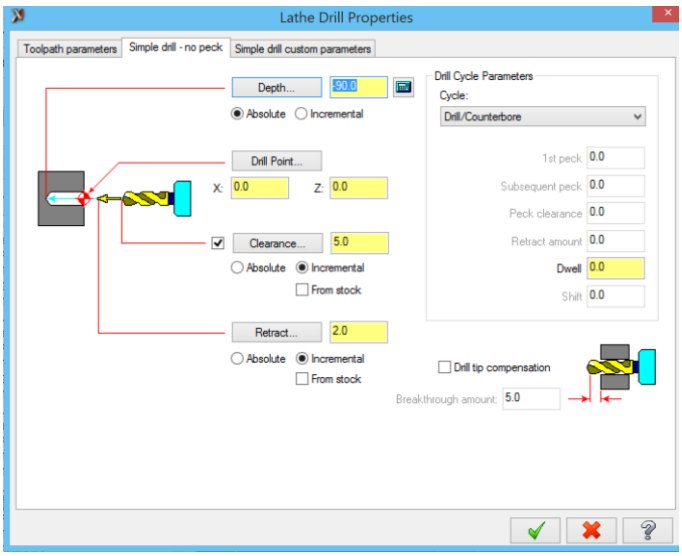
The next process is to determine the tool path on the workpiece to be processed. This process begins by determining the position of the tool and the direction of the trajectory so that the resulting G code matches the shape of the workpiece to be processed. The yellow color in the image below shows the tool path during the feeding process.



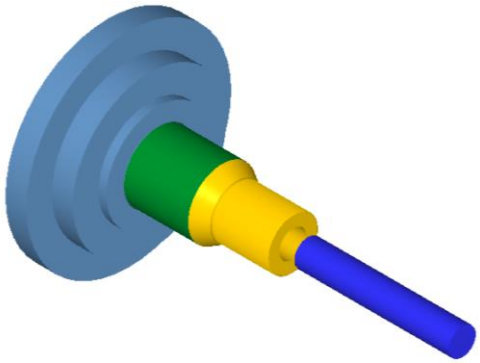
The image above must be filled in by a mastercam designer, in the diameter column, fill in Do with the number 51 mm according to the workpiece diameter of 50 mm.
Number of turns means how many turns are passed for the threading process, here the number 10 is stated, meaning ten turns are passed for the threading process.



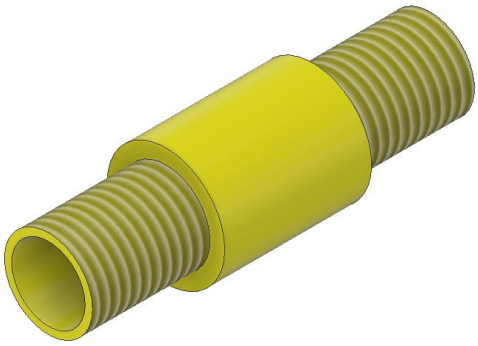
Dept is the drilling distance



After all the processes are done, the next step is to verify to simulate the results of the design that has been filled in. The image below shows the front nevel that has been turned.



The next step is to work on the other side by turning the workpiece over in its clamping position. The method is the same as the first step, so the results are as follows



Nevel image simulation results

Program to create a nevel result from MasterCam Program simulation

```
O0000
(PROGRAM NAME - NVEL)
(DATE=DD-MM-YY - 22-01-22 TIME=HH:MM - 16:49)
(MCX FILE - T)
(NC FILE - F:\Tugas Akhir \ MESIN \NVEL.NC)
(MATERIAL - Kuningan)
G21
(TOOL - 1 OFFSET - 1)
(OD ROUGH RIGHT - 80 DEG.  INSERT - CNMG 12 04 08)
G0 T0101
G18
G97 S275 M03
G0 G53 X54. Z-99.498
G99 G1 X-1.6 F.25
G0 Z-97.498
G28 U0. V0. W0. M05
T0100
M01
(TOOL - 91 OFFSET - 91)
(OD THREAD LEFT- SMALL  INSERT - R166.0G-16MM01-100)
G0 T9191
G18
M05
G0 G54 X44. Z16.594
Z10.805
G76 P010029 Q0. R0.
G76 X36. Z-40. P20000 Q5867 R0. E1.
Z16.594
G28 U0. V0. W0.
T9100
M01
(TOOL - 126 OFFSET - 126)
(DRILL 20. DIA.)
G0 T12726
```

```
G18
G97 S500 M03
G0 G54 X0. Z5.
Z2.
G1 Z-90. F.5
G0 Z5.
G28 U0. V0. W0. M05
T12600
M30
%
G0 T0101
G18
G97 S275 M03
G0 G53 X54. Z-99.498
G99 G1 X-1.6 F.25
G0 Z-97.498
G28 U0. V0. W0. M05
T0100
M01
(TOOL - 91 OFFSET - 91)
(OD THREAD LEFT- SMALL  INSERT - R166.0G-16MM01-100)
G0 T9191
G18
M05
G0 G54 X44. Z16.594
Z10.805
G76 P010029 Q0. R0.
G76 X36. Z-40. P20000 Q5867 R0. E1.
Z16.594
G28 U0. V0. W0.
T9100
M01
(TOOL - 126 OFFSET - 126)
(DRILL 20. DIA.)
G0 T12726
G18
G97 S500 M03
G0 G54 X0. Z5.
Z2.
G1 Z-90. F.5
G0 Z5.
G28 U0. V0. W0. M05
T12600
M30
```

CONCLUSION

Nevel is a tool used to connect two pipes, nevel can be made of metal or non-metal materials. In designing this nevel, mastercam software is used to simulate and produce G code which can later be transferred to the CNC machine. The process of making this nevel uses a lathe, with two processes, namely the longitudinal lathe process and the thread lathe process. The Nevel Making Process is an application of the Machining Process course and the Cad Cam course.

The nevel made has a length dimension of 130 mm with a hole diameter of 20 mm, the thread used is a metric thread type where both sides of the nevel are threaded. The machining process parameters used are spindle rotation 500 rpm, depth of feed 0.5 mm, the diameter of the drill used for the workpiece drilling process is a diameter of 20 mm.

The simulation process is a process carried out before the actual process on the CNC machine, the G code produced from the simulation process does not guarantee that the program is correct, in the future the author really hopes that there will be a CNC machine on campus, in addition to increasing student knowledge, it can also increase the enthusiasm for learning because students gain a lot of knowledge with the CNC machine.

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