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DESIGN AND SIMULATION OF THE PROCESS OF MAKING CERAMIC TILES MOLDUSING 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.
Mold or Mold is a technology that is 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 ceramics industry gradually using automated processes to replace processes manuals. The purpose of this study is to analyze the manufacture of ceramic masters by using a CNC machine in the Kasongan ceramic industry. Results This research is expected to be a reference in making ceramics using a CNC machine. Analysis of machining processes performed includes machining parameters, time and yield or product This research is an application of the CAD CAM course, the Mastercam software application is very helpful in mold making innovation. Tiles are a form of a product resulting from a metal molding process, the mold material is made of st 37 steel.

Keywords: Master Cam X5, Prints, Tiles, Cad Cam.

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Introduction

The Manufacturing Industry is currently growing rapidly in line with the needs of service users or producers, 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 the manufacture of molds, molds or molds which are components for making a product or component by forming metal or non-metallic liquid which is inserted into the mold cavity according to the shape of the workpiece to be made. Molds can be categorized into Metal molds and Sand molds, metal molds are forms of molds made of metal while non-metal molds are made of sand, metal molds are used to make a product that has good accuracy and has a smooth and precise surface.

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 enginesproduction process that replaces manual processes. However, the ceramics industry was until now not much use of the machine in the process production. The process of making ceramic molds is still done manually. So that the ability to generate new motives is experiencing constraints. While Ability in producing new motifs will add value to the ceramic industry. The research to be carried out is to design a form of mold made of metal that will be used to make ceramic tiles. The choice of the type of metal mold so that the manufacturing process can be carried out repeatedly without changing the dimensions and shape of the tiles because the manufacturing process will produce in sufficient quantities, then the surface of the mold process must also have a good level of accuracy and smoothness. Metal molds are also known as permanent molds

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Ceramics

Ceramics are floor tiles made of clay and covered with glazing. There are two types of ceramics available on the market today, namely glazed ceramics and porcelain tiles (homogoneous tiles). The process of making glazed ceramics begins by mixing clay with kaolin and then firing it up to 1000 degrees Celsius where the resulting ceramic does not disintegrate when immersed in water. After that, the coating process is carried out by printing on the tiles. While porcelain tiles start from grinding the raw materials in the form of a mixture of feldspar, quartz sand, and clay. This mush-like mixture is then dried so that it becomes very fine granules which are then pressed into tile shapes. After being pressed with a load of thousands of tons, these "raw" tiles are dried again. After that, it is fired at a temperature of 1250ºC—the optimal temperature to get tiles that are hard but not brittle. Finally, some are directly cut to size and some are polished before being cut. This final process causes two types of porcelain tiles, namely those with a rough surface (because they are not polished) and those with a smooth/glossy surface. The polishing process is a relatively expensive process. Because of this, porcelain tiles are 2 to 8 times more expensive than glazed ceramic tiles. To reduce production costs, there are porcelain tiles that are deliberately not polished but are coated with glazing so that the surface remains smooth. Products produced from this combined technique are specially made so that some consumers can still use porcelain floors but at a more affordable price.

Ceramics have a choice of motifs, colors and sizes that vary. Its various sizes make this type of floor popular because it can be combined with various sizes of tiles to create beautiful floor patterns. Meanwhile, ceramic motifs are currently the most diverse, from minimalist motifs to natural impressions such as wood and natural stone motifs, creating more choices for consumers [3].

Metal Mold

Metal molds are only used to make castings in large quantities, although metal molds are less profitable for large castings and for castings with the highest melting point, this type of metal mold is very profitable for small and medium sized castings in large quantities.

The first thing to do is make a casting product drawing which was originally a machining drawing. In this case it is considered how to make good castings, how to reduce the cost of making molds, make easy patterns, how to stabilize the cores, and how to make it easier to disassemble the mold then determine the coupling and drag directions, the position of the separating surfaces, the parts made by the main mold and the part made up by the core. Next, determine additional shrinkage, additions for machine finishing, pattern slope, and so on, and draw drawings for casting which are then submitted to the pattern maker.

There are many types of molds and mold manufacturing methods that can be used in the casting process. Each type of mold and method of manufacture each has its own limitations, advantages and disadvantages.

There are several factors that need to be considered in choosing the type of mold and the manufacturing process, including:

1. Capital costs of equipment and materials
2. Final work costs for the mold to be ready for use, such as burning, transportation, etc.
3. The accuracy of the size and dimensions of the castings
4. mold control (pollution and material recycling)
5. Manufacturing process costs include metal yield
6. The cost of finishing the casting includes cutting, welding, heat treatment, and machining
7. Number of castings per unit time
8. The area and size of the foundry workshop floor.

In principle, these factors are taken into account to obtain high yields with metal quality that is in accordance with the wishes of the customer.

In general, the selection of the type of mold and the method of making molds in the casting process is more emphasized on several technical and economic considerations in addition to the possibility of applying the technology that can be used.

CAM (COMPUTER-AIDED MANUFACTURING)

Hardware Technology and CAD/CAM Operation System

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.

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

1.Tool

The equipment used in this study are as follows:
a. Laptops
b. Software Master Cam X5

2 Materials

The materials to be used in this study are as follows
a. AISI 1045 steel

3 Research Methods

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

4. 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. Mold design for tile making
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.

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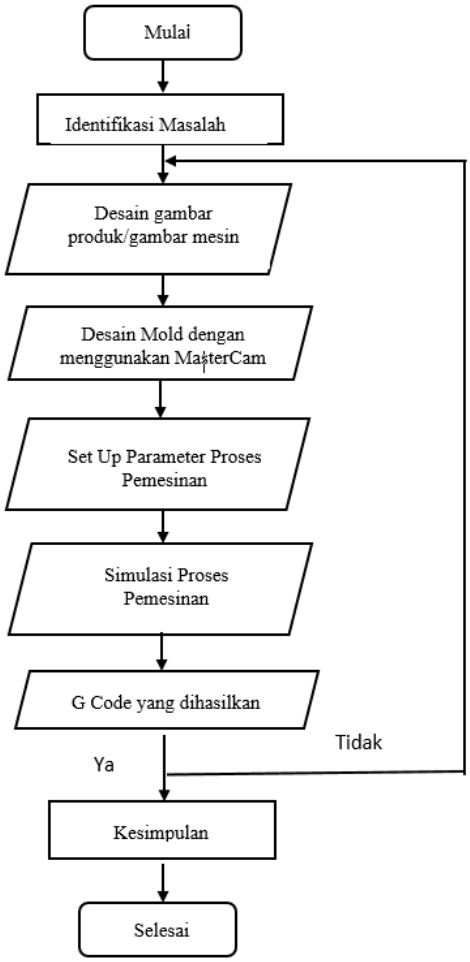
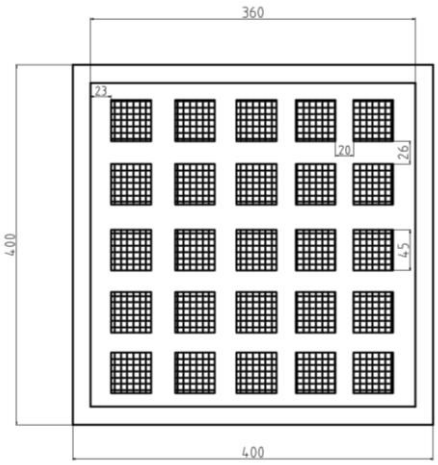


Tile Design

The tiles to be molded with the following dimensions:



Material Selection

In making and planning the design of a tool or machine, it is very necessary to calculate and choose the material to be used. Material is the main element in addition to other elements. We must know the materials produced in order to increase the value of the product. This will greatly affect the equipment because if the material is not in accordance with the functions and needs it will affect the condition of the equipment and the value of the product.

Selection of a very suitable material will greatly support the success of making the design and planning. The material to be processed must meet the requirements set out in the product design, alone the material properties will greatly determine the forming process.

Results and Discussion

Design and Manufacturing Process

a. 2D Design Process

Master Cam X5 software has capabilities that can be used to design. In making the ceramic mold design, the first thing to do is to draw 2D with an outer mold size of 400 x 400 mm, then a square profile with a size of 45 x 45 mm is made in the center.

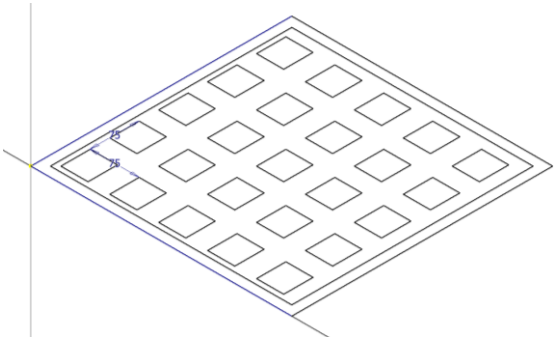
b. 3D Design Process

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

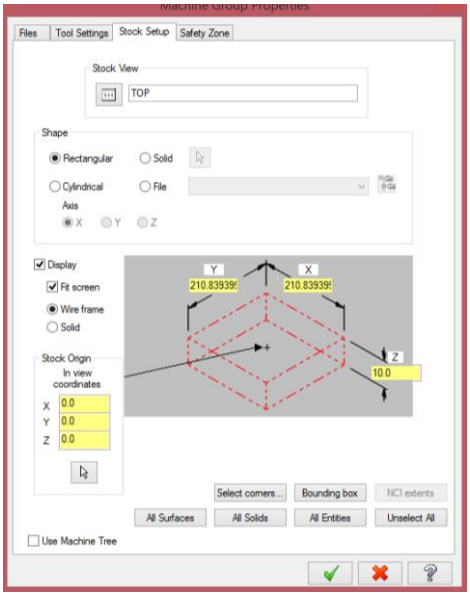
MasterCam Setup Process

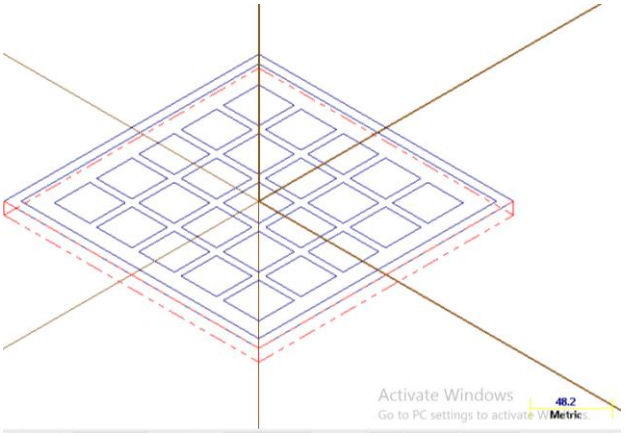
The metal mold design process for making tile prints begins with the mold drawing process. The drawing or design process can be done using AutoCAD, Inventor or trim software on MasterCam.
In this research, the drawing process was carried out in the Inventor software with the aim of making it easier to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

Image of Tile Prints



The next process is to make the size of the print on the master cam by selecting the stock setup button, then filling in the size of the print according to the X, Y, Z axes.





Machining Process Data

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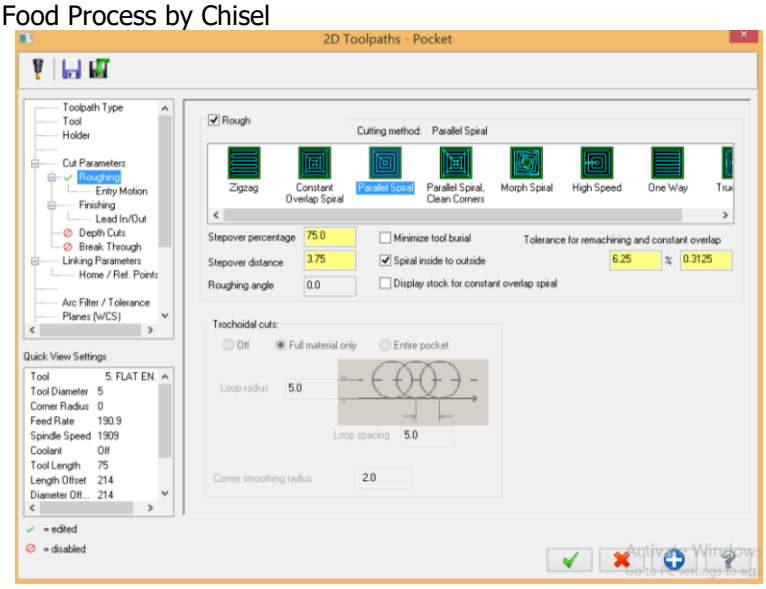
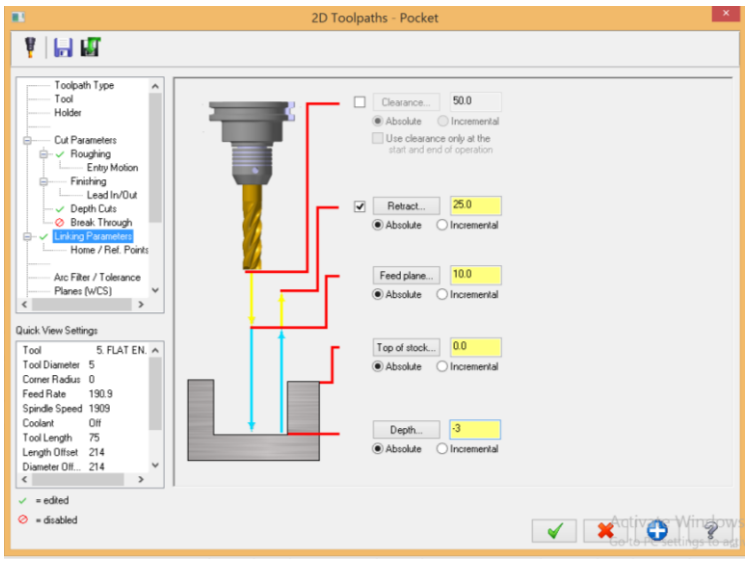
No	Keterangan	Roughing	Finishing
1.	Pahat, D (mm)	8	4
2.	Jenis Pahat	HSS	HSS
3.	Stopover (mm)	3,75	3,75
4.	Stepdown (mm)	3	3
5.	Feed Rate (mm)	190	190
6.	Plunge Rate (mm/s)	3	3
7.	Spindle Speed (rpm)	1900	1900

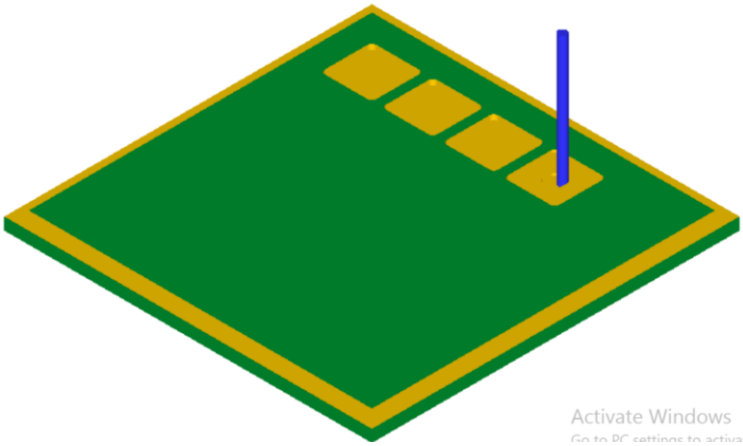
Determining the Food Process by Chisel



Determine the Cutting Process

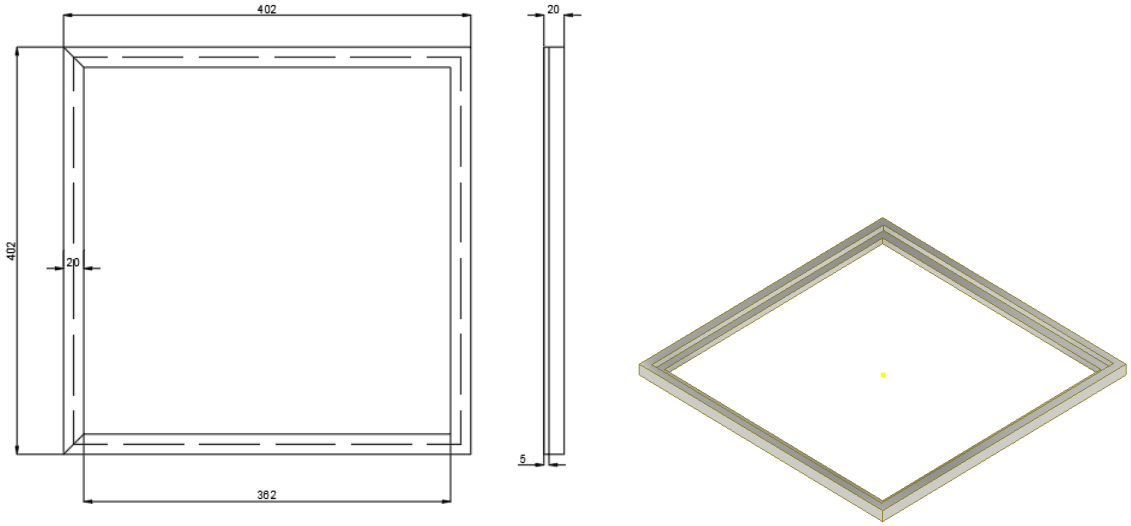


Process Simulation of the results of the tile design process



Mold Frame Making

The frame functions as a place to hold impressions and accommodate molding sand during the pressing process. The die frame is made of ST 37 steel with dimensions of 402 x 402 mm and a thickness of 20 mm.



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Conclusion

Metal molding is a type of product manufacturing process with the aim of producing products with higher precision and having a smoother surface. Master Cam software is currently widely used to create and generate G codes. Molds for these tiles are made of AISI 1045 steel, this steel is used as a mold because it has heat resistance and can withstand loads caused by compressive forces.

From the simulation results with mastercam software, a G code is generated that can be applied to CNC machines so that the mold making process is faster and has the same dimensions and accuracy. From the simulation results obtained several parameters of the cutting process, such as:

1. Feeding depth 3mm
2. Spindle speed 1900 rpm
3. The diameter of the chisel is 8 and 4 mm
4. Feed rate 190mm/min

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