

Design and create tool path cavity insert of helmet buckle plastic injection mold

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Received 02 May 2024; Accepted 13 May 2024

Abstract:

Background: In machine manufacturing in general, to shape a series of products with the same shape and size in a short time, it brings high productivity and lower product production costs, so the mold still exists and develops further. at this time and in the future. There is also a lot of research to improve the errors of previous molds so that the most optimal mold cannot deny the tireless research of scientists and technicians.

Materials and Methods: Scientific experimentation is an important practical research method in which scientists actively influence the subject and the evolution of the event or phenomenon in which the subject participates, to guide its development. them according to their intended goals. Successful experiments will give us objective results, and thus the purpose of scientific discovery is carried out in a completely proactive way. Experience shows that experimentation is significant as a revolution in science, overturning old-style scientific thinking and it is thoroughly used in many scientific fields, especially in the sciences. nature, science and technology. Experimentation has helped speed up the scientific process and the ability to quickly apply research results to the practice of plastic injection mold production.

Results: Apply mechanical design software to design, simulate, analyze, optimize design and program cavity machining (Core and Cavity) of plastic injection molds. The project of applying software to optimize the design and programming of important details of the mold set has helped to achieve product quality and significantly reduce the time to complete the mold set.

Key Word: Plasstic injection mold, Core, Cavity, Design, CAD/CAM, CNC.

I. Introduction

Process of creating products using plastic injection molding: Plasticization process; Filling process (Filling); Holding pressure process; Cooling process (Colling); Demolding process.

Plasticization process: In the cooling stage when shaping is completed without the need to provide additional plastic, this is the process of bringing the necessary amount of molten plastic for the next shaping. Plastic is in granular state thanks to gravity, passes through the hopper, falls into the wing behind the screw. Thanks to the rotation of the screw, the plastic follows the groove and is transferred to the front part of the cylinder. At that time, the plastic is kneaded by the rotation of the screw. At the same time, with the friction heat generated, the cylinder and the external hot device, the plasticization state takes place. If the plastic is filled in front of the heating cylinder, due to the back pressure of this material, the screw pushes back, the amount of back is exactly equal to the amount of plastic in one shot.

Filling process (Filling): The filling process is the process by controlling the forward speed of the screw, bringing and pushing the plastic inside the mold cavity. When the screw reaches the air compression transition point, the mold cavity is completely filled. Because the filling process is a speed control process when filling, the injection pressure formed in front of the screw is also different. If the filling speed is not suitable, the injection pressure can increase greatly. So in what state does the plastic enter the mold? This becomes an important factor determining product quality. During the filling process, predicting pressure, temperature and pressure in the mold means accurately analyzing the filling process.

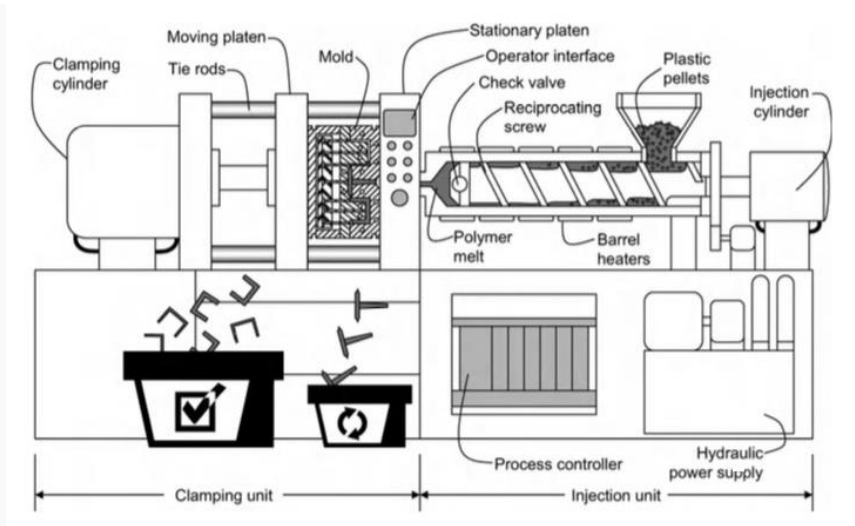


Figure 1. Process diagram of plastic injection molding machine

Holding pressure process: The pressure holding process is a pressure control area that causes the screw to move forward to form a certain pressure on the front of the screw for a certain time, to supplement the amount of plastic shrinkage caused by the filling plastic. It's cold in the mold. Normally, the air compression is set to last until the injection port solidifies, because when the injection port solidifies, no more plastic can be supplied inside the mold cavity. Accordingly, the compression process is closely related to the product shrinkage rate.

Cooling process (Colling): After injection is completed, with the process of cooling the plastic at high temperatures, this will be the waiting period until the product temperature can exit the mold. Normally, if the product solidifies about 80% and the channel cools about 50%, the mold can be released. To minimize the shrinkage of the molded product during the cooling process, the compression process and the cooling process must take place at the same time by pushing an excess amount of plastic inside to help the plastic always be maintained at the same level. a certain volume, through this process it is possible to create a shaping product with higher precision. Due to the difference in thickness of the product, there is a difference in cooling temperature in each area, causing shrinkage.

Demolding process: This is the process after the molded product is cooled enough, under the temperature to change shape, the mold is opened, and the product is taken out of the mold. The movable plate is pushed back, the mold is opened, the push pin is inserted, and the product is released. To prepare for the next process, the mold closes.

II. Material and Methods

Design is part of the work in the design process, usually carried out in the following order: Prepare a calculation diagram in which the structure has been simplified and the applied forces are considered concentrated or distributed according to a certain rule. Determine the load applied to the detail

- Choose materials suitable for the working conditions of the part, machinability and consider economic factors (cost, supply issues, lifespan...etc)
- Calculate the main dimensions of machine parts according to the main criteria for working capacity. These calculations are usually preliminary, because they are based only on simplified profiles, the load and stress factors have not been accurately evaluated, etc.
- Based on calculations and conditions of fabrication, assembly, etc., draw the specific structure of the detail
- Conduct calculations and tests according to the main criteria of working ability, specifically determining the safety factor at dangerous cross-sections, determining deformation, temperature of parts, etc.

Before accepting an order to manufacture a mold, the customer and the engineer responsible for the design and manufacture of that mold set must discuss with each other the design of each part, the quality of the mold material, and the quality of the mold. surface finishing, tolerance requirements and all other information. To make the mold economical, it is necessary to use all standardized details such as: assembly details, connectors, auxiliary parts for the mold and replacement parts.

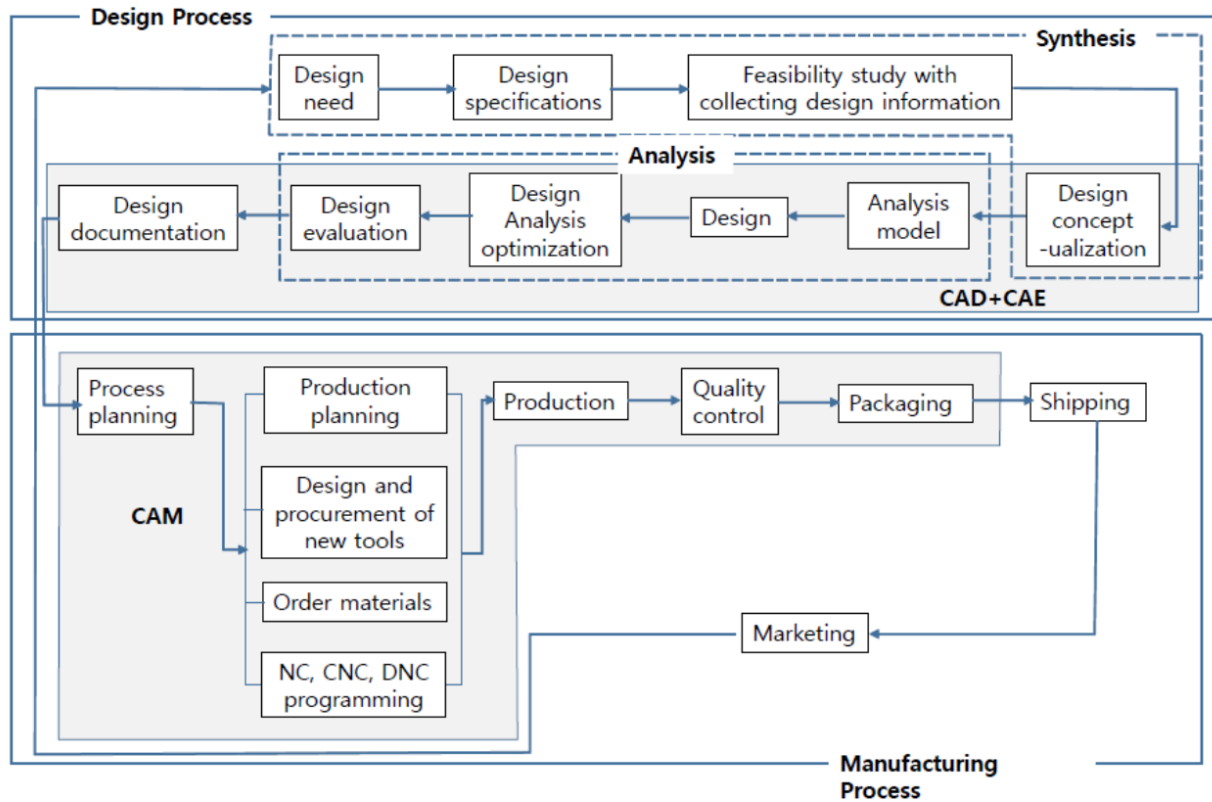


Figure 2: The design and manufacturing an injection mold.

Design a helmet lock product using Unigraphics NX software.

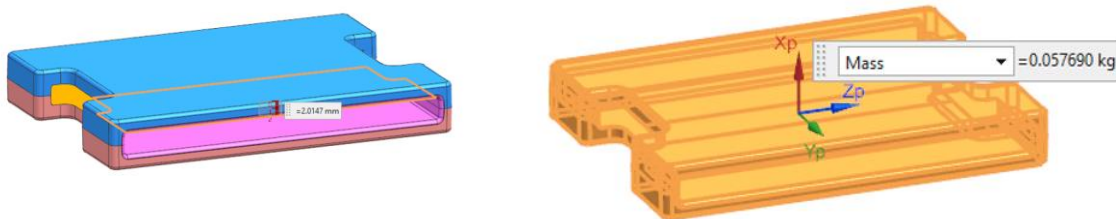


Figure 3. Helmet lock product.

Design the mold base using Mold Base Library in NX software:

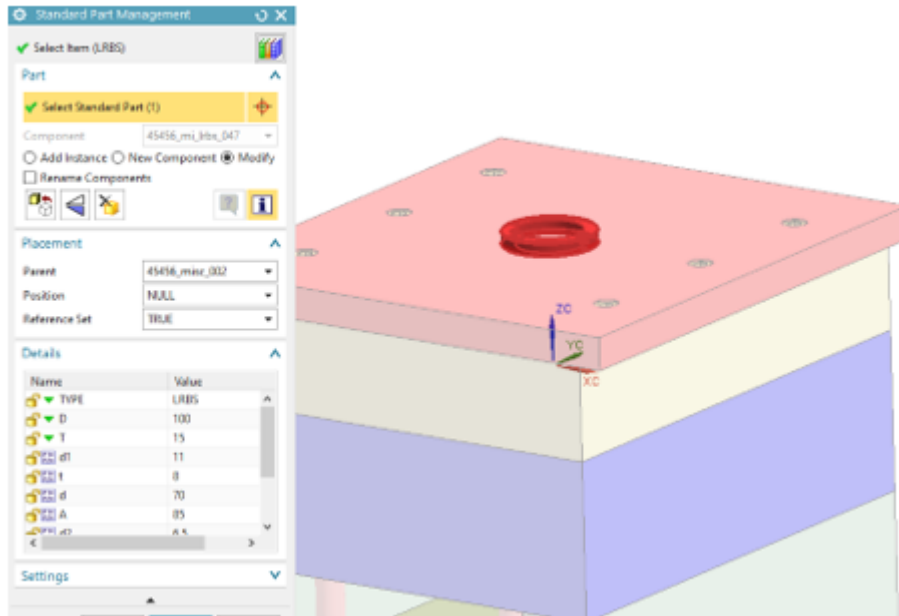


Figure 4. Locate ring in Mold base.

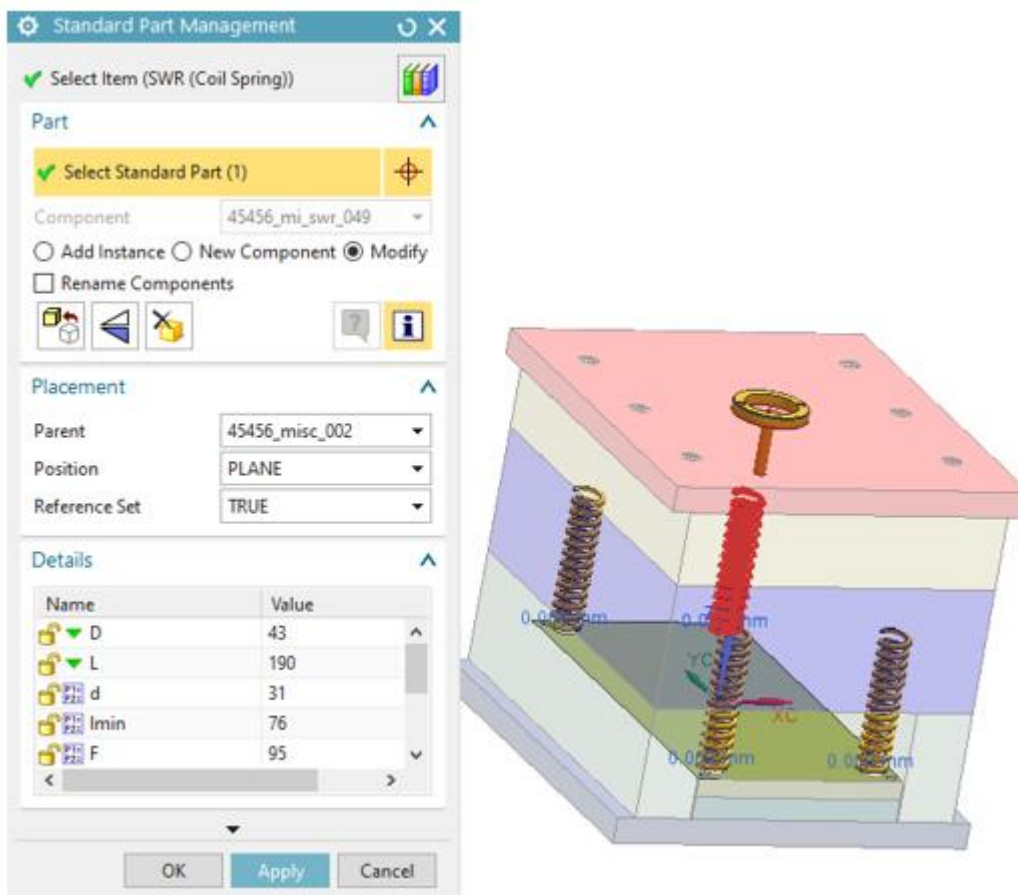


Figure 5. The spring.

Design Ejector Pins:

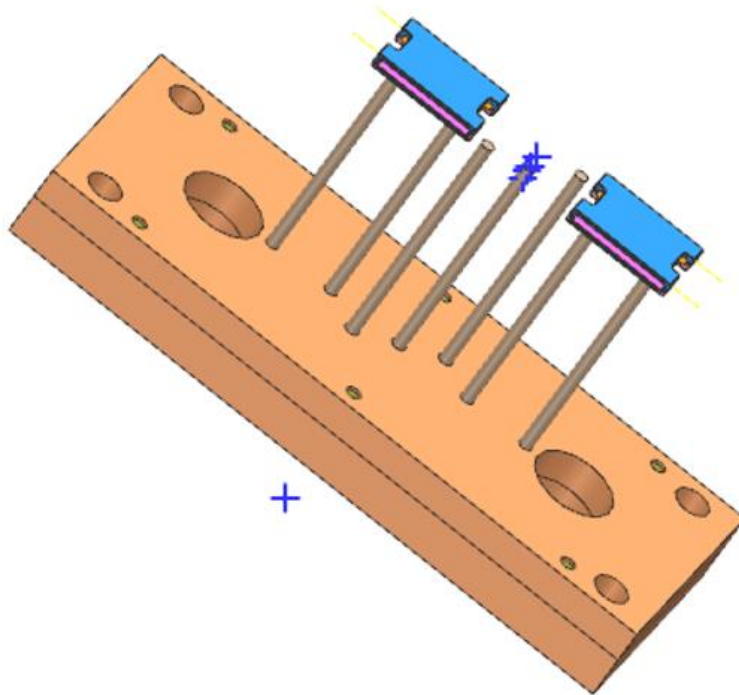


Figure 6. Ejector pín.

Design of mold cooling water lines: Select (Pattern Channel) on the Mold Wizard toolbar to build Sktech and create the water line according to the calculation parameters above.

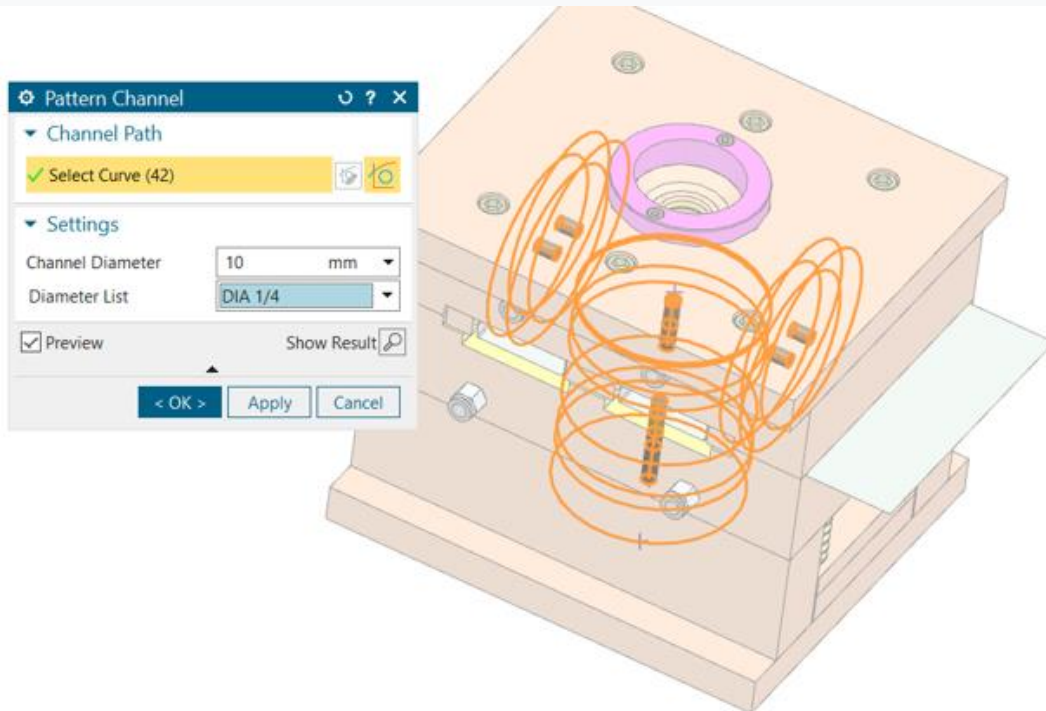


Figure 7. Mold cooling water lines.

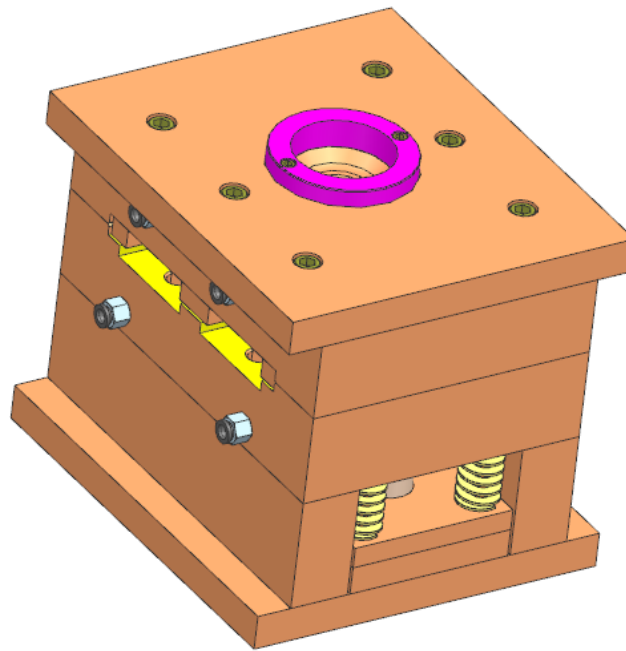


Figure 8. An injection mold of helmet lock.

Cavity insert machining technology process:

Determine the types of production.

Due to the large machine productivity, and at the same time because one set of molds can be used to produce many products, diverse product designs, and long mold life, this form of mold production is single-piece production.

Select the workpiece.

The method of selecting workpieces depends on many issues such as: technical functions, structure of machine parts in the machine cluster, materials used, technical requirements, shape and size of detailed surfaces, scale and flexibility. production activities. Choosing a blank means choosing the type of material to make the blank, the method of forming the blank, determining the amount of machining allowance for the surfaces, calculating the dimensions, and determining the tolerances for the blank manufacturing process.

The material used to make Cavity insert parts is SKD11 steel. Select the stamping blank. This blank is placed in the blank manufacturing workshop, which will cut the large blank sheet into small pieces depending on the order size of the mold maker.

The Cavity insert part has a standard size of 65x180x28, so we order the blank to be 70x185x33.

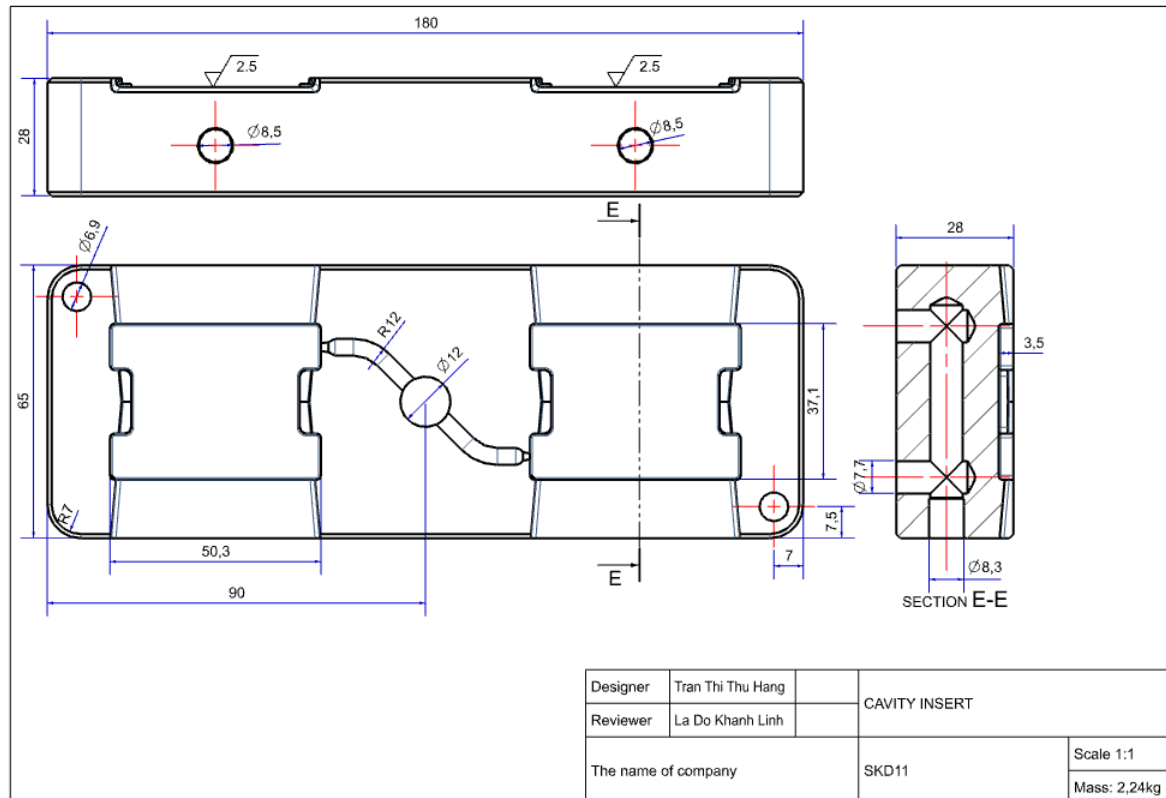


Figure 9. The drawing of cavity insert.

Sequence of operations:

Technological process planning must be reasonable to shorten service time and processing time to ensure productivity. When designing operations, it must be based on the following principles:

- The following operations must reduce errors and reduce surface roughness with previous operations.
- First, the surfaces must be machined to serve as standards for the following operations.
- The more precise the surfaces are, the later they are machined.
- Operations that are likely to cause waste are brought up first to avoid wasting time processing defective parts.
- To reduce the time for multiple jigs and other service times, the technological perspective is to concentrate the work, using specialized jigs with multiple knives to allow machining of many surfaces on the same jig to increase productivity and suitable for production.

Operation 1:

- Step 1: Face milling
- Step 2: Wall profiling
- Step 3: Drilling
- Step 4: Chamfering.

Operation 2:

- Step 1: Floor facing.
- Step 2: Wall profiling.
- Step 3: Cavity milling- Rest milling – Area milling.

III. Result

Create tool path of machining process on CAM software and declare all cutting mode parameters, cutting tools, fixtures, machining residuals and optimize tool paths for machining simulation to minimize errors during the actual machining process.

The parameters of operation 1 as the table below:

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Name	Path	Tool	Time	Depth of Cut	Feed	Speed
NC_PROGRAM			00:37:17			
Unused Items			00:00:00			
PROGRAM			00:00:00			
NGUYENCONG1			00:37:17			
B1_PHAYPHANG_NC1			00:10:24			
FLOOR_FACING	✓	D63	00:08:45	0.5000	600 mmpm	606 rpm
FLOOR_FACING_FINISH	✓	D63	00:01:27	0.3000	400 mmpm	909 rpm
B2_PHAYMATXQ_NC1			00:23:35			
WALL_PROFILING	✓	D20	00:06:25	2.0000	800 mmpm	1061 rpm
WALL_PROFILING_COPY	✓	D20	00:16:58	2.0000	300 mmpm	2546 rpm
B3_KHOANLO_NUOC			00:00:58			
SPOT_DRILLING	✓	STD_DRILL	00:00:07		.12 mmpr	2546 rpm
DEEP_HOLE_DRILLING	✓	KHOAND8	00:00:26		.15 mmpr	3979 rpm
B4_VATMEP			00:02:20			
CHAMFERING_MODELED	✓	CHAMFER_MILL	00:02:08	0.0000	250 mmpm	1061 rpm

The tool paths as the figure 10.

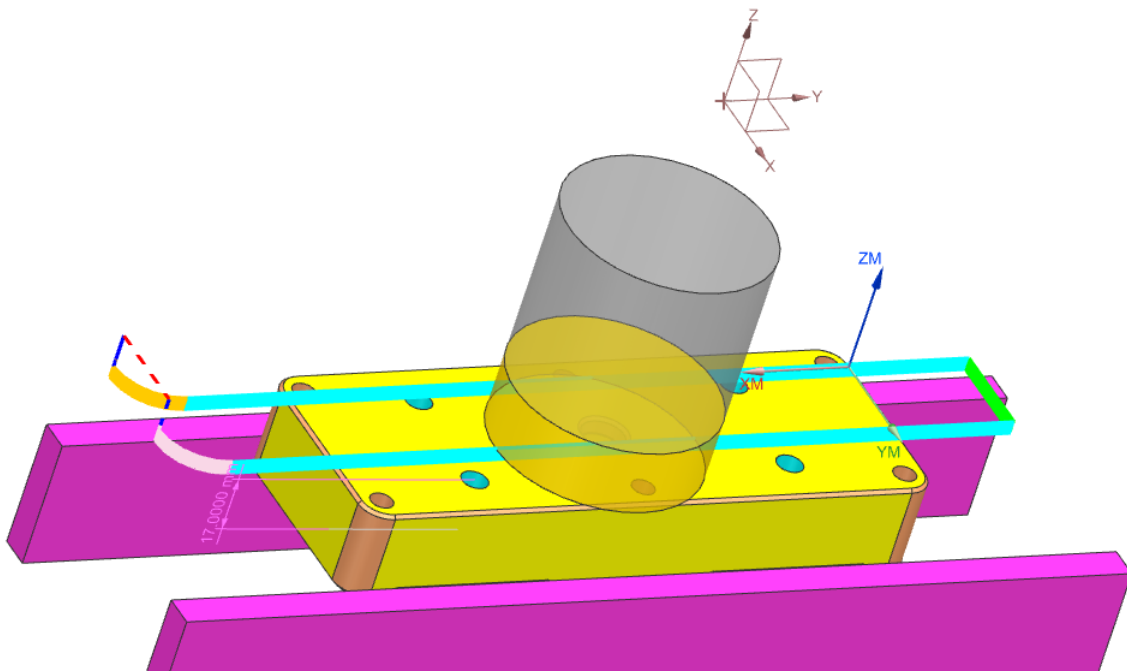


Figure 10: The tool path in one step of operation 1.

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The parameters of operation 2 as the table below:

Name	Path	Tool	Time	Depth of Cut	Feed	Speed
NC_PROGRAM			04:09:38			
Unused Items			00:00:00			
PROGRAM			00:00:00			
NGUYENCONG2			04:09:38			
B1_PHAYPHANG_NC2			00:04:51			
FLOOR_FACING_1	✓	D63	00:02:19	0.0000	250 mmpm	1061 rpm
FLOOR_FACING_1TINH	✓	D63	00:02:19	0.0000	250 mmpm	1061 rpm
B2_PHAYXQ_NC2			00:06:59			
WALL_PROFILING_1	✓	D20	00:06:47	2.0000	250 mmpm	1061 rpm
B3_PHAYLONGKHUON_NC2			03:57:49			
CAVITY_MILL	✓	MILL_D10	00:26:23	1 mm	250 mmpm	1061 rpm
REST_MILLING	✓	MILLD6	02:22:34	.5 mm	250 mmpm	1061 rpm
REST_MILLING_COPY	✓	MILLD2	01:05:30	.5 mm	250 mmpm	1061 rpm
AREA_MILL	✓	BALL_MILLD6	00:02:33		250 mmpm	1061 rpm
B4_PHAYKENHDANNHUA_NC2	✓		00:00:00			

The tool paths as the figure 11.

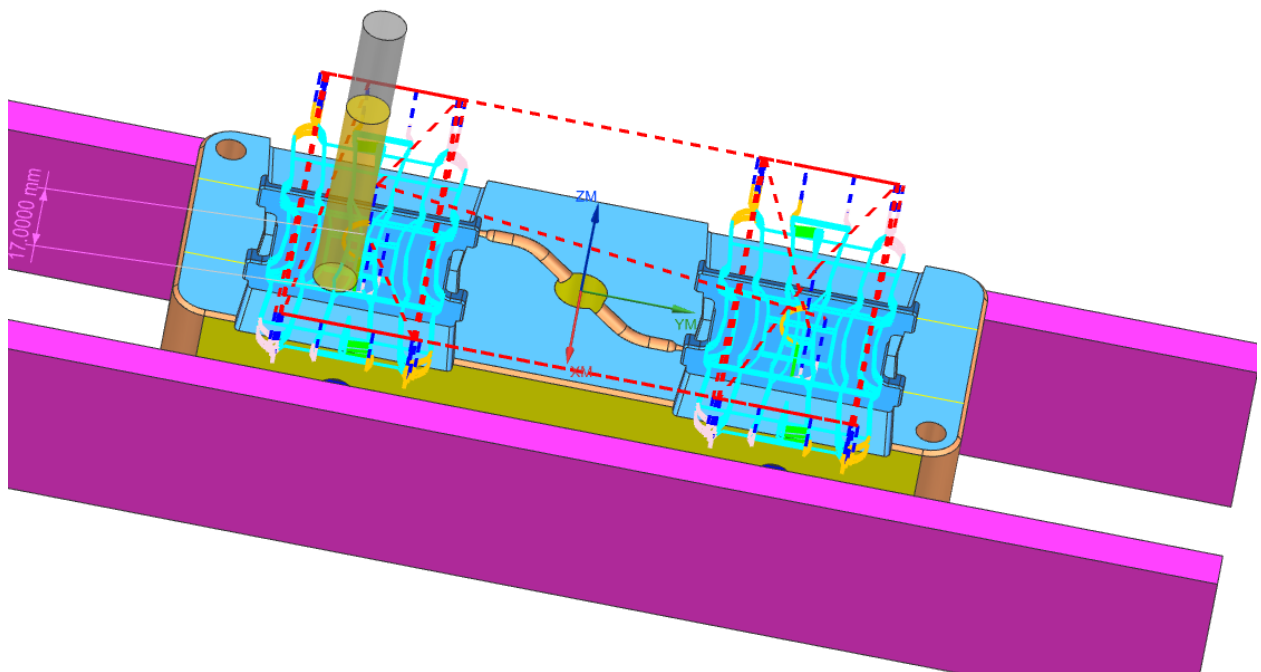


Figure 11: The tool path in one step of operation 2.

IV. Discussion

CAM software better automates the actual handling of the entire process.

It becomes more accessible to customers: The software allows users to design faster, manage projects, simulate and work faster.

Improved programming control. Excellent control capabilities result in perfectly finished parts.

Errors and scrap are kept to a minimum. CAM software provides powerful simulation functions, allowing visual inspection of the machining process.

V. Conclusion

Designing a complete mold set and simulating the machining of a cavity insert are illustrations and important applications for engineers to have a basis for choosing quick and optimal mold design software.

The simulation of detailed machining of the cavity insert also shows the efficiency and productivity of programming engineers and minimizes most waste errors.

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