MACHINING SIMULATION OF A BOWL SHAPED MOULD USING HSM INVENTOR

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ABSTRACT: The objective of this project is to produce G code and machining simulation for a bowl shaped mould. The design of this prototype and mould were made by using Computer Aided Design software of Autodesk Inventor Professional which is then simulated with the use of High Speed Machining Inventor software. The design is divided into three parts namely prototype, core and cavity. In order to generate the G code, certain type of milling processes in the HSM Inventor software is used to create the core and cavity. The simulation software will then generate toolpath that drive the selected machine tools to turn the design drawing into physical part. Throughout these manufacturing processes, parameters such as stock size, tools type, cutting parameter and axes are important in order to avoid damage and failure in design.

KEYWORDS: *Injection Moulding, Mould, Machining, HSM Inventor*

1.0 INTRODUCTION

In mould manufacturing, machining activities play a large part during the mould fabrication (Rech, Calvez & Dessoly, 2004 and Ajay, 2006). Current technology with the invention of Autodesk Inventor Professional is able to create design models by using geometrical parameters. These models typically appear on a computer monitor as a three-dimensional representation of a part or a system of parts, which can be readily altered by changing relevant parameters. The software enables designers to view objects under a wide variety of representations and to create mould from the prototype. HSM Inventor software enables the mould part core and cavity to be tested by simulating real-world machining conditions. The simulation software will then generate toolpath that drive the selected machine tools to turn the stock into core and cavity part. The software then encodes the geometrical data in G-codes and can be used to run the CNC machine that creates the designed core and cavity of a bowl. This project consists of the design and simulation of the machining process. This project was completed according to the process flow under Section 2 Methodology.

Among the measures and work done in preparing this project were:-

(i)   Designing mechanism process;
(ii)   Machining parameters; and
(iii)   Simulation process of the designed prototype.

The Table 1 shows the stages of the process flows:-

Table 1.1 Stages of process flow

Stage	Process Flow
Stage 1	Product Design Brainstorming and Selection Design the prototype and dimension it. Its important to choose for right plane. Use XY plane for start a drawing. After finishing the drawing, find suitable mould base for the prototype. Sketch the shape of the core and cavity with dimension according to the mould base. If necessary change the prototype to suite the mould base.
Stage 2	Mould Design (Core and Cavity Parts) Using Autodesk Inventor, design the mould base according to standard mould base. From this standard mould base create the cavity part. The cavity part dimension is as the outside dimension of the prototype. Then create core part by using the same mould base part and use the inside dimension of the prototype. After complete the core and cavity parts, make an assembly for the core and cavity. Any defect can be seen from the assembly drawing. Make an adjustment if this happens.
Stage 3	Stock Setup Setup the UCS coordinate at the top centre of the stock and make sure the z axis is pointing up ward. Then set the size of stock and if necessary set the offset according to the size of the core plate and cavity plate. The offset is only in XY direction and positive Z axis.
Stage 4	Machining Parameters for Cutting Core and Cavity Parts First set the type of machining to milling and used 3 type of cutting process:- (i) Adaptive with offset; (ii) Facing; and (iii) Contour. For each process set the tool type, geometry of cutting, height, XXX and YYY. Use adaptive, contour, and horizontal for the core process. Then for the cavity process, use adaptive 3D, contour 3D and horizontal 3D.
Stage 5	Simulation Process After complete the machining parameter, used simulation to see the real cutting process.
Stage 6	Generate G-Code from HSM Inventor Post processes are selected to take the G-code. First, change settings, Haas Automation and the programme code is 2002 and post. It will give all the G-codes for the core and cavity.

2.0 METHODOLOGY

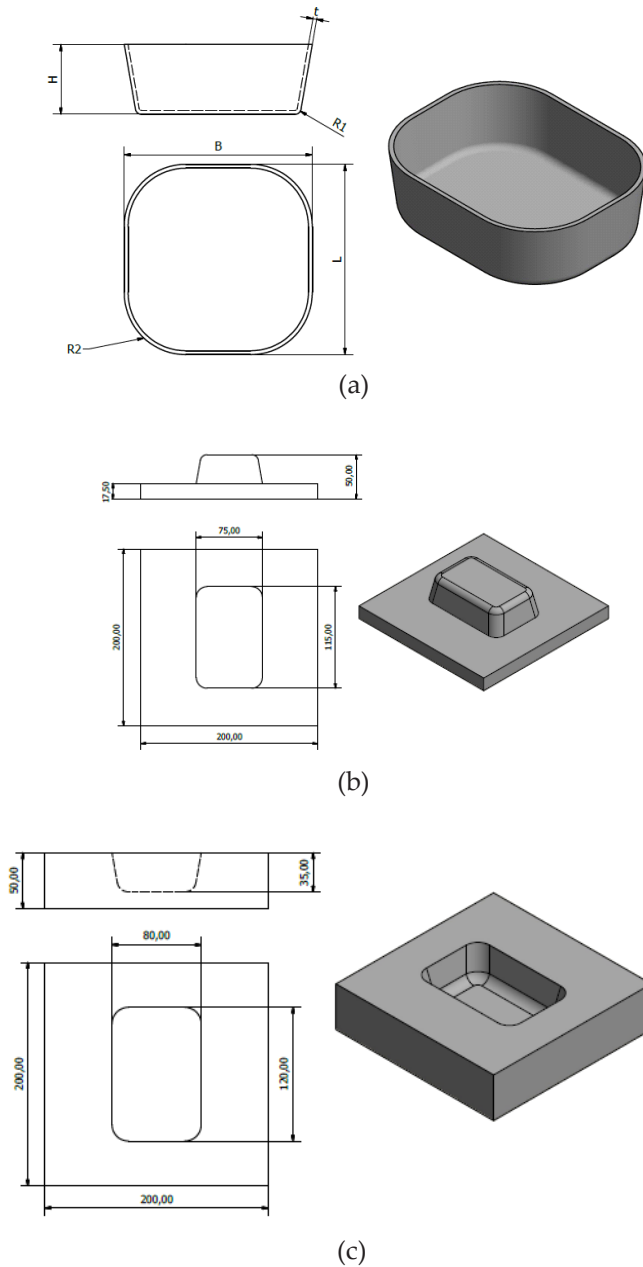The design is divided into three parts namely prototype, core and cavity as shown in Figure 1.

(a)

(b)

(c)

Figure 1: Design of the bowl shape (a) cavity, (b) core and (c) cavity

3.0 RESULTS AND DISCUSSION

In the simulation results, it shows the right tools to be used in cutting as shown in Figure 2. The diameter or body length can also be changed, for example such as to make it smaller or bigger. The right of setting steps such as adaptive, contour, horizontal, vertical, pocket and so on need to be observed (Rao, 2010). Contour is where the finishing process for the cut is applied. The advantage of part of simulations is one can trial and error in order to have good finishing. From the comparison side, the application of HSM Inventor can make the process easier other than using manual processes. Furthermore, it can save time, simple steps and easier to make any design. For the modified parts, we will know the right settings to apply on a prototype. For example, if the simulation is not at the right cutting part, then will need to change the tools and so on.
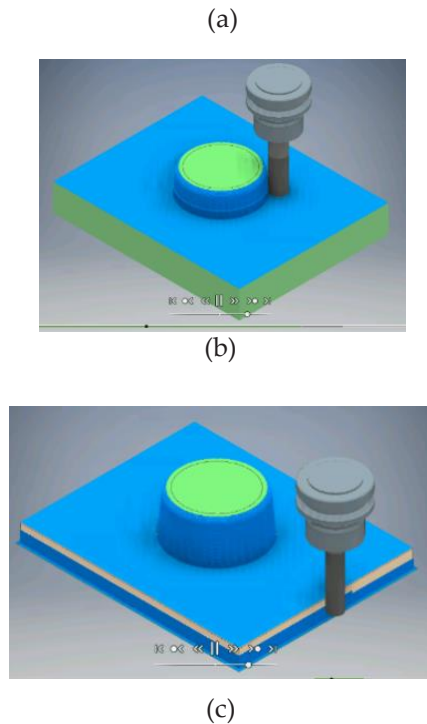
(a)

(b)

(c)
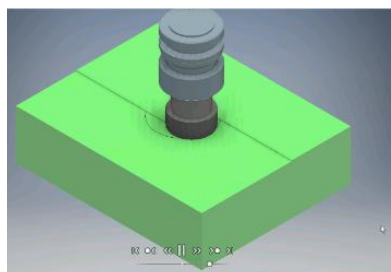
Figure 2: Types of Cutting Process (a) facing, (b) adaptive and (c) contour processes.

4.0 CONCLUSION

The understanding of the mould structure and its function especially from the cavity side of the mould is important in choosing the most appropriate manufacturing process for the mould construction. In this project, obtaining the tolerance of the mould dimension needs to be as precise as possible. The scope of this project was to study and verify the dimensions of the bowl for suitable simulation processes. These include of the understanding of all components in the mould and each of its function. Lastly is to develop the cavity of the mould by using most suitable manufacturing process.

5.0 REFERENCES

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