STUDY REGARDING COMPLEX SHAPES MANUFACTURING USING CAM

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Abstract: In the case of complex cavities shapes, manufacture using classical methods proved to be a very difficult process. Classical methods imply splitting the part in many leveling planes, the distance between them being given by the depth of the cut and the feeding rate. The purpose of this paper is to present how cavities are made using CAM softwares, mainly SolidCAM and how fast this method is in comparison with the classical one. A mold cavity of a complex shape is presented as the example of this aspect. The cavity of the mold was made using 3 axes machine tool equipped with Heidenhain CNC control.

1. INTRODUCTION

Today, by using special software for manufacturing, it is very easy to manufacture a part with complex 3D shapes. The limit is given by the aptitudes of the manufacturing engineers that can select numerous processing technologies that various CAM softwares generously offer. The problem that arises is how to realize a complex part without using CAM software. We can consider as the motivation for this, high cost of such softwares and inability of the company to purchase this software (considering that they have an initial cost and a possible maintenance cost). Motivation is very realistic in the present context.

We consider a complex 3D piece which is part of a mold; actually it is the core of the mold which gives the interior shape of the piece. The part realized in SolidWorks CAD software can be seen in Figure 1. This is a punch type part, with two cores (that makes two models, left and right) with the gate runner channel central disposed, realizing a fine adjustment with the other part of the mold. The settlement is very clear, a deeper assembly or shallow leading to a spoilage. The plate of the core cavity contains four holes for four screws with a role in securing the movable mold plate with the injection molding machine mobile plate.
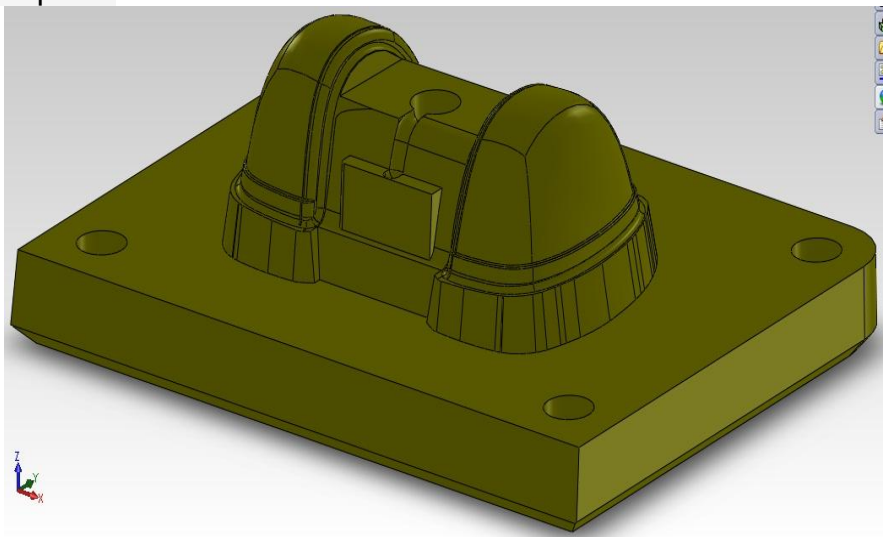

Figure 1 3D design of the piece that should be manufactured using CAM software

2. PART MANUFACTURING USING CAM

The part presented above can be done very easily and in a short time using modern design instruments, i.e. CAM software. SolidCAM is one of the most used software in today manufacturing processes. It runs very well under SolidWorks CAD software, which is very powerful CAD software and it allows designing extremely complicated products. Hence, having the CAD environment in which the part can be created and the CAM program included in it, the loss of time for transferring parts from one environment to another is excluded and also the imported part is not with gaps like it would be if it were exported in another CAM environment. Steps in designing are simple, the software having a friendly interface for engineers, a tool library from were different types of cutting tools can be set according to the reality from the factory. Also, it includes various manufacturing technologies so the design engineer is not forced to develop a strategy for every operation. The most important aspect of using CAM softwares is the possibility to simulate the manufacturing process before the bulk material is even brought to the machine-tool. Thus, any error in part manufacturing can be retrieved before the post processing program is send to the machine-tool CNC equipment. The part from Figure 1 can be manufactured using SolidCAM following few steps which represent actually a technological plan.

First, it is necessary to choose a coordinate system for the part that has to manufacture which is taken in the middle of the part, in this case (Figure 7).
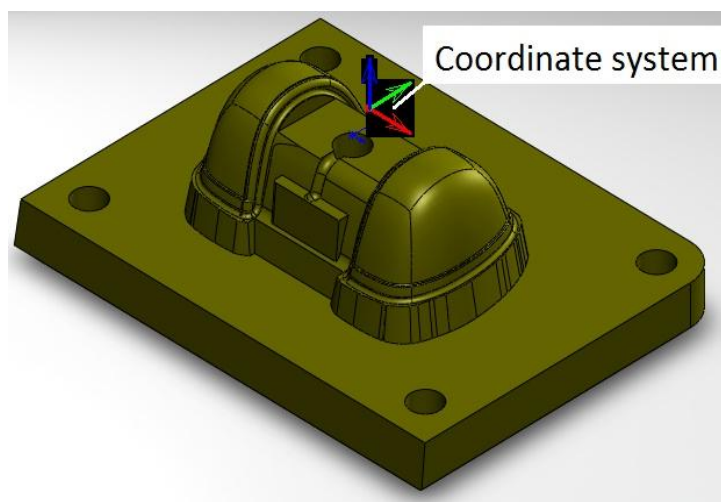

Figure 7 Coordinate system defining

After defining the coordinate system, the bulk material also has to be defined. The bulk material is a parallelepiped with 1 mm material addition on Z axis and on the X and Y axis being at the final quotas. The target model is the next parameter that has to be defined. It is exactly the CAD part or the final part.

For the post processing module we choose FANUC CNC equipment. The last step before defining the technological operations is to add the tools that have to be used for the manufacturing. According to the technological plan, we can define all the tools necessary for these operations in conformity with the tools that exist in the factory. If there will be any modification during the programming of the operations, the tools can be modified without any consequences.

First operation is face milling, to reduce the 1 mm material addition of the bulk. The rest material for the next operation should be 0.1 mm which will be milling at roughing and finishing operations.

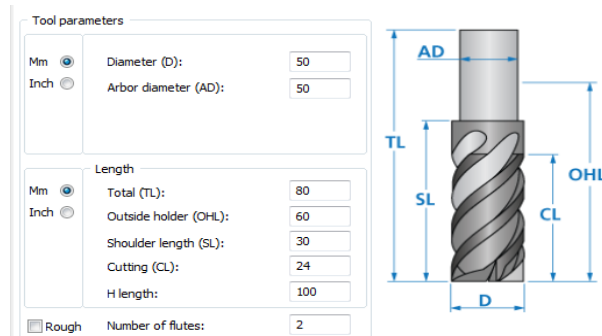The roughing operation is next and it is made using a 50 mm diameter mill cutting tool (Figure 8).

Figure 8 Part tool table

An image from SolidCAM during the roughing operation is shown in Figure 9.
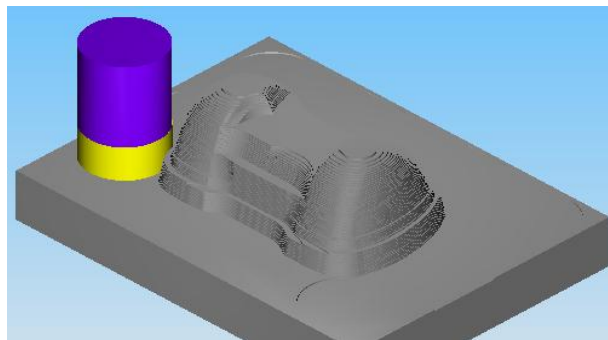

Figure 9 Roughing operation (final-with the tool)

Semi-finishing operation is made using a 12 mm ball-nose mill cutter. A print screen of this operation can be seen in Figure 10. The rest material can be periodically checked using program tools such as colors. We can define a colors palette for negative dimensions (to much material remove from the part), 0 (desired value) or positive (rest material).
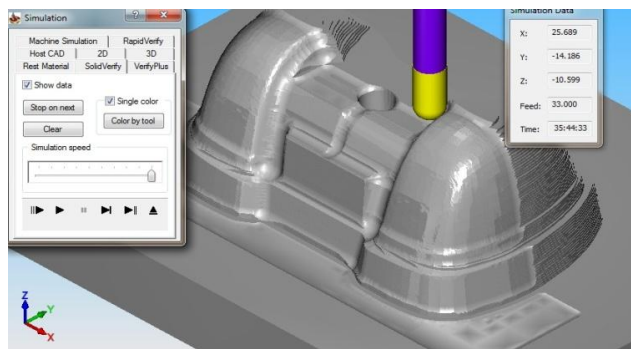

Figure 10 Semi-finishing operation

After the semi-finishing operation comes the finishing operation. For this, we can keep the previous technology as for the semi finishing, changing only the cutting tool. A 6 mm diameter ball-nose mill cutting tool is chosen instead and all the cutting parameters and rest of material will be chosen for this. The offset from the final surface will be 0.

The final stage is drilling holes for setting the core cavity on the injection machine

plate table. An 18 mm drill cutting tool is taken for this operation. The burrs will be removed manually. After all these operations are done the post processor will help us writing the program that has to be introduced in the CNC equipment. The manufactured part looks like in the pictures in Figure 11.
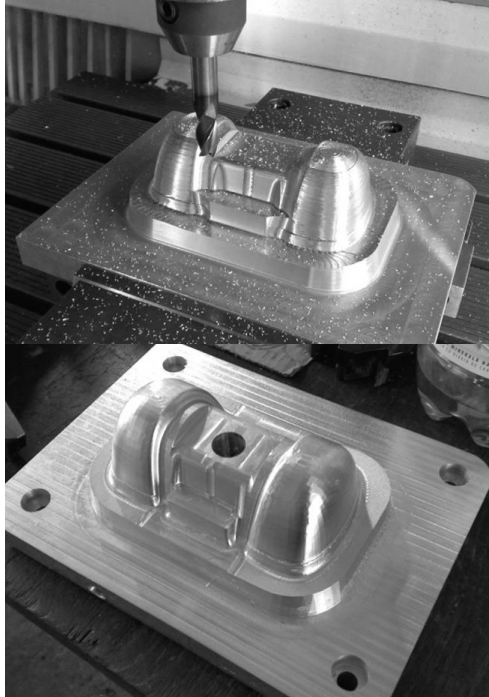

Figure 11 Pictures of the core manufacturing

3. CONCLUSION

Even if mathematically we are able to determine the contours of the part, too much time involved in obtaining the program for CNC equipment, the possibility to obtain spoilage and also the high costs caused by some deficiency, require using CAM software. Parts with complex shapes constrain such an acquisition. The success in manufacturing complex shapes does not depend only on the CAM software attributes, but also on the technological engineer who conceives and designs all these processes.

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