THE CAD-CAM DESIGN OF THE DIE CASTING MOLD FOR GYPSUM SOUND ABSORBING PANELS

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Abstract: This study deals with the technology of manufacturing the mold for casting sound absorbing panels. The mold presented at A1 was designed with the assistance of a CAD program, SolidWork 2008 type, after which a CAM program, Solid CAM, was use for the simulation.

Keywords: mold manufacturing, aluminum, CAD-CAM program

1. INTRODUCTION

In order to obtain the gypsum sound absorbing panels, the design and the making of the die casting molds are necessary. The manufacturing technology of the die casting molds for gypsum sound absorbing panels has more stages:

- Designing the mold
- Making of the mold
- Preparing of the gypsum for casting
- Preparing a silicon mold for gypsum casting
- Casting of the gypsum into the silicon mold
- The extraction of the gypsum panel shape
- The drying
- Encasement/ packing up

2. DIE DESIGN

The design stage consists of the 3D projection of the A1 die casting mold by using the SolidWork 2008 program. The die casting mold of the gypsum sound absorbing panel represents the negative mold of the sound absorbing panel's shape. The figure 1 shows the 3D drawing of the A1 die casting mold, and the figure .2 the shape of the silicon mold in which the sound absorbing panel will be cast. The mold is made of aluminum 6061, with a 300x210x20 mm size, and the sound absorbing panel will represent a combination of simple geometrical forms.

For the making of the mold, the manufacturing on a CNC machine tool was chosen. Thenceforth we describe the stages of the program.

The stages the workpiece has to pass through are:

a. the selection of the semiproduct
b. the selection of the manufacturing technology
c. the selection of the working tool
d. the selection of the splintering tools

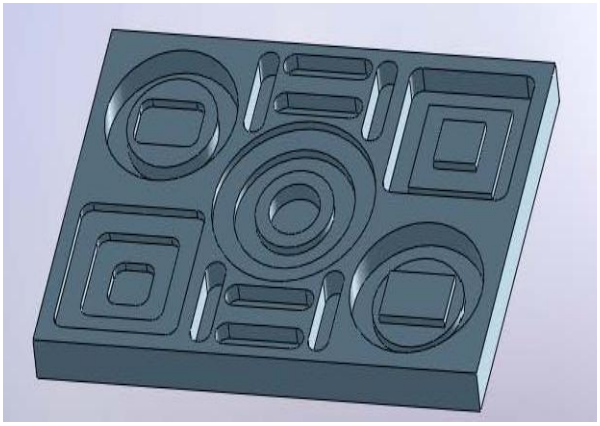

Fig.1. The 3D design of the A1 mold

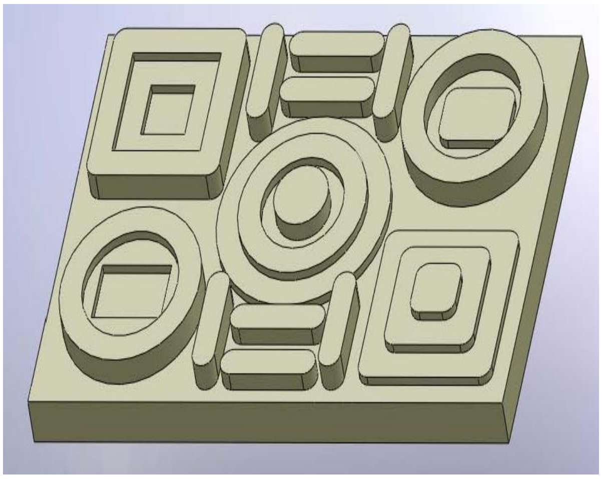

Fig.2. The 3D design of the silicon mold

The workpiece, previously designed with the aid of Solid Works, opens in the working window of the Solid CAM and then, the types of operations that have to be made are selected (fig 3).

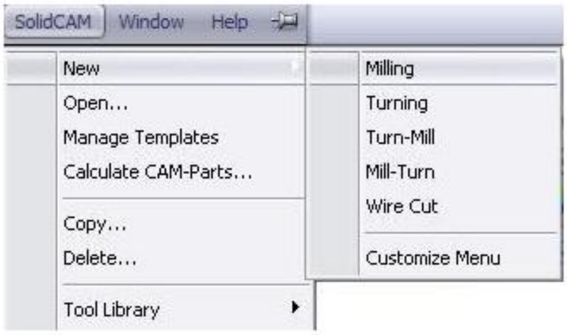

Fig.3. The operation choice menu

The next step is to define the new CAMpart, which means the creation of a new director for the workpiece, director in which all the files of the module will be stored/saved. This director may be by default or a new one may be created.The semiproduct/preform is chosen so that it has manufacturing additions all over the surface that is to be splintered. Figure.4 presents the definition of the work directory with the option of working inside the directory of the workpiece.

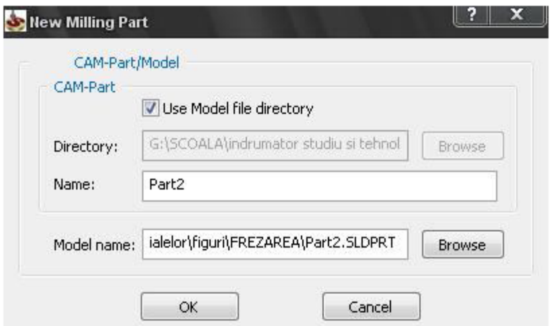

Fig.4. The work directory choice menu

In order to manufacture the whole workpiece, two systems of coordinates need to be defined due to the fact that, at a certain moment during the production technology a new manufacturing of its inferior area will be necessary.

The selection of the second system of coordinates is made in a similar manner as for the first one, as there are no other aspects that need observation. The only aspect one has to consider is that when the manufacturing of the inferior area is wanted, one will have to select the second system of coordinates in the dialogue window of the operation. The main system of coordinates was selected in the middle of the workpiece manufacturing in order to facilitate a subsequent intervention on it.

The semiproduct/preform is a parallelepiped in which the workpiece is inscribed and which is larger by 2 mm on the z-positive axis and by 10 mm on the z-negative axis. For the other direction one shall chose "0" meaning the semiproduct/preform has the dimensions of the workpiece (fig 5).

After the dimensions of the semiproduct/preform were selected, "Stock model" and "Target model" will be further on defined.

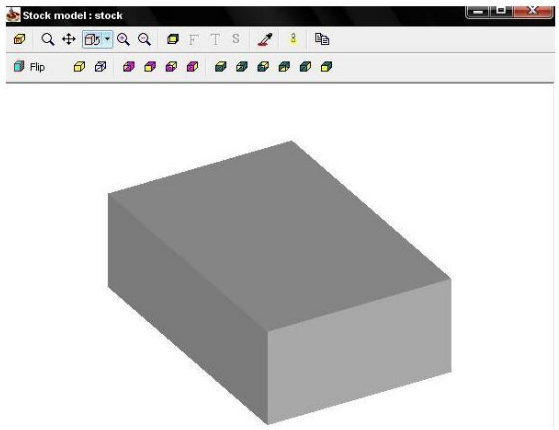

Fig.5. Stock model definition

After all the aspects related to the preparation of the workpiece for manufacturing have been defined, the next step is the selection of tools that are going to be used for milling, drilling, etc, from a tool table. Figure 6 presents the tool table that the Solid CAM program offers for the operations of milling, drilling, boring, etc.

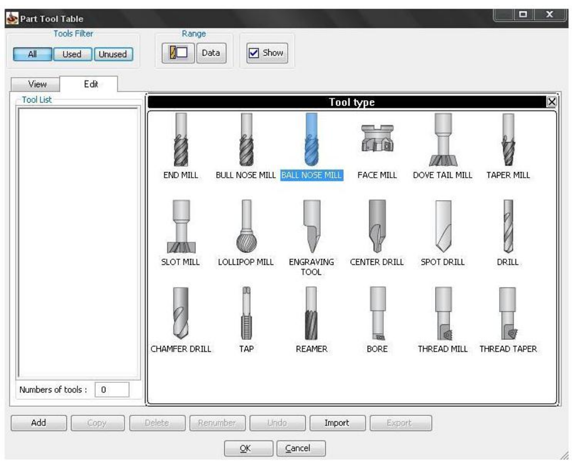

Fig.6. Table of the mill types of the Solid CAM program.

The next step consists in selecting the tools for the operations that must be performed in order to obtain the mold, and the definition of their parameters. These tools are:

- tool 1 – drill Ø 12 mm;
- tool 2 – end mill Ø 12 mm.

Knowing also the stages that are necessary for the manufacture of the workpiece, next step may take place: the actual manufacturing of the workpiece in order to generate a program for it, program that later on will be trasmitted to the machine tool and will phisically manufacture the workpiece.

The Solid CAM program posseses more options to manufacture a workpiece.

In figure 7 one can see the operations as they were selected to manufacture by milling the selected piece. Their order/sequence takes into account the technological steps that were proposed in order to manufacture the workpiece.

In figure number 8 one can see, in the visualising mode „Solid Verify", the execution stages of the workpiece begining with the parallelepiped semiproduct/ preform, with a 2 mm addition on the superior area and a 10 mm addition on the inferior one.

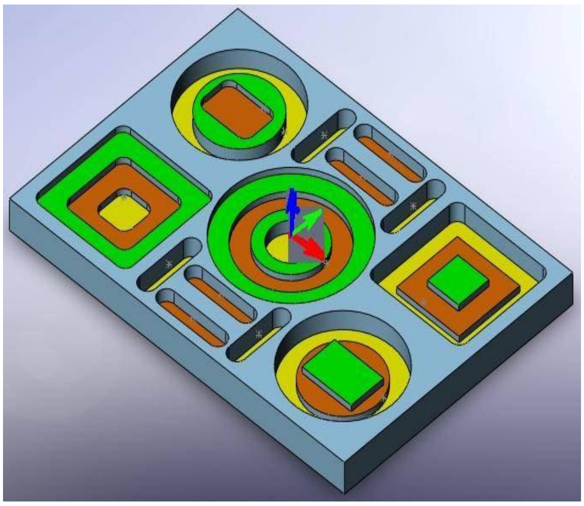

Fig. 7. Defining the level planes where the delineation operations will take place

Only the roughing manufacturing is shown, "rough", the semifinishing and finishing operations not being simulated. If the simulation is satisfying, one can move on to details that regard the surface of the workpiece (roughness, tolerance) and can define the finishing operations. Then, the program that will be loaded in the memory of the machine tool that will execute the workpiece is generated.

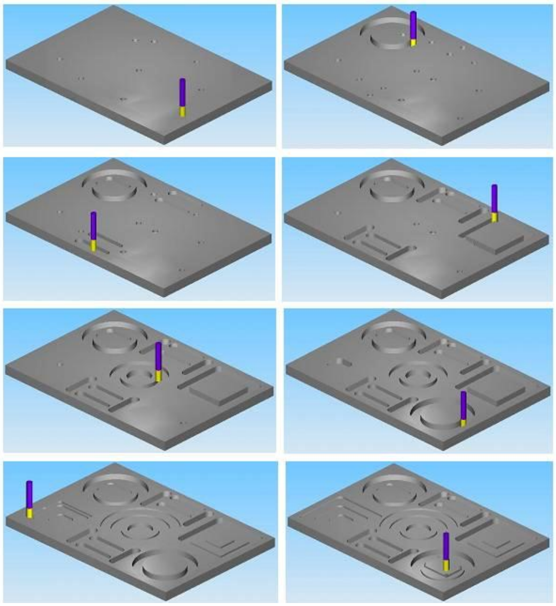

Fig.8. The simulation of the manufacturing stages.

The CNC program is generated by the CAD-CAM procedure described before.

3. DIE MANUFACTURING

The manufacturing of die has made by center machine tools "Machining Center 550 PN" from Italy, with CNC type Sinumerik 3 to Siemens, placed in Mecatronic Lab of IMT Faculty, from Oradea University.

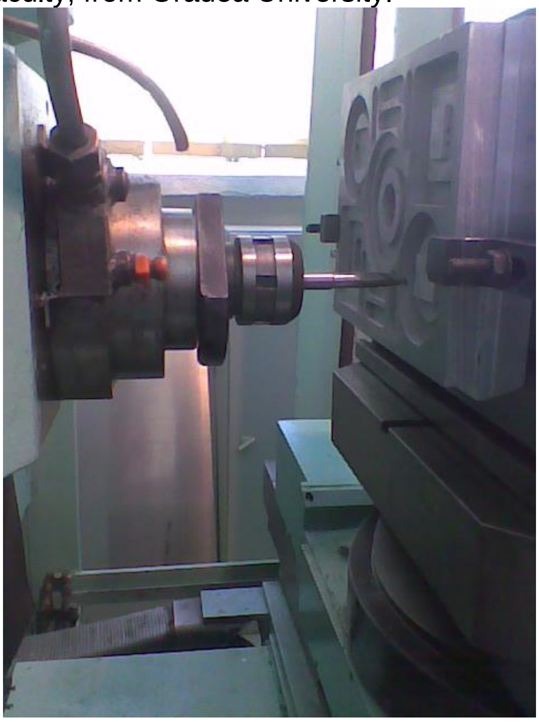

Fig.9. The manufacturing of die on center machine tools.

The cutting was done with the following characteristics:

- spindle speed for rough finish=500-800 rpm,
- feed for rough=30mm/min,
- feed for finishing=15mm/min,
- The main tools used for cutting:
  -end milling cutter of Ø6mm, Ø8mm and Ø14mm,
  -drilling cutter of Ø8mm, Ø10mm and Ø12mm.

4. PREPARING OF GYPSUM

The material used for casting is gypsum on base of alpha plaster with 95% and perlite with 5%, which is used of light cassette panels with sonic absorbent and thermal isolator properties. The characteristics of gypsum are:

-The time setting is:

- Initial time of 11 min,
- Final time of 20 min,

-Water of normal consistent of 70%

5. SILICON DIE FOR GYPSUM CASTING

The aluminum die is used for obtaining o silicon mask, in which the gypsum material will be getting in for casting.

To realize the extraction of gypsum form from die after casting it's required to do a plastic die from silicon (Fig.10). This mask has obtained by pouring the silicon in aluminum die, resulting the silicon die for casting of gypsum.

Fig.10. The silicon die for casting of gypsum.

6. GYPSUM CASTING

The gypsum obtain before is pouring in the silicon die, which is placed in a wood frame that its height is in function of sonic absorbent panel's thickness.

7. EXTRATION OF GYPSUM MODEL

The gypsum casting form is pulling out from flexible silicon die and put to drying during 24-26 hours for straightening.

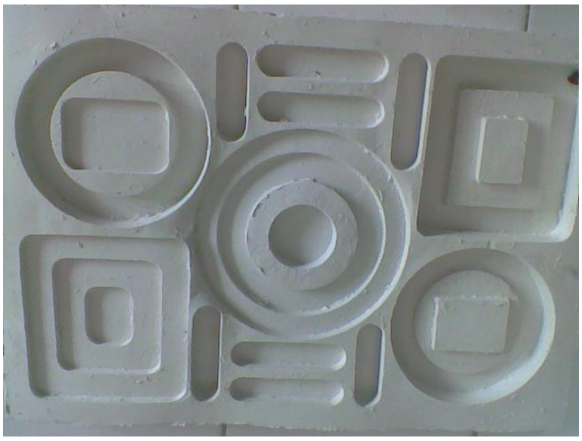

Fig.11. The model of gypsum casting.

The drying is realized in natural mode by lying a gypsum model obtains to casting at room temperature during 48 hours.

After drying the gypsum panel is trimming and packaged for protection and delivery.

8. SOLID CAM PROGRAMS

The mold processing technology of using SolidCAM FANUC simulation equipment is:

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%
O5000 (AL 001.TAP)
( MCV-OP ) (27-JUL-2010)
(SUBROUTINES: O2 .. O0)
G90 G17
G80 G49 G40
G54
G91 G28 Z0
G90
M01
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N1 M6 T1
( TOOL -1- DRILL DIA 8.0 MM )
G90 G00 G40 G54
G43 H1 D31 G0 X-60.691 Y55.596 Z50.
S1000 M3
M8
(------------------)
(D-DRILL-T1 - DRILL)
(------------------)
  X-60.691 Y55.596 Z10.
G98 G81 Z-12. R2. F33
   X-40.194 Y70.999
   X40. Y71.
   X98. Y21.
   X0. Y0.
   X-98. Y-53.
   X-40.226 Y-71.001
   X40. Y-71.
   X132.494 Y-51.
G80
(-------------------)
(D-DRILL1-T1 - DRILL)
(-------------------)
G0 X-83. Y59. Z10.
G98 G81 Z-8. R2. F33
   X0. Y65.
   Y91.
   X31.935 Y0.
   X0. Y-65.
   Y-91.
G80
G91 G28 Z0
G90
M01
N2 M6 T2
(TOOL -2- MILL DIA 8.0 R0. MM )
G90 G00 G40 G54
G43 H2 D32 G0 X-60.691 Y55.596 Z50.
S1000 M3
M8
(---------------------)
(P-CONTOUR-T2 - POCKET)
(---------------------)
  X-60.691 Y55.596 Z10.
  Z2.
G1 Z-12. F33
  X-62. Y51. F100
G3 X-62. Y51. I-34. J0.
G1 X-61.6
G3 X-61.6 Y51. I-34.4 J0.
G1 X-58.8
G3 X-58.8 Y51. I-37.2 J0.
G1 X-56.
G3 X-56. Y51. I-40. J0.
G0 Z10.
(----------------------)
(P-CONTOUR1-T2 - POCKET)
(----------------------)
  X-83. Y59. Z10.
  Z2.
G1 Z-8. F33
  X-98. Y48.4 F100
  X-88.4
  Y53.6
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   X-107.6
   Y48.4
   X-98.
   Y45.6
   X-85.6
   Y56.4
   X-110.4
   Y45.6
   X-98.
   Y42.8
   X-83.
G3 X-82.8 Y43. R0.2
G1 Y59.
G3 X-83. Y59.2 R0.2
G1 X-113.
G3 X-113.2 Y59. R0.2
G1 Y43.
G3 X-113. Y42.8 R0.2
G1 X-98.
   Y40.
   X-83.
G3 X-80. Y43. R3.
G1 Y59.
G3 X-83. Y62. R3.
G1 X-113.
G3 X-116. Y59. R3.
G1 Y43.
G3 X-113. Y40. R3.
G1 X-98.
G0 Z10.
```

9. CONCLUSION

The paper has presented a technology of aluminum die manufacturing for gypsum casting, which used SolidWorks Program for design and Solid CAM for simulation.

The manufacturing process has realized by “Machining Center 550 PN” with CNC type Simulink 3, and the results of gypsum casting with aluminum die was good that recommend this proceeding for fabrication of aluminum dies used in this scope.

It is remark that for casting of gypsum a silicon mask is necessary, which is made into aluminum die to ensure the extract of gypsum form in good conditions.

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