

CAD-CAE-CAM METHODOLOGY FOR OBTAINING COMPLEX PARTS

Cristian COSMA*, Danut SOSDEAN*, Adrian DUME*

* Mechanical Engineering Faculty, Bv. Mihai Viteazu 1, RO 300222, Timisoara, Romania,
cristian.cosma@upt.ro, danut.sosdean@upt.ro, adrian.dume@upt.ro

Abstract. With the passage of time the demand for consumer goods has grown enormously and is continuously growing. Parts made of plastics are at the forefront of these goods. With ever increasing CAD-CAM-CAE system performances, the complexity of design and process problems which can be analyzed is expanding. This paper aims to present the methodology for obtaining a part following CAD-CAM-CAE itinerary.

Keywords: design, part, simulation, mold

1. Introduction

Every day we are surrounded by objects that are the product of centuries of scientific and technological development. The production process is an engineering activity that generally ends with the achievement of technical objects.

The main stages of development of a product are: defining a general concept of product, technical project to establish manufacturing technology, development of experimental model and product approval, production itself.

Injection molding is one of the most significant processes for manufacturing of plastic products and approximately one-third of all plastics are converted into parts using injection molding processes [1]. While plastic part design is complex, consistently producing injection-molded parts free of manufacturing defects is possible with some preparation [2].

Simulation increases decision-making confidence and provides insight into what, where, and how to adjust in-progress designs. This cycle of making and validating decisions throughout the design process is called simulation-driven design—and it's being used more and more by leading manufacturers. Hardware and software advances have continued to reduce simulation times from days to hours to minutes, making it possible to explore and validate more design

iterations in less time, and to significantly increase ROI by optimizing product designs and finding problems before manufacturing [3].

Virtually any product can be achieved without significantly increasing costs and / or production time [4], [5].

The case study is to design a housing for a mobile phone; manufacturing technology is the injection mold.

2. Design part

2.1. Modelling part

Part design was done in Solid works software. The proposed solution is simple and the steps are presented below:

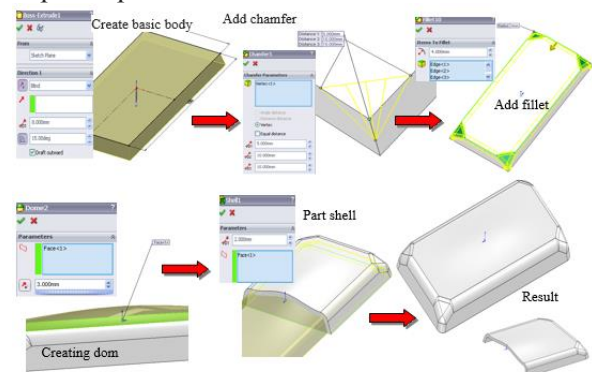


Figure 1 Part design

2.2. Computer aided engineering

Computer-aided engineering (CAE) is the use of computer software to simulate performance in order to improve product designs or assist in the resolution of engineering problems for a wide range of industries. This includes simulation, validation, and optimization of products, processes, and manufacturing tools [6].

To see the effect of a strong action on this part was performed a static simulation. Steps taken to achieve the simulation are presented in figure 2.

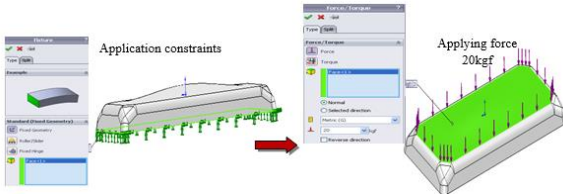


Figure 2 Static simulation

In figure 3 are presented the result obtained.

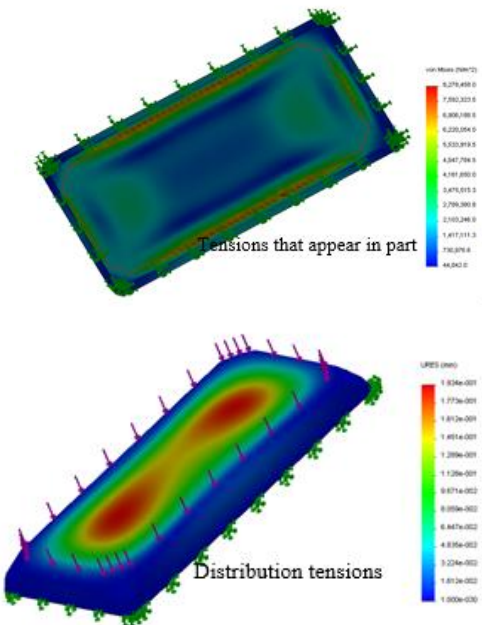


Figure 3 Results obtained

After the simulation is observed we can see the deformation of the workpiece possibility.

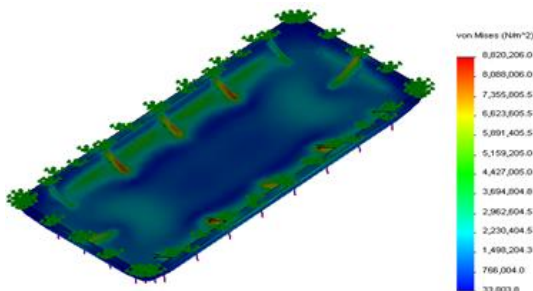
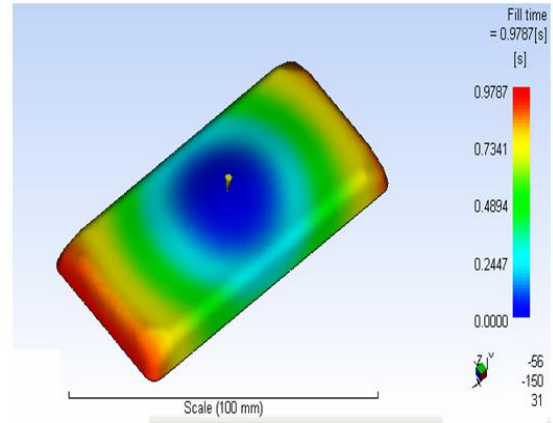


Figure 4 Simulation application reinforcing ribs

To eliminate this drawback will apply stiffening ribs. In figure 4 we can see that solicitations are absorbed by the reinforcing ribs.

In the simulation will be a study of the part from the point of view of injection (Moldflow). It will examine whether the part has a minimum inclination of 3 degrees walls. Also during the simulation will be an analysis of mold filling (filling time) figure 5.



Your part can be filled easily with acceptable quality using the current injection locations.

Actual filling time	0.98 (s)
Actual injection pressure	14.294 (MPa)
Clamp force area	17.4202 (cm ²)
Max. clamp force during filling	1.269 (tonne)
Velocity/pressure switch-over at % volume	99.12 (%)
Velocity/pressure switch-over at time	0.96 (s)
Estimated cycle time	17.44 (s)
Total part weight	12.400 (g)
Shot volume	12.5606 (cm ³)

Clamp force estimate during packing using:	
20% of the injection pressure	0.508 (tonne)
80% of the injection pressure	2.031 (tonne)
120% of the injection pressure	3.046 (tonne)

Figure 5 Filling time

When considering part and mold design, gate location and part filling are initial concerns. The simulation will provide a visual representation of how the mold will fill (figure 6).

This information is valuable in showing potential problems, such as areas of the part that will not completely fill with plastic. It will also show where weld lines develop, areas on the part where two different flow fronts meet and plastic "welds" together [7].

Pressure results derivation discusses the color distribution of this result. At the beginning of filling, the pressure is zero everywhere in the mold. The pressure at a specific location starts to increase only after the melt front reaches that location.

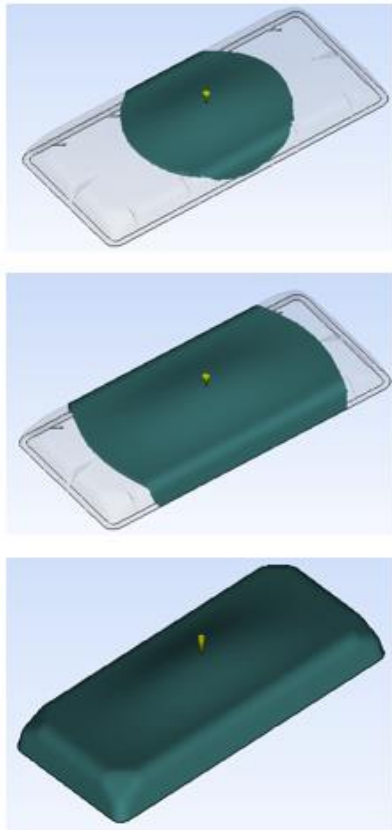


Figure 6 Injection mold filling simulation

The pressure continues to increase as the melt front moves past, due to the increasing flow length between this specific location and the melt front. The typical maximum hydraulic pressure of an injection molding machine ram is around 14 MPa (in our case 14.29Mpa), figure 7. When the polymer is injected and is forced into the nozzle, there is a pressure intensification factor of between 8 -15 due to the smaller area of the ram compared to the hydraulic cylinder moving the ram [8].

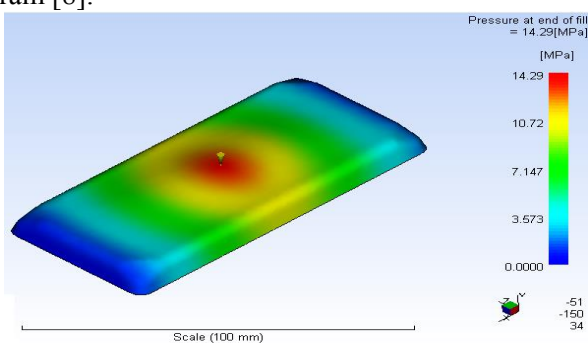


Figure 7 Pressure during filling

The Temperature at flow front result uses a range of colors to indicate the region of lowest temperature in blue through to the region of highest temperature in red. The colors represent the material temperature at each point as that point was filled. The result shows the changes in

the temperature of the flow front during filling (figure 8).

If the flow front temperature is too low in a thin area of the part, hesitation or short shot may occur. In areas where the flow front temperature is too high, material degradation and surface defects may occur [9].

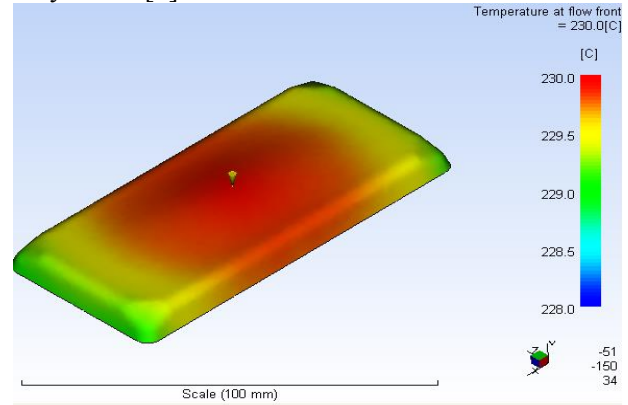


Figure 8 Flow front temperatures

3. Realization of mold cavities

Mold cavities have been designed in SolidWorks Mold Tools module. The material of which will be made part is ABS. The contract will be between 0.4 - 0.6% - using the Scale function.

Typically, the first step in designing the cavity and core for a mold is to apply a shrinkage factor to the part based on its material. Usually, the next step in mold design is to create the parting surfaces that define the separation between the core and cavity.

Once you have created parting surfaces, you can use the Tooling Split command to split the mold into two solid bodies [10]. A more detailed presentation of these steps is shown in figure 9.

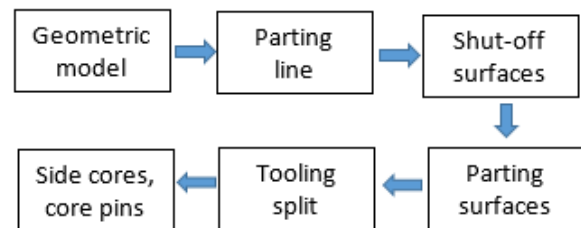


Figure 9 Workflow [11]

The two mold cavities obtained are shown in Figure 10.

To make physical mold cavities need to use a CAM software.

CAM – Computer Aided Manufacturing

The use of software to control machine tools and related machinery in the manufacturing of components.

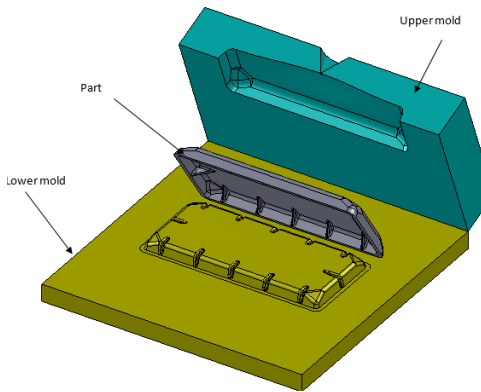


Figure 10 Mold cavities

The steps to obtain the NC file are:

- Define the Machine and modify the controller parameters;
- Define the stock;
- Part zero choice;
- Choose the machining sequence;
- Choose tools;
- Cutting parameter setting;
- Choice of strategies work;
- Simulation of machining part;
- Generation of NC program.

Simulation milling for our part (finishing) is presented in figure below:

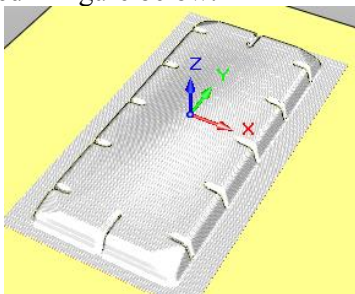


Figure 11 Simulation of machining part

4. Conclusions

In this paper was presented a simple and clear methodology for getting a part. In the study case they were awarded two stages. In the first step was made part design and its related simulations, so that in the second stage to obtain the geometric model of the part mold cavities. To achieve these things were common software used (easy to use and affordable).

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METODOLOGIE CAD-CAE-CAM PENTRU OBTINEREA PIESELOR COMPLEXE

Rezumat

Odată cu trecerea timpului cerința pentru bunuri de larg consum a crescut enorm și se află într-o continuă creștere. Piese realizate din materiale plastice stau în fruntea acestor bunuri. Odată cu creșterea performanțelor sistemelor CAD-CAM-CAE, complexitatea pieselor proiectate și problemele aparute în cadrul proceselor ulterioare și care pot fi analizate sau extinse. Aceasta lucrare și-a propus să prezinte metodologia de obținere a pieselor urmând itinerariul CAD-CAE-CAM.

Scientific reviewers:

Daniel STAN, Politehnica University Timisoara, Romania
Dorian STEF, Politehnica University Timisoara, Romania