Transylvania University of Brasov,
Romania

13th INTERNATIONAL CONFERENCE
"STANDARDIZATION, PROTYPES AND QUALITY:
A MEANS OF BALKAN COUNTRIES' COLLABORATION"

Brasov, Romania, November 3 - 4, 2016

CAD Standard Design Elements for Injection Molds

POPA Luminița
Transilvania University of Brasov, Romania, mluminita2001@yahoo.com

Abstract
The economic side of the design process required their optimization based on criteria to ensure designed products competitiveness. This paper aims to provide rapid methods of designing plastic injection moulds using CAD filing systems modelled in Solid Works. Article addresses the issue of using innovative high performance technology, integrated into a unitary concept.

Keywords
injection molds, CAD standard

1. Introduction

The representative of today's material is the plastic and in the past two decades have brought plastic products made from a wide range of benefits in optimizing a wide range of specific components across multiple domains. The share use of plastics has reached maturity in the automotive, electronic, electrical, appliances and household appliances sectors.

Plastics are a unique class of materials, but they exist in different physical and varied forms, some are hard and rigid, others are soft and flexible, some are solid, others have a cellular structure, some are transparent, others are opaque. All plastics are part of a single family of materials known as polymers. This family of materials includes rubber-like (both the natural and the synthetic), paints, adhesives and synthetic textiles. Nowadays, there are about fifty different kinds of plastics in commercial production and in many cases, for each material there are many variations and modifications. Among the most common plastics include: Polyethylene (PE), polypropylene (PP), acrylonitrile-butadiene-styrene (ABS), polyamides (PA), Polybutene terephthalate (PBT), polyacetal (POM), epoxy resins, polyurethane (PU) etc.

As manufacturing process, the plastic products can be obtained in several ways. One of the most common is called injection moulding. The products are obtained by means of plastic injection machines. Principle of operation of these machines is relatively simple. The raw material polymers in the form of granules, is brought to a certain temperature after which it is injected into a mould [1]. Low production cost is reflected in the final product cost, which is easy to see in the case of injecting plastic products.

2. Plastic Injection Mould

Injection processing is the process by which the plastic material made flow able by the action of heat is introduced under *pressure* into a mould cavity (nest) where takes place its cooling and solidification.

Processing plastic injection is subject to the following factors: the characteristics of injection machine, the characteristics of plastic and the characteristics of the plastic injection mould. Plastic injection mould is mechanical subassembly that has the role to print some form of plastic material with well-defined dimensions. In Figure 1a, b, c, there are shown the constructive elements of a plastic injection mould.

In designing of a plastic *injection* mold, we have to pay attention to cavity design mold; it directly influences the whole process of injection molding.

Considering the cavity design in the *initial* phase of the project, it will lead to a quality of injected products, in this design entering factors such as:

- Number of cavities;
- The dividing line;

- The mold type;
- The type and position of the injection;
- The distribution system;
- The cooling system;
- The throw system.

Fig. 1a. Representation in "explode" mode

Fig. 1b. Representation of assembled injection mould

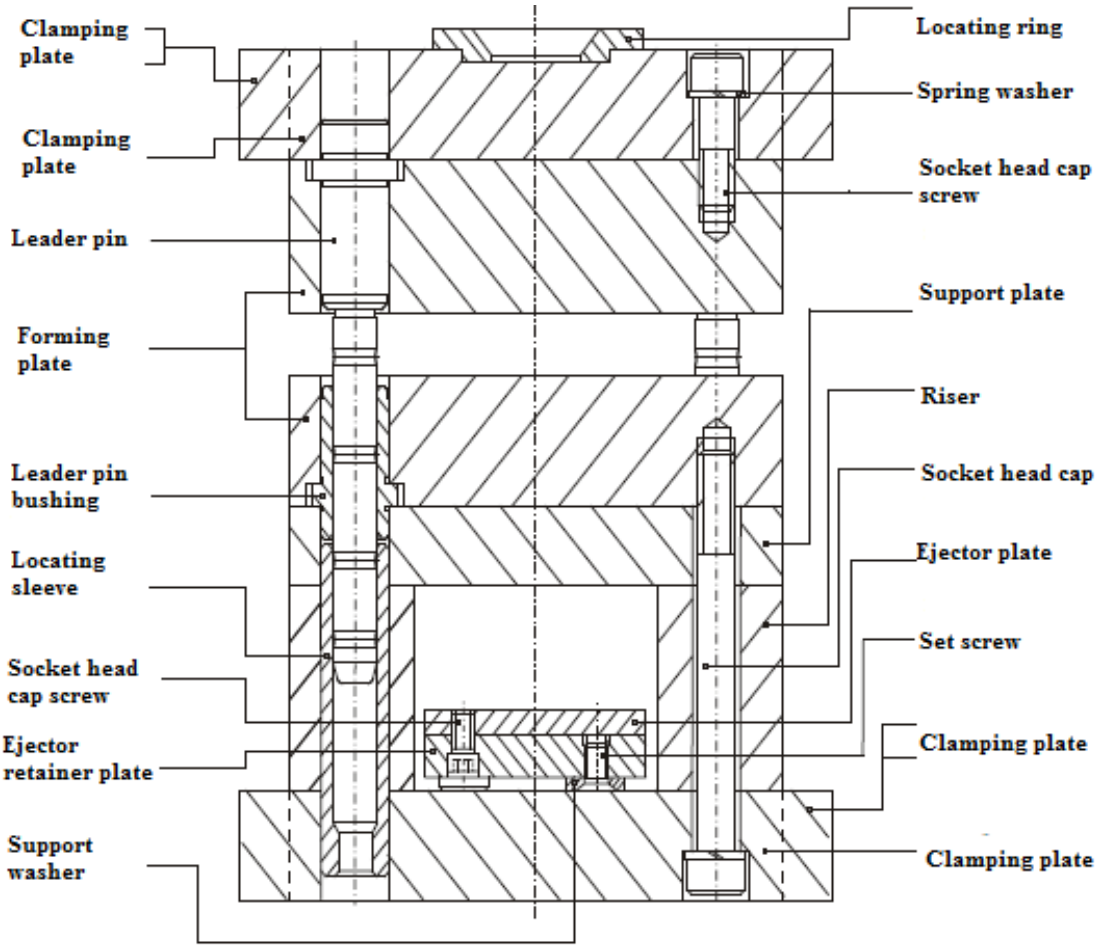

Fig. 1c. Representation of sections of plastic injection mould (the parts)

Designing a matrix model is often a time consuming activity and is not the easiest task for a designer and an engineer. If this is done according to customer specifications, the mould must provide exactly the desired shape and to withstand very large production series.

3. The Moulds CAD Design

The design processes of plastics injection molds, requires dedication, experience and innovation, and meeting all the requirements of high quality design and manufacturing.

In plastic injection mold designing, we need to pay attention to mold cavity, it directly influences the whole process of mold injection.

In order to increase molds design productivity, there are used CAD modeling software. CAD software is used to improve designed product quality, and to create an electronic and virtual database of designed products. Using this CAD software is a great way to maximize the benefits of computer assisted design.

Aided design activity is dominated by the imperative of efficiency

The organization has an essential role in the products design; this depends decisively in design efficiency. It is necessary that the entire standard not be drawn whenever it is necessary to use them, but to be stored as standardized libraries.

The software products are designed to help the design engineer to faster create documents in the ordering information fields and generate reports.

The created documents must be standardized according to specific rules, so as to enable future reuse of the information they contain, whenever necessary.

To maximize the use of CAD applications to understanding application requirements, we need to know more about these standards and the detailed form of standard design molds. Wanting to complete the product range of applications in manufacturing of molds, manufacturers have developed specialized and standardized typified elements introduced in CAD libraries in conditions of great quality.

4. CAD Libraries Standardization

A little known direction is the system of plastic injection molds components standardization. Product libraries have become essential in this system; the user searches in the database the best constructive type and extracts the archived data. There are a lot of companies that produce all the necessary elements for construction of injection moulds such as: heaters, hot nozzle, command and control systems.In order to increase the efficiency not only in the implementation but also in molds design, it has developed a standard library which contains the majority of standard products elements. Please note that the items are drawn according to ISO, differences from STAS are minimal. We select the appropriate catalog code package which is considered suitable to injected piece. The available pack sizes range is between 99.5×99.5 (code N1010) and 596×896 (code N6090) with 50 intermediate variants.

We take the elements from the shelf, or if we want to manufacture some elements alone is sufficient to distribute drawings once then just mention the relevant codes.

The CAD libraries will offer the possibility of introducing those moulds elements with hot channels in two systems.

Considering the great availability of the Romanian plastics industry, the presented library is:

- Useful to all enterprises producing injection moulds;
- In the design process, the time is reduced by at least 70%;
- Facilitates the work;
- We can use of the facilities offered by standardized libraries;

There are elements drawings organized as libraries:

- https://na.dmecompany.com/
- https://www.dme.net/resources/cad-data

The portability of files is an effective tool in design work. Creating libraries with standardized elements, it is one of the first professional-level issues.

International standardization initiative is materialized through libraries that can be transferable and portable in the design software solutions.

A family of products includes a library for drawing and designing parts and molds assemblies that:

- can easily perform multiple design alternatives;
- develops increased productivity by easing the design of buildings with complex geometry.

5. Case Study

I exemplified below a model of designing a plastic part obtained by injection moulding process using Solid Works software.

It is based on the solid which is the final part (Fig. 2) and the interim assembly module; It is inserted into a parallelepiped representing the two active components of the mould: cavity and core reunited.

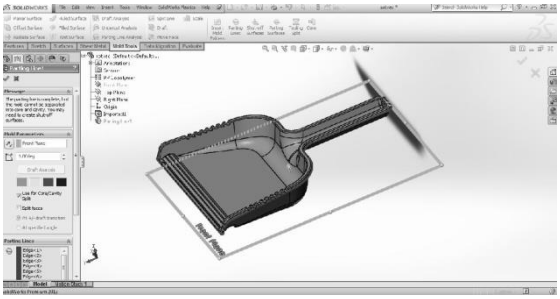

Fig. 2. Representation of sections of plastic injection mould (the parts)

There are generated the extended surfaces (Fig. 3) on the part side faces, which will generate the lines of separation.

By coercion, there are controlling the part positioning in relation to the basic rectangular block Fig. 4.

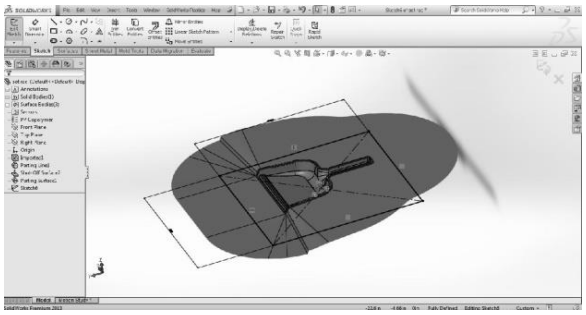

Fig. 3. Extended surfaces generation

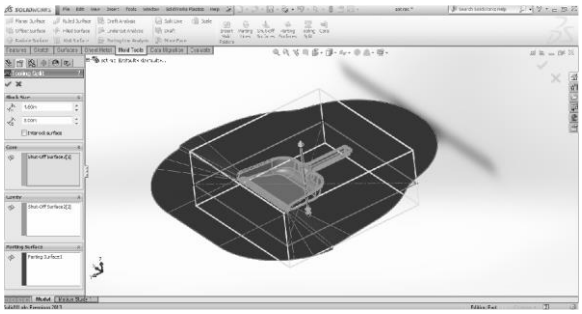

Fig. 4. Controlling of part positioning in mould

In Fig. 5 we obtained the two halves of the mould superior / inferior.

Fig. 5 shows the positioning of the component relative to the rectangular block. Fig. 6 represents the cavity and the mould. There is scaling the interim assembly relative to the centroid or a reference system to take account of material shrinkage.

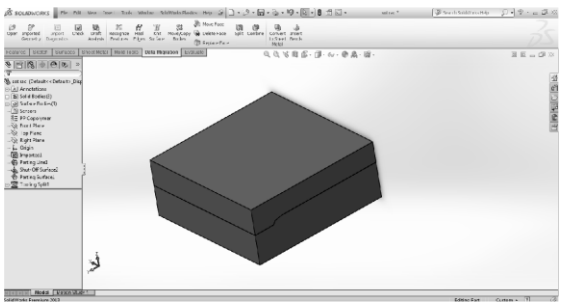

Fig. 5. The two superior/inferior

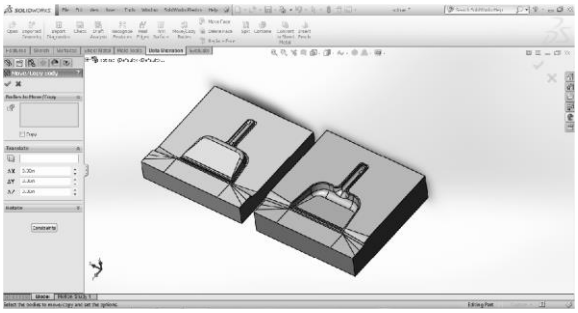

Fig. 6. Cavity and mould halves of the mould

The lines of separation are generated on the side faces and develop a boundary surface on which is divided the rectangular block obtaining, as derived solid: the cavity and the mould (Fig. 6).

By using CAD libraries we have chosen the mould type. These types of moulds are carried out in a great variety of constructive shapes, which mainly differ in size.

The CAD component libraries are transformed into sets of various CAD software specific entities that support IGES, VDA, STL, Parasolid, DXF files import.

The imported entities can perform assisted editing operations (Fig. 7).

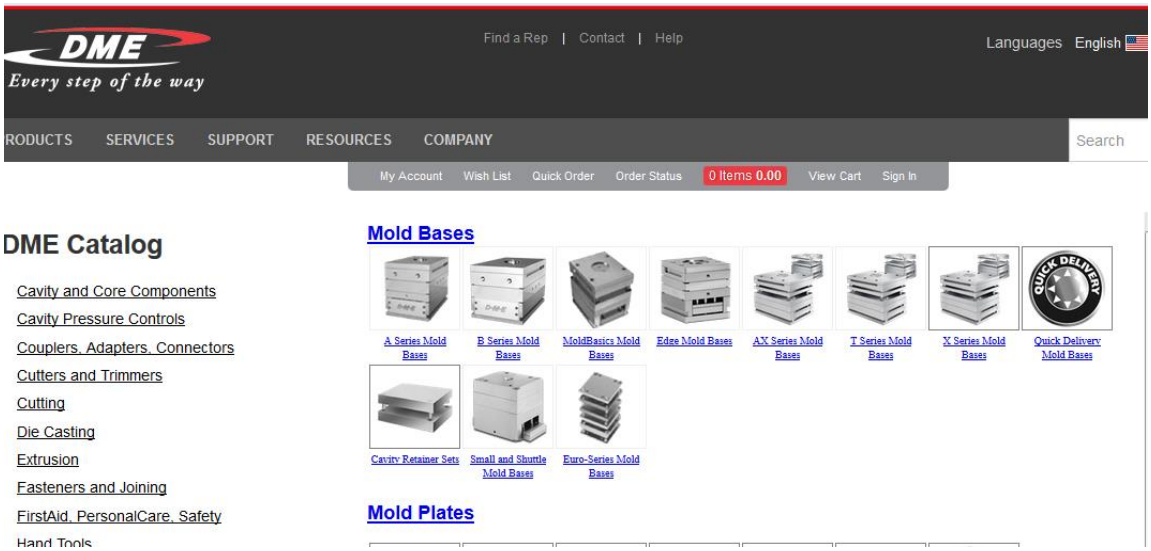

Fig. 7. DME catalogue with CAD libraries

In Fig. 8 is shown a preview model of the mold (with assembled components) chosen from the DME suppliers' site of CAD standardized items for injection molds.

Once we have chosen the standardized mold, we can choose the CAD file type imported from CAD library which can be interpreted by software modeling (Fig. 9).

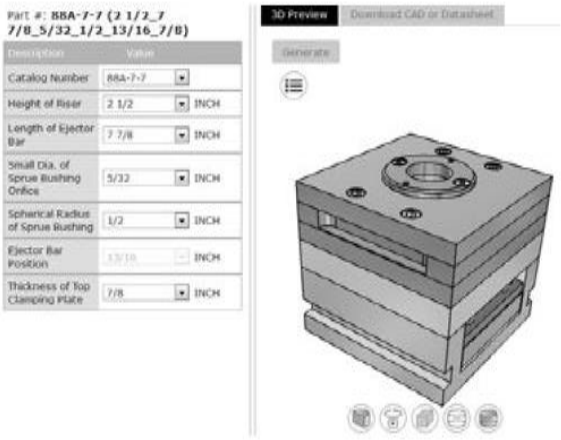

Fig. 8. Preview mould

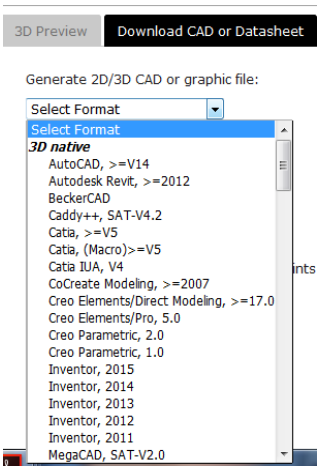

Fig. 9. CAD file type indication

We could import the components of mould plates and corresponding panels. The result is the full mould (assembled representation and exploded representation).

In Fig. 10 are shown the insertion elements "Support Plate". In Fig. 11 are shown the insertion elements "Clamping plate".

In Fig. 12 is represented the assembled model of injection mold. In Fig. 13 is represented the exploded model of injection mold.

The correct entry of constraints between components is very important for the assembly.

The pieces are selected from the *Standard Catalogue* or from *Catalogue Browse*r. It opens pop-up window *Catalogue Browser* with fasteners. To use the *ISO Catalogue* is preferred mechanical standard *Parts Catalogue*.

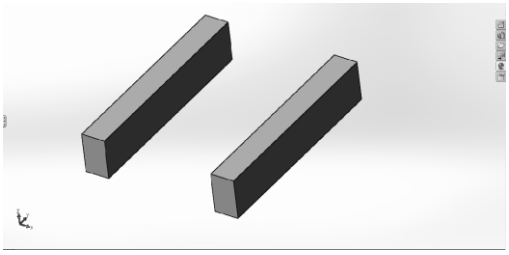

Fig. 10. Screenshot of insertion elements "Support Plate"

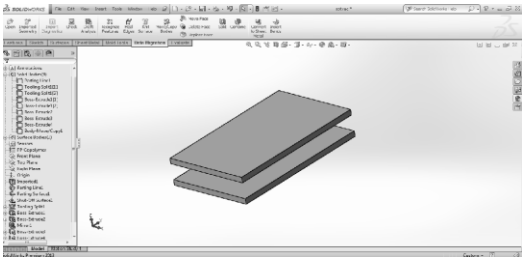

Fig. 11. Screenshot of insertion elements "Clamping plate"

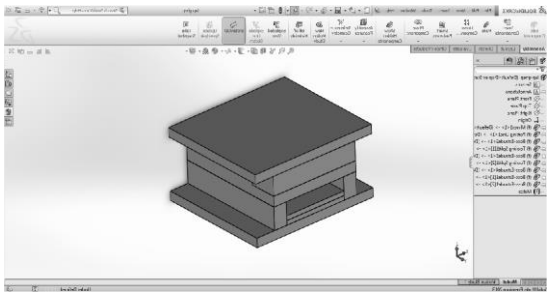

Fig. 12. Assembled model of injection mold screenshot

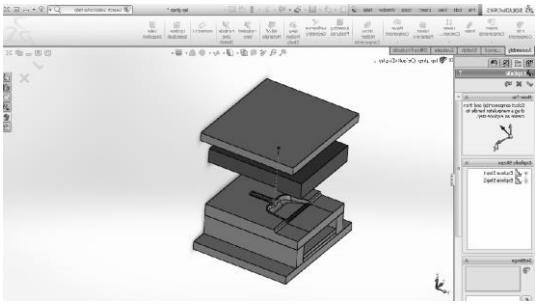

Fig. 13. Exploded model of injection mold screenshot

6. Conclusions

In terms of performance, we can say that when we have used these libraries CAD, we could design a mould in two or three hours.

With traditional methods, for 3D prototyping realization we could wait weeks to design a landmark. When the designers and engineers that create moulds for plastic products are using CAD libraries, they can have 3D prototypes in a time reduced to a few hours. These cuts translate into two key benefits:

1) the product can be developed and brought to market faster;
2) can be created review of the projects and prototypes at the same time would have been needed to create just one product.

Accelerating the generation of prototypes combined with the opportunity to test form and function, have a positive effect on the quality of the final part.

References

1. Malloy, A.R. (2010): *Plastic Part Design for Injection Molding*. *An introduction*. 2nd Edition, Hanser Gardner Publications, ISBN 978-1- 56990-436-7, Munich, Germany
2. Wang J. (2012): *Some Critical Issues for Injection Molding*. InTech, ISBN 978-953-51-0297-7, Croatia
3. Martin, I. (2012): *A CAD/CAE-integrated injection mold design system for plastic products*. The International Journal of Advanced Manufacturing Technology, ISSN 0268-3768, Vol. 63, No. 5, p. 595–607
4. http://partsolutions.com/partsolutions-3d-part-catalog-technology-enables-dme-to-offer-4-5-million-different-cad-files/
5. https://www.dme.net/resources/cad-data