Jaroslaw Zubrzycki[1], Marek Opielak[2]

CAD 3D AS AN OPTIMIZATION TOOL

The paper gives an overviews on the main features of 3D projecting. Its usefulness was qualified as to projecting, the analysis of the construction, executing part and the assembly of teams. The examples are presented regarding practical utilization of the chosen functions of modelling in real constructional solutions.

Keywords: *CAD 3D; optimization; injection mold; melting.*

Ярослав Зубжицький, Марек Опеляк

3D CAD ЯК ЗАСІБ ОПТИМІЗАЦІЇ

У статті описано основні риси проектування засобами 3D. Продемонстровано корисність даного методу у проектуванні, а також при аналізі. Надано приклади практичного застосування даних функцій моделювання для реальних конструкторських рішень.

Ключові слова: *3D CAD; оптимізація; лиття під тиском; плавлення.*

Рис. 14. Літ. 10.

Ярослав Зубжицкий, Марек Опеляк

3D CAD КАК СРЕДСТВО ОПТИМИЗАЦИИ

В статье описаны основные черты проектирования 3D. Показана полезность данного метода в проектировании, а также при анализе. Представлены примеры практического применения данных функций моделирования для реальных конструкторских решений.

Ключевые слова: *3D CAD; оптимизация; литьё под давлением; плавка.*

Introduction

The development of the technology giving the possibilities of production of machine engines units on folded shapes and on specific usable sights is ergonomically connected with the development of projecting methods (Chlebus, 2000). In constructions folded shapes are used more and more often, since the traditional methods of projecting do not suffice the description. The used parametric description of part inflicts, which until now required large financial expenditures, at present is possible due to the realization in shorter time and at considerably lower costs.

Parametric modelling

Virtual models of parts push out the traditional construction leaning on records 2D. This refers to the construction of injection mold where already at the phase of projecting the models of injection molds form the realization of the construction model servant core come into being (Figure 1).

Possession of the three-dimensional record of a construction inflicts that the realization of these elements is easy and comparatively cheap in realization thanks to using the CAM method (Duda, 2003). CAM methods assure the possibility of exercise about folded shapes of the units. It happens because machine tools numerally control the abilities to exercise the unrestricted number of tools passages of very complexed trajectories (Pajak, 2000).

[1] Institute of Technological Systems of Information, Lublin University of Technology, Poland.
[2] Institute of Transportations, Combustion Engines end Ecology, Lublin, Poland.

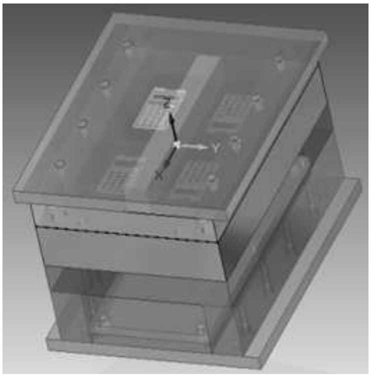


Figure 1. **The appearance of 3D model built on the basis of the models of injection mold end injected object**

Figure 2 introduces a view of the processed object after virtual injection. The usage of the advanced systems of projection permits the automatic generating unit of machine engines such as: shafts, cog-wheel, chain wheel, sheaves, cam, beam, line astern the set characterizing values in the given unit, the value of parameters and what have they to achieve (Zubrzycki, 2010; Gaska, 2013).

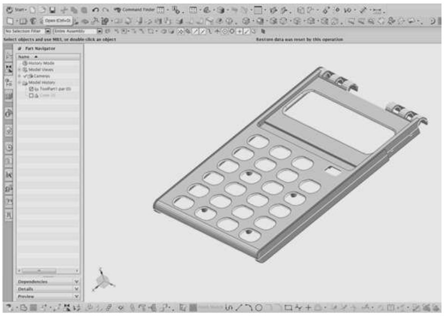


Figure 2. **Processed object after virtual injection**

3D projection creates the possibility of execution row of analyses' connected directly with the technology production preparation also and so for thin-walled plastic products validate the wall thickness (Swic et al., 2013). The qualification of demand on material is possible, the check of unit mass, centre of mass, centre of volume etc. permit the preparation of proper construction (Figure 3).

Figure 3. **Results of the thickness validations**

The constructor can look at the results of a running before physical realization of a construction. He can check its functionality by conducting an aggregate analysis, in this case, flow analysis during the injection process. This inflicts products, for which this method of projection was used. The given products are characterized by large reliability despite the fact that they do not execute the prototypes, only directly introducing production (Beaumont, 2004).

The next step in the optimization production preparation process is the flow analysis of plastic material during injection process (Zubrzycki et al., 2010). For this analysis two materials were used – ABS and PC.

The results of the flow analysis for PC material

– melt time T1 = 50 sec.

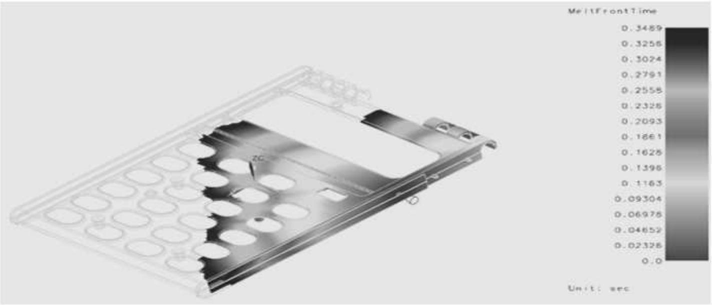


Figure 4. **Melt time T1 = 50 sec.**

– melt time T2 = 100 sec.

Figure 5. **Melt time T2 = 100 sec.**

Figures 6 and 7 show the results of the numerical analysis of pressure drop for PC material and melt front temperature analysis.

Figure 6. **Pressure drop analysis**

Figure 7. **Melt front temperature analysis**

The results of the flow analysis for ABS material

– melt time T1 = 50 sec.

Figure 8. **Melt time T1=50 sec.**

– melt time T2 = 100 sec.

Figure 9. **Melt time T2=100 sec.**

Figures 10 and 11 show the results of the numerical analysis of pressure drop for ABS material and melt front temperature analysis.

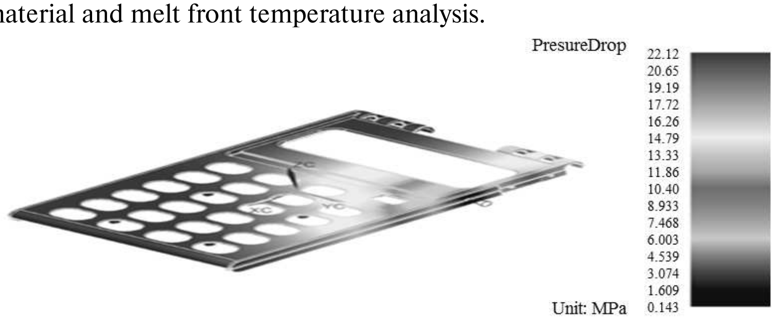
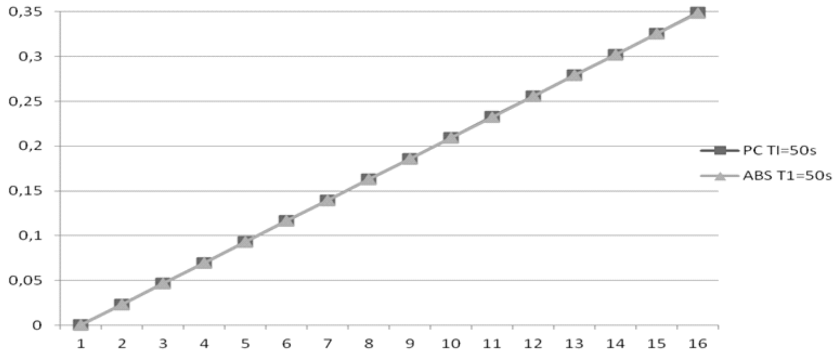


Figure 10. **Pressure drop analysis**

Figure 11. **Melt front temperature analysis**

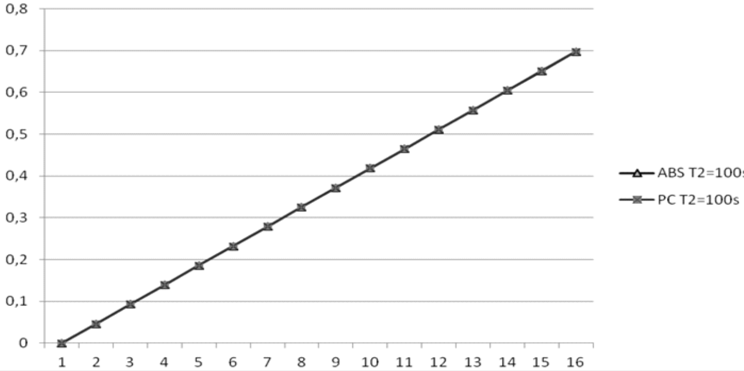
Final results and conclusions



No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PC T1 = 50 s	0	0,0233	0,0465	0,0698	0,093	0,1163	0,1396	0,1628	0,1861	0,2093	0,2326	0,2558	0,2791	0,3024	0,3258	0,3489
ABS T1 = 50 s	0	0,0233	0,0465	0,0698	0,093	0,1163	0,1395	0,1628	0,186	0,2093	0,2325	0,2558	0,2791	0,3023	0,3256	0,3488
PC-ABS(s)	0	1E-05	1E-05	2E-05	2E-05	0	1E-04	0	1E-04	0	1E-04	0	0	1E-04	0,0002	1E-04

Figure 12. **Melt time T1 = 50 sec. for PC and ABS**

Melt times for the used materials differ from each other up by 0,0002 sec. (points 4,5,15). The injection of PC material is more quickly than ABS (except points 6,8,10,12 and 13), indicating better plasticization of this material.



No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PC T2 = 100	0	0,04652	0,09304	0,1396	0,1861	0,2326	0,2791	0,3256	0,3721	0,4187	0,4652	0,5117	0,5582	0,6047	0,6513	0,6978
ABS T2 = 100	0	0,04651	0,09302	0,1395	0,1865	0,2326	0,2791	0,3256	0,3721	0,4186	0,4651	0,5116	0,5581	0,6046	0,6511	0,6977
PC-ABS (s)	0	1E-05	2E-05	1E-04	-0,0004	0	0	0	0	1E-04	1E-04	1E-04	1E-04	1E-04	0,0002	1E-04

Figure 13. **Melt time T2 = 100 sec. for PC and ABS**

Melt times for used materials differ from each other up to 0,0002 sec. (points 3,15). Injection of PC material is faster than ABS (except points 6,8,9), indicating better plasticization of this material and faster filling of mold cavity.

The development of this method of projecting allows project management in the process way (Figure 14).

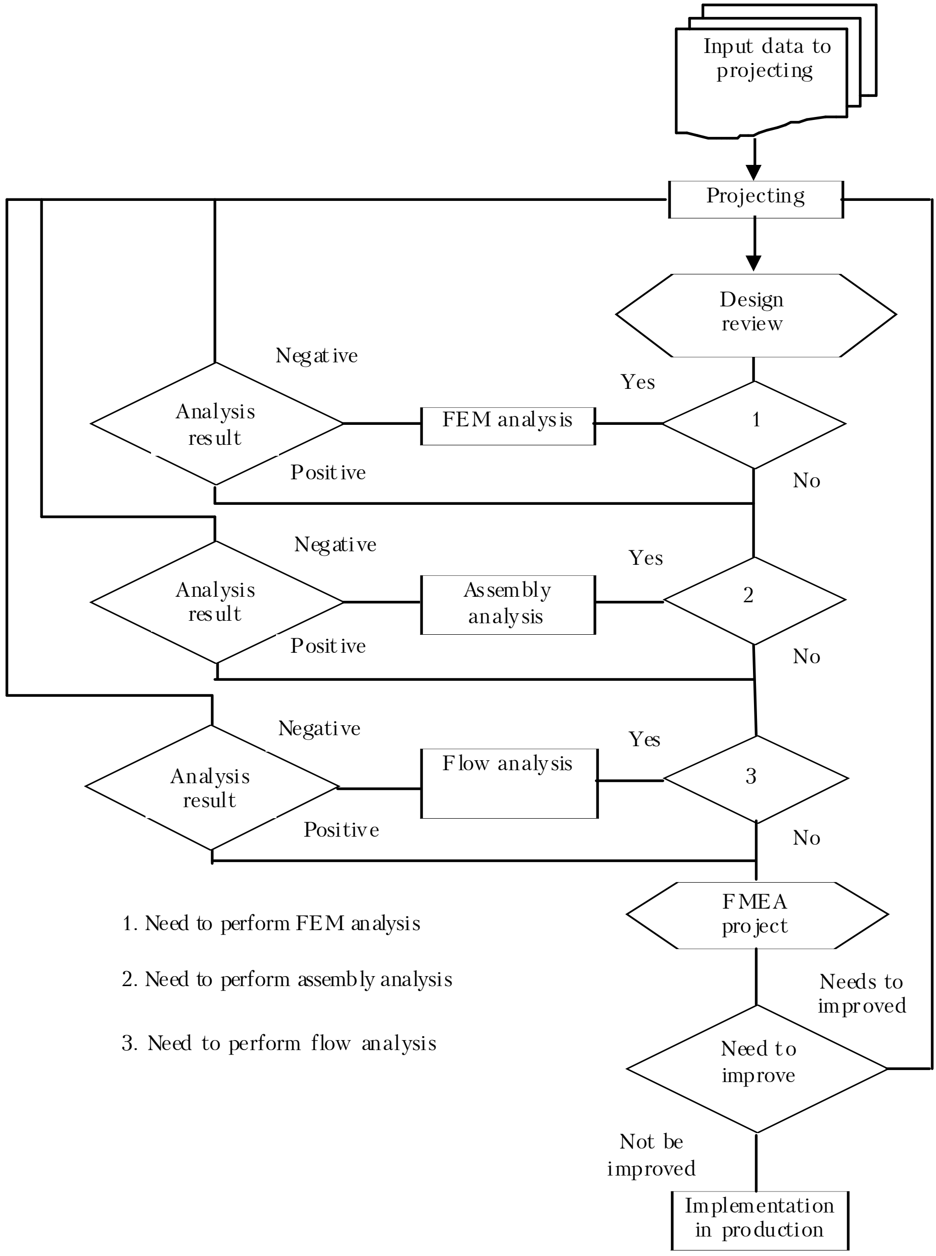


Figure 14. **The diagram of project management** *(Beaumont, 2004)*

Such approach to projecting gives a guarantee to the continuous improvement of a product through the search of better, more unfailing solutions. Reducing the production costs is done due to projecting steered on technological possibilities.

Summary

Projecting leaning on the parametrization of the elements of machine engines creates new possibilities for products development (Pajak, 2000). Controlling many features is possible at the stage of the product construction:

- checking the feasibility of details;
- the study of the technology of realization;
- the study of the technology of assembly;
- the elimination of mistakes in projecting;
- using engineers calculations in modelling;
- the execution of strength analyses;
- execution of kinematic analyses of a system;
- the qualification of the demands on materials.

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