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3D MODELING OF CASTING TOOL USING SOFTWARE PACKAGE SOLIDWORKS

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Abstract: Modern production in foundries is based on carefully drawn casting technology. Thus, technological development drawings for making casting tools can be considered as the first and most important phase in the cycle of production of castings. This paper shows the necessity of application of computer modeling for design and modeling of casting tools intended for special casting processes for more efficient and faster production and better quality of barricade columns cast. Solidworks 2013 package 3D modeling software tools were used for this purpose.
Keywords: computer-modeling, casting, barricade pole, technical documentation

INTRODUCTION

Modern production in foundries is based on carefully drawn casting technology. Thus, technological development drawings for making casting tools can be considered as the first and most important phase in the cycle of production of castings.

In the construction of the cast is necessary to ensure that the casting technology in production provide the minimum expenditure of labor and materials and allows a maximum mechanized and automated production. That constructor of casting tools could decide on the method of molding, material models, and construction of the core, has to have data how many castings need to cast, the casting tolerance that should meet, where it will be placed etc. [1,2]

Using CAD software we perform the mechanical design and automation processes that are based on parametric modeling of full body. The program allows to convert basic 2D sketch into a full body model with simple but highly effective tools for modeling. This program prepares technical drawings of elements and systems.

Usage of CAD software contributes to a better design, complex parts are faster designed with the help of software that allows the user a visual representation of work and dimensions using CAD.

CAD software programs can provide compatibility of all components and their check and allows you at any time to add another part, which is impossible to achieve without modern software tools such as SolidWorks. One of the advantages of SolidWorks 2013 software package is that the techniques work sorted by the so-called "Module cards", identical to today's Microsoft solutions, which significantly facilitates the work and means that crossing by from module to module is not necessary. [3,4]

Further study shows modeling of casting barricade column (on the basis of cast, the construction of molds is made with all related aspects and conditions which one casting tool has to have). Then is shown the technical documentation - technical drawing of barricade column cast, as well as analysis of material consumption.

CAST MODELING

Before selection of software tools, which will carry out modeling, it is necessary to define the geometric structure - Design Intent components for which we form a 3D model.

Example - barricade column casting - Desing Intent: casting is axisymetrical shape and consists of a certain number of segments that can be created with one software tool "Revolve Boss / Base "semi-

sectional rotation of given casting defined in one sketch, or by forming successive segments of software tools "Extrude Boss / Base" from the respective drafts.

Finalization of 3D models, such as the development of curvature of the edges on the right location, is done by the so-called "Pick & Place" programming tools "Fillet" and "chamfer".

The first step represents a defining closed sketches in the selected level (Top Plane), ie. shape and dimensions of a given semi-sectional cast (Figure 1) as the basis for the implementation of "Revolve Boss / Base" software tool (Figure 2), which will form the basis of the model casting executive body, rotation of defined sketch around the axis of rotation, for the angle of 360 °.

Module card for defining the sketch has a large number of software tools to facilitate the definition of the individual segments of the same sketches, such as Line, Rectangle, Circle, Ellipse, Slot, Spline, Fillet Sketch,

Figure 1. Formed sketch of semi-sectional casting [6]
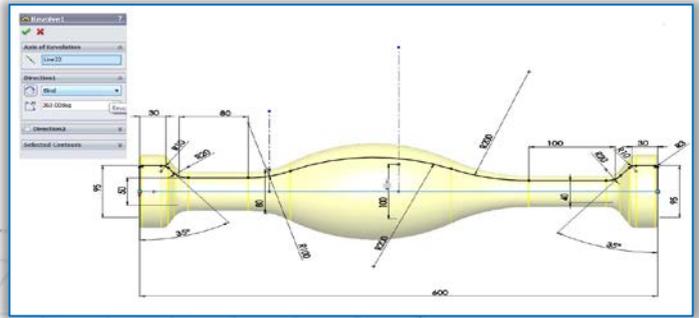
Figure 2. The basic form of the cast [6]

Sketch Chamfer, then Dimension and Relations to define the dimensions and relations of 2D sketch entities.In the same tab, there are also software tools for copying, deleting, cutting, extension, diagnosis, and Mirror, Pattern, Trim, Extend, Repair. (Figure 3).

Figure 3. Layout of module cards with basic software tools for defining sketches

We must pay attention to material shrinking during the cooling of the cast, and therefore we need to increase the model with software tool "Scale". Barricade column is made of aluminum alloy AlCu and his shrinking we will express in percentages. Shrinking of aluminum alloy is 1.25%.

Figure 4. Model increase in percentage [6]
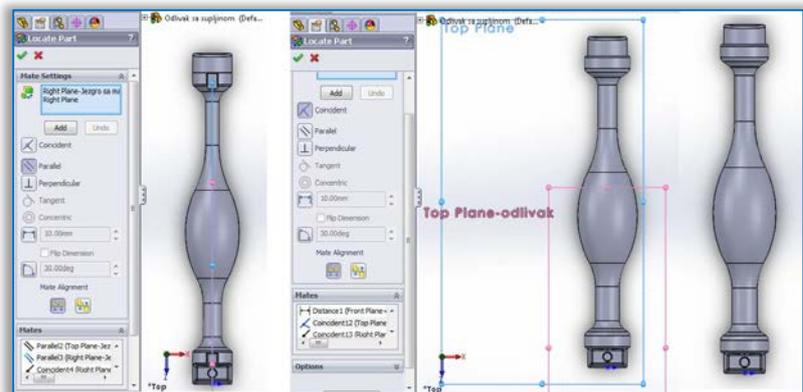
Figure 5. Positioning of the core and cast in the new part with software tool,, Insert-Part " [6]

MODELING OF BARRICADE COLUMN

The construction of the finished work is based on the core and face cast, after we've done modeling core with stamps and face casting, we can form a finished part – barricade column.

Creating barricade column along,, Top-Plane "is performed by importing predefined model,, core with stamps and face casting " with software tool " Insert Part ".

It is necessary to lock all "External" connections - with a reference model Barricade column, in order to avoid changes in positioning, by changing the desired configuration of the same model .(Figure 6)
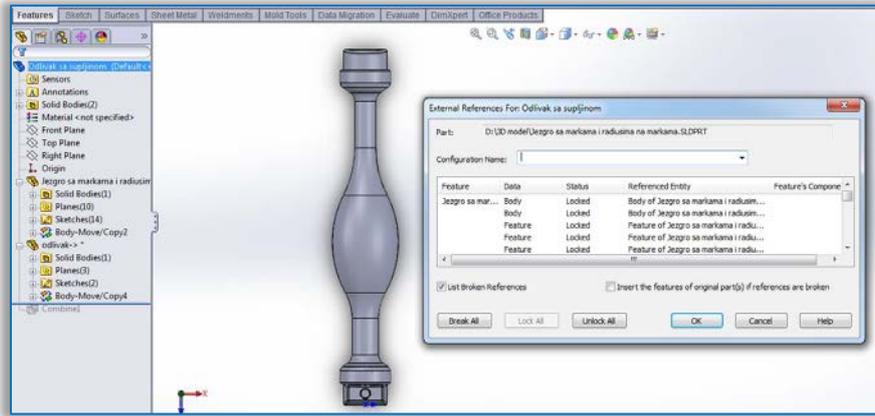
Figure 6. "External" references Interruption in relation to the basic model [6]

Below is a Boolean operations over the bodies with the following command,, Combine ". It is clear that the body must overlap. Under the command,, Combine-Subtract ", it is necessary to select a body over which we need to execute Boolean operations (select on the model or structural tree) (Figure 7)
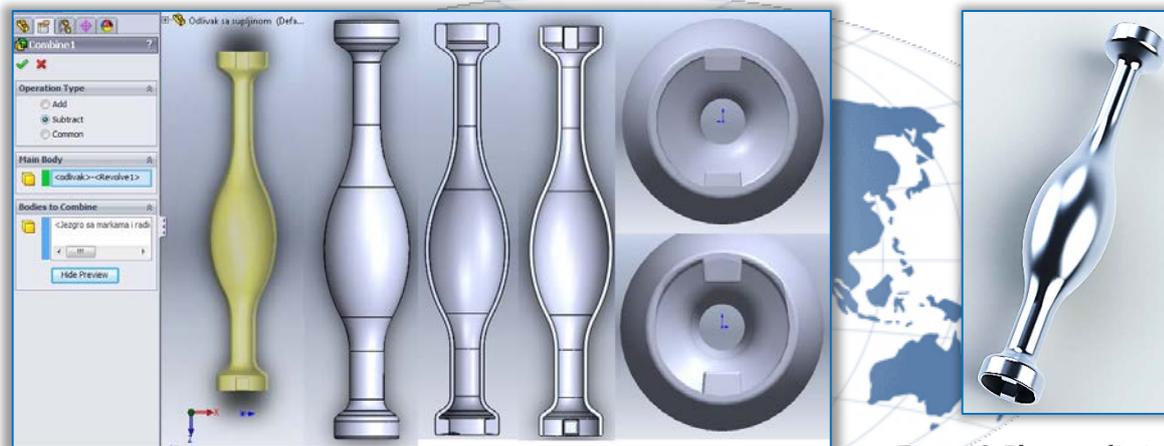
Figure 7. Forming barricade column using the "Combine-Subtract" [6]

Figure 8. Photorealistic image of barricade column [6]

Analysis of material consumption

Construction of each tool includes, among other things, a specific bill of materials, which is essential for its development. Given the calculation must be analyzed in detail, to access tools construction more efficiently and with lower costs. When analyzing the necessary materials must be considered various factors that can affect the increase or decrease in the amount of material used, its purchase price as the cost of procurement of certain materials.
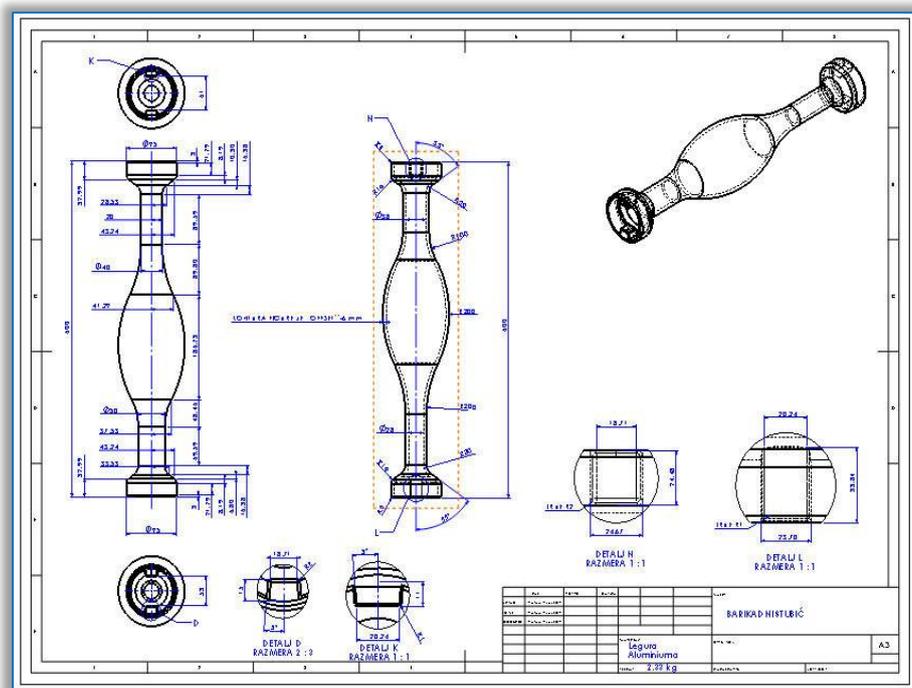
Figure 9. Technical drawing barricade column [6]

Table 1. Characteristics of mass tools from barricade columns [6]

Tools	Pre machining tool	Mass Properties prior to machining	Tool after machining operations	Mass properties after machining	Pieces
Fixed half of the model		$\rho = 7200 \text{ kg} * \text{m}^3$ $m = 203{,}040 \text{ kg}$ $V = 0{,}028 \text{ m}^3$ $P = 0{,}637 \text{ m}^2$		$\rho = 7200 \text{ kg} * \text{m}^3$ $m = 106{,}15 \text{ kg}$ $V = 0{,}01 \text{m}^3$ $P = 0{,}61 \text{ m}^2$	1
Movable half of the model		$\rho = 7200 \text{ kg} * \text{m}^3$ $m = 94{,}75 \text{ kg}$ $V = 0{,}01 \text{ m}^3$ $P = 0{,}50 \text{ m}^2$		$\rho = 7200 \text{ kg} * \text{m}^3$ $m = 75{,}92 \text{ kg}$ $V = 0{,}01 \text{ m}^3$ $P = 0{,}55 \text{ m}^2$	1
Fixed half of the model		$\rho = 7200 \text{ kg} * \text{m}^3$ $m = 193{,}23 \text{ kg}$ $V = 0{,}03 \text{ m}^3$ $P = 0{,}80 \text{ m}^2$		$\rho = 7200 \text{ kg} * \text{m}^3$ $m = 175{,}901 \text{ kg}$ $V = 0{,}024 \text{ m}^3$ $P = 0{,}867 \text{ m}^2$	1
Movable half of the model		$\rho = 7200 \text{ kg} * \text{m}^3$ $m = 150{,}29 \text{ kg}$ $V = 0{,}02 \text{ m}^3$ $P = 0{,}75 \text{ m}^2$		$\rho = 7200 \text{ kg} * \text{m}^3$ $m = 134{,}14 \text{ kg}$ $V = 0{,}02 \text{ m}^3$ $P = 0{,}81 \text{ m}^2$	1
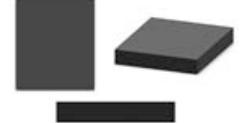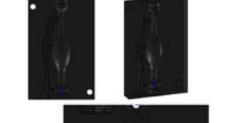
CONCLUSIONS

Nowadays there are many software packages, which enable us to facilitate design tools, simulation systems that help us in the construction of the casting system by using them we can simulate the casting ingot-casting molds. The paper presents the basic rules of CAD modeling where we pay special attention during the design phase of the cast. Although it seems that the casting technology is very simple, the rules require that we should be careful to take into account every step in the design process. It is not enough to melt material, pour it into a mold, and thereafter realize that a number of errors appeared. Particular care should be taken about the construction of the cast. Construction of the cast must be such that with a minimum of effort we can make the casting, which will be made with cheaper funding and constructing a process, and that will eventually meet exploitative working conditions, which are necessary.

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References

[1] Risto, K., Tehnologija izrade odlivaka, Fakultet tehničkih nauka, Novi Sad 2006 g.
[2] Ašonja, A. Desnica, E., Palinkaš, I., Analysis of the static behavior of the shaft based on the finite elements method under effect of different variants of load, Applied Engineering Letters- Journal of Engineering and Applied Sciences, vol. 1. No. 1, 2016.
[3] Letić, D., Desnica, E., Inženjerska grafika I i II, Tehnički fakultet „Mihajlo Pupin", Zrenjanin, 2011.
[4] Jovanović, M., CAD tehnologija 2, Mašinski fakultet, Niš, 2012.
[5] Lombard, M., Uvod u SolidWORKS 2013, Kompjuter biblioteka, Beograd 2013.
[6] Vlajkov, V., Primena cad sistema u procesu automatizacije postupka konstruisanja odlivaka za livenje u kokile sa analizom utroška materijala, Master rad, Tehnički fakultet „Mihajlo Pupin", Zrenjanin, 2016.
[7] Vlajkov, V., Desnica, E., Palinkaš, I., 3d modeling of casting tool using software package solidworks, The VIth International Conference Industrial Engineering and Environmental Protection 2016 – IIZS 2016, University of Novi Sad, Technical Faculty "Mihajlo Pupin" Zrenjanin, Zrenjanin, SERBIA