STRESS STRAIN ANALYSIS OF THE MOLDS FOR IRON CASTING

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1. Introduction

Time for designing prototype becomes shorter and shorter nowadays. The most of parts in automotive industry, rail vehicles and other kind of parts are castings. Old-fashioned foundries had existed all over the world. To modernize the production process and make product concurrent CAD support is necessary.

First step in reaching that goal is a creation of virtual model. After that rapid prototype have to be prepared. For this purpose, computer techniques and software support were used. Rapid prototype in this case is master pattern. According to the virtual model, casting tool (mold) can be created. Second step in this process design of foundry molds. At the figure 1, master pattern and foundry models are shown.

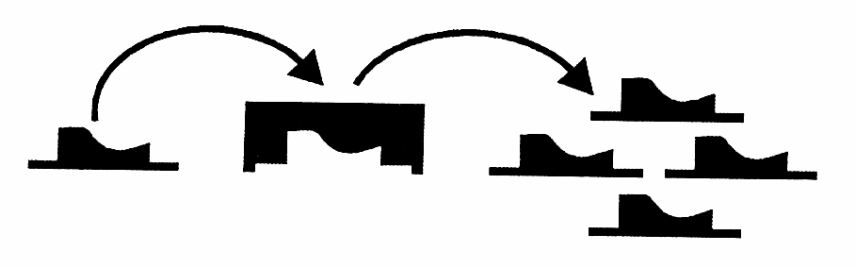

Fig.1.Master pattern and foundry models

Foundry molds have to be checked and predict a number of load cycles. Numerical simulations are the best and short time way to do that. All procedure described above have been performed in a case study for a railway fork. The fork is casting and it is used as some kind of connection in a railway.

2. Virtual model-first step in RP process

The casting virtual model was created using 3D modeler of I-deas software obeying all casting demands for angles and features. All construction constrains are ordered by legal standards. At the figure2, the sketch and virtual model of the considering fork are shown.

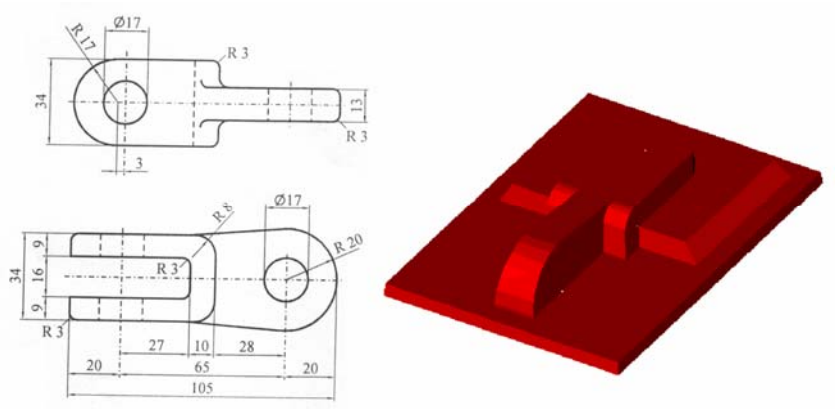

Fig 2. Sketch and virtual model

The fork has a symmetrical shape and therefore only one half has the foundry model. For foundry model 1% of shrinkage has taken into account for gray iron. That value of shrinkage is a result of experience, not exactly determined. In fact, virtual foundry model is inverted virtual model of the fork.

3. RP foundry model

This model is not necessary to be presented in this paper. All simulations can be done at the virtual foundry model. But to clarify all process, rapid prototype will be mentioned in few words. On a basis of virtual foundry model rapid prototype can be done. Virtual foundry model – virtual mold for casting was translated into stereolitography file (STL). There are two principal methods in rapid prototyping: layered methods and rapid with CNC. In considering case of fork, second one is used. Cam software DeskProto and CNC milling machine were used to create rapid prototype. Material used for a master pattern was CibaTool BM 5460, produced by Ciba.

4. Foundry model durability

New approach in foundry model design, make development of foundry models. They become cheaper, more precise, especially models with complicated geometry shape, models with several uniformly distributed holes and small in size. After creating virtual model several simulations can be done. One of them assumed stress and strain simulations under prescribed load. The determined results are some kind of control quality of a mold durability and quality of casting.

Real parameters used in practice have been use for simulations. In this case only load pressure was taken in account. The value of subjected pressure was 0,001 N/mm, and that value has been taken according to experience. Acting impact load was neglected as well as existing damping. All neglected influence factors are subject of experimental testing. At the figure 3, applied boundary conditions and applied load pressure are shown.

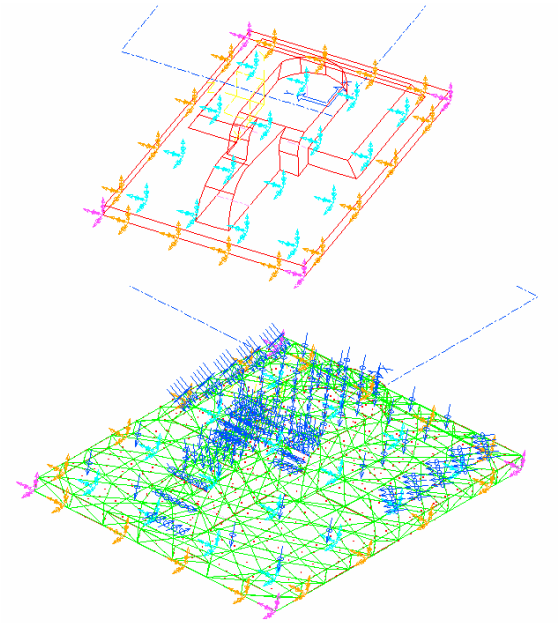

Fig.3.Boundary conditions and applied load

Load pressure is uniformly distributed at the surface of the mold.

Stress strain distribution under considered load is presented at the fig. 4.

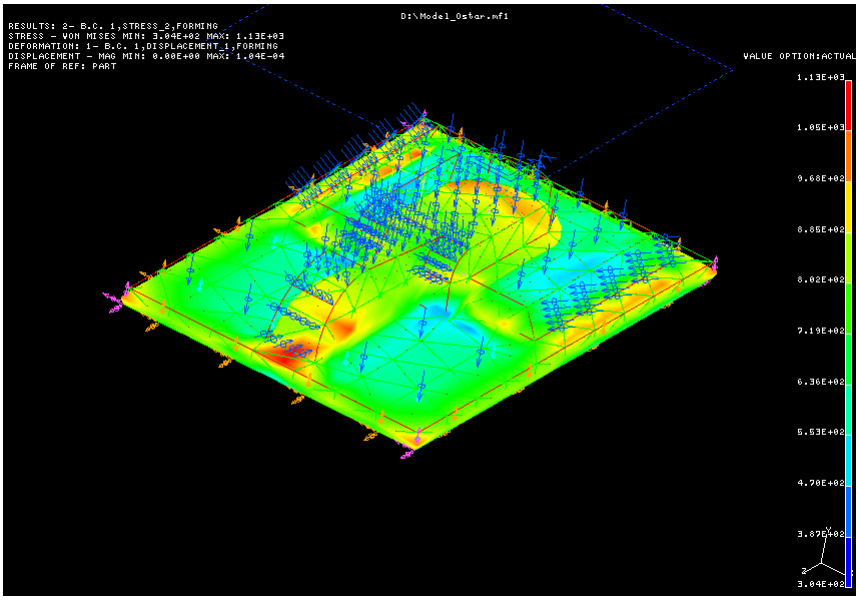

Fig.4. Stress strain distribution

Maximum calculated stress value in the mold is 1,13 N/ mm, which is less than compressive strength 20-25 N/mm (ISO 604), for the used material mentioned previously.

5. Conclusion

Stress strain analysis was determined for a casting part-fork for a railway. New part for a production is ready and it will be in a good quality because the tool for production has a satisfied construction and durability. After master part construction and testing several new foundry models can be done.

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Summary:

In a production of parts in mechanical, especially automotive industry, time for designing and performing prototype becomes shorter and shorter. Alloys and iron are usually used for casting small parts into the molds. Master pattern molds are made of new special materials discovered recently. CAD support is necessary to shorten time for making virtual model of a vehicle part. The same path is used to produce virtual mold-rapid prototype. In this paper all procedure for virtual model and rapid model is presented. The considered object was a casting fork. Stress strain analysis was performed using I-deas software for modeling and simulations.

Key words: virtual modeling, rapid prototyping, foundry models