CONTRIBUTIONS REGARDING THE OPTIMIZATION PROCESS OF THE BENCH DRAUGHT BAR IN THE ROLLING MATERIAL INDUSTRY

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Abstract

The paper is developed in conditions of elaboration of a research grant realised between University "Politehnica" from Timișoara and S.C. MEVA S.A. regarding the optimization of the processing procedure (according to the stipulation from STAS 3135-76.) of the bench draught bar. It was considered as a factor of progress in optimization of the technological process the utilization of the simulation concept in the manufacturing of such components (draught bars).

1.Introduction, objectives

The paper presents the result of the researches obtained by the contractual collaboration established between University "Politehnica" of Timisoara and SC MEVA SA Drobeta-Turnu-Severin, referring to the processing optimization of the bench "draught bar" in the industry of rolling material. The product representing the research object (draught bar) is tested to elongation, crushing and shearing for which the modeling was made using the 3D soft SolidWorks, starting from the execution drawing of the bench draught bar. This 3D model was applied in the simulations hich use the finite element method, as well as for creating the technological itinerary using CAM soft, defined by the STAS 3135-76.

According to these specifications, for the bench "draught bar" has been elaborated a simulation of the real conditions of functioning [4] using the analysis with finite element (ABAQUS/CAE), which highlighted correct value results in the area of the restrictions stipulated in the STAS attached to the manufacturing conditions.

As well, in the paper there are presented the contributions related to the elaboration of the optimization method for the processing of the bench draught bar using the simulation method, conditions for which there was accepted the development of the modeling in the real conditions of the manufacturing capabilities, specific to a certain company, for which will covered be the following stages:

- The first step in the simulation conception is to import into a CAM software the 3D model and the conception history of the model (the conception tree) from different conception/projection soft-wares, this operation having as result the reduction of the conception time of the technological itinerary;
- The next step in the simulation conception is to implement the MUCN (CNC machine tools), initially evaluating the technological itinerary applied within the company from the viewpoint of time and costs necessary to process the bench, considering as representative the milling operation of the surfaces of the analyzed bench construction. This analysis helps to develop the optimization process using three-dimensional simulations on CNC machine tools with advanced cutting tools which can be imposed as comparison means, and for the selection of the optimization method. The conception and the simulation of the technological itinerary were realized using the CAM Esprit soft which exists in the endowment of the laboratory HTEC-TIMISOARA MUCN of the TCM Department. Development and evaluation of modeling-simulation results show the

following useful objectives in such applications (objective with main effect to increas the productivity):

- optimization of the manufacturing time for the bench draught bar;
- processing cost effectiveness by developing a mathematical model that makes possible the simulation process for a process without restricting the accessibility of this method without any risk or in accessing and using it in the manufacture of such a reference preparation.

In order to achieve those objectives, using the results of previous research [8], it was necessary to following the next steps:

- 3D model development for the draught bar by using dedicated design software (SolidWorks) assisted by the computer;
- analyzing the behavior of the draught bar using finite element simulation (ABAQUS/CAE specialized software);
- realization of the processing tree (such as processing, tools used and processing parameters) using CAM simulation;
- import the results of simulations on the CNC machine tools and processing.
- the response evaluation (defining target paper) optimized bench through simulation-modeling process.

2. Contributions concerning the elaboration of the optimization method for the processing of the bench draught bar by simulation method

In order to assure the real conditions of development of the simulation program for the bench “draught bar”, it is analyzed and evaluated [8] in its natural succession taking into consideration the known constructive and technological data from the manufacturing program developed by the partner company within the research initiated together as following:

a). Identification of the most significant operations is the consequence of a suite of simulations of the actions to which the bench (the 3D model of the draught bar) will be subjected by the method of finite element and also these are necessary in order to create the technological itinerary using CAM soft basing on the concrete working conditions of the product that is evaluated by research.

b). The specifications for the simulation elaboration are:

- the meshing (elements type tetrahedron with 4 points, hybrid formulation, linear pressure, 21271 nodes, 102137 elements);
- imposing of the conditions on contour (embedding into the threaded region);
- charging establishment (force by 300 kN, uniform distribution, amplitude în rampă). The research results at charging, according to STAS-3135-76, are confirmed by evaluating the tensions distribution in the tensile area, fig.1.1 and fig.1.2.

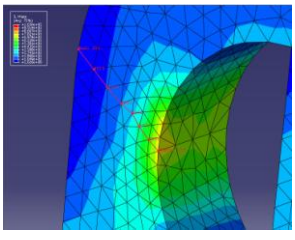

Fig11.Path chosen for the stress distribution

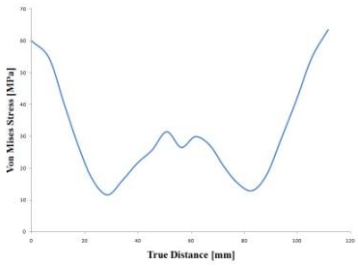

Fig.1.2. Von Misses stress variation along the path

The graph for the areas subjected to crushing stresses and the distribution of von Misses tensions along the path are presented in the figure .1.3. and fig. 1.4

After traction and crushing simulations of the bench draught bar, in order to optimize the manufacturing process there will be considered as representative for this purpose the processing operations by turning for the processing of the head draught bar and boring of the assembling holes of the traction bolt.

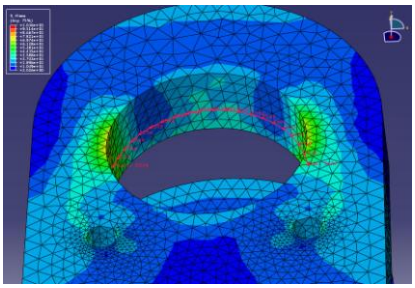

Fig1.3. Path chosen for the stress distribution

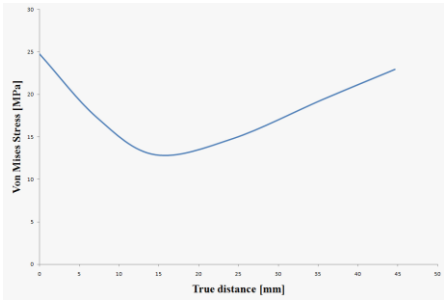

Fig1.4. Von Misses stress variation along the path

2.1. Contributions to the alternative optimization of the manufacturing process

For the alternative optimization there will be determined the processing times obtained in the processing simulation of the bench (itinerary, management processing equipments) in the real manufacturing conditions of this bench within the company. In the next stage, established by the research program, there will be used for simulation advanced production systems (CNC machine tool and performant cutting tools) based on totally changing of the cutting regimes (inclusively the installation of the semi-finished product and the management of the cutting process in real time)..

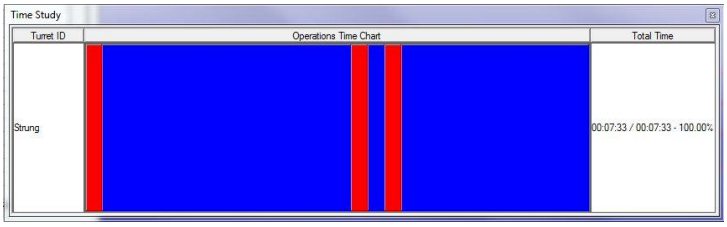

Fig.1.5. Real length time of the turning operation according to the company itinerary

In the actual conditions, within the company, for the bench manufacturing there are used a range of conventional tool machines with different processing capacities using special fixing systems, and the semi-finished product of the used bench is delivered in moulded shape with an appropriate tolerance for the gauge rates sufficient for the processing operations realization. In order to compare these two processing ways (identical to the actual processing ways within the company and to CNC machine tools way), the simulation of the system with the afferent times was made using the CAM Esprit software, establishing that the processing times resulted by simulations will be evaluated by us. After development of the simulation system for the bench processing, using the data provided by the company, by turning operation, using 100% of the processing capacity of the tool machine, resulted that the total time

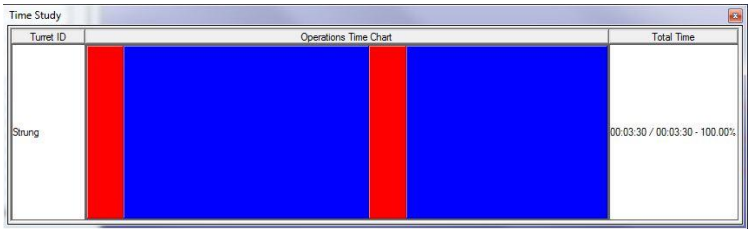

Fig.1.6. Real length time at the turning simulation using CNC machine tools

necessary to finish this operation is approximately by 7.5 minutes, as can be also observed in the (fig1.5) .Using new conception systems necessary to realize the processing operation of the draught bar using CNC machine tools which develop intensive cutting regimes, using tools by ultimate generation, it could be obtained an optimization of the processing times of the bench. Using these simulation systems for the turning operation resulted a processing time by 3,30 minutes, as is represented in the figure 1.6.
The consequence of the research by simulation methods of the manufacturing systems based on MUNC highlights consistent reductions of the processing times and thus of the processing costs, situation revealed by decreasing of the processing time from 7.50 minutes to 3.30 minutes, which signifies a reduction of the processing time with 55%, as can be shown in the graph from the figure 1.7.

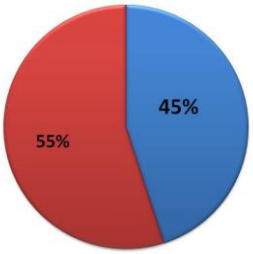

Fig.1.7. Reduction of the real time length [55%] at turning operation in conditions of processing simulation using MUNC

4. Conclusions

The paper succeeds in satisfying the objectives enounced in its content, especially those concerning the interactive and mainly simultaneous projection of the approached steps.

The researches alternatively performed for the two situations, that for the initial conditions existing within the company and then for advanced systems, highlight the substantial reduction of the processing times (fig.1.7) and even the elimination of the expensive prfiled tools used in the manufacturing process. The precision conditions of the processing processes represent a guarantee of the obvious utilization of the CNC machine tools.

The performed researches in the mentioned conditions of the company put in evidence the advantages of using and applying of such research results into products development and in investments, because the analysis of the simulation results shows that the processing process will develop without programming errors or cycles and paths exceeded in time, and respecting the displacement geometry by CNC, cumulated with the rigorous assuring of the behaviour requirements of the bench within the functioning period, regardless the situation of the equipment, in conditions of traction forces development which are required in the functioning moment.

5. References

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