16th International Research/Expert Conference
"Trends in the Development of Machinery and Associated Technology"
TMT 2012, Dubai, UAE, 10-12 September 2012

SIMULATION AND OPTIMISATION OF THE DESIGN PROCESS IN FUNCTION TO THE CLEARANCE BETWEEN THE BLANKING TOOL ELEMENTS

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ABSTRACT
The present paper covers and describes the influences of the clearance on the part edge quality of blanked parts. To solve the main problems in the tool design process is compiled and is used a program for generating technological parameters, that provides solutions which with a high safety can be realized in real conditions. The defined model in this paper provides the basis for analysis and simulation of the process which should enable to us to solve the optimal construction of the tool. Experiments have been conducted using different material, by changing clearances and different cutting speeds.
Keywords: experiments, quality, clearance, blanking.

1. INTRODUCTION

In this paper is used a new concept for the designing of the tools, enabling to input of the new strategies for using the computer with all its elements (CAD, CAM, CAPP, CAE), which entails the automation of the design processes and of the tools in all phases of the metal processing with blanking and punching. Application of the new technologies enables to reduce the required time for acquisition and processing of the incoming datas, by using of the standard methods of the optimization during the performance of the experiments and simulation of the optimal working parameters of the tool in function to optimize the material flow during the blanking - punching process. Parallel for any sizes gained with experimental proofs will be done a compare of the results obtained by the help of the 3D simulation of the blanking and punching process.

2. THE GENERATING OF THE TECHNOLOGICAL PARAMETERS

In our case, to resolve the problem it is designed a software program which in one working step gives two options for ordering the details on strip and enables to choose the constructive possible resolution. Every constructive solution will be followed by a full description of all technological parameters (strength, work of the deformation, working step etc.) and with constructive dimensions of the main positions of the tool (dimensions of the stamper, puncher and holes in the cutting plate with the clearances and tolerances of the work). In other side, large values of the clearance between the working elements will reduce the quality of the work piece (detail) as in surfaces as well as in terms of the accuracy of its geometry.

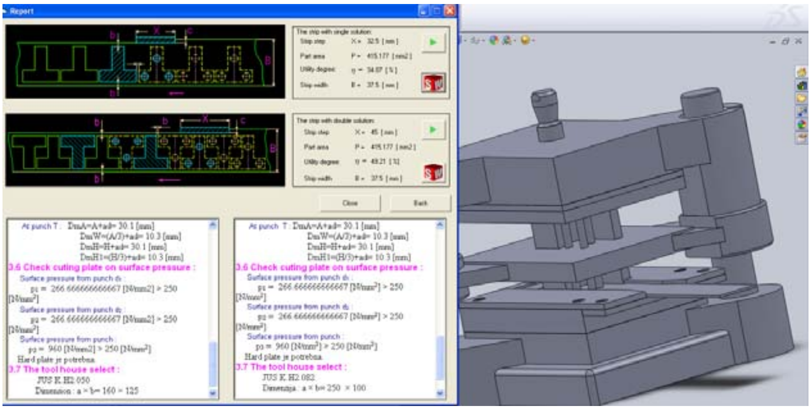

Figure 1. Process parameters for a queues part of the strip

3. OPTIMIZATION OF THE TOOLS IN THE FUNCTION OF THE CLEARANCE

The chosen criteria to optimize the whole process represent the real values of the reach clearance between the upper mobile elements of the tool and the cutter plate in the separation zone of the material. This parameter has a crucial role in the quality of the ready work piece(detail), in the accuracy of the required geometry and at the time of the tool exploitation. By introduction of the new values of the clearance is gained new depending of the force from the working step which is followed by the change in higher values or lower values. Every newly inserted value could be deleted and be generated and then to be proved for the new conditions of the deformation. With this the application is fully flexible and able to convey the real conditions of the exploitation.

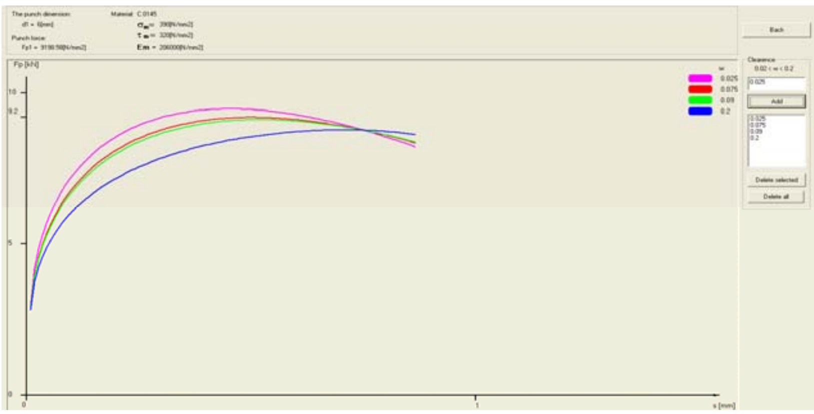

Figure 2. Dependence of force that punching Ø 6 mm for the space provided

4. MACHINES AND TOOLS FOR REALIZATION OF THE EXPERIMENTAL PROOFS

Experimental proofs are realized in a sequential ranking tool parts on the strip, which is done only for this purpose and is brought into the state of exploitative conditions. During the evidence are obtained some results that may be notified in real conditions in manufacturing. The experimental tests to review the difference of the maximum force is examined in order to change the speed of the punching and to change the work clearances of the tool elements. Depending on the material and the value of the working clearance are acquired different legality of the changing force.

Figure 3. The experimental tool located in the eccentric presses with the equipments for the presentation of the force and the working foot.

By experimental proofs are obtained some characteristic diagrams of changes of the punching force in the function of the way of punch.

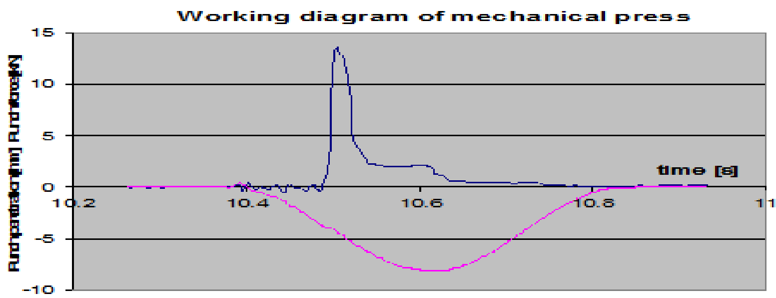

Figure 4. Dependence of the force and the working step in real time during the punching process in the eccentric cutting area 0.06 mm, ST37-2

Also by using the experimental proofs we have managed to gain the speed characteristics and the results of the curve collision force as shown in table 1. Results in relation to speed are important for comparing the estimated cutting force in real experimental conditions with the results obtained from simulation of the work tool for the pre-conditions with the help of the software code [first part].

Table 1. Values of the results of the experimental and simulated forces

Nr.of meas.	Experimental	Simulated	Experimental	Simulated	Experimental	Simulated	Experimental	Simulated
	The speed of Eccentric Presses [mm]							
	0.04		0.075		0.1		0.2	
M1[kN]	18.700	17.491	16.980	16.131	16.010	15.209	14.120	13.970
M2[kN]	18.120	17.280	17.450	16.664	15.870	15.170	13.870	13.540
M3[kN]	18.090	17.185	17.020	16.254	15.450	15.090	14.060	13.830
Mmes[kN]	18.303	17.319	17.150	16.350	15.777	15.156	14.017	13.780

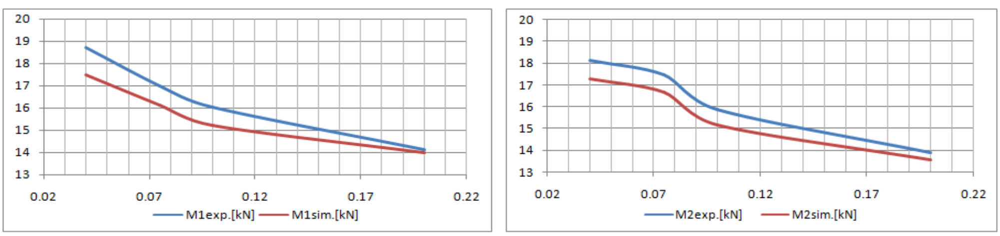

Figure 5. Comparison of the collision force curve obtained with simulated and experimental proofs for the first nad and second series of readings.

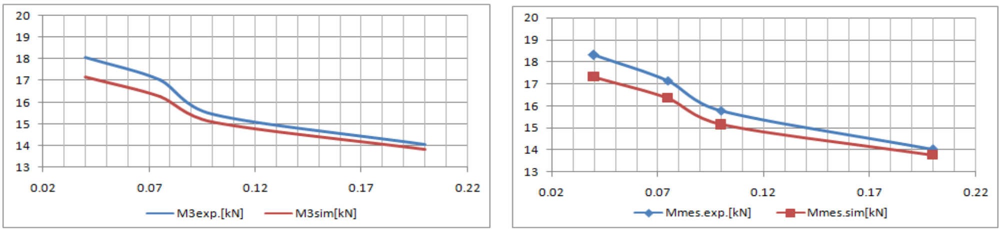

Figure 6. Comparison of the collision force curve obtained with simulated and experimental proofs for the first nad and second series of readings.

From the obtained results can be concluded that the difference between the force values obtained with experimental proofs and the force values obtained through simulation can be considered very small. The quality of the blanking-punching surfaces with a small speed and with speeds over standard speed does not change. Definitely can be concluded that the values of the forces are comparable and acceptable for the real conditions of production.

5. ANALYSIS OF THE OBTAINED RESULTS

Based on experimental results compared with results obtained by FEM numerical analysis we can conclude that:

- By obtained diagrams from experimental proofs and the software "prog. Dea" designed for computer analysis, clearly shows that the maximal force has a higher value when the working clearance between the working tool elements has the smallest value. By increasing the working clearance the blanking-punching force will decrease, but this decrease is not linear. Also, from diagrams we can conclude that for different working clearances the blanking-punching force depends on the type of the material. These optimal, which we have defined are very important for the tool constructors who always by setting right the working clearance should try to reduce the blanking-punching force which affects in the tool.
- The researches also show that increasing the speed of blanking - punching process to a certain value, the maximum force will increase, so then these speeds will reduce. In other words, by increasing the speed of the blanking - punching process to a certain amount the force increase is not linear and affects to the tool lifespan, therefore we must be careful in determining the optimum speed and the working clearances in blanking - punching process.
- Parallel to each size that are obtained with experimental proofs there are simulated and are obtained values of the forces through simulation. From the results that are obtained can be concluded that the difference between the force values obtained with experimental proofs and the force values obtained through simulation are very small. Therefore, definitely could conclude that the force values are comparable and acceptable to the real conditions of the production.

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